ENVIRONMENTAL IMPACT ASSESSMENT PROCESS
FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

PROPOSED CONSTRUCTION OF THE ROGGEVELD WIND FARM: PHASE 1 AND ASSOCIATED INFRASTRUCTURE

DEA REF. NO: 12/12/20/1988/1

FINAL REPORT FOR PUBLIC REVIEW
JANUARY 2014

Prepared for:

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PROJECT DETAILS

DEA Reference No.	:	12/12/20/1988/1
Title	:	Final Environmental Impact Assessment Report: Proposed Construction of the Roggeveld Wind Farm: Phase 1 and Associated Infrastructure
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Client	:	Roggeveld Wind Power (Pty) Ltd
Report Status	:	Final Environmental Impact Assessment Report for public review
Review Period	:	06 January 2014 – 14 February 2014

When used as a reference this report should be cited as: Savannah Environmental (2014) Final EIA Report: Proposed Construction of the Roggeveld Wind Farm Phase 1 and Associated Infrastructure

PURPOSE OF THE FINAL EIA REPORT

An Application for Authorisation and an EIA process for the 750 MW Roggeveld Wind Farm was previously undertaken by Environmental Resource Management (Pty) Ltd between 2010 and 2013 (DEA Reference number: 12/12/20/1988) for G7 Renewable Energies (Pty) Ltd. The Final EIA report was first submitted to the National Department of Environmental Affairs (DEA) in 2011. Following requests made by DEA for additional information pertaining to the design of the facility, the Developer have reconsidered all relevant aspects of the project relating to project phasing, the facility layout, and grid connection:

» The 750MW Wind Farm project is required to be split into 3 phases to comply with the capacity threshold stipulated by the Department of Energy (DoE).
» The Phase 1 facility has been given priority focus over Phase 2 and 3.
» The layout for Phase 1 has been slightly amended from the previously considered layout. Spacing between the turbines has increased, which resulted in a change in the location of nine turbines.
» The twelve months pre-construction bird and bat monitoring programme has been completed for Phase 1 of the project, and the results of these studies have been considered in this Final EIA Report.

The following changes to the EIA process for the Roggeveld Wind Farm have taken place and are relevant to note:

» There has been a change in the Environmental Assessment Practitioner from Environmental Resource Management (Pty) Ltd (ERM) to Savannah Environmental (Pty) Ltd.
» The project has been spilt into three project development phases in order to be in line with the Department of Energy's bidding requirements.
» The Final EIA report has now been revised by Savannah Environmental to assess the impacts associated with **Phase 1 only** of the Roggeveld Wind Farm. This revised Final EIA Report for Phase 1 is available for public review.

The purpose of this updated Final EIA report is to consider and includes the additional information requested by DEA, the result of bird and bat monitoring studies and to consider only Phase 1 of the Roggeveld Wind Farm. This EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The release of this Final EIA Report for a 40 day public review period provides stakeholders with an opportunity to consider Phase 1 of the Roggeveld Wind Farm, changes to the wind turbine layout and to verify the issues raised through the EIA process have been captured and adequately considered. The final EIA

Report to be submitted to DEA will incorporate all issues and responses raised during the public review period.

INVITATION TO COMMENT ON THE FINAL EIA REPORT

This final EIA Report for Phase 1 of the Roggeveld Wind Farm has been made available for a 40-day public review period, and will thereafter be submitted to DEA for consideration and decision-making. The 40 day public review period is from **06 January 2014 – 14 February 2014**.

The report is available for download on www.savannahsa.com/projects or on request from Savannah Environmental.

Please submit your comments to
Gabriele Wood of Savannah Environmental PO Box 148, Sunninghill, 2157 Tel: 011 656 3237 Fax: 086 684 0547 E-mail: gabriele@savannahsa.com
The due date for comments on the Final EIA Report is 14 February 2014

Comments can be made as written submission via fax, post or e-mail. All comments received will be submitted to DEA.

SUMMARY: ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Roggeveld Wind Power (Pty) Ltd proposes the establishment of a wind energy facility on a site located ~20km north of Matjiesfontein (referred to as the Roggeveld Wind Farm). The project development site falls within both the Western Cape and Northern Cape Provinces. The proposed facility would utilise wind turbines to generate electricity that will be fed into the National Power Grid. The facility is proposed to be developed in phases. This final **EIA report pertains to Phase 1 of Roggeveld Wind Farm** (**DEA Ref. No. 12/12/20/1988/1).** Phase 1 of the Roggeveld Wind Farm will have an energy generation capacity of up to 140 MW, which is in line with the bid submission threshold set by the Department of Energy (DoE) under the Renewable Energy Independent Power Producers Procurement (REIPPP) Programme.

The site for Phase 1 of the Roggeveld Wind Farm includes the following thirteen farm portions:

Farm Name	Farm No	Portion No	Province
Ekkraal	199	1	Northern Cape
Ekkraal	199	0	Northern Cape
Bon Espirange	73	1	Western Cape
Bon Espirange	73	0	Western Cape
Rietfontein	197	0	Northern Cape
Appelsfontein	201	0	Northern Cape
Ou Mure	74	1	Western Cape
Fortuin	74	0	Western Cape
Fortuin	74	3	Western Cape
Brandvallei	75	0	Western Cape
Nuwerus	284	0	Western Cape
Standvastigheid	210	2	Northern Cape
Aprils Kraal	105	0	Western Cape

Phase 1 of the Roggeveld Wind Farm will include the following infrastructure:

» Up to 60 2MW - 3.3MW wind turbines with a foundation of 20m in diameter and 3m in depth.
» Permanent compacted hardstand areas / crane pads for each wind turbine (60mx50m).
» Electrical turbine transformers (690kV/33kV) at each turbine (2m x 2m typical but up to 10m x 10m at certain locations).
» Internal access roads up to 12 m wide.
» Approximately 11km of 33kV overhead power lines; and approximately 6km of 400kV overhead power line to Eskom's Komsberg Substation.
» Electrical substations (an on-site 132/400 kV substation (100m x 200m) and a 400 kV substation (200m x 200m) adjacent to the existing Eskom Komsberg Substation.
» An operations and maintenance building (O&M building) next to the smaller substation.
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction phase includes construction lay down

areas and a construction camp up to 4.5ha (150m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~2.2ha).

The EIA process for the proposed Phase 1 of the Roggeveld Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice GN33306 of 18 June 2010, in terms of Section 24(5) of NEMA (Act No. 107 of 1998).

As agreed with the competent authority (DEA), the current final EIA report has been revised to assess the impacts of Phase 1 of the Roggeveld Wind Farm only (applicable to DEA Ref. No.: 12/12/20/1988/1). The approach to this Final EIA Report included:

» Update of the existing EIA report, specialist studies and impact assessment utilising the revised layout for Phase 1 of the project.
» Consider and address DEA's additional requirements and requests for information.
» Incorporate the findings of the bird and bat pre-construction monitoring programmes for Phase 1 into the EIA report.
» Undertake the relevant public participation tasks required to inform the registered I&APs regarding the Final EIA report for Phase 1 of the project.

Evaluation of the Proposed Project

The chapters contained of this report together with the specialist studies contained within **Appendices F - L** provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of Phase 1 of the Roggeveld Wind Farm.

The assessment of potential environmental impacts presented in this report is based on a layout of the turbines and associated infrastructure provided by Roggeveld Wind Power (Pty) Ltd. This layout includes 60 wind turbines as well as all associated infrastructure. No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However of the potential for impacts of major and high significance were identified which require mitigation. Mitigation to avoid impacts are primarily associated with the relocation of certain turbine positions of concern, as well as measures to be utilised during the construction phase to prevent negative impacts from occurring. These are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental **Management Programme (EMPr)** included within **Appendix M**.

The most significant impacts associated with the construction and operational phases of the development of Phase 1 of the Roggeveld wind energy facility (without the use of mitigation measure) are impacts on flora and fauna and visual impacts.

Impact of the Substations and Power Line

Two substations are proposed for Phase 1 of the Roggeveld Wind Farm. The proposed on-site substation is located within a previously cultivated area, is not sensitive. The second substation which is proposed to be located adjacent to the Eskom Komsberg substation is also located within an area of relatively low sensitivity and no species of conservation concern were observed in this area. The **impact of the two substations on ecology** will be of a **low significance**. The two substation positions are located in ecologically acceptable areas.

The **overhead power line** which is proposed to connect the facility to the Komsberg substation will also have a **low impact on ecology**. Although the power line traverses several drainage lines, the pylon foundations placement can be adjusted where necessary to avoid impact to drainage lines or any other sensitive features. No deviations to the power line route are recommended at this stage.

Power lines can also cause bird injury and/ mortality resulting from collisions with power lines and electrocution. The risk of collision where the power line cross upper valley slopes is considered greater for this group of birds than at the turbines on the ridges. This situation must be mitigated by installing markers at 3 m intervals on each wire to make the power line more visible. With the use of mitigation measures the **impact of the power line on avifauna** will be of **medium-low significance**.

An ecological and avifaunal pre-construction walk-through for the power line is recommended.

Cumulative Impacts

Cumulative impacts are detailed in Chapter 10. Significant cumulative impacts that could result from the development of Phase 1 of the Roggeveld Wind Farm and other wind energy facilities in the area include:

- visual intrusion;
- change in sense of place and character of the area;
- an increase in the significance of avifaunal impacts;
- an increase in the significance of the potential impact on bats;
- loss of vegetation; and
- temporary traffic impacts during construction.

Cumulative impacts will be of a **moderate significance** on a landscape level in this region of the

Northern and Western Cape. The use of the EMPr and mitigation measures would assist in mitigating these negative impacts to an acceptable level.

Environmental Sensitivity Mapping

From the specialist investigations undertaken for the proposed Phase 1 of the Roggeveld Wind Farm, a number of sensitive areas were identified (refer to **Figure 1 and the A3 map in Appendix N**). The following sensitive areas/environmental features have been identified on the site:

- Prominent horizontal ridges/slopes.
- Drainage lines and associated riparian vegetation.
- Special habitats (rock fields – refer to Figure 10.2 for a zoomed in map of this area).
- Avifaunal sensitive areas:
  - Five saddles (the lowest areas along ridge sections). Many bird species, including the Ludwig's Bustard (vulnerable species), often use saddles when crossing ridges, especially when this requires them to fly into headwinds. The risk of collision mortalities can be mitigated by leaving a 100 m gap between successive turbines across the five saddles designated from monitoring observations.
  - Verreaux's Eagles nesting areas - to minimise the risk of disturbance to, and collision mortality risk of, no turbines should be located nearer than 1.3 km from the established nesting area.
- Areas of high bat sensitivity:
  - Drainage lines closest to proposed turbine positions, especially when exposed rock that can be used as roosting space is visible in the drainage line.
  - Clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. Mostly in drainage lines.
  - Most prominent horizontal ridges of exposed rock on hill slopes can offer roosting space.
- Areas of moderate bat sensitivity: Valleys and lower altitudes are expected to offer more sheltered terrain for bat prey (insects) as well as foraging bats.
- Heritage sites (although outside the development footprint and of low heritage significance).

Recommendations for Micro-Siting of Turbines

The specialist studies assessed the Phase 1 layout and the following points regarding the wind turbine layout are made:

- Ecology (flora, fauna and drainage lines):

  * The ecological walk-through survey of the final layout of Phase 1 of the Roggeveld wind farm revealed that the majority of the turbines were located within physically and ecologically acceptable areas.
  * Turbine 52 was located within a rock field, which is an exceptional and unique habitat on the site and no other similar areas are present in the area.
- Birds:
    * The 100m gap between turbines occurring in saddles has been maintained in the revised layout. However, all turbines are spaced by a minimum of 3 x Rotor Diameter (i.e. up to 351m apart).
    * No turbines are located nearer than 1.3 km from the established Verreaux's Eagles nesting areas.
- Bats:
  * No proposed turbines are located within High bat sensitive areas and their respective buffer zones.
  * Turbines within Moderate Bat Sensitivity areas and buffer zones (turbines 26 - 29, 31 - 46, 54, 55, 57, 58 – 60) must be prioritised for potential mitigation; however other turbines must be observed during post construction monitoring.
- Heritage Site – archaeological sites of low heritage significance occur outside the development footprint.
- Noise – Based on the current layout - no noise mitigation procedures would need to be implemented at any of the dwellings located within Phase 1 the Roggeveld Wind Farm site boundaries.

The ecological walk-through survey of the final layout of Phase 1 of the Roggeveld wind farm revealed that a section within the central part of the site has several turbines within a sensitive environment, and the developer was encouraged to alter the final layout of the development in response to these findings. Figure 2 shows the turbines which are proposed to be relocated, which are described below:

- Turbine 52 was located within a rock field, which is an exceptional and unique habitat on the site and no other similar areas are present in the area. There a numerous geophytes, small succulents and forbs among the rocks in this area.
- As a result of relocating Turbine 52, both Turbines 53 and 54 also need to be relocated in order to maintain the required turbine spacing for wake effects.
- Turbine 57 was located along a narrow ridge that was not wide enough to accommodate the turbine and service area without considerable damage to the ridge, and the access road was also problematic as it traversed a steep slope. The turbine was

relocated to the east and although the sensitive area cannot be entirely avoided, the primary sensitive portion of the ridge will no longer be impacted.

As a result of the ecologically sensitive areas, the layout for Phase 1 was revised and is presented in Figure 3. The following changes to the layout of 8 wind turbines have been made to avoid impacts on the above-mentioned sensitive areas:

Turbine	Shift [metres]	Direction of Shift	Reason for Change
11	10	south-west	keeping minimum 3D distance to shifted turbine 12
12	11	south-south-west	keeping minimum 3D distance to turbine 16
45	13	south	keeping minimum 3D distance to turbine 46
52	80	north-east	removed from ecologically sensitive area
53	108	north	keeping minimum 3D distance to shifted turbine 52 (knock-on effect)
54	66	north-north-west	keeping minimum 3D distance to shifted turbine 53 (knock-on effect)
56	15	north	keeping minimum 3D distance to shifted turbine 57 (knock-on effect)
57	164	east	removed from ecologically sensitive area

Mitigation of impacts is the next option for the rest of the environmentally sensitive areas shown in Figure 1. Mitigation measures as detailed in the specialist studies, this final EIA report and the **Draft EMPr (Appendix M**) are to be applied during the development of the wind farm. The revised layout allows for avoidance of negative impacts on sensitive areas and is considered acceptable from an environmental and social perspective.

Overall Conclusion (Impact Statement)

The findings of the specialist studies undertaken within this EIA for Phase 1 of the Roggeveld Wind Farm 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, monitoring and management measures are implemented.
» The most significant impacts associated with the construction and operational phases of the development of Phase 1 of the Roggeveld wind energy facility (without the use of mitigation measure) are impacts on flora and fauna and visual impacts.
» Majority of the environmental and social impacts associated with development of Phase 1 of

the Roggeveld wind energy facility will be of moderate significance and of acceptable levels.

» 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.

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**.

Overall Recommendation

Based on the nature and extent of the proposed 140MW wind farm, 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 Phase 1 of the Roggeveld Wind Farm and associated infrastructure can be mitigated to an acceptable level, provided appropriate mitigation is implemented and adequate regard for the recommendations of this report and the associated specialist studies is taken during the detailed design of the project.

The EAP recommends DEA needs to consider that the visual impact and impact on heritage sense of place as well as the impact on vegetation remain of moderate-major significance. This should then be weighed up against the benefits to the local economy as well as the government's commitments in terms of renewable energy targets. If promoting renewable/ alternative energy is an important consideration for the SA Government (also because of the associated benefits in terms of reduction in CO_2 emissions) it may become important that some **trade-offs and choices** would need to be made between promoting renewable energy versus the local and regional environmental and social impacts and benefits of the proposed wind farm.

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

» Adherence to the final layout as indicated in Figure 3.
» Mitigation measures detailed within this report should be considered to minimise environmental impact. These are either already taken into account in the design of the final layout or are incorporated into the EMPr.
» The draft Environmental Management Programme (EMPr) as contained within Appendix M of this report should be approved and 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 EMPr 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.

» The detailed engineering design of the facility must be submitted to DEA for prior to the commencement of construction.
» Should there be any changes to the location of the wind turbines and associated infrastructure (including power lines) that fall within identified sensitive areas (if any), walk - through surveys must be undertaken by ecological and avifaunal specialists. The findings of these surveys must be included in the site-specific EMPr to be compiled for the project.
» An ecological and avifaunal pre-construction walk-through for the power line to be undertaken.
» Feasible curtailment measures (feathering of blades) as recommended by the pre-construction bat monitoring programme to be implemented.
» Feasible mitigation measures as recommended by the pre-construction bird monitoring programme to be implemented.
» Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to detect, quantify and remove any alien plant species that may become established.
» Implement site specific erosion and stormwater control measures to prevent excessive surface runoff from the site (turbines and roads).
» Should any heritage site, human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to Heritage Western Cape. The developers, site managers, and any operators of excavation equipment, need to be alerted to this possibility. If fossil material is encountered, the palaeontologist must be given sufficient time and access to resources to recover at least a scientifically representative sample for further study. If it cannot be studied immediately, the costs of housing the material should be borne by the developers. In the event of human bones being found on site, SAHRA must be informed immediately and the remains removed by an archaeologist under an emergency permit. This process will incur some expense as removal of human remains is at the cost of the developer. Time delays may result while application is made to the authorities and an archaeologist is appointed to do the work.

- Applications for all other relevant and required permits if required to be obtained by the developer must be submitted to the relevant regulating authorities. This includes, where necessary, permits for the transporting of all components (abnormal loads) to site, water use licence for disturbance to any water courses/ drainage lines, permits for disturbance of protected vegetation and borrow pit/s.
- Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.

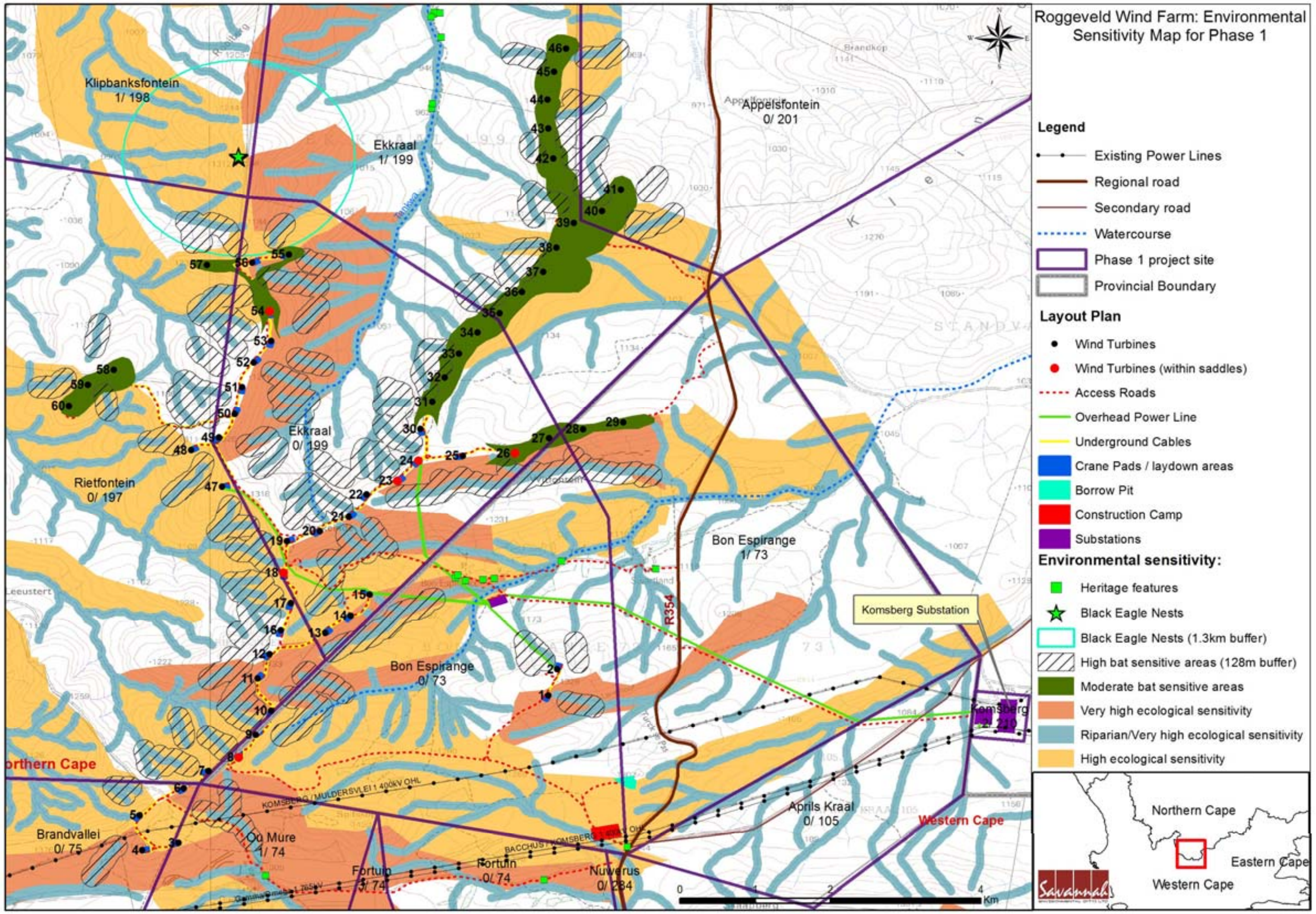

Figure 1: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the proposed development footprint for Phase 1 of the Roggeveld Wind Farm **(Appendix N contains an A3 map)**

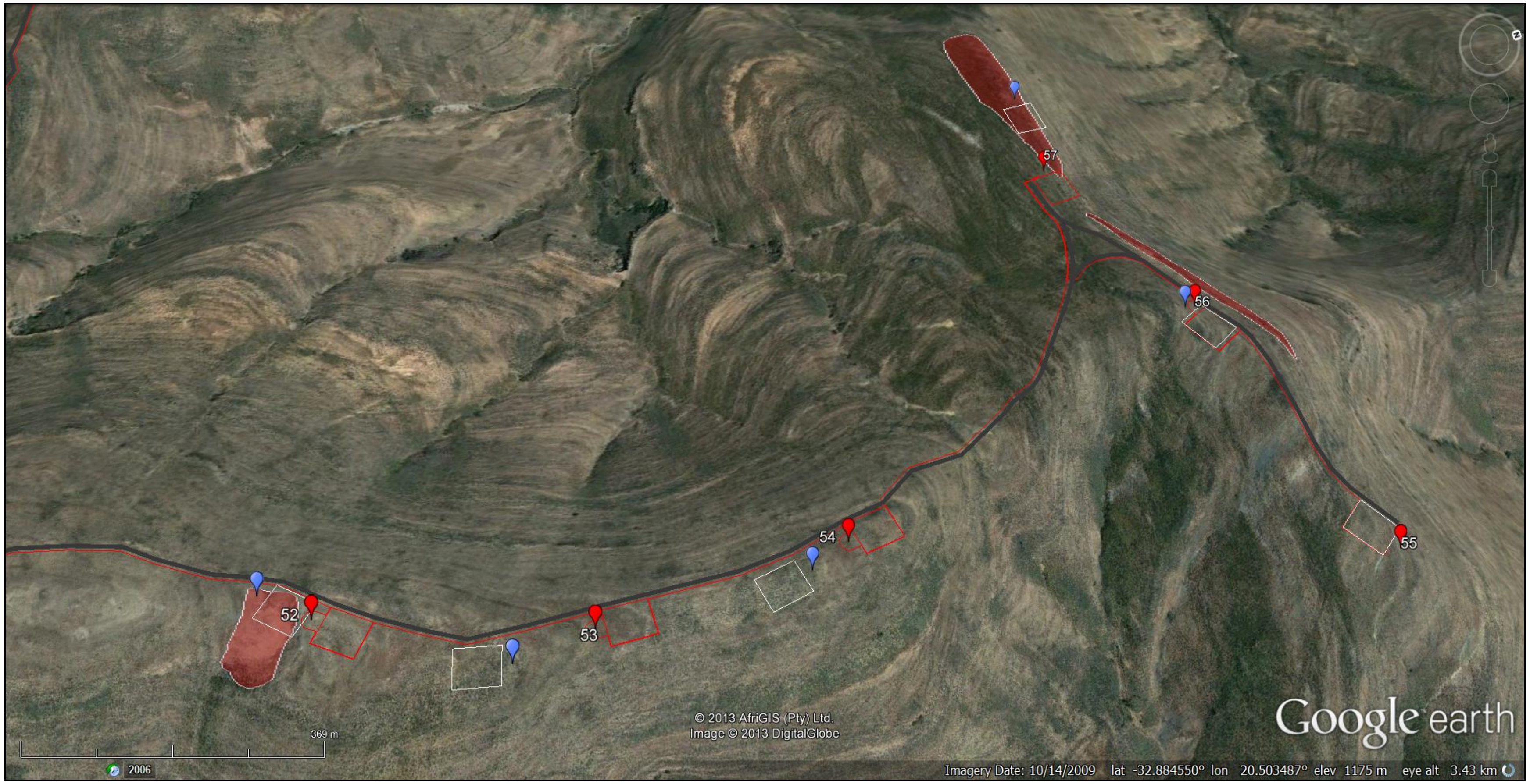

Figure 2 Satellite image illustrating the turbines that were relocated on the basis of the assessment of the final development layout. The blue markers illustrate the original location of the turbines, while the red markers show the revised locations. The red polygons illustrate the sensitive areas that were observed and mapped in the field.

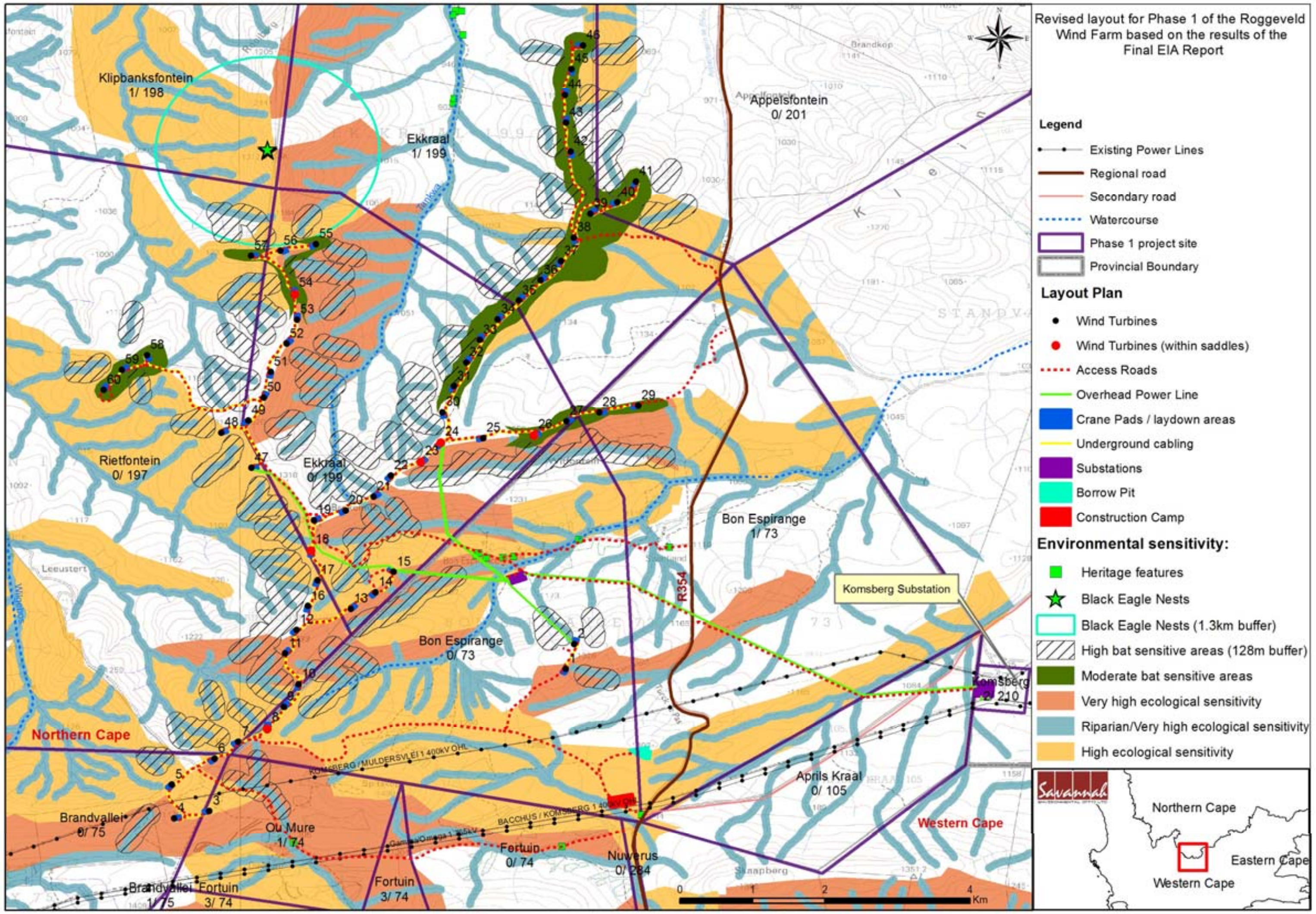

Figure 3: Revised layout for Phase 1 of the Roggeveld Wind Farm based on the findings of the final EIA report, for DEA approval

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APPENDICES

ABBREVIATIONS AND ACRONYMS

CDM	Clean Development Mechanism
CO_2	Carbon dioxide
D	Diameter of the rotor blades
DEA	National Department of Environmental Affairs
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
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
LUPO	Rezoning and Subdivision in terms of Land Use Planning Ordinance, Ordinance 15 of 1985
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)
NIRP	National Integrated Resource Planning
NWA	National Water Act (Act No 36 of 1998)
SAHRA	South African Heritage Resources Agency
SANRAL	South African National Roads Agency Limited
SDF	Spatial Development Framework

DEFINITIONS AND TERMINOLOGY

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

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

Archaeological material: Remains resulting from human activities which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

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.

Calcrete: A soft sandy calcium carbonate rock related to limestone which often forms in arid areas.

Clean Development Mechanism (CDM): An arrangement under the Kyoto Protocol allowing industrialised countries with a greenhouse gas reduction commitment (called Annex 1 countries) to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. The most important factor of a CDM project is that it establishes that it would not have occurred without the additional incentive provided by emission reductions credits. The CDM allows net global greenhouse gas emissions to be reduced at a much lower global cost by financing emissions reduction projects in developing countries where costs are lower than in industrialised countries. The CDM is supervised by the CDM Executive Board

(CDM EB) and is under the guidance of the Conference of the Parties (COP/MOP) of the United Nations Framework Convention on Climate Change (UNFCCC) (refer http://unfccc.int/kyoto_protocol/mechanisms/items/2998.php).

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.

Early Stone Age: A very early period of human development dating between 300 000 and 2.6 million years ago.

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.

Energy utilisation factor (EUF): The percentage of actual generation compared to the total possible installed generation annually.

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

Fossil: Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Generator: The generator is what converts the turning motion of a wind turbine's blades into electricity

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

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.

Integrated Energy Plan (IEP): A plan commissioned by the DME in response to the requirements of the National Energy Policy, in order 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.

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.

Late Stone Age (LSA): In South Africa this time period represents fully modern people who were the ancestors of southern African KhoeKhoen and San groups (40 000 – 300 years ago).

“Micro-siting”: An international convention with regards to wind energy facilities. It refers to the process of specifically determining the position of each turbine based on the wind resource and topographical constraints in order to maximise production.

Middle Stone Age (MSA): An early period in human history characterised by the development of early human forms into modern humans capable of abstract though process and cognition 300 000 – 40 000 years ago.

Midden: A pile of debris or dump (shellfish, stone artefacts and bone fragments) left by people after they have occupied a place.

Miocene: A geological time period (of 23 million - 5 million years ago).

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/)

Palaeontological: Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Pleistocene: A geological time period (of 3 million – 20 000 years ago).

Pliocene: A geological time period (of 5 million – 3 million years ago).

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).

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/).

Structure (historic): Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those which are over 60 years old.

Tower: The tower, which supports the rotor, is constructed from tubular steel. 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.

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/)

INTRODUCTION CHAPTER 1

Roggeveld Wind Power (Pty) Ltd proposes the establishment of a wind energy facility on a site located ~20km north of Matjiesfontein (referred to as the Roggeveld Wind Farm). The project development site falls within both the Western Cape and Northern Cape Provinces. The proposed facility would utilise wind turbines to generate electricity that will be fed into the National Power Grid. The facility is proposed to be developed in phases. This **EIA report pertains to Phase 1 of Roggeveld Wind Farm** (**DEA Ref. No. 12/12/20/1988/1).** Phase 1 of the Roggeveld Wind Farm will have an energy generation capacity of up to 140 MW, which is in line with the bid submission threshold set by the Department of Energy (DoE) under the Renewable Energy Independent Power Producers Procurement Programme (REIPPPP). The purpose of the proposed wind energy facility is to sell the electricity generated to Eskom under the REIPPPPe. This programme has been introduced by the Department of Energy to promote the development of renewable power generation facilities by Independent Power Producers in South Africa.

The nature and extent of Phase 1 of the Roggeveld Wind Farm, as well as potential environmental impacts associated with the construction, operation and decommissioning of a facility of this nature are assessed in this Final Environmental Impact Assessment (EIA) Report. This EIA Report consists of the following sections:

» **Chapter 1** provides background to the proposed wind energy facility project and the environmental impact assessment process.
» **Chapter 2** provides information on the site selection process and consideration of alternatives within the EIA process.
» **Chapter 3** describes the operating characteristics of a wind energy facility.
» **Chapter 4** describes the project and the construction, operation and decommissioning phases of the wind energy facility.
» **Chapter 5** outlines the regulatory and legal context of the EIA study.
» **Chapter 6** outlines the process which was followed during the EIA Phase of the project, including the public consultation programme that was undertaken.
» **Chapter 7** describes the existing biophysical and socio-economic environment.
» **Chapter 8 and Chapter 9** describes the assessment of environmental impacts associated with Phase 1 of the Roggeveld Wind Farm.
» **Chapter 10** describes cumulative impacts.
» **Chapter 11** presents the conclusions of the impact assessment as well as the impact statement for Phase 1 of the Roggeveld Wind Farm.
» **Chapter 12** contains a list references for the EIA report and specialist reports.

1.1. Background

An Application for Authorisation and an EIA process for the 750 MW Roggeveld Wind Farm was previously undertaken by Environmental Resource Management (Pty) Ltd between 2010 and 2013 (DEA Reference number: 12/12/20/1988) for G7 Renewable Energies (Pty) Ltd. The Final EIA report was first submitted to the National Department of Environmental Affairs (DEA) in 2011. Following requests made by DEA for additional information pertaining to the design of the facility, the Developer have reconsidered all relevant aspects of the project relating to project phasing, the facility layout, and grid connection:

» The 750MW Wind Farm project is required to be split into 3 phases to comply with the capacity threshold stipulated by the Department of Energy (DoE).
» The Phase 1 facility has been given priority focus over Phase 2 and 3.
» The layout for Phase 1 has been slightly amended from the previously considered layout. Spacing between the turbines has increased, which resulted in a change in the location of nine turbines.
» The twelve months pre-construction bird and bat monitoring programme has been completed for Phase 1 of the project, and the results of these studies have been considered in this Final EIA Report.

The following changes to the EIA process for the Roggeveld Wind Farm have taken place and are relevant to note:

» There has been a change in the Environmental Assessment Practitioner from Environmental Resource Management (Pty) Ltd to Savannah Environmental (Pty) Ltd.
» The project has been spilt into three project development phases in order to be in line with the Department of Energy's bidding requirements.
» The Final EIA report has now been revised by Savannah Environmental to assess the impacts associated with **Phase 1 only** of the Roggeveld Wind Farm. The revised Final EIA Report for Phase 1 is available for public review.

1.2. Split of the Project into Three Phases

The original application for environmental authorisation for the Roggeveld Wind Farm project (submitted by the previous EAP – Environmental Resource Management (Pty) Ltd in July 2010) was for a 750 MW wind energy facility. The DoE subsequently stipulated a maximum capacity threshold of 140MW for each wind farm project that can be bid as part of the REIPPPP. Therefore, as a result, the larger Roggeveld Wind Farm project (and the project development site) has been spilt into three phases in line with the DoE's REIPPPP bidding requirements.

In a process discussed and agreed with the competent authority (DEA), three applications for environmental authorisation (one for each phase of the Roggeveld Wind Farm) have been opened under the following project names and DEA reference numbers:

» Proposed Construction of the Roggeveld Wind Farm Phase 1 and Associated Infrastructure – 12/12/20/1988/1 (Applicant: Roggeveld Wind Power (Pty) Ltd)
» Proposed Construction of the Roggeveld Wind Farm Phase 2 and Associated Infrastructure – 12/12/20/1988/2 (Applicant: G7 Renewable Energies (Pty) Ltd)
» Proposed Construction of the Roggeveld Wind Farm Phase 3 and Associated Infrastructure – 12/12/20/1988/3 (Applicant: G7 Renewable Energies (Pty) Ltd)

The original Application for Authorisation applied for the EIA Listed Activities under the EIA Regulations of April 2006. The three revised Applications for Authorisation are now in terms of the currently enacted EIA Regulations of June 2010.

1.3. Approach to Final EIA Report

Through detailed consultation with the competent authority (DEA), it was agreed that the current final EIA report be revised to assess the impacts of Phase 1 of the Roggeveld Wind Farm only (applicable to DEA Ref. No.: 12/12/20/1988/1). The approach included:

» Update of the existing EIA report, specialist studies and impact assessment utilising the revised layout for Phase 1 (utilising the methodology as previously utilised in the EIA report undertaken by Environmental Resource Management (Pty) Ltd).
» Consider and address DEA's additional requirements and requests for information.
» Incorporate the findings of the Phase 1 bird and bat pre-construction monitoring programmes into the EIA report.
» Undertake the relevant public participation tasks required to inform the registered I&APs regarding the Final EIA report for Phase 1 of the project[1]:
  * Compile and distribute a letter to registered I&APs announcing split of project/change in project description;
  * Placement of newspaper adverts announcing a public review of the Final EIR for Phase 1;
  * Compile and distribute a letter to registered I&APs announcing availability of Final EIR for public review;

[1] Note that an EIA process has already been conducted for the Roggeveld Wind Farm under DEA reference number 12/12/20/1988/1). A full public participation process was conducted and completed between 2010 and 2012.

* Obtain comment (or updated comment) from all Organs of State;
* Preparation of a Comments and Responses report;
* Compile and distribute a letter to registered I&APs to inform all parties when the final EIR has been submitted to DEA.

This final EIA Report for Phase 1 of the Roggeveld Wind Farm has been made available for a 40-day public review period, and will thereafter be submitted to DEA for consideration and decision-making. Phase 2 and Phase 3 have separate applications for environmental authorisations and will have separate EIA reports generated at a later stage.

1.4. Project Description and Summary

1.4.1. Development Site location

The site for the proposed Phase 1 of the Roggeveld Wind Farm is located ~20km north of Matjiesfontein and falls within both the Northern Cape and Western Cape Province. Nearest towns include Matjiesfontein (Western Cape), Laingsburg (Western Cape) and Sutherland (Northern Cape). The site falls within Ward 4 of Laingsburg Local Municipality and Ward 1 of the Karoo Hoogland Local Municipality. The broader study area for Phase 1 of the Roggeveld Wind Farm is ~265 km^2 in extent includes the following thirteen farm portions (refer to Figure 1.1):

Farm Name	Farm No	Portion No	Local Municipality	Province
Ekkraal	199	1	Karoo Hoogland Municipality	Northern Cape
Ekkraal	199	0	Karoo Hoogland Municipality	Northern Cape
Bon Espirange	73	1	Laingsburg Municipality	Western Cape
Bon Espirange	73	0	Laingsburg Municipality	Western Cape
Rietfontein	197	0	Karoo Hoogland Municipality	Northern Cape
Appelsfontein	201	0	Karoo Hoogland Municipality	Northern Cape
Ou Mure	74	1	Laingsburg Municipality	Western Cape
Fortuin	74	0	Laingsburg Municipality	Western Cape
Fortuin	74	3	Laingsburg Municipality	Western Cape
Brandvallei	75	0	Laingsburg Municipality	Western Cape
Nuwerus	284	0	Laingsburg Municipality	Western Cape
Standvastigheid	210	2	Karoo Hoogland Municipality	Northern Cape
Aprils Kraal	105	0	Laingsburg Municipality	Western Cape

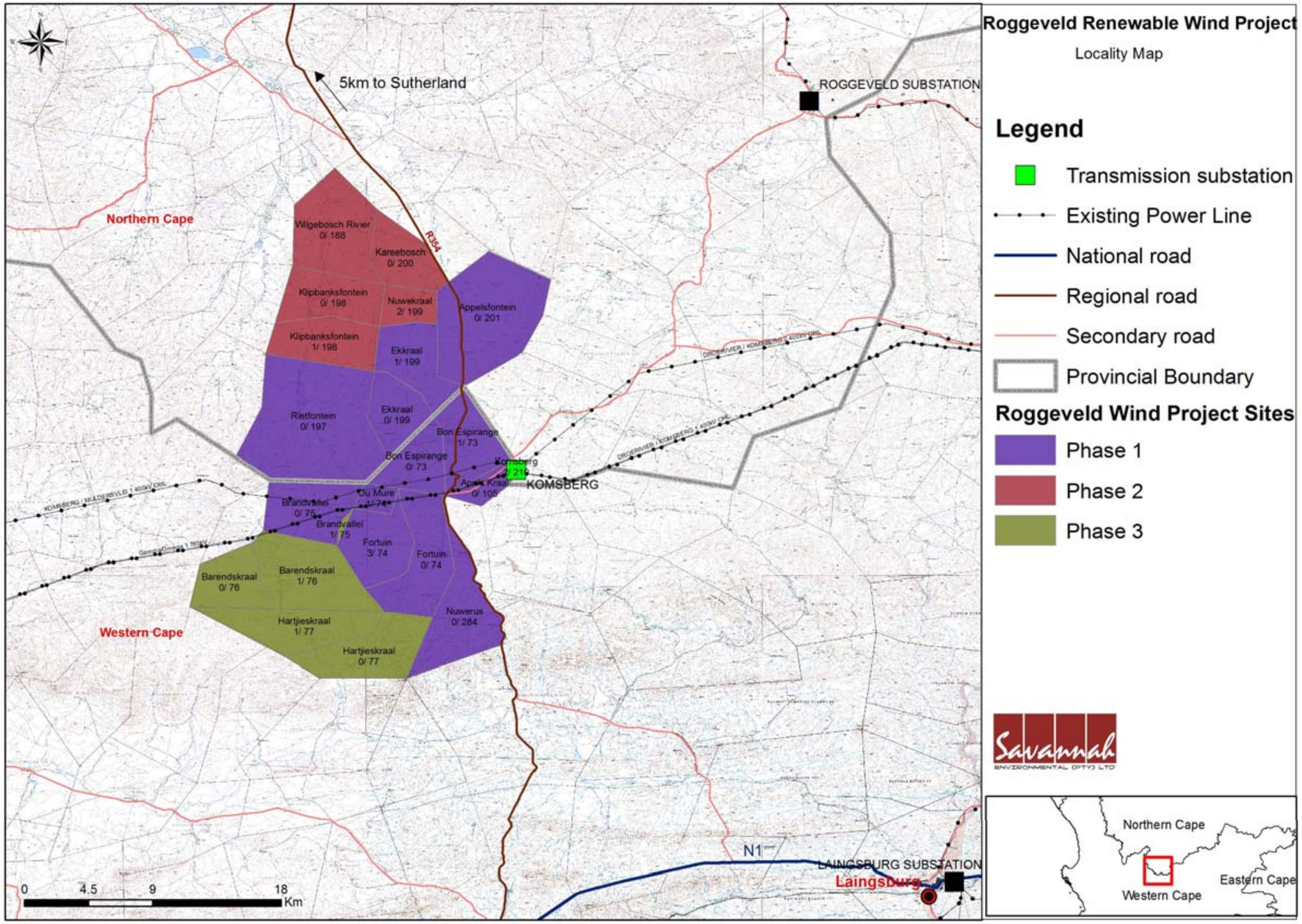

Figure 1.1: Locality map showing the farm portions and study area for the establishment of Phase 1 (and other phases) of the Roggeveld Wind Farm

Phase 1 lies in the centre of the original larger development site. Phase 2 is located to the north of Phase 1, with Phase 3 being located to the south of Phase 1. Phase 1 of the Roggeveld Wind Farm will have an energy generation capacity of up to 140 MW.

1.4.2. Project infrastructure

In summary, the infrastructure to be constructed as part of the wind energy facility includes the following:

- » Up to 60 2MW -3.3MW wind turbines with a foundation of 20m in diameter and 3m in depth.
- » Permanent compacted hardstanding areas / crane pads for each wind turbine (60mx50m).
- » Electrical turbine transformers (690kV/33kV) at each turbine (2m x 2m typical but up to 1m0 x 10m at certain locations)
- » Internal access roads up to 12 m wide.
- » Approximately 11km of 33kV overhead power lines and approximately 6km of 400kV overhead power lines to Eskom's Komsberg substation.
- » Electrical substations (An on-site 132/400kV substation (100m x 200m) and a 400kV substation (200m x 200m) next to existing Eskom Komsberg substation.
- » An operations and maintenance building (O&M building) next to the smaller substation.
- » Up to 4 x 100m tall wind measuring masts.
- » Temporary infrastructure required during the construction phase includes construction lay down areas and a construction camp up to 4.5ha (150m x 300m).
- » A borrow pit for locally sourcing aggregates required for construction (~2.2ha)

A detailed project description including the components of Phase 1 of the Roggeveld Wind Farm (including details of the construction, operation and decommissioning phases) are discussed in Chapter 2.

The electricity generation capacity of Phase 1 of the Roggeveld Wind Farm will depend on the most suitable wind turbine (in terms of the turbine efficiency; a function of rotor diameter, height, generator size, performance and cost) selected by the developer. Turbines of between 2 and 3.3 MW in capacity are being considered for the site. The worst case scenario i.e. a wind turbine up to 3.3 MW in capacity has been considered in the EIA. Up to 60 wind turbines are proposed to be constructed on the site, with an estimated total installed capacity for the proposed facility of up to 140MW.

Various specialist software packages are available to assist developers in selecting the optimum position for each turbine before the project is constructed. The developer's scientific background has enabled them to create highly specialised wind measurement and analysis tools. These include a mesoscale wind atlas, which can be used to calculate wind speed and consistency across a large area at high-resolution enabling the developer to locate and validate optimum sites for wind farm development. The wind resource for the Roggeveld site has been monitored for over 3 years using equipment mounted on 60 m high wind monitoring towers. The general industry requirement is to collect at least 12 months data in order to evaluate the exact wind resources properties of a particular site. This enables the developer to reduce the market risk by ensuring that the sites they have earmarked for development are more likely to lead to commercially viable projects. This layout also informed the positioning of other infrastructure such as access roads and substation/s. The positioning or detailed layout of the components of this wind energy facility has been developed and is shown in **Figure 1.2**. Final placement will be informed by the outcomes of the EIA.

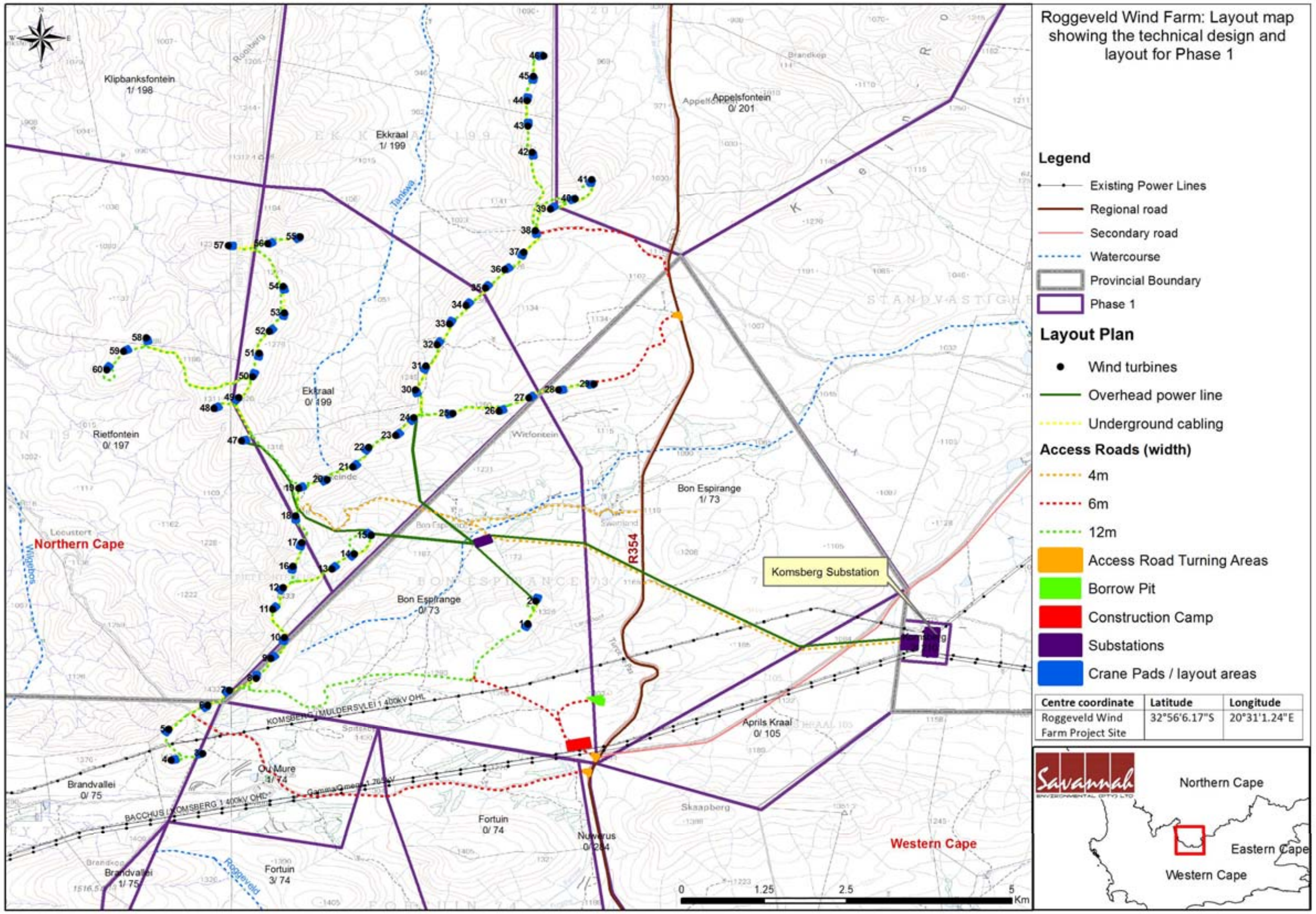

Figure 1.2: Layout map showing the technical design and layout for Phase1 of the Roggeveld Wind Farm

1.5. The Need Desirability for the Proposed Project

Compared with other renewable energy sources such as solar and bio-energy, wind turbines generate the highest energy yield while affecting the smallest land space. Wind technologies convert the energy of moving air masses at the earth's surface to mechanical power that can be directly used for mechanical needs (e.g. milling or water pumping) or converted to electric power in a generator (i.e. a wind turbine).

Use of wind for electricity generation is essentially a non-consumptive use of a natural resource. 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.

The proposed site was selected for the development of a wind energy facility based on its predicted wind climate (high wind speeds), suitable proximity in relation to the existing electricity grid, and minimum technical constraints from a construction and technical point of view. Roggeveld Wind Power (Pty) Ltd considers this area, and specifically the demarcated site, to be highly preferred for wind energy facility development.

The current land-use on the site is agriculture. The proposed site and majority of land surrounding it have minimal or no crop farming taking place. The development of the wind energy facility will allow current livestock grazing on areas of the farm portions which will not be occupied by wind turbines and associated infrastructure. Therefore the current land-use will be retained, while also generating renewable energy from the wind. This represents a win-win situation for landowners and the developer.

The Roggeveld project site is located within one of the study areas identified as part of the Strategic Environmental Assessment (SEA)[2]. The SEA project was initiated by the Department of Environmental Affairs (DEA) and being run by the CSIR with intent to "*identify geographical areas best suited for the rollout of wind and solar PV energy projects and the supporting electricity grid network.* Through consultation with various stakeholders including the wind energy industry, the CSIR identified prioritised locations that that are potential Renewable Energy Development Zones (REDZ) which projects a development timeline of 5, 10 and 15 years. The location of the Roggeveld site is within the prioritised area per the projected development, after the consultations.

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http://www.csir.co.za/nationalwindsolarsea/

1.6. Technical Motivation for the Project

Roggeveld Wind Power (Pty) Ltd considers the Roggeveld Wind Farm site as well-suited for wind energy development due to the strength of the prevailing wind resources. Topography such as hills and ridges has a significant influence on average wind speed and represent areas of greater electricity generation relative to the number of turbines and the disturbance footprint.

The developer has been measuring the wind resources at the Roggeveld site for more than 3 years and has determined that the site is viable for commercial electricity generation using wind turbines.

Roggeveld Wind Power (Pty) Ltd motivates the development of the Roggeveld Wind Farm due to the following reasons:

» Reduce South Africa's dependence on fossil fuel resources;
» Improve reliability and range of electrical services;
» Meet demand for diversified energy sources;
» Ensure the future of sustainable energy use;
» Reduce CO2 emissions and the nation's carbon footprint;
» Contribute to targets for emission reduction as outlined in IRP 2010/2030;
» Promote environmental, social and economically sustainable development;
» Create long-term jobs;
» Contribute to meeting the IRP goal of 30% of all new energy from IPPs.

1.7. Requirement for an Environmental Impact Assessment Process

The Phase 1 of the Roggeveld Wind Farm is subject to the requirements of the Environmental Impact Assessment Regulations (EIA Regulations) of June 2010 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 of June 2010 and their application to Phase 1 of the Roggeveld Wind Farm.

NEMA is national legislation that provides for the authorisation of certain controlled activities known as "listed activities". In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. The National Department of Environmental Affairs (DEA) is the competent authority for this project. An application for authorisation for Phase 1 of the Roggeveld Wind Farm has been accepted by the DEA (under Application Reference number: 12/12/20/1988/1). Through the decision-making process, the DEA will be supported by the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) and the Northern Cape Department of Environment and Nature Conservation (DENC), as the commenting authorities.

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. Roggeveld Wind Power (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd as the independent Environmental Assessment Practitioner (EAP) to complete the Final EIA Report for Phase 1 of the Roggeveld Wind Farm[3].

In terms of sections 24 and 24D of NEMA, as read with Government Notices R543, R544, R545 and R546, a Scoping and EIA process is required for the proposed project (GG No 33306 of 18 June 2010). The key listed activity contained in GN545 which triggered a full EIA process is Listed Activity 1: The construction of facilities or infrastructure, for the generation of electricity where the output is 20 megawatts or more, as the wind farm will have an electricity generation capacity of up to 140MW.

This report documents the assessment of the potential environmental impacts of the proposed construction and operation of the Phase 1 of the Roggeveld Wind Farm. This study concludes the EIA process and was conducted in accordance with the requirements of the EIA Regulations in terms of Section 24(5) of the National Environmental Management Act (NEMA; Act No 107 of 1998).

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.

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[3] Note that Environmental Resource Management (Pty) Ltd had undertaken full scoping and EIA process (DEA Ref. No.: 12/12/20/1988) for the 750MW Roggeveld Wind Farm between 2010 – 2013. The Final EIA report was submitted to DEA. DEA subsequently requested additional information. The EAP has now changed to Savannah Environmental and the FEIR has been updated for Phase 1 only (this report under DEA ref. no.: 12/12/20/1988/1).

1.8. EIA Process and Purpose of the Final EIA Report

The EIA process consists of a scoping phase and an EIA phase. The Scoping Phase refers to 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 EIA Phase aimed to address those identified potential environmental impacts and benefits (direct, indirect and cumulative impacts) associated with the project including design, construction, operation and decommissioning, and recommend appropriate mitigation measures for potentially significant environmental impacts. The purpose of this updated Final EIA report is to consider and includes the additional information requested by DEA, the result of bird and bat monitoring studies and to consider only Phase 1 of the Roggeveld Wind Farm. This EIA report aims to provide the environmental authorities with sufficient information to make an informed decision regarding the proposed project.

The release of this Final EIA Report for a 40 day period provides stakeholders with an opportunity to consider Phase 1 of the Roggeveld Wind Farm, changes to the wind turbine layout and to verify the issues raised through the EIA process have been captured and adequately considered. The final EIA Report to be submitted to DEA will incorporate all issues and responses raised during the public review period.

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

Savannah Environmental was contracted by Roggeveld Wind Power (Pty) Ltd as the independent environmental consultant to complete the EIA report for the proposed project. Neither Savannah Environmental nor any of its specialist sub-consultants on this project are subsidiaries of or are affiliated to Roggeveld Wind Power (Pty) Ltd. 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 holistic environmental management services, including environmental impact assessments and planning to ensure compliance and evaluate the risk of development; and the development and implementation of environmental management tools. Savannah Environmental benefits from the pooled resources, diverse skills and experience in the environmental field held by its team.

The Savannah Environmental team have considerable experience in environmental impact assessments and environmental management, and have been actively involved in undertaking environmental studies, for a wide variety of projects throughout South Africa, including those associated with electricity generation.

The EAPs from Savannah Environmental who are responsible for this project are:

» Karen Jodas - a registered Professional Natural Scientist and holds a Master of Science degree. She has 16 years of experience consulting in the environmental field. Her key focus is on strategic environmental assessment and advice; management and co-ordination of environmental projects, which includes integration of environmental studies and environmental processes into larger engineering-based projects and ensuring compliance to legislation and guidelines; compliance reporting; the identification of environmental management solutions and mitigation/risk minimising measures; and strategy and guideline development. She is currently responsible for the project management of EIAs for several renewable energy projects across the country.
» Ravisha Ajodhapersadh– the principle author of this report holds an Honours Bachelor of Science degree in Environmental Management and has 6 years' experience in environmental management and EIA. She is currently the responsible EAP for several renewable energy projects across the country.

In order to adequately identify and assess potential environmental impacts associated with Phase 1 of the Roggeveld Wind Farm, Savannah Environmental obtained input from the following specialist sub-consultants to conduct revised/ updated specialist impact assessments for the Phase 1 project:

Specialist	**Area of Expertise**
Simon Todd of Simon Todd Consulting	Ecology (including flora and fauna)
Tony Williams of African Insights cc	Avifauna
Werner Marais of Animalia	Bats
Bernard Oberholzer Landscape Architect and Quinton Lawson of MLB Architects	Visual impact
Tim Hart and team of ACO Associates	Heritage
Tony Barbour Environmental Consulting and Research	Social
Adrian Jongens of JKA Associates	Noise

The curricula vitae for EAPs from Savannah Environmental as well as the specialist consultants team are included in **Appendix A**.

SITE SELECTION AND ALTERNATIVES CHAPTER 2

The site for the proposed Phase 1 of the Roggeveld Wind Farm is located ~20km north of Matjiesfontein and falls within both the Northern Cape and Western Cape Provinces. Up to 60 wind turbines are proposed to be constructed within a broader area of approximately 265 km^2 in extent. Depending on the final turbine selection, the estimated total installed capacity for the proposed facility is up to 140MW.

2.1 Site Selection, Environmental and Social Pre-Feasibility Assessment

The proposed site was selected for the development of the Roggeveld Wind Farm based on its predicted wind resource (high wind speeds), suitable proximity in relation to the existing electricity grid, and minimum technical constraints from a construction and technical point of view. Roggeveld Wind Power (Pty) Ltd considers the Roggeveld site as well-suited for wind energy development due to the strength of the prevailing wind resources (confirmed by more than three years of wind monitoring on the site).

During the site selection phase the developer commissioned an environmental and social pre-feasibility assessment of several sites, including the Roggeveld Wind Farm site. This study, which was undertaken by Coastal and Environmental Services (CES) in 2009 and included a high-level screening of potential environmental and socio-economic issues, as well as 'fatal flaws'. Amongst a number of other potential sites in the Karoo region identified as being potentially suitable from a wind resource perspective, the Roggeveld Wind Farm site was selected by the developer. Once the land lease agreements had been entered into with the landowners, the wind measurement campaign commenced with the erection of wind monitoring masts to assess the wind resource patterns on the site.

2.2 Findings and Conclusions of Pre-feasibility/Screening Study

A number of the sites considered in the pre-feasibility assessment were flagged as having potentially significant environmental issues. Two sites were considered as fatally flawed. Two sites were identified to hold the most potential for resulting in cumulative impacts. These sites were then excluded from developers list of priority sites while the remaining sites were prioritised in terms of those that held the best potential for success subject to an EIA being completed. The pre-feasibility study concluded that the Roggeveld site could be considered in an EIA process. The Roggeveld site was selected by the developer as one of five priority sites. Thereafter, the EIA and other permitting processes for the Roggeveld Wind Farm were commissioned.

2.3 Technology Alternatives

Based on site characteristics it was determined by the developer that the Roggeveld site would be best-suited for a wind energy facility, rather than any other renewable energy technology. Through the project development process, Roggeveld Wind Power has considered various wind turbine designs in order to maximise the capacity of the site. It is anticipated that the turbines utilised for the proposed project will have a hub height of up to 100m, and rotor diameter of up to 117m (i.e. turbines between 2 MW – 3.3 MW are being considered for use on the site). The technology provider has not yet been confirmed and will only be decided at a later stage. Therefore, no technologies alternatives are assessed in this EIA report, at this stage of the project.

2.4 Motivation for Site Selection and Layout Alternatives

The site that was selected for proposed Phase 1 of the Roggeveld Wind Farm is considered by the developer as highly desirable from a technical and land use perspective, which considers the following factors:

» Wind resource: Analysis of publicly available information, proprietary information and specialist on site analysis of weather data indicated that the site has sufficient wind resource to make a wind energy facility financially viable.
» Site extent: Sufficient land was secured under long-term lease agreements to allow for a minimum number of wind turbines to make the project feasible.
» Grid access: Grid access and the distance to a viable connection point were key considerations in terms of prioritising appropriate sites. Grid access is deemed favourable for this site due to the existence of the existing Eskom Komsberg Substation.
» Land suitability: The current land use of the site is an important consideration in site selection in terms of limiting disruption to existing land use practices. Agricultural land was preferred as the majority of farming practices can continue in parallel to the operation of the wind farm once the construction and commissioning of the project is complete. Sites that facilitate easy construction conditions (relatively flat, limited watercourse crossings, lack of major rock outcrops) are also favoured during site selection.
» Proximity to aerodromes: The proximity to aerodromes and possible interactions with these facilities was considered as part of site selection.
» Landowner support: The selection of sites where the landowners are supportive of the development of renewable energy is essential for ensuring

the success of the project. The landowners do not view the development as a conflict with their current land use practices.

The consideration of the above criteria resulted in the selection of the preferred site by the developer. Therefore, no further site location alternatives were considered in the EIA process.
Furthermore the National Departments of Energy (DoE) and Environmental Affairs (DEA) have initiated in 2013 a process for Strategic Environmental Assessment for the Renewable Energy Development Zones (REDZ), discussed in Chapter 1 of this report. The process is currently being run by the CSIR and Department of Environment Affairs, and has identified preliminary potential areas for wind energy development, which include the Roggeveld site and speaks for a location well suited for the project.

A wind turbine layout has been undertaken to effectively 'design' the wind energy facility. Through the process of determining constraining factors and environmentally sensitive areas during the pre-feasibility study and scoping phase, the layout of the wind turbines and infrastructure has been developed by Roggeveld Wind Power (Pty) Ltd. This layout is considered to be final, but shall allow for some adjustment to avoid site-specific environmental and construction constraints, where necessary and identified in further micro-siting studies (e.g. geotech per turbine position). The overall aim of the layout is to maximise electricity production through exposure to the wind resource, while minimising infrastructure, operation and maintenance costs, and social and environmental impacts. The planning process also included the positioning of other ancillary infrastructure, including, the power lines and substations. This has been informed through the understanding of the local power requirements and the stability of the local electricity network. This EIA report considered optimised and technically preferred infrastructure locations on the site and layout alternatives, as informed by the EIA process. Therefore, no site or layout alternatives were assessed in the EIA phase, as the layout has already been optimised based on technical and environmental considerations. The optimisation the Phase 1 layout took into consideration previous input made by specialists for the previous report.

2.5 The 'do-nothing' Alternative

The 'do-nothing' alternative is the option of not constructing the Phase 1 of the Roggeveld Wind Farm on the proposed site near Matjiesfontein. The primary considerations pertaining to the do-nothing alternative relate to:

» The current land-use regime of the site; and
» The need to diversify the energy mix is South Africa.

These are discussed in further detail below.

Land-Use Regime of the Site

The current land use of the site is an important consideration in site selection in terms of limiting disruption to existing land use practices. The site is currently utilised mainly for livestock grazing (sheep farming). Should the wind energy facility not be developed on the site, the status quo (sheep farming) will be maintained on the site. Agricultural land was preferred as the majority of farming practices can continue unhindered and in parallel to the operation of the wind farm once the construction and commissioning of the project is complete. The development of the wind energy facility would allow continued agricultural activities on the areas of the farm portions which will not be occupied by wind turbines and associated infrastructure. Therefore the current land-use can be retained, while also generating renewable energy from the wind. This represents a win-win situation for landowners and the developer. Therefore, from a land-use perspective, the do nothing alternative is not considered to be a preferred alternative.

Need To Diversify the Energy Mix in South Africa

The electricity demand in South Africa is placing increasing pressure on the country's existing power generation capacity. There is, therefore, a need for additional electricity generation options to be developed throughout the country. The decision to expand South Africa's electricity generation capacity, and the mix of generation technologies is based on **national policy** and informed by on-going strategic planning undertaken by the national Department of Energy (DoE), the National Energy Regulator of South Africa (NERSA) and Eskom Holdings SOC Limited (as the primary electricity supplier 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 - and more so when social and environmental costs are taken into account.

The generation of electricity from renewable energy in South Africa offers a number of socio-economic and environmental benefits. These benefits were explored in further by NERSA, and include:

» **Increased energy security:** The current electricity crisis in South Africa highlights the significant role that renewable energy can play in terms of supplementing the power available. 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 where compared with wet cooled conventional power stations. This translates into revenue saving 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 as the detrimental effects of climate change on water availability are experienced in the future.

» **Exploitation of our significant renewable energy resource:** At present, valuable national resources (including biomass by-products, solar insulation and wind) 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 of fossil fuel burning 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, contributing to the mitigation of climate change through the reduction of greenhouse gas emissions. South Africa as a nation 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.

» **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 an opportunity to establish a new industry within the South African economy and set South Africa at the forefront on the continent.

» **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.

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

Within a policy framework, the development of renewable energy in South Africa is supported by the White Paper on Renewable Energy (November 2003. In order to meet the long-term goal of a sustainable renewable energy industry and to diversify the energy-generation mix in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to a goal of ~42% of all new power generation being derived from renewable energy forms by 2030. The target is to be achieved primarily through the development of wind, biomass, solar and small-scale hydro.

The 'do nothing' alternative will not assist the South African government in reaching the set targets for renewable energy. In addition, the country's national power supply will not be strengthened by the additional generated power being evacuated directly into the Provinces' electricity grid. There would be no negative or positive environmental and social impacts associated with the development of a wind energy facility, as identified in this EIA report.

Through research and detailed investigations since 2009, the viability of the development of a wind energy facility on the Roggeveld site has been confirmed, and the developer proposes that up to 60 turbines can be established as part of the facility.

The 'do nothing' alternative is not a preferred alternative, as the result of not developing the wind energy facility will be that the following positive impacts will not be realised:

2. No increase in electricity generation from renewable forms in South Africa.
3. Job creation from the construction and operational phases.
4. Economic benefit to participating landowners due to the revenue that will be gained from leasing the land to the developer.
5. Community benefit (socio and local economic development)
6. Utilisation of clean, renewable energy in an area where it is optimally available.

Compared with other renewable energy sources such as solar and bio-energy, wind turbines generate the highest energy yield while affecting the smallest land space and is already to date the cheapest generation technology for new built power stations in South Africa. Wind technologies convert the energy of moving air masses at the earth's surface to mechanical power that can be directly used for mechanical needs (e.g. milling or water pumping) or converted to electric power in a generator (i.e. a wind turbine).

Use of wind for electricity generation is essentially a non-consumptive use of a natural resource. 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. The power generated from Phase 1 of the Roggeveld Wind Farm will be at a commercial scale to up to 140MW and will feed into the Eskom national grid.

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.

3.1 The Importance of the Wind Resource for Energy Generation

The importance of using the wind resource for energy generation 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. The doubling of wind speed increases the wind power by a factor of 8, so even small changes in wind speed can produce large changes in the economic performance of a wind farm. Wind turbines can start generating at wind speeds of between ~3 m/s to 4 m/s, with yearly average wind speeds greater than 6 m/s currently required for a wind energy facility to be economically viable. Wind speed can be highly variable and is also affected by a number of factors, including surface roughness of the terrain. 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 influences the flow of air, and results in turbulence within the air stream, and this has to be considered in the placement of turbines.

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

» **Wind direction** is reported by the direction from which it originates. Wind direction at a site is important to understand, but it is not typically critical in site selection as wind turbine blades automatically turn to face into the predominant wind direction at any point in time.

A wind resource measurement and analysis programme must be conducted for the site proposed for development, as only measured data will provide a robust prediction of the facilities expected energy production over its lifetime.

The placement of the individual turbines within a wind energy facility must consider the following technical factors:

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

Wind turbines typically need to be spaced approximately 3 to 8 times the rotor diameter apart in order to minimise the induced wake effect the turbines might have on each other. 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 spacing requirements were considered through the process of micro-siting the turbines on the site.

3.2 What is a Wind Turbine and How Does It Work

The kinetic energy of wind is used to turn a wind turbine to generate electricity. A wind turbine typically consists of **three rotor blades** and a **nacelle** mounted at the top of a tapered **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 or permanent magnets.

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. It is anticipated that the turbines utilised for the proposed facility will have a hub height of up to 100 m, and rotor diameter of up to 117 m. These turbines would be capable of generating in the order of between 2 – 3.3 MW each (in optimal wind conditions).

3.2.1. Main Components of a Wind Turbine

The turbine consists of the following major components:

» The foundation
» The tower
» The rotor
» The nacelle

The foundation
The foundation is used to secure each wind turbine to the ground. These structures are commonly made of concrete and are designed for vertical loads (weight) and lateral loads (wind).

The tower
The tower, which supports the rotor, is constructed from tubular steel or concrete. It is typically –up to 120m in height. The nacelle and the rotor are attached to the top of the tower.

The tower is part of the overall wind turbine structure. It also raises the wind turbine so that its blades safely clear the ground and so it can reach the stronger winds at higher elevations. The tower must be strong enough to support the wind turbine and to sustain vibration, wind loading and the overall weather elements for the lifetime of the wind turbine.

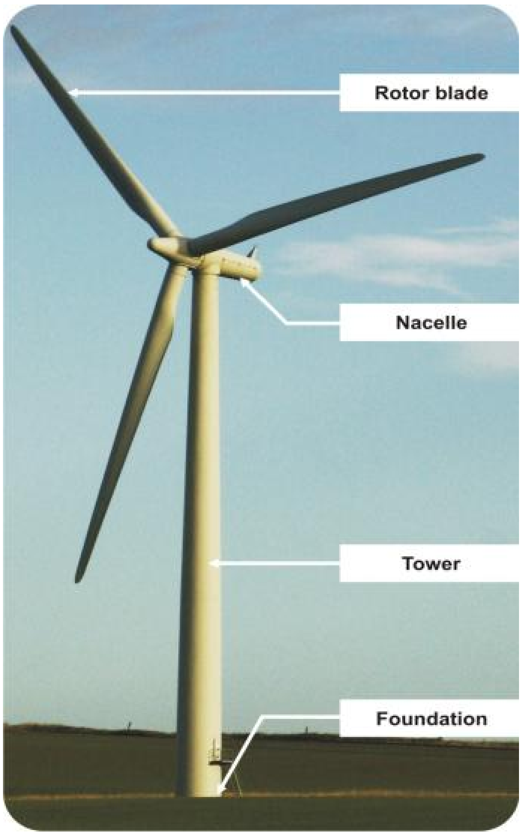

Figure 3.1: Illustration of the main components of a wind turbine

The rotor

The portion of the wind turbine that collects energy from the wind is called the rotor. The rotor converts the energy in the wind into rotational energy to turn the generator. The rotor has three blades, typically made from fibreglass materials or carbon fibre reinforced plastics. When a rotor blade is in contact with wind, the airflow is deflected; airflow over the top arched edge has to take a longer path than at the relatively straight underside. This results in a low pressure at the upper side and a high pressure at the lower side. The pressure differential causes the blades to start moving. 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 nacelle (geared)

The nacelle at the top of the tower accommodates the gears, the generator, anemometer for monitoring the wind speed and direction, cooling and electronic control devices, and yaw mechanism. Geared nacelles generally have a longer form than a gearless turbine.

3.2.2. 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 farm 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 3 m/s and 4 m/s.

At very high wind speeds, typically over 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.

PROJECT DESCRIPTION CHAPTER 4

This chapter provides details of the infrastructure required for Phase 1 of the Roggeveld Wind Farm and the main project development activities for the construction, operation and decommissioning phases.

4.1. Project Location

The site for the proposed Phase 1 of the Roggeveld Wind Farm is located ~20km north of Matjiesfontein and falls within both the Northern Cape and Western Cape Provinces. Nearest towns also include Laingsburg (Western Cape) and Sutherland (Northern Cape). The site falls within Ward 4 of Laingsburg Local Municipality and Ward 1 of the Karoo Hoogland Local Municipality. The broader study area (~265 km^2 in extent) for Phase 1 of the Roggeveld Wind Farm includes the following thirteen farm portions:

Farm Name	Farm No	Portion No
Ekkraal	199	1
Ekkraal	199	0
Bon Espirange	73	1
Bon Espirange	73	0
Rietfontein	197	0
Appelsfontein	201	0
Ou Mure	74	1
Fortuin	74	0
Fortuin	74	3
Brandvallei	75	0
Nuwerus	284	0
Standvastigheid	210	2
Aprils Kraal	105	0

4.2. Layout of the Facility and Infrastructure Required

Phase 1 of the Roggeveld Wind Farm will have an energy generation capacity of up to 140 MW. The layout for Phase 1 of the Roggeveld Wind Farm is shown in Figure 4.1.

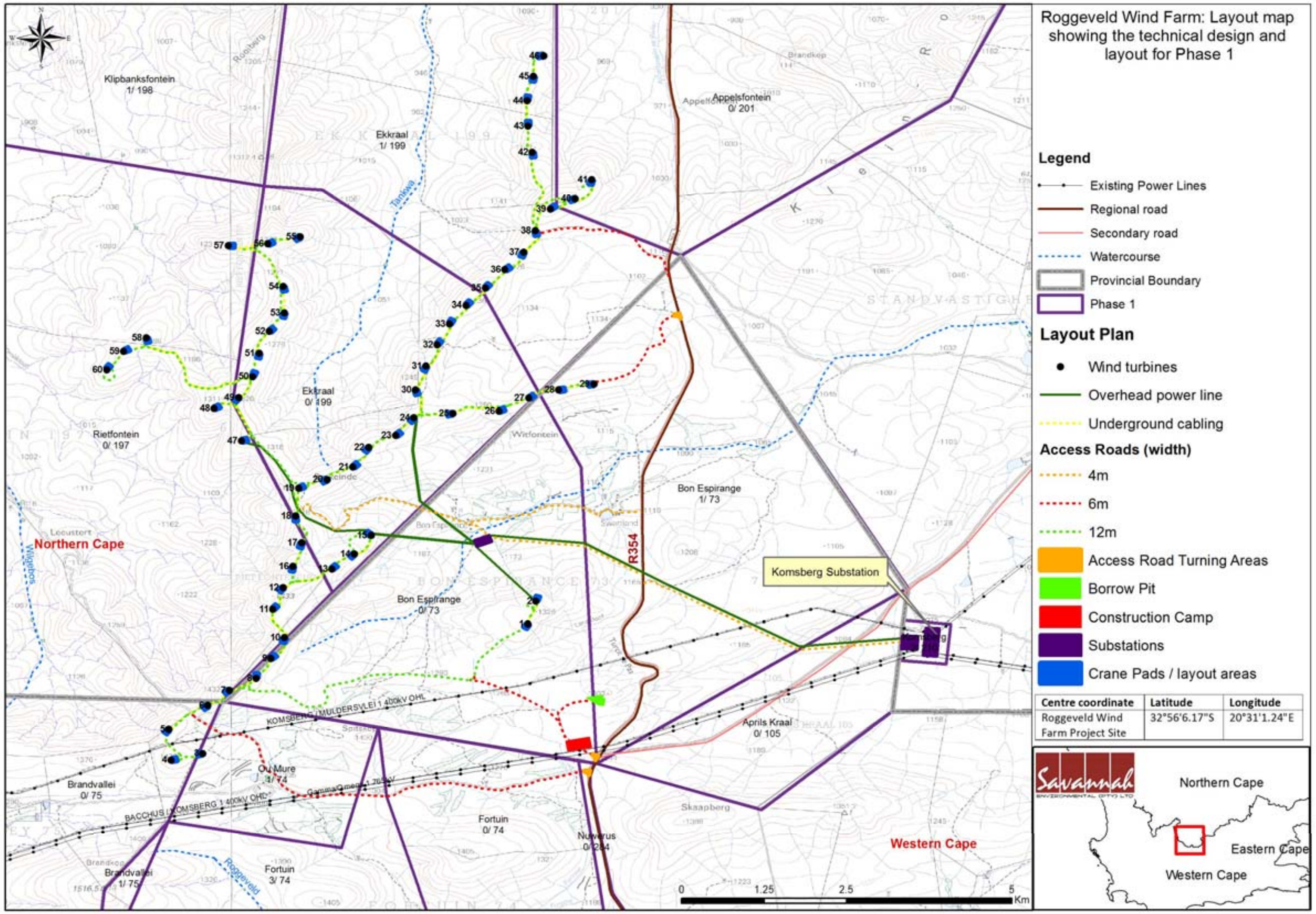

Figure 4.1: Layout map showing the technical design and layout for Phase 1 of the Roggeveld Wind Farm

Phase 1 of the Roggeveld Wind Farm will include the following infrastructure:

» Up to 60 2MW -3.3MW wind turbines with a foundation of 20m in diameter and 3m in depth.
» Permanent compacted hardstanding areas / crane pads for each wind turbine (60mx50m)
» Electrical turbine transformers (690kV/33kV) at each turbine (2m x 2m typical but up to 10 x 10m at certain locations)
» Internal access roads up to 12 m wide.
» Approximately 11km of 33kV overhead power lines and approximately 6km of 400kV overhead power lines to Eskom's Komsberg substation.
» Electrical substations (An on-site 132/400 kV substation (100m x 200m) and a 400 kV substation (200m x 200m) next to existing Eskom Komsberg substation.
» An operations and maintenance building (O&M building) next to the smaller substation.
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction phase includes construction lay down areas and a construction camp up to 4.5ha (150m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~2.2ha)

4.2.1 Wind Turbines

Up to 60 wind turbines are proposed for the site. Modern wind turbine designs include a tubular tower, three blades and a nacelle which houses a generator, gear box and other operating equipment. Each of the turbines at the Roggeveld Wind Farm will have an individual capacity of between 2MW -3.3MW. The turbines will be up to 100 m high (to the turbine hub), with a rotor diameter of up to 117m. The tip height (or the total height from the ground to the highest blade tip) would be up to 158.5m.

Each turbine will have a foundation of up to 20m in diameter and 3m in depth as its base, with the visible above ground part of 4m in diameter. A gravel hardstand and laydown area (60m x 50m in extent) adjacent to each turbine foundation is required during turbine construction for construction activities and for turbine maintenance during operation (as shown in Figure 4.2). The hard-stand area will be compacted in order to facilitate the use of a crane during construction and maintenance activities. Figure 4.3 shows details of the crane pad / lay-down area. Each turbine will be accompanied by an electrical transformer which will be located adjacent to the wind turbine. The turbines will also need to be lit to meet the Civil Aviation Authority's safety standard requirements.

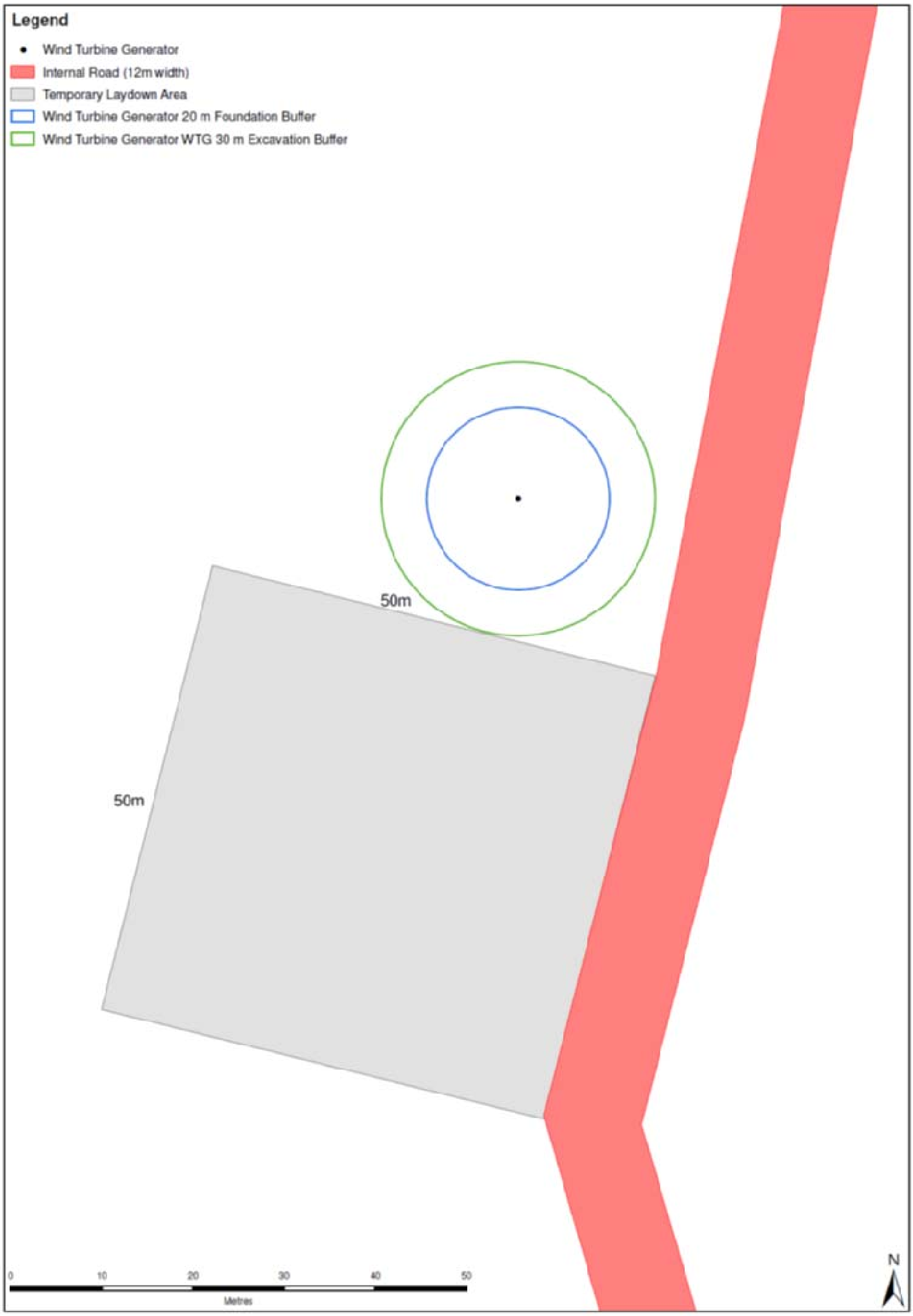

Figure 4.2 Typical drawing showing wind turbine, internal road and laydown area footprints.

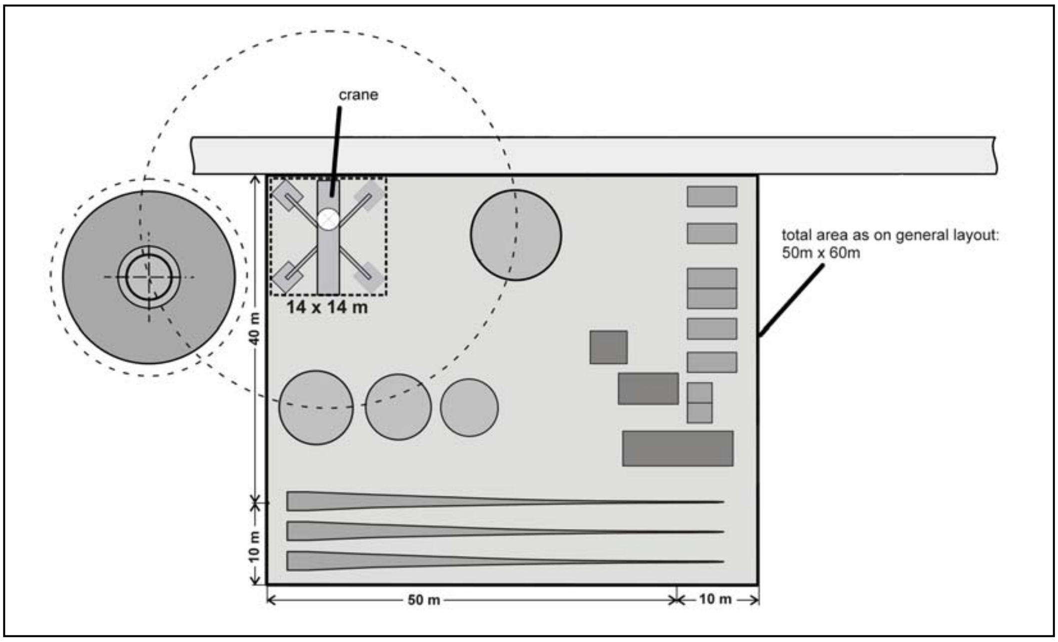

Figure 4.2: Details of the crane pad / lay-down area

4.2.2 Grid Connection and Electrical Infrastructure

Ultimately, the electricity generated by the wind farm would be fed into the national grid network via a new substation to be built right adjacent to the existing Komsberg 400 kV series capacitor station of Eskom, which is located on the south-eastern boundary of the proposed wind farm site. The electrical infrastructure required for Phase 1 of the Roggeveld Wind Farm would consist of the following:

» Connections between the turbines using medium voltage (33kV) underground electrical cabling or limited overhead lines from the high ridges down to the substation in the valley where it is not practical or feasible to install cabling below ground level. Installation of underground cables would require excavation of trenches, approximately 1m to 1.5m below ground, within which cables would be laid, following internal access roads as far as possible.
» Connections of the turbine rows to a new 132/400kV on-site substation using medium voltage (33kV) underground electrical cabling or overhead transmission lines.
» Connection of the on-site 132kV substation to a new 400kV Substation located adjacent to the existing Komsberg station, using high voltage overhead transmission lines (up to 400 kV).
» Short (~50m) 400kV loop-in loop-out overhead power line sections to connect the new 400kV substation to one of the existing 400kV lines traversing the site.

Approximately 11km of 33kV power lines and 6km of 400kV overhead power line is required to be constructed. The 132kV power line will have a servitude of about 50m.

4.2.3 Substations

Two substations are proposed:

» An on-site 132/400 kV substation (100m x 200m): This on-site substation complex would also house site offices, storage areas and ablution facilities.
» A 400 kV substation (200m x 200m) adjacent to existing Eskom Komsberg station, which is located on the south-eastern boundary of the wind farm site. The 400kV substation would be a single-storey complex of approximately 200m x 200m in size; it would house electrical equipment and would be fenced for security and safety.

Refer to Figure 4.3 for a map which shows proposed and existing infrastructure around the Komsberg substation.

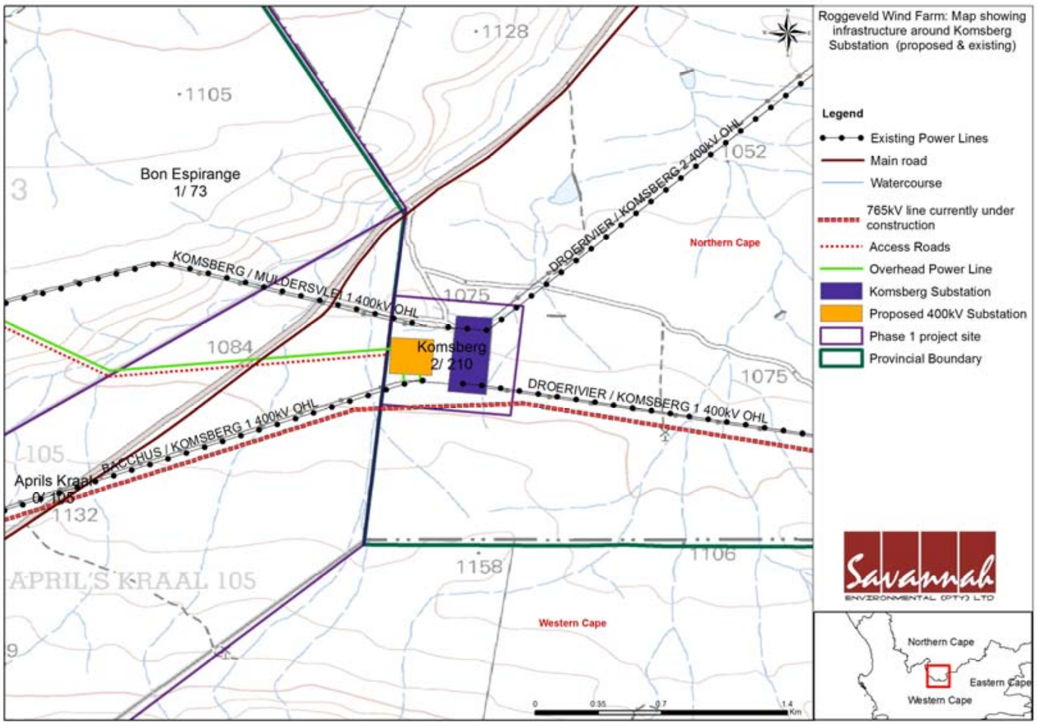

Figure 4.3: Proposed and existing infrastructure around the Komsberg substation.

4.2.4 Access Roads and Site Access

The site would be accessed via the R354. Some existing public roads may need to be upgraded to facilitate the transport of the turbines and other construction materials to the site. In addition to site access roads there would be a network of access roads between each of the wind turbines. Site access roads would be up to 12m wide with stormwater control channels adjacent to the road. Within the development site area existing farm tracks would be used where feasible, some of which would be required to be upgraded, and new gravel roads will also be constructed to facilitate movement of construction and maintenance vehicles.

There will be four site access roads, including two accessing the south of the site from the R354; and two accessing the north and centre of the site from the R354A number of different site access road options are being considered as part of the development. The final design of the access roads is based on the site development plans presented in Figure 4.1. Some minor adjustments may be effected based on a number of environmental, technical and economic considerations which will be explored further during the detailed project design phase.

4.2.5 Other Associated Infrastructure

Additional infrastructure that would be required for the project includes the following:

- » Four wind measuring masts (lattice structure; up to 100m in height) are required to collect data on wind conditions.
- » Site fencing (as required).
- » A temporary construction camp and construction laydown area for a batching plant, the storage of spoil heaps, chemicals, construction equipment and vehicles, site offices and additional worker facilities, is envisaged to occupy approximately 4.5 ha (150m x 300m). The proposed location of the temporary construction camp is shown on the layout and is located close to the R354 road on Remainder of the farm Bon Esperange 73.
- » Construction laydown areas adjacent to each turbine of approximately $3000m^2$ ***(hardstand area for the temporary laydown of the turbine and to provide a level surface for a crane pad).***
- » An on-site concrete batching plant will be established for use during the construction phase. The batching plant is to be located right next to the temporary construction camp on land adjacent to the R354.
- » It is likely that a borrow pit (subject to the appropriate permits) would be required within the site area to obtain aggregate material for construction of the internal roads and possibly turbine foundations. Final road capping may, however, have to be obtained from a commercial quarry and transported to

the site, to ensure the materials meet the quality requirements for the road surface layer. Siting of the borrow pit is indicated on the layout above about 500m north of the temporary construction camp but would still require a separate geotechnical investigation. The size of the borrow pit is approximately 2.1ha but also depends on suitability of the subsurface soils and the requirement for granular material for access road construction and other earthworks. The relevant mining permits for borrow pits will be applied for from the Department of Mineral Resources and does not fall within the scope of this EIA report.

4.3. Project Construction Phase

In order to construct the proposed wind energy facility and associated infrastructure, a series of activities will need to be undertaken. The construction phase is anticipated to be between 18 and 24 months in duration. A construction workforce will be required, and it is estimated that between 266 and 310 jobs could potentially be created during the construction phase. As far as possible, local labour will be utilised. More information on construction activities in provided below.

Prior to the installation of the wind turbines, the site would be prepared as required; this would include the following activities:

» site surveys;
» vegetation clearance;
» subcontractor mobilisation;
» erection of fencing and site security;
» construction/upgrading of on-site access roads;
» construction of site office and storage facilities;
» levelling and compacting of laydown areas and hardstand areas;
» excavation, laying and setting of turbine foundations;
» delivery of all wind turbine components (tower sections, hub, nacelle, blades etc.)
» turbine erection utilising specialised cranes;
» digging of trenches and laying of underground cables;
» substation construction; and
» Stringing of overhead lines.

4.3.1. Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to, topographical surveys, geotechnical surveys, site survey and confirmation of the turbine micro-siting footprint and access road routes, survey of substation site, and survey of power line servitude/s to determine pylon locations.

4.3.2. Establishment of Access Roads to provide access on the Site

The proposed site is currently accessible from the R354 road to Sutherland and each farm portion is accessible via existing gravel access roads. The individual farm portions already have a good network of "tracks" and internal roads which will be considered for use by the wind energy facility. Access roads to each turbine are required to be established. As far as possible, existing access roads would be utilised, and upgraded where required. Within the site itself, access will be required between the turbines for construction purposes (and later limited access for maintenance). Special haul roads of up to 12m in width will need to be constructed to and within the site to accommodate abnormally loaded vehicle access and circulation. 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 (e.g. blades) during operation of the facility.

4.3.3. 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.

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

4.3.4. Construction Compound

A temporary construction camp will be required during the construction phase to house construction equipment, provide amenities to the construction crew, and house construction workers as well as security guards. The construction camp will be up to 4.5 hectares in extent. Construction of the camp will entail vegetation clearing, site compaction, establishment of offices, amenities (including ablution facilities) and basic services such as electricity.

4.3.5. Establishment of Laydown Areas on Site

Laydown areas will be required on the site. Laydown and storage areas will be required to be established for the normal civil engineering construction equipment which will be required on site. Laydown areas will also need to be established at each turbine position for the storage and assembly of wind turbine components. The turbine laydown area will need to accommodate the cranes required in tower/turbine assembly. The extent of one turbine laydown area is up to 3000m^2.

In addition, construction compound areas will need to be established around the site. These will be temporary structures for site offices, storage and safe refuelling areas.

4.3.6. Construct Foundations

Concrete foundations will be constructed at each turbine location. Foundation holes will be mechanically excavated to a depth of approximately 3m, or where the bedrock is close to the surface, cleared by way of blasting or through specialised rock anchors. Concrete will have to be batched on site as there are no suitable concrete suppliers available in the vicinity. The reinforced concrete foundation will be poured and will support a mounting ring. The foundation will then be left up to a month to cure.

Figure 4.4: Photograph illustrating the construction of the foundation for a wind turbine[9]

[9]Photo sourced from http://www.news-gazette.com/news/environment/2011-08-16/wind-farm-construction-begins-near-paxton.html

4.3.7. Transport of Components and Equipment to Site

The wind turbine, including the tower, will be brought to the site by the turbine supplier in sections on flatbed trucks. Turbine units which must be transported to site consist of: the tower (in segments), hub, nacelle, and three rotor blades. The individual components are defined as abnormal loads in terms of Road Traffic Act (Act No 29 of 1989)[10] 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, site offices etc.).


Figure 4.5: Images illustrating transportation of wind turbine components via road[11]

The components required for the establishment of the substation/s (including transformers) as well as the power line (including towers and cabling) will also be transported to site as required. The dimensional specifications (length/height) of some loads transported during the construction phase 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, Provincial and local roads, and the dedicated access/haul roads to the site itself. In terms of transporting the turbine components from the Port of Saldanha to the site, the route envisaged is shown in Figure 4.6 below. The route generally follows the R45 then onto the N7 followed by the R46. The route continues on the N1 until it reaches the R354 which intersects with the boundary of the site.

[10] A permit will be required for the transportation of these abnormal loads on public roads.
[11] Images sourced from: windpowerninja.com and renewableenergyfocus.com

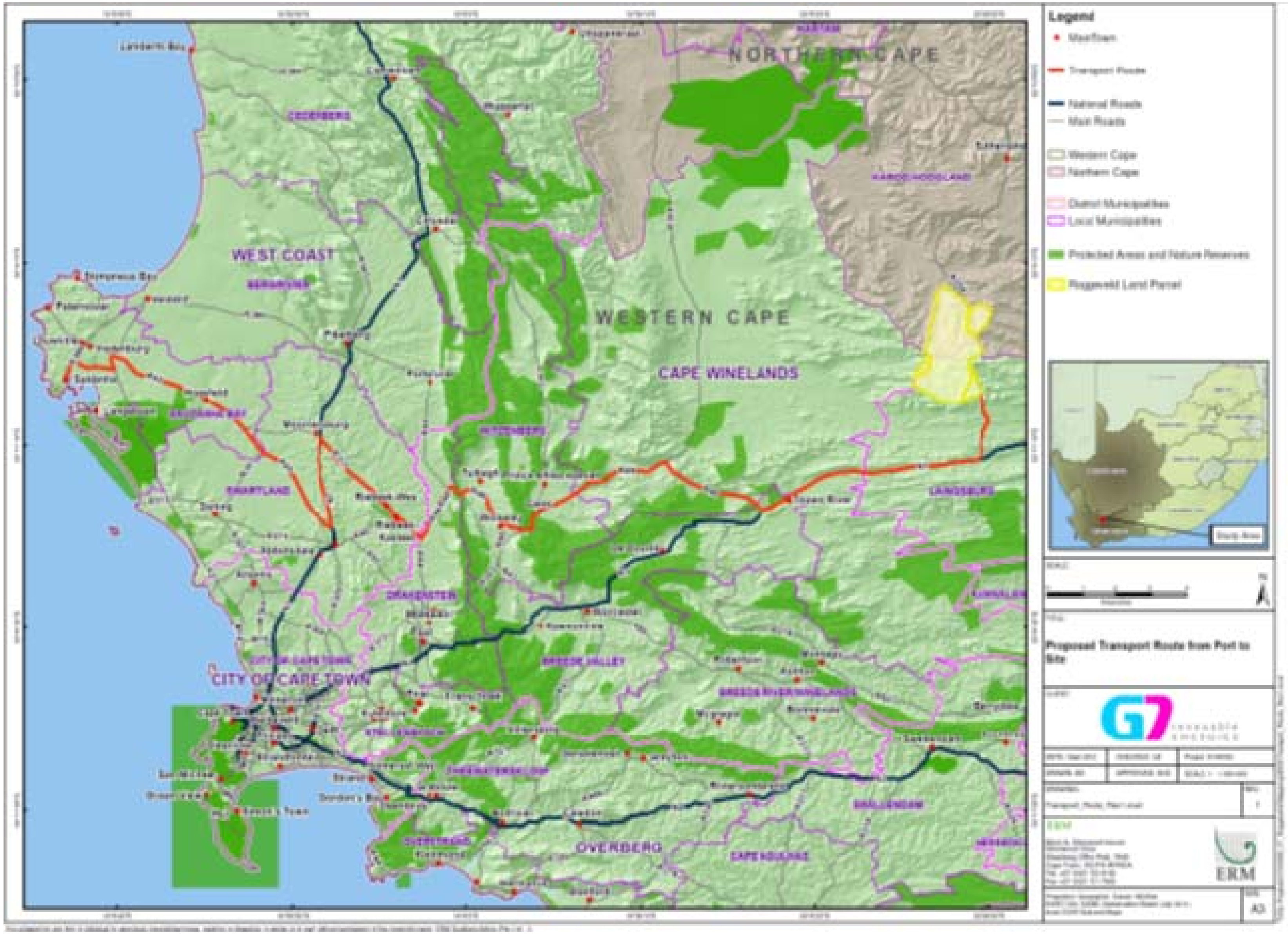

Figure 4.6: Planned Access Route from the Port of Saldanha to the Roggeveld Site

4.3.8. Construct Turbine

A large lifting crane will be brought on site. It will lift the tower sections into place, one at a time. The nacelle, which contains the gearbox, generator and yawing mechanism, will then be placed onto the top of the assembled tower. The next step will be to assemble or partially assemble the rotor (i.e. the blades of the turbine) on the ground to the hub. It will then be lifted to the nacelle and bolted in place. Auxiliary cranes will be needed for the assembly of the rotor while a large crane will be needed to put it in place.

4.3.9. Construct Substations

Two substations will be constructed. The position of the substation has been informed by the positioning of the wind turbines and Eskom's existing infrastructure. The construction of the substation would require a survey of the site; site clearing and levelling and construction of access road/s to the substation site (where required); construction of substation terrace and foundations; earthing grids, 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.

4.3.10. Connection of Wind Turbines to the Substation

Each wind turbine will be connected to the on-site substation via underground cabling (wherever possible). The installation of these cables will require the excavation of trenches, approximately 1.5 m in depth and 1m wide within which these cables can then be laid. The underground cables have been designed to follow the internal access roads, where possible.

4.3.11. Connect Substation to Power Grid

An overhead power line of up to 400kV will be required to connect the on-site substation within the wind farm to the planned new 400kV substation adjacent to Eskom's Komsberg station. The route for the power line will be surveyed and pegged prior to construction (see layout above).

4.3.12. Commissioning

Prior to the start-up of a wind turbine, a series of checks and tests will be carried out. This will include both static and dynamic tests to make sure the turbine is working within appropriate limits. Grid interconnection and unit synchronisation will be undertaken to confirm the turbine and unit performance. Physical adjustments may be needed such as changing the pitch of the blades. The schedule for this activity will be subject to site and weather conditions.

4.3.13. 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.

4.4. Project Operation Phase

Each turbine within the wind energy facility will be operational except under circumstances of mechanical breakdown, inclement weather conditions or maintenance activities. Technical and general maintenance staff will be required. It is anticipated that there could be security and maintenance staff required on site.

4.4.1. Maintenance & Staff

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. Approximately 27- 76 technical and general maintenance staff will be required. Potable water will be required for staff, and will be sourced locally from the local municipality.

4.5. Decommissioning

The turbine infrastructure which will be utilised for the proposed project is expected to have a lifespan of approximately 20 - 30 years (with maintenance). Generally a power purchase agreement (PPA) of 20 years is signed with the energy buyer, typically Eskom. After the PPA comes to an end, the PPA may be renegotiated at terms that are financially viable at that point in time. The PPA may be based on a shorter term agreement using the existing turbines (if the existing turbines are still suitable) or a new longer term PPA may be negotiated based on re-powering (refurbishment) of the wind farm. It is most likely that refurbishment of the infrastructure discussed in this EIA would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time. New turbine technology may also reduce potential environmental impacts. Where no new PPA can be negotiated it is likely that the wind farm will be decommissioned as required in the EMPr, Land Use Planning ordinance (LUPO) and other relevant regulations of that time. The following decommissioning and/or repowering activities have been considered to form part of the project scope of the proposed wind energy facility.

6.3.1 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 decommissioning equipment.

6.3.2 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. The land-use will revert back to agriculture/grazing.

REGULATORY AND LEGAL CONTEXT CHAPTER 5

5.1 Requirement for an EIA

In terms of sections 24 and 24D of NEMA, as read with Government Notices R543, R544, R545 and R546, a Scoping and EIA process is required for the proposed project (GG No 33306 of 18 June 2010). The key listed activity contained in GN545 which triggered a full EIA process is Listed Activity 1: The construction of facilities or infrastructure, for the generation of electricity where the output is 20 megawatts or more, as the wind farm will have an electricity generation capacity of up to 140MW. The table below contains all the listed activities in terms of the EIA Regulations of June 2010 which apply to Phase 1 of the Roggeveld Wind Farm, and for which an Application for Authorisation has been applied. The table also includes a description of those activities which relate to the applicable listed activities.

Table 5.1: Listed activities in terms of the EIA Regulations of June 2010 which apply to Phase 1 of the Roggeveld Wind Farm

Listed activity as described in GN R.544, 545 and 546	**Description of project activity that triggers listed activity**	**Reference to section in this EIA Report were the activity has been assessed**
GN544, 10(i): The construction of facilities or infrastructure for the transmission and distribution of electricity – » Outside urban areas or industrial complexes with a capacity of more than 33kv but less than 275kv~~; or~~	The project will entail construction of power line/s (outside an urban area).	Chapter 8
GN544, 11 (iii), (x) and (xi) The construction of: (iii) bridges; (x) buildings exceeding 50 square metres in size; (xi) infrastructure or structures covering 50 square metres or more Where such construction occurs within a watercourse or within 32 metres of a watercourse, measures from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	The wind energy facility will include the construction of infrastructure within 32m of a watercourse.	Chapter 8, Section 8.1
GN544, 18(i): The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells,	Construction activities or infrastructure will impact on or traverse watercourses.	Chapter 8, Section 8.1

Listed activity as described in GN R.544, 545 and 546	Description of project activity that triggers listed activity	Reference to section in this EIA Report were the activity has been assessed
shell grit, pebbles or rock from (i) a watercourse		
GN544, 22(i)(ii) The construction of a road, outside urban areas, (i) with a reserve wider than 13.5 metres or, (ii) where no road reserve exists where the road is wider than 8 metres	The wind energy facility will require access roads >8m in width to be constructed outside urban areas.	Chapter 8, Section 8.1
GN544, 39 (iii) The expansion of » bridges within a watercourse or within 32 metres of watercourse, measured from the edge of watercourse, where such expansion will result in an increased development footprint but excluding where such expansion will occur behind the development setback line.	Existing bridges will require expansion which will impact on or traverse watercourses.	Chapter 8, Section 8.1
GN545, 1: The construction of facilities or infrastructure, for the generation of electricity where the output is 20 megawatts or more	The wind energy facility will generate an electricity output of more than 20MW. Power lines and substations are ancillary infrastructure for this energy generation process.	Chapter 8, 9 and 10
GN545, 8: The construction of facilities or infrastructure for the transmission and distribution of electricity with a capacity of 275 kilovolts or more, outside an urban area or industrial complex	The wind energy facility will require the construction of a transmission substation (400kV substation) as well as a power line with a capacity of greater than 275 kilovolts.	Chapter 8
GN545, 15: Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more; Except where such physical alteration takes place for: (i) Linear development activities. (ii) Agriculture or afforestation where activity 16 in this schedule will apply.	The development footprint for the proposed wind energy facility will cover an area greater than 20 hectares.	A Chapter 8, 9 and 10
GN546 4(a) and (d): The construction of a road wider than 4 metres with a reserve less than 13,5 metres. (a) In ~~Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga~~	A road wider than 4 m will be constructed. The site occurs : • Outside urban areas » In a National Protected Area Expansion Strategy Focus area » Critical Biodiversity Areas in	Chapter 8

Listed activity as described in GN R.544, 545 and 546	**Description of project activity that triggers listed activity**	**Reference to section in this EIA Report were the activity has been assessed**
~~and~~ Northern Cape provinces: ii. Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; ~~(ff) Core areas in biosphere reserves;~~ ~~(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in~~ ~~terms of NEMPAA or from the core areas of a biosphere reserve;~~ ~~(hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined.~~ ~~iii. In urban areas:~~ ~~(aa) Areas zoned for use as public open space;~~ ~~(bb) Areas designated for conservation use in Spatial Development~~ Frameworks adopted by ~~the competent authority or zoned for a conservation purpose;~~ ~~(cc) seawards of the development setback line or within urban protected areas.~~	terms of the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009) and Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).	
GN 546, 10(a) and (e) The construction of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres a) In ~~Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and~~ Northern Cape provinces: ii. Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (e) In Western Cape:	Fuel and other dangerous goods to be used during construction and operations and will be stored on-site. The site occurs: » Outside urban areas » In a National Protected Area Expansion Strategy Focus area » Critical Biodiversity Areas in terms of the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009) and Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).	Chapter 9, Section 9.8

Listed activity as described in GN R.544, 545 and 546	**Description of project activity that triggers listed activity**	**Reference to section in this EIA Report were the activity has been assessed**
ii. All areas outside urban areas;		
GN 546, 12: The clearance of an area of 300 square metres or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (b) Within critical biodiversity areas identified in bioregional plans;	An area of 300 square metres or more of indigenous vegetation cover will be cleared. The site occurs within a Critical Biodiversity Area in terms of the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009) and Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).	Chapter 8, Section 8.1
GN 546, 13(a) (b) & (c) The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation. (a) Critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the competent authority. (b) National Protected Area Expansion Strategy Focus areas. (c) In ~~Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga,~~ Northern Cape and Western Cape: ii. Outside urban areas, the following: (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;	An area of 1 ha or more of indigenous vegetation cover will need to be cleared. The site occurs: » Outside urban areas » In a National Protected Area Expansion Strategy Focus area » Critical Biodiversity Areas in terms of the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009) and Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).	Chapter 8, Section 8.1
GN 546, 14 The clearance of an area of 5 hectares or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation : a) In ~~Eastern Cape, Free State, KwaZulu-Natal, Gauteng, Limpopo, Mpumalanga,~~ Northern Cape, ~~Northwest and~~ Western Cape: i. All areas outside urban areas	The clearing of an area of 5 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation is required to be undertaken outside of an urban area.	Chapter 8, Section 8.1
GN 546, 16 (iii),(iv), (a) & (d) The construction of (iii) buildings with a footprint exceeding 10 square metres in size or (iv) infrastructure covering 10 square	Buildings such as the workshop and site office and/or infrastructure larger than 10 m^2 or 10 m^2 within 32 m of a watercourse will be required to be built. The site occurs:	Chapter 8

Listed activity as described in GN R.544, 545 and 546	Description of project activity that triggers listed activity	Reference to section in this EIA Report were the activity has been assessed
metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line. a) In ~~Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and~~ Northern Cape: ii. Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (d) In the Western Cape: ii. Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;	» Outside urban areas » In a National Protected Area Expansion Strategy Focus area » Critical Biodiversity Areas in terms of the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009) and Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).	
GN 546, 19 (a) & (d) The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. a) ~~In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and~~ Northern Cape provinces: ii. Outside urban areas, in: (bb) National Protected Area Expansion	The wind energy facility will require access roads to be upgraded, which will include the widening of the roads as well and lengthening on roads in some areas. The site occurs : » Outside urban areas » In a National Protected Area Expansion Strategy Focus area » Critical Biodiversity Areas in terms of the Biodiversity	Chapter 8, Section 8.1

Listed activity as described in GN R.544, 545 and 546	Description of project activity that triggers listed activity	Reference to section in this EIA Report were the activity has been assessed
Strategy Focus areas; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ii) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined; (d) In the Western Cape: ii. All areas outside urban areas;	Assessment of the Central Karoo District Municipality (Skowno et al. 2009) and Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).	
GN 546, 24(d) The expansion of (d) infrastructure where the infrastructure will be expanded by 10 square metres or more. where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of the watercourse, excluding where such construction will occur behind the development setback line. a) ~~In Eastern Cape, Free State, KwaZulu-Natal, Limpopo, Mpumalanga and~~ Northern Cape provinces: ii. Outside urban areas, in: (d) Western Cape ii All Watercourses iii. Outside urban areas, in: (bb) National Protected Area Expansion Strategy Focus areas; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;	The project may require the expansion of roads (i.e. infrastructure) across waterways.	Chapter 8, Section 8.1

5.2 Strategic Electricity Planning in South Africa

The need to expand electricity generation capacity in South Africa is based on national policy and is 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 wind energy facilities is illustrated in Figure 5.1. 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 wind energy facility.

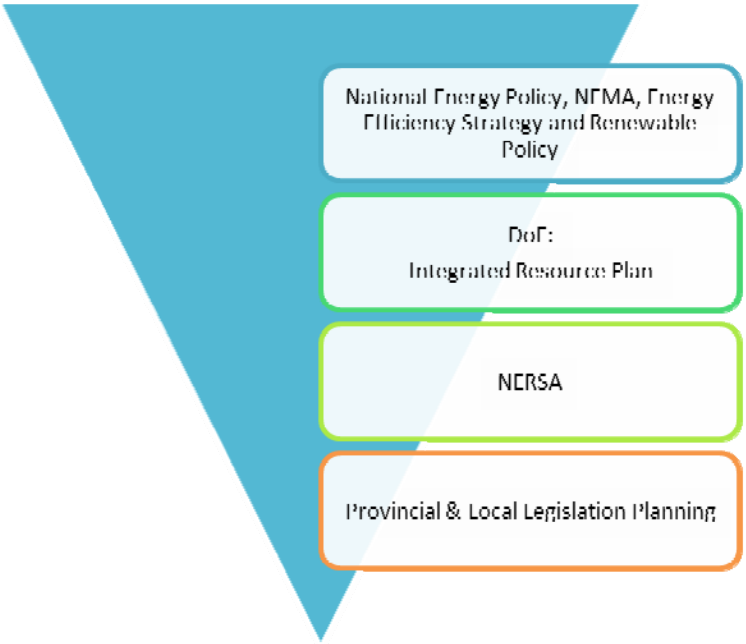

Figure 5.1: Hierarchy of electricity policy and planning documents

5.1.1 The Kyoto Protocol, 1997

South Africa's electricity is mainly generated from coal-based technologies. South Africa accounts for ~38 % of Africa's CO_2 (a greenhouse gas contributing to climate change) from burning of fossil fuels and industrial processes. The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. South Africa ratified the Kyoto Protocol in 2002. The Kyoto Protocol requires developing countries to reduce its greenhouse gas emissions through actively cutting down on using fossil fuels, or by utilising more renewable resources. Therefore certain guidelines and policies (discussed further in the sections below) were put in place for the Government's plans to reduce greenhouse gas emissions. The development of renewable energy projects (such as the proposed wind energy facility) is therefore in line with South Africa's international obligations in terms of the Kyoto Protocol. A second commitment period commenced from 1 January 2013, and extends to 31 December 2020.

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

Development within the energy sector in South Africa is governed by the White Paper on a National Energy Policy (the National Energy Policy), published by DME in 1998. This White Paper identifies five key objectives for energy supply within South Africa, i.e.:

» increasing access to affordable energy services;
» improving energy sector governance;
» stimulating economic development;
» managing energy-related environmental impacts; and
» securing supply through diversity.

Furthermore, the National Energy Policy identifies the need to undertake an Integrated Energy Planning (IEP) process and the adoption of a National Integrated Resource Planning (NIRP) approach. Through these processes, the most likely future electricity demand based on long-term southern African economic scenarios can be forecasted, and provide the framework for South Africa to investigate a whole range of supply and demand side options.

5.1.3 Renewable Energy Policy in South Africa

Internationally there is increasing development of the use of renewable technologies for the generation of electricity due to concerns such as climate change and exploitation of resources. In response, the South African government ratified the United Nations Framework Convention on Climate Change (UNFCCC) in August 1997 and acceded to the Kyoto Protocol, the enabling mechanism for the convention, in August 2002. In addition, national response strategies have been developed for both climate change and renewable energy.

Investment in renewable energy initiatives, such as the proposed wind energy facility, is supported by the National Energy Policy (DME, 1998). This policy recognises that renewable energy applications have specific characteristics which need to be considered. The Energy Policy is "*based on the understanding that renewables are energy sources in their own right, and are not limited to small-scale and remote applications, and have significant medium- and long-term commercial potential*." In addition, the National Energy Policy states that "*Renewable resources generally operate from an unlimited resource base and, as such, can increasingly contribute towards a long-term sustainable energy future*".

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. It also informs the public and the international community of the Government's vision, and how the Government intends to achieve these objectives; and informs Government agencies and organs of their roles in achieving the objectives.

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. In spite of this range of resources, the National Energy Policy acknowledges that the development and implementation of renewable energy applications has been neglected in South Africa.

Government policy on renewable energy is therefore concerned with addressing the following challenges:

» Ensuring that economically feasible technologies and applications are implemented;
» Ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options; and
» Addressing 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*."

5.1.4 Final Integrated Resource Plan 2010 - 2030

The current iteration of the Integrated Resource Plan (IRP) for South Africa, initiated by the Department of Energy (DoE) after a first round of public participation in June 2010, led to the Revised Balanced Scenario (RBS) that was published in October 2010. A second round of public participation was conducted in November/December 2010, which led to several changes to the IRP model assumptions

The document outlines the proposed generation new-build fleet for South Africa for the period 2010 to 2030. This scenario was derived based on the cost-optimal solution for new-build options (considering the direct costs of new build power plants), which was then "balanced" in accordance with qualitative measures such as local job creation.

The Policy-Adjusted IRP includes the same amount of coal and nuclear new builds as the RBS, while reflecting recent developments with respect to prices for renewables. 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; and 8,9 GW of other generation sources. The Policy-Adjusted IRP has therefore resulted in an increase in the contribution from renewables from 11,4 GW to 17,8 GW.

The DoE has released a draft Integrated Energy Planning Report (June 2013) for public comment. The Draft Integrated Energy Planning Report gives insight on the possible implications of pursuing alternative energy policy options in South Africa. Once the implications of all the alternative options have been explored and evaluated against each of the eight (8) key objectives, final recommendations will be made in the form of the Final IEP Report.

5.1.5 Department of Energy Process for Independent Power Producers (IPPs)

In order to meet the long-term goal of a sustainable renewable energy industry and to diversify the energy-generation mix in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation being derived from renewable energy forms by 2030.

In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, Roggeveld Wind Farm (Pty) Ltd proposes the establishment of Phase 1 of the Roggeveld Wind Farm to add new capacity to the national electricity grid. Roggeveld Wind Farm (Pty) Ltd will be required to apply for a generation license from the National Energy Regulator of South Africa (NERSA), as well as a power purchase agreement from Eskom (i.e. typically for a period of 20 - 25 years) in order to build and operate the proposed wind energy facility. As part of the agreement, Roggeveld Wind Farm (Pty) Ltd would be remunerated per kWh by Eskom or subsequent authority/market operator. Depending on the economic conditions following the lapse of this period, the facility can either be decommissioned, or the power purchase agreement renegotiated and extended.

The IPP will undergo a bidding process in which the Department of Energy will determine preferred bidders. A Preferred Bidder will be held to compliance with the price and economic development proposals in its bid, with regular reporting to demonstrate compliance during the life of the project.

The DoE REIPPP Programme is underway, with preferred bidders having been awarded a total of 3 916MW across 7 of the 9 Provinces. Construction on many of these has already commenced. The government signed contracts for 47 IPP projects (in 2012 and 2013 from the Round 1 and Round 2 projects), and have awarded a further 17 projects in Round 3. Roggeveld Wind Farm (Pty) Ltd intend bidding the project to the DoE for the bid submission in 2014.

5.3 Regulatory Hierarchy for Energy Generation Projects

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

At **National Level**, the main regulatory agencies are:

» *Department of Energy (DoE):* This Department is responsible for policy relating to all energy forms, including renewable energy, and are responsible for forming and approving the IRP (Integrated Resource Plan for Electricity). Wind energy is considered under the White Paper for Renewable Energy (2003) and the Department undertakes research in this regard. It is the controlling authority in terms of the Electricity Regulation Act (Act No 4 of 2006, and as amended).
» *National Energy Regulator of South Africa (NERSA):* This body is responsible for regulating all aspects of the electricity sector, and will ultimately issue licenses for wind energy developments to generate electricity.
» *Department of Environmental Affairs (DEA):* This Department is responsible for environmental policy and is the controlling authority in terms of NEMA and the EIA Regulations. The DEA is the competent authority for this project, and charged with granting the relevant environmental authorisation.
» *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.
» *South African Civil Aviation Authority (SACAA):* This Department is responsible for aircraft movements and radar, which are aspects that influence wind energy development location and planning.
» *South African National Roads Agency (SANRAL):* This agency of the Department of Transport is responsible for all National road routes.
» *Department of Water Affairs (DWA):* This Department is responsible for effective and efficient water resources management to ensure sustainable economic and social development. This Department is also responsible for evaluating and issuing licenses pertaining to water use.
» *Department of Agriculture, Forestry and Fisheries (DAFF):* This Department is the custodian of South Africa's agriculture, fisheries and forestry resources and is primarily responsible for the formulation and implementation of policies governing the Agriculture, Forestry and Fisheries Sector. This Department has published a guideline for the development of wind farms on agricultural land.
» *Department of Mineral Resources:* Approval from the Department of Mineral Resources (DMR) may be required to use land surface contrary to the objects of the Act in terms of section 53 of the Mineral and Petroleum Resources

Development Act, (Act No 28 of 2002): In terms of the Act approval from the Minister of Mineral Resources is required to ensure that proposed activities do not sterilise a mineral resources that might occur on site.

For the **Northern Cape Province** the main **provincial** regulatory agencies are:

» P*rovincial Government of the Northern Cape – Department of Environment and Nature Conservation (Northern Cape DENC).* This department is the commenting authority for this project.
» *Department of Transport and Public Works - Northern Cape.* This department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *Northern Cape Department of Agriculture and Rural Development* – This is the provincial authority responsible for matters affecting agricultural land.
» *Northern Cape Heritage*: provides legislative protection for listed or proclaimed heritage sites, such as urban conservation areas, nature reserves and proclaimed scenic routes.

For the **Western Cape Province** the main **provincial** regulatory agencies are:

» *Provincial Government of the Western Cape – Department of Environmental Affairs and Development Planning (DEA&DP):* This department is the commenting authority for this project.
» *Department of Transport and Public Works (Western Cape):* This department is responsible for roads and the granting of exemption permits for the conveyance of abnormal loads on public roads.
» *CapeNature:* This Department's involvement relates specifically to the biodiversity and ecological aspects of the proposed development activities on the receiving environment to ensure that developments do not compromise the biodiversity value of an area. The Department considers the significance of impacts specifically in threatened ecosystems as identified by the National Spatial Biodiversity Assessment or systematic biodiversity plans.
» *Department of Agriculture and Land Care:* This Department's involvement relates specifically to sustainable resource management and land care.
» *Heritage Western Cape:* Heritage Western Cape is a provincial heritage resources authority. This public entity seeks to identify, protect and conserve the rich and diverse heritage resources of the Western Cape.
» *Department of Water Affairs:* This Department is responsible for evaluating and issuing licenses pertaining to water use.

At a **Local Level**, the local and municipal authorities are the principal regulatory authorities responsible for planning, land use and the environment. The site is located within the Karoo Hoogland Local Municipality of the Northern Cape and within the Laingsburg Local Municipality of the Western Cape. In terms of the

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

There are also numerous non-statutory bodies such as Wind Energy Associations and environmental lobby groups that play a role in various aspects of planning and the environment that will influence wind energy facility development.

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

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

- » National Environmental Management Act (Act No. 107 of 1998)
- » EIA Regulations, published under Chapter 5 of the NEMA (GNR R543 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).
- » Provincial Government Western Cape, Department of Environmental Affairs and Development Planning: Guideline for Environmental Management Plans. 2005
- » Provincial Government Western Cape, Department of Environmental Affairs and Development Planning: Guideline for the Management of Development on Mountains, Hills and Ridges in the Western Cape (2002)
- » Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (Jenkins et al 2012)
- » South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments. Wildlife & Energy Programme of the Endangered Wildlife Trust (2011).

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 in Table 5.2.

Table 5.2: Relevant legislative permitting requirements applicable to EIA and Phase 1 of the Roggeveld Wind Farm project

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
National Legislation			
National Environmental Management Act (Act No 107 of 1998)	EIA Regulations have been promulgated in terms of Chapter 5. Activities which may not commence without an environmental authorisation are identified within these Regulations. In terms of Section 24(1) of NEMA, the potential impact on the environment associated with these listed activities must be considered, investigated, assessed and reported on to the competent authority (the decision-maker) charged by NEMA with granting of the relevant environmental authorisation. In terms of GNR 387 of 21 April 2006, a scoping and EIA process is required to be undertaken for the proposed project	National Department of Environmental Affairs – lead authority. Provincial Environmental Department - commenting authority.	This EIA report is to be submitted to the DEA and Provincial Environmental Departments 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. 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.	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.
National Environmental Management: Waste Act (Act No 59 of 2008)	» The purpose of this Act is to reform the law regulating waste management in order to protect health and the environment by	Hazardous Waste – National DEA General Waste – WC DEA&DP	Waste licence could be required in the event that more than 100m^3 of general waste or more than 35m^2 of hazardous

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	providing for the licensing and control of waste management activities. » The Act provides listed activities requiring a waste license.		waste is to be stored on site at any one time. The volumes of waste generated during construction and operation of the facility are not expected to be large enough to require a waste license.
Environment Conservation Act (Act No 73 of 1989)	In terms of section 25 of the ECA, the national noise-control regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992) were promulgated. The NCRs were revised under Government Notice No R55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations. Subsequently, in terms of Schedule 5 of the Constitution of South Africa of 1996, legislative responsibility for administering the noise control regulations was devolved to provincial and local authorities. Provincial Noise Control Regulations exist in the Western Cape Province. Allows the Minister of Environmental Affairs to make regulations regarding noise, among other concerns.	National Department of Environmental Affairs Provincial Environmental Department - commenting authority. Local Municipality	There is no requirement for a noise permit in terms of the legislation; although a provision is made that exemption from any of the regulations of the NCR can be applied for from a local authority. A Noise Impact Assessment is required to be undertaken in accordance with SANS 10328 – this has been undertaken as part of the EIA process. There are noise level limits which must be adhered to.
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 general authorisation in terms of S39 and GN 1191 of GG 20526 October 1999. In terms of Section 19, the project proponent must ensure that reasonable measures are taken throughout the life cycle of this project to prevent and remedy the effects of pollution to water resources from occurring, continuing or recurring.	Department of Water Affairs	A water use permits or licenses are required to be applied for or obtained, if infrastructure such as access roads, cabling or power lines cross watercourses, or for infrastructure within 500m of a wetland or watercourse (Section 21 c and i) . If ground or surface water is planned to be abstracted for use at the facility (either during construction or operation), this will

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
			also require a water use licence (Section 21 a and b).
Minerals and Petroleum Resources Development Act (Act No 28 of 2002)	A mining permit or mining right may be required where a mineral in question is to be mined (e.g. materials from a borrow pit) in accordance with the provisions of the Act. Requirements for Environmental Management Programmes and Environmental Management Plans are set out in Section 39 of the Act.	Department of Mineral Resources	If borrow pits are required for the construction of the facility, a mining permit or right is required to be obtained.
National Environmental Management: Air Quality Act (Act No 39 of 2004)	Sections 18, 19 and 20 of the Act allow certain areas to be declared and managed as "priority areas" in terms of air quality. Declaration of controlled emitters (Part 3 of Act) and controlled fuels (Part 4 of Act) with relevant emission standards. Section 34 makes provision for: (1) the Minister to prescribe essential national noise standards - (a) for the control of noise, either in general or by specified machinery or activities or in specified places or areas; or (b) for determining – (i) a definition of noise (ii) the maximum levels of noise (2) When controlling noise the provincial and local spheres of government are bound by any prescribed national standards.	National Department of Environmental Affairs – air quality Local Municipality - Noise	No permitting or licensing requirements applicable for air quality aspects. The section of the Act regarding noise control is in force, but no standards have yet been promulgated. Draft regulations have however, been promulgated for adoption by Local Authorities. An atmospheric emission licence issued in terms of Section 22 may contain conditions in respect of noise. This will however, not be relevant to the facility, as no atmospheric emissions will take place. The Act provides that an air quality officer may require any person to submit an atmospheric impact report if there is reasonable suspicion that the person has failed to comply with the Act.
National Heritage Resources Act (Act No 25 of 1999)	Section 38 states that Heritage Impact Assessments (HIAs) are required for certain kinds of development including » the construction of a road, power line, pipeline,	» South African Heritage Resources Agency (SAHRA) – National heritage sites (grade 1 sites) as well as all historic	Section 4 of the NHRA provides that within 14 days of receipt of notification the relevant Heritage Resources Authority must notify the proponent to submit an

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	canal or other similar linear development or barrier exceeding 300 m in length; » any development or other activity which will change the character of a 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. Standalone HIAs are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils the provisions of Section 38. In such cases only those components not addressed by the EIA should be covered by the heritage component.	graves and human remains. » Heritage Western Cape – Issue of permits for removal or destruction of heritage resources in the Western Cape.	impact assessment report if they believe a heritage resource may be affected. 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.
National Environmental Management: Biodiversity Act (Act No 10 of 2004)	» Provides for the MEC/Minister to identify any process or activity in such a listed ecosystem as a threatening process (S53) » A list of threatened & protected species has been published in terms of S 56(1) - Government Gazette 29657. » Three government notices have been published,	National Department of Environmental Affairs	Specialist flora and fauna studies are required to be undertaken as part of the EIA process. A specialist flora, fauna and wetland's assessment has been undertaken for the proposed project. A permit may be required should any listed plant species on site be disturbed or

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	i.e. GN R 150 (Commencement of Threatened and Protected Species Regulations, 2007), GN R 151 (Lists of critically endangered, vulnerable and protected species) and GN R 152 (Threatened or Protected Species Regulations). » Provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The first national list of threatened terrestrial ecosystems has been gazetted, together with supporting information on the listing process including the purpose and rationale for listing ecosystems, the criteria used to identify listed ecosystems, the implications of listing ecosystems, and summary statistics and national maps of listed ecosystems (National Environmental Management: Biodiversity Act: National list of ecosystems that are threatened and in need of protection, (G 34809, GoN 1002), 9 December 2011). » This Act also regulates alien and invader species. » Under this Act, a permit would be required for any activity which is of a nature that may negatively impact on the survival of a listed protected species. The developer has a responsibility for: » The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).		destroyed as a result of the proposed development.

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

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	veld fire occur on the property, that it does not spread to adjoining land. In terms of section 12 the applicant must ensure that the firebreak is wide and long enough to have a reasonable chance of preventing the fire from spreading, not causing erosion, and is reasonably free of inflammable material. In terms of section 17, the applicant must have such equipment, protective clothing and trained personnel for extinguishing fires.		this act will find application during the operational phase of the project. Due to the fire prone nature of the area, it must be ensured that the landowner and developer are part of the local Fire Protection Agency.
National Forests Act (Act No 84 of 1998)	Protected trees: According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that ' no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'. Forests: Prohibits the destruction of indigenous trees in any natural forest without a licence.	Department of Water Affairs	A permit or license is required for the destruction of protected tree species and/or indigenous tree species within a natural forest. No protected tree species were observed within or near the study area and it is highly unlikely that any protected tree species would be impacted by the development..
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 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	Civil Aviation Authority (CAA)	This act will find application during the operational phase of the project. Appropriate marking is required to meet the specifications as detailed in the CAR Part 139.01.33. An obstacle approval for the wind energy facility is required to be obtained from the CAA.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	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.		
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. » 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	Department of Health	It is necessary to identify and list all the Group I, II, III and IV hazardous substances that may be on the site and in what operational context they are used, stored or handled. If applicable, a license is required to be obtained from the Department of Health.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	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. 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.	» 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 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.	Provincial Department of Environmental Affairs and Development Planning (DEA&DP) - Drakenstein Local 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.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
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. This act may find application during through the project EIA.
Promotion of Administrative Justice Act (Act No 3 of 2000)	» In terms of Section 3 the government is required to act lawfully and take procedurally fair, reasonable and rational decisions » Interested & affected parties have right to be heard	National Department of Environmental Affairs (DEA)	No permitting or licensing requirements. This act will find application during through the project EIA.
Subdivision of Agricultural Land Act (Act No 70 of 1970)	Details land subdivision requirements and procedures. Applies for subdivision of all agricultural land.	Provincial Environmental Department - commenting authority. Local Municipality, District Municipality	Subdivision will have to be in place prior to any subdivision approval in terms of Section 24 and 17 of LUPO. Subdivision is required to be undertaken following the issuing of an environmental authorization for the proposed project.
Provincial Policies / Legislation			
Western Cape Noise Control Regulations: PN 627 of 1998	» The control of noise in the Western Cape Province is legislated in the form of Noise Control Regulations promulgated in terms of section 25 of the Environment Conservation Act No. 73 of 1989.	Western Cape DEA&DP	In terms of Regulation 4 of the Noise Control Regulations: "No person shall make, produce or cause a disturbing noise (greater than 5 dBA), or allow it to be made, produced or caused by any person, animal, machine, device or apparatus or any combination thereof".
Western Cape Land Use Planning Ordinance 15 of 1985	Details land subdivision and rezoning requirements and procedures	Western Cape Department of Environmental Affairs and Development Planning Local authorities, i.e. Drakenstein Local Municipality	Given that the wind energy development is proposed on land that is zoned for agricultural use, a rezoning application in terms of Section 17 of LUPO to an alternative appropriate zone will be required. It is anticipated that the wind energy development would require a

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
			rezoning to either Industrial Zone 1[7] or Special Zone[8] as defined in the Scheme Regulations in terms of Section 8 of LUPO (Government Gazette, December 1988). Rezoning is required to be undertaken following the issuing of an environmental Authorisation for the proposed project.
The Nature and Environmental Ordinance 19 of 1974, (as amended by the Western Cape Nature Conservation Laws Amendment Act, Act 2 of 2000	The Nature and Environmental Ordinance 19 of 1974, (as amended by the Western Cape Nature Conservation Laws Amendment Act, Act 2 of 2000) defines the protection status of plants as follows: * **''endangered flora''** means flora of any species which is in danger of extinction and is specified in Schedule 3 or Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973; provided that it shall not include flora of any species specified in such Appendix and Schedule 4; (thus all Schedule 3 species) * **''protected flora''** means any species of flora specified in Schedule 4 or Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington, 1973; provided that it shall not include any species of flora specified in such Appendix and Schedule 3	Cape Nature	Removal / relocation of protected plant / animal species require a permit to be obtained from the Cape Nature

[7] "Industry: means an enterprise defined in the regulations made in terms of Section 35 of the Machinery and Occupational Safety Act (Act 6 of 1983)" (note, these Regulations include any 'electrical installation')."
[8] "Special Usage: means a use which is such, or in respect of which the land use restrictions are such, that it is not catered for in these regulations, and which is set out in detail … by means of conditions of approval, or by means of conditions applicable to the special zone."

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	* **''indigenous unprotected flora''** means any species of indigenous flora not specified in Schedule 3 or 4;		
Northern Cape Nature Conservation Act, Act No. 9 of 2009	This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project: » Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property; » Aquatic habitats may not be destroyed or damaged; » The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species. » The Act provides lists of protected species for the Province.	Provincial Department of Environmental Affairs - DENC	Permitting or licensing requirements arise from this legislation for the proposed activities to be undertaken for the proposed project as there are a succulent plants species on the proposed development site. A permit is required to remove the plants.
Local Legislation / Policies / Plans			
Western Cape Transportation Amendment Act of 1996	» The provincial MEC may grant permit to undertake works within 200m of the published route upon receipt of the report assessing the potential impacts thereof.	Western Cape Department of Public Transport and Community Liaison	Any application for authorisation contemplated in the ECA and NEMA in respect of a 200m area on either side of a published route determination for a provincial road must be accompanied by a report that addresses the issues listed in

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
			that section of the Act.
Namwaka District Municipality Integrated Development Plan (IDP) (2006-2012)	» Contains planning and sustainability objectives for Local and District municipalities.	Namwaka District Municipality	None, generally applicable and new developments in the area must be aligned with the municipality's development planning.
Laingsberg Local Municipality Integrated Development Plan (2007-20112)	» Contains planning and sustainability objectives for Local municipality.	Laingsberg Local Municipality	None, generally applicable and new developments in the area must be aligned with the municipality's development planning.
Karoo Hoogland Local Municipality Integrated Development Plan (2009-2011)	» Contains planning and sustainability objectives for Local municipality.	Karoo Hoogland Local	None, generally applicable and new developments in the area must be aligned with the municipality's development planning.
Standards/ Guidelines			
Noise Standards	Four South African Bureau of Standards (SABS) scientific standards are considered relevant to noise from a Wind Energy Facility. They are: » SANS 10103:2008. 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'. » SANS 10210:2004. 'Calculating and predicting road traffic noise'. » SANS 10328:2008. 'Methods for environmental noise impact assessments'. » SANS 10357:2004. 'The calculation of sound propagation by the Concave method'. The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are	Local Municipality	The recommendations that the standards make are likely to inform decisions by authorities, but non-compliance with the standards will not necessarily render an activity unlawful per se.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
	acceptable for land use purposes.		
Draft Guidelines For The Evaluation And Review Of Applications Pertaining To Wind Farming On Agricultural Land (September 2010)	This document provides an outline of the type of agricultural / soil study required for wind farms and for submission to DAFF.	National Department of Agriculture	Requirements for soils and agricultural potential assessments to inform decisions regarding layouts affecting agricultural land and food security.
The Equator Principles (June 2003)	The Equator principles is benchmark in the financing of projects, which deals with determining, assessing and managing social and environmental risks related to the financing of projects, such as wind energy facilities.	International Finance Corporation (IFC) and World Bank	A wind energy facility is considered a Category B project
Environmental, Health, and Safety (EH&S) Guidelines for Wind Energy (2007)	The EH&S Guidelines for wind energy developments are technical reference documents with general and wind energy specific examples of Good International Industry Practice.	International Finance Corporation (IFC) and World Bank	This document was developed to guide the development of wind projects (which intend on applying for WB/IFC funding). Broad recommendations for management of environmental, health and safety impacts of wing energy facilities are provided in this document, which developers who intend on applying for finance must consider.
Regional Methodology for Wind Energy Site Selection: a Guideline Document prepared by DEA&DP	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) for the Western Cape	DEA&DP	Developers can use the guideline document as a tool for siting of wind energy facilities in the Western Cape.
Birdlife South Africa / Endangered Wildlife Trust Best Practice Guidelines For Avian Monitoring And Impact Mitigation At Proposed Wind	» Stipulates an integrated programme of pre- and post-construction monitoring for wind farm projects in order to develop the understanding of the effects of wind energy facilities on southern African birds.	Birdlife South Africa / Endangered Wildlife Trust	A pre-construction bird monitoring programme has been completed for the project.

Legislation / Policy / Guideline	Applicable Requirements	Relevant Authority	Compliance requirements
Energy Development Sites In Southern Africa	» To develop the most effective means to mitigate the impacts on birds.		
South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments (2011)	» Stipulates an integrated programme of pre- and post-construction monitoring for wind farm projects in order to develop understanding of the effects of wind energy facilities on bats. » To develop the most effective means to mitigate the impacts on bats.	Endangered Wildlife Trust	A pre-construction bird monitoring programme has been completed for the project.

APPROACH TO UNDERTAKING THE EIA PHASE — CHAPTER 6

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

The EIA process for the proposed Phase 1 of the Roggeveld Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice GN33306 of 18 June 2010, in terms of Section 24(5) of NEMA (Act No. 107 of 1998). This chapter serves to outline the EIA process that was undertaken by Environmental Resource Management (Pty) Ltd between 2010 and 2012 for the full extent of the Roggeveld Wind Farm project (i.e. Phase 1, Phase 2 and Phase 3 considered in one EIA process), as well as the subsequent approach by Savannah Environmental (Pty) Ltd to finalising the EIR report for Phase 1 only during 2013 and 2014.

6.1 Scoping Phase undertaken by Environmental Resource Management (Pty) Ltd

The Scoping Phase of the EIA process was undertaken in 2010 and 2011 by Environmental Resource Management (Pty) Ltd. Environmental scoping has several important functions aimed at facilitating decision-making. These include the following:

- » providing a description of the proposed project and associated activities;
- » reviewing existing information to gain an understanding of the baseline environmental conditions;
- » identifying any gaps in information and uncertainties;
- » investigating and screening of alternatives;
- » obtaining input from I&APs about their issues and concerns;
- » identification and initial assessment of potential environmental and social impacts associated with the project; and
- identifying potential mitigation and management measures.

Accordingly, the Scoping Report provided a detailed overview of the project, the associated public participation process, and proposed an EIA methodology. It also included a preliminary identification and evaluation of potential impacts and a Plan of Study for the EIA. The Draft Scoping Report was released for a 40-day public and authority review period (01 October 2010 to 12 November 2010) prior to submission to the DEA. The Scoping Report was received by the DEA on 03 January 2011 and accepted by the DEA on 07 March 2011.

6.1.1 Public Participation Tasks Undertaken during the Scoping Phase

The tasks relating to public participation during the Scoping Phase and included in the Scoping Report are summarised below:

- Development and expansion of the I&AP database.
- Placement of newspaper adverts. The project was advertised in Die Burger (Afrikaans) and Cape Times (English) on Wednesday 21 July 2010 and Die Noordwester (Afrikaans and English) on Friday 23 July 2010. The advertisements informed the public of the project and requested them to register as I&APs if they would like to participate in the EIA process. I&APs that responded to the advertisements were included on the project stakeholder database.
- Distribution of the Background Information Document (BID).
- Erection of on-site notices.
- The Draft Scoping Report was released for a 40-day public and authority comment period (1 October – 12 November 2010). A notification letter was sent to all registered and identified I&APs to inform them of the release of the report and that the report could be reviewed at the Laingsburg and Sutherland Libraries and on the project website.
- A public meeting/open day was held during the Scoping Phase (on 27 October 2010 at Laingsburg) to afford I&APs and the general public the opportunity to comment on the proposed project and engage with the EIA team. Notification of these meetings was sent to all registered I&APs when the Draft Scoping Report was released for comment.
- Throughout the Scoping process, issues and concerns raised by I&APs and authorities, and communicated to Environmental Resource Management (Pty) Ltd via post, email or fax were recorded, incorporated into the report and submitted with the Final Scoping Report.

6.2 EIA Phase undertaken by Environmental Resource Management (Pty) Ltd

Synthesis of the specialist studies, which addresses the key issues identified during the Scoping Phase, was documented in the Environmental Impact Report (EIR). Relevant technical and specialist studies were included in the EIR.

The Draft EIR was made available to I&APs for a 40-day comment period (which ended on 28 November 2011), and a notification letter was sent to all registered and identified I&APs to inform them of the release of the Draft EIR and where the report could be reviewed.

Public meetings were held in Sutherland on 08 November 2011 and Matjiesfontein on 09 November 2011 to communicate the findings of the EIA and afford stakeholders the opportunity to comment on the Draft EIR and engage with the EIA team. Comments received on the Draft EIR were assimilated and the EIA project team provided responses to comments. A Comments and Responses Report was developed and submitted to DEA for decision-making.

This EIR provided a description of the project, a synthesis of relevant baseline information and identified and evaluated the key issues and opportunities associated with the full extent of the Roggeveld wind farm development. Recommendations on the mitigation of adverse impacts and the enhancement of positive impacts associated with the proposed project were also included. These mitigation measures/enhancements were also translated into specific actions in the draft Environmental Management Programme (EMPr) appended to the EIR.

6.2.1 Specialist Studies

During the EIA Phase, the specialists gathered data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. They assisted the project team in assessing potential impacts according to a predefined assessment methodology which was described in the Scoping and EIA Reports. Specialists have also suggested ways in which negative impacts could be mitigated and benefits enhanced, and have assessed the potential for cumulative impacts. The independent specialists responsible for the specialist studies undertaken in 2011 are listed in Table 6.1.

Table 6.1 Independent Specialist Studies (2011)

Specialist Study	**Specialists and Organisation**	**Qualifications**
Ecological and Biodiversity study	Simon Todd (Simon Todd Consulting)	MSc Conservation Biology, University of Cape Town
Bird impact assessment study	Andrew Jenkins (AVISENSE Ornithological Consulting)	PhD Zoology, University of Cape Town
Pre-Construction Bird Monitoring Programme	Tony Williams (African Insights cc)	PhD Zoology, University of Cape Town
Bat impact assessment study	Kate MacEwan (Natural Scientific Services)	PrSciNat - Zoology BSc Zoology Honours, University of the Witwatersrand (Wits) MSc (Bat Conservation Biology - Wits) in progress
Pre-Construction Bat Monitoring Programme	Werner Marias (Animalia cc)	MSc (Biodiversity and Conservation)

Noise study	Adrian Jongens (Jongens Keet Associates)	M.Sc. Electrical Engineering, University of Cape Town
Visual and Landscape study	Bernard Oberholzer, (Bernard Oberholzer Landscape Architect (Bola) Quinton Lawson (MLB Architects)	B.Arch, University of Cape Town and MLA, Univ. of Pennsylvania PrArch BArch, University of Natal
Archaeological, Heritage and Paleontological study	Tim Hart (ACO Associates *cc.*)	MA University of Cape Town and Texas A&M University
Socio-economic study	Kerryn McKune Desai (Environmental Resource Management (Pty) Ltd)	MA Geography of Third World Development Royal Holloway, University of London BA Hons Environmental & Geographical Science, University of Cape Town

6.2.2 Public Participation Undertaken during the EIA Phase

The following tasks relating to public participation were undertaken as part of the EIA phase undertaken by Environmental Resource Management (Pty) Ltd in 2011 and 2012.

» The Draft EIR and EMPr were released for a 40-day comment period and registered I&APs notified of the release of the Draft EIR. The full report was made available at key locations and on the project website.
» Public meetings were held to afford I&APs and the general public the opportunity to comment on the proposed project and engage with the EIA team. The meetings were held at accessible venues and facilitated (and partly presented) in Afrikaans in order to ensure that the information was made accessible to the community.
» Comments received on the Draft EIR and EMPr were assimilated and the project team provided appropriate responses to comments (and were included in the Comments and Responses Report).
» All registered I&APs were notified of the submission of the Final EIR to the DEA and the availability of the Final EIR and EMPr.
» Following revisions to the FEIR, all registered I&APs were notified of the submission of the Revised Final EIR to the DEA and the availability of the Revised Final EIR and EMPr.

A summary of the all public participation tasks undertaken by Environmental Resource Management between 2010 – 2012 is provided in Table 6.2.

Table 6.2: Summary of Public Participation Activities undertaken by Environmental Resource Management between 2010 – 2012

Activity	Date
Site Notice Placement at Roggeveld	21 July 2010
Distribution of BID to neighbouring landowners and commenting authorities	21 July 2010
Notification advert placed in the Die Burger	21 July 2010
Notification advert placed in the Cape Times	21 July 2010
Notification advert placed in Die Noordwester	23 July 2010
Distribution of Draft Scoping Report for comment	01 October 2010
Public Meeting in Laingsburg	27 October 2010
Notification of submission of Final Scoping Report to DEA	04 January 2011
Distribution of Draft EIR for comment	17 October 2011
Public meetings in Sutherland and Matjiesfontein	08 and 09 November 2011
Notification of submission of Final EIR to DEA	November 2011
Notification of submission of revised Final EIR to DEA	November 2012

6.3 Authority Consultation and Involvement

The Scoping Report and Plan of Study for EIA undertaken by Environmental Resource Management (Pty) Ltd were accepted by the DEA. The Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) and the Northern Cape Department of Environment and Conservation (DENC), as the provincial commenting authorities for this application, were engaged for their comments on the Draft EIR, as were other commenting authorities including, but not limited to, Heritage Western Cape, Heritage Northern Cape, SAHRA, CapeNature, Department of Water Affairs and the Department of Agriculture.

Comments on the Roggeveld Wind Farm project have been received from the following Organs of State to date:

- Western Cape DEA&DP
- Department of Water Affairs
- SAHRA
- Heritage Western Cape
- Cape Nature
- Northern Cape Department of Agriculture, Land Reform and Rural Development

Additional comments will be sought during the review period for this FEIR, and will include the authoristies listed above, as well as the following organs of state/stakeholders:

- SALT

» SKA
» DENC
» DAFF
» CAA

6.4 Impact Assessment Methodology[9]

The methodology utilised for the detailed impact assessment is outlined below (taken from the Roggeveld EIR compiled by Environmental Resource Management, 2012). The purpose of impact assessment and mitigation is to identify and evaluate the significance of potential impacts on identified receptors and resources according to defined assessment criteria and to develop and describe measures that will be taken to avoid or minimise any potential adverse effects and to enhance potential benefits.

Impact Types and Definitions

An impact is any change to a resource or receptor brought about by the presence of a project component or by the execution of a project related activity. The evaluation of baseline data provides crucial information for the process of evaluating and describing how the project could affect the bio-physical and socio-economic environment. Impacts are described as a number of types as summarised in Table 6.3. Impacts are also described as *associated*, those that will occur, and *potential,* those that may occur.

Table 6.3: Impact Nature and Type

Nature or Type	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.

[9] Taken from the Roggeveld EIR compiled by Environmental Resource Management, 2012.

Assessing Significance

Impacts are described in terms of '*significance*'. Significance is a function of the **magnitude** of the impact and the **likelihood** of the impact occurring. Impact magnitude (sometimes termed *severity*) is a function of the **extent, duration and intensity** of the impact. The criteria used to determine significance are summarised in Table 6.4**Table 6.**. Once an assessment is made of the magnitude and likelihood, the impact significance is rated through a matrix process as shown in Table 6.5 and Table 6.6.

Significance of an impact is qualified through a statement of the **degree of confidence**. Confidence in the prediction is a function of uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence is expressed as low, medium or high.

Table 6.4 Significance Criteria

Impact Magnitude	
Extent	**On-site** – impacts that are limited to the boundaries of the development site. **Local** – impacts that affect an area in a radius of 20km around the development site. **Regional** – impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem. **National** – impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.
Duration	**Temporary** – impacts are predicted to be of short duration and intermittent/occasional. **Short-term** – impacts that are predicted to last only for the duration of the construction period. **Long-term** – impacts that will continue for the life of the Project, but ceases when the project stops operating. **Permanent** – impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the project lifetime.
Intensity	BIOPHYSICAL ENVIRONMENT: *Intensity can be considered in terms of the sensitivity of the biodiversity receptor (i.e. habitats, species or communities).* **Negligible** – the impact on the environment is not detectable. **Low** – the impact affects the environment in such a way that natural functions and processes are not affected. **Medium** – where the affected environment is altered but natural functions and processes continue, albeit in a modified way. **High** – where natural functions or processes are altered to the extent that it will temporarily or permanently cease. ***Where appropriate, national and/or international standards are to be used as a measure of the impact.*** *Specialist studies should attempt to quantify the magnitude of impacts and outline the rationale used.*

	____ SOCIO-ECONOMIC ENVIRONMENT: *Intensity can be considered in terms of the ability of project affected people/communities to adapt to changes brought about by the Project.* **Negligible** – there is no perceptible change to people's livelihood **Low** - People/communities are able to adapt with relative ease and maintain pre-impact livelihoods. **Medium** - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support. **High** - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.
Likelihood - the likelihood that an impact will occur	
Unlikely	The impact is unlikely to occur.
Likely	The impact is likely to occur under most conditions.
Definite	The impact will occur.

Once a rating is determined for magnitude and likelihood, the following matrix can be used to determine the impact significance.

Table 6.5: Significance Rating Matrix

SIGNIFICANCE				
		LIKELIHOOD		
		Unlikely	Likely	Definite
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table 6.6: Significance Colour Scale

Negative ratings	**Positive ratings**
Negligible	Negligible
Minor	Minor
Moderate	Moderate
Major	Major

Table 6.7: Significance Definitions

Significance definitions	
Negligible significance	An impact of negligible significance (or an insignificant impact) is where a resource or receptor (including people) will not be affected in any way by a particular activity, or the predicted effect is deemed to be 'negligible' or 'imperceptible' or is indistinguishable from natural background variations.
Minor significance	An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value.
Moderate significance	An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that 'moderate' impacts have to be reduced to 'minor' impacts, but that moderate impacts are being managed effectively and efficiently.
Major significance	An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the EIA process is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors such as employment, in coming to a decision on the Project.

Once the significance of the impact has been determined, it is important to qualify the **degree of confidence** in the assessment. Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact. Degree of confidence can be expressed as low, medium or high.

Mitigation Measures and Residual Impacts

For activities with significant impacts, the EIA process is required to identify suitable and practical mitigation measures that can be implemented. The implementation of the mitigations is ensured through compliance with the EMPr. After first assigning significance in the absence of mitigation, each impact is re-evaluated assuming the appropriate mitigation measure/s is/are effectively applied, and this results in a significance rating for the residual impact.

Identification of Mitigation Measures

For the identified significant impacts, the project team with the input of the client has identified suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the project design in order to avoid or reduce the negative impacts or enhance the positive impacts have been defined and require final agreement with the client as these are likely to form the basis for the conditions of authorisation by DEA.

6.5 Specialist Study Methodology

All specialists undertook an iterative process of assessment which significantly informed the proposed turbine layouts for the larger Roggeveld Wind Farm project. An initial turbine layout (Layout Alternative 1) was assessed, with the results of this assessment informing Layout Alternative 2 (which therefore incorporated inputs from the specialists)[10].

Ecology and Biodiversity

A desk-based study was carried out to identify flora and fauna species likely to be found within the study area. A site visit was undertaken on 22 and 23 November 2010 to assess the flora and fauna (mammals, reptiles and amphibians) of the Roggeveld site. The site was walked and plant species encountered were recorded and where necessary, photographed for verification and documentation purposes. The various habitats were delineated on a satellite image of the site. Particular attention was given to potentially sensitive habitats or areas that appeared to be species-rich or harbour different or unique species, such as drainage areas and rocky ridges. All reptiles, amphibians and mammals observed were recorded as was any characteristic evidence of faunal presence or activity such as scat, diggings, burrows etc. Within certain habitats such as rocky outcrops, the area was actively searched for reptile species characteristic of these areas or species of conservation concern which were identified beforehand as potentially occurring at the site.

Sensitivity maps of the study area were compiled based upon the findings of the site visit and available literature. The impact assessment phase involved the determination and evaluation of the nature of likely impacts of the development and recommendations on mitigation.

Avifauna

The study was undertaken in three phases, namely, scoping, site visit and impact assessment. During the scoping phase of the assessment, a literature review of bird and renewable energy facility interactions and bird species and habitats likely to occur in the study area was undertaken. This was followed by a site visit, which took place between 21 to 22 October 2010 to ground-truth predicted bird habitats and birds present, mainly by visiting as much of the inclusive area of the proposed development as possible, with an emphasis on sampling the avifauna in all of the primary habitats available. Additionally, the extent and direction of possible movements of birds within/through the site was estimated. The impact assessment phase involved the determination of the nature of likely impacts the development may have on birds and recommendations on mitigation.

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[10] taken from the Roggeveld EIR compiled by Environmental Resource Management, 2012.

Bats

A desktop review of publically available literature was undertaken during the initial phase of the assessment to understand bat and turbine interactions and the bat species and habitats likely to occur in the study area. A site visit took place on the night and day of 5 and 6 September 2010, respectively. During the day, the area was scanned for suitable roosting and foraging habitat. During the night, bat detectors and mist nets were set up at various points within the study area, in order to monitor actual bat activity. Finally the impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations for mitigation.

Noise

The environmental noise impact investigation and assessment of the wind farm was conducted in accordance with Section 8 of SANS 10328. This procedure included determining the existing residual (ambient) levels of noise within the study area during a one-day site visit. As well as calculating the expected level of noise due to the wind turbines on the identified noise sensitive land. The impact assessment phase involved the determination and evaluation of the likely noise impacts of the development on noise receptors around the site and recommendations for mitigation.

Visual

The Roggeveld land parcels were plotted on a map and distance circles were overlaid in order to roughly determine the areas that would be visually affected by the proposed wind farm. Using this visual radius map, a site visit was undertaken in September and October 2010. During the site visit a number of critical viewpoints were identified, particularly those relating to intersections of major roads, arterial and scenic routes, as well as settlements, including farmsteads. Panoramic photographs were taken from these viewpoints both for records and for use in determining the potential visibility of the wind farm from each viewpoint during the Visual Impact Assessment (VIA) stage of the EIA.

A viewshed map was prepared based on the proposed site layout and the proposed height of the turbines. This map provides a good indication of the areas which would be visually affected by the proposed facility. Photomontages were produced showing turbines superimposed on the panoramic photographs. These photomontages were used to assist with determining the nature of likely impacts of the development and recommendations on mitigation.

Archaeology, Heritage and Palaeontology

Archaeology

A desktop study was carried out of publicly available scientific publications to determine the archaeological history of the study area. In addition, an archaeological field survey was undertaken of the study area. Archaeological materials and structures were inventoried, with GPS positions, with approximate age and descriptions recorded as necessary. The impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

Heritage
Publications of the history of the study area were investigated and informed the specialist study. A heritage field survey was undertaken in order to identify existing heritage structures in the study area. These heritage structures were inventoried, with their GPS positions, age and descriptions recorded. The impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

Palaeontology
A desktop study was undertaken assessing the potentially fossiliferous rock units (groups, formations etc.) represented within the study area, determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience. Additionally, a palaeontological field survey was undertaken of the study area. This data was then used to assess the palaeontological sensitivity of each rock unit to development (Provisional tabulations of palaeontological sensitivity of all formations in the Western, Eastern and Northern Cape have already been compiled by Almond & Pether (2008). Finally the impact assessment phase involved the determination of the nature of likely impacts of the development and recommendations on mitigation.

Socio-economic
The socio-economic specialist study commenced with the compilation of a baseline description derived from a range of secondary data (including but not limited to, census data, existing reports, development plans other strategic planning documents) and primary data collection. The primary data used for the baseline was based on information provided by the directly-affected landowners and issues raised through the public consultation process.

The impact assessment phase incorporated the identification and assessment of socio-economic impacts (direct, indirect and cumulative) that may result from the construction and operation phases of the project. Mitigation measures that address the local context and needs were recommended as the final phase of the study.

6.6 Assumptions and Limitations

Environmental Impact Assessment is a process that aims to identify and anticipate possible impacts based on past and present baseline information. As the EIR deals with the future, there is inevitably some uncertainty regarding actual results. Impact predictions have been made based on field surveys and with the best data, methods and scientific knowledge available at this time. However, some uncertainties cannot be entirely resolved. Where significant uncertainty remains in the impact assessment, this is acknowledged and the level of uncertainty is provided as the degree of confidence.

In line with best practice, this EIR has adopted a precautionary approach to the identification and assessment of impacts. Where it has not been possible to make direct predictions of the likely level of impact, limits on the maximum likely impact have been reported and the design and implementation of the project (including the use of appropriate mitigation measures) will ensure that these are not exceeded. Where the magnitude of impacts cannot be predicted with certainty, the team of specialists have used professional experience and available scientific research from wind farms worldwide to judge whether a significant impact is likely to occur or not. Throughout the assessment this conservative approach has been adopted to the allocation of significance.

6.7 Approach to Updated FEIR for Phase 1 of the Roggeveld Wind Farm undertaken by Savannah Environmental

6.7.1 Background

The Application for Authorisation and the EIA process for the 750 MW Roggeveld Wind Farm undertaken by Environmental Resource Management (Pty) Ltd between 2010 and 2012 form the basis of this FEIR. Savannah Environmental (Pty) Ltd has been contracted as the Environmental Assessment Practitioner (EAP) to take the EIR for the first phase of development to conclusion.

Following requests made by DEA for additional information pertaining to the design of the facility, the Developer have reconsidered all relevant aspects of the project relating to project phasing, the facility layout, and grid connection. As a result, it is clear to the Developer as well as DEA that a further update to the FEIR was required prior to decision-making by DEA due to the following:

» The 750MW Wind Farm project is required to be split into 3 phases to comply with the capacity threshold stipulated by the Department of Energy (DoE).
» The Phase 1 facility has been given priority focus over Phase 2 and 3.
» The layout for Phase 1 has been slightly amended from the layout previously considered by the specialist team. Spacing between the turbines has

increased, which resulted in a change in the location of turbines. The revised layout has been considered by the specialists and the results of these studies have been considered in this Final EIA Report.

» The twelve months pre-construction bird and bat monitoring programme has been completed for Phase 1 of the project, and the results of these studies have been considered in this Final EIA Report.

In summary, the following changes to the EIA process for the Roggeveld Wind Farm have taken place in 2013:

» There has been a change in the Environmental Assessment Practitioner from Environmental Resource Management (Pty) Ltd to Savannah Environmental (Pty) Ltd.
» The project has been spilt into three project development phases in order to be in line with the Department of Energy's bidding requirements.
» The Final EIA report has now been revised by Savannah Environmental to assess the impacts associated with **Phase 1 only** of the Roggeveld Wind Farm. The revised Final EIA Report for Phase 1 is available for public review.

6.7.2 Split of the Project into Three Phases

The original application for environmental authorisation for the Roggeveld Wind Farm project (submitted by the previous EAP – Environmental Resource Management (Pty) Ltd in July 2010) was for a 750 MW wind energy facility. The DoE subsequently stipulated a maximum capacity threshold of 140MW for each wind farm project that can be bid as part of the REIPPPP. Therefore, as a result, the larger Roggeveld Wind Farm project (and the project development site) has been spilt into three phases in line with the DoE's REIPPPP bidding requirements.

In a process agreed with the competent authority (DEA), three applications for environmental authorisation (one for each phase of the Roggeveld Wind Farm) have been opened under the following project names and DEA reference numbers:

» Proposed Construction of the Roggeveld Wind Farm Phase 1 and Associated Infrastructure – 12/12/20/1988/1 (Applicant: Roggeveld Wind Power (Pty) Ltd)
» Proposed Construction of the Roggeveld Wind Farm Phase 2 and Associated Infrastructure – 12/12/20/1988/2 (Applicant: G7 Renewable Energies (Pty) Ltd)
» Proposed Construction of the Roggeveld Wind Farm Phase 13and Associated Infrastructure – 12/12/20/1988/3 (Applicant: G7 Renewable Energies (Pty) Ltd)

The original Application for Authorisation applied for the EIA Listed Activities under the EIA Regulations of April 2006. The three revised Applications for Authorisation are now in terms of the currently enacted EIA Regulations of June 2010. Phase 2 and Phase 3 have separate applications for environmental authorisations and will have separate EIA reports generated at a later stage.

6.7.3 Approach to Final EIA Report

Through detailed consultation with the competent authority (DEA), it was agreed that the current final EIA report be revised and updated to assess the impacts of Phase 1 of the Roggeveld Wind Farm only (applicable to DEA Ref. No.: 12/12/20/1988/1).

The approach to the update of the EIR report for Phase 1 of the Roggeveld Wind Farm includes:

- » Update of the existing EIA report which was compiled by Environmental Resource Management, the specialist studies and the impact assessment[11] considering the revised layout for Phase 1.
- » Consider and address DEA's additional requirements and requests for information.
- » Include DEA requirements for updated GIS mapping to:
  - ∗ Show high sensitive areas.
  - ∗ Incorporated buffers, exclusion zones, and no-go areas as recommended by specialist studies.
  - ∗ Prepare map with layout plan overlain on the environmental sensitivity map.
  - ∗ Provide clear A3 maps.
- » Update and add relevant plans in the EMPr including:
  - ∗ Plant rescue and protection plan
  - ∗ Re-vegetation and habitat rehabilitation plan
  - ∗ Alien invasive management plan
  - ∗ Erosion management plan
  - ∗ Measures to protect hydrological features
- » Incorporate the findings of the Phase 1 bird and bat pre-construction monitoring programmes into the EIA report.
- » Undertake the relevant public participation tasks required to inform the registered I&APs regarding the Final EIA report for Phase 1 of the project[12]:

[11] Utilising the methodology as previously utilised in the EIA report undertaken by Environmental Resource Management (Pty) Ltd.

[12] Note that an EIA process has already been conducted for the Roggeveld Wind Farm under DEA reference number 12/12/20/1988/1). A full public participation process was conducted and completed between 2010 and 2012.

* Compile and distribute a letter to registered I&APs announcing split of project/change in project description;
* Placement of newspaper adverts announcing a public review of the Final EIR for Phase 1;
* Compile and distribute a letter to registered I&APs announcing availability of Final EIR for public review;
* Obtain comment (or updated comment) from all Organs of State including
  - SALT
  - DEA&DP
  - DENC
  - Cape Nature
  - HWC
  - SAHRA
  - DWA
  - DAFF
  - DoA
  - CAA
  - any other relevant stakeholders
* Preparation of an updated Comments and Responses report;
* Compile and distribute a letter to all registered I&APs to inform all parties when the final EIR has been submitted to DEA.
* Notify all registered I&APs once a decision has been issued by the DEA. An appeal period will follow the issuing of the Environmental Authorisation.

Updated specialist studies which support this updated FEIR (and are appended to this report) are as follows:

Specialist Study	Specialists and Organisation	Appendix
Revised Ecological and Biodiversity study for Phase 1 of the Roggeveld Wind Farm	Simon Todd (Simon Todd Consulting)	Appendix F
Pre-Construction Bird Monitoring Programme and Impact Assessment Report for Phase 1 of the Roggeveld Wind Farm	Tony Williams (African Insights cc	Appendix G
Pre-Construction Bat Monitoring Programme and Impact Assessment Report for Phase 1 of the Roggeveld Wind Farm	Werner Marias (Animalia cc)	Appendix H
Revised Noise Study Phase 1 of the Roggeveld Wind Farm	Adrian Jongens (Jongens Keet Associates)	Appendix I
Revised Visual and Landscape study for Phase 1 of the Roggeveld Wind Farm	Bernard Oberholzer, (Bernard Oberholzer Landscape Architect (Bola) Quinton Lawson (MLB Architects)	Appendix J

Revised Archaeological, Heritage and Paleontological study Phase 1 of the Roggeveld Wind Farm	Tim Hart (ACO Associates *cc*)	Appendix K
Statement on Socio-economic impacts associated with Phase 1 of the Roggeveld Wind Farm	Tony Barbour (Tony Barbour Consulting)	Appendix L

The specialist reports and declarations of each specialist are attached to this EIA report. This final EIA Report for Phase 1 of the Roggeveld Wind Farm has been made available for a 40-day public review period, and will thereafter be submitted to DEA for consideration and decision-making. The 40 day public review period is from 06 January 2014 – 14 February 2014. The report is available for download on www.savannahsa.com/projects or on request from Savannah Environmental.

The nature and extent of Phase 1 of the Roggeveld Wind Farm, as well as potential environmental impacts associated with the construction, operation and decommissioning of a facility of this nature are assessed in this Final Environmental Impact Assessment (EIA) Report.

DESCRIPTION OF THE ENVIRONMENT CHAPTER 7

This section of the Final EIA Report provides a description of the environment that may be affected by the proposed Phase 1 of Roggeveld Wind Farm (DEA Ref. No. 12/12/20/1988/1). Aspects of the biophysical, social and economic environment that could be directly or indirectly 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 work undertaken by specialists and aims to provide the context within which this EIA is being conducted. Use of baseline information from the previous EIA undertaken by Environmental Resource Management (Pty) Ltd is acknowledged. A more detailed description of each aspect of the affected environment is included within the specialist EIA reports contained within Appendices F to L.

7.1 Climatic Conditions

The Roggeveld site is located in the Karoo Highland region. The climate is arid to semi-arid, but temperatures are tempered by the altitude of the region. Rainfall occurs throughout the year although the peak seasons are autumn and winter. Mean annual precipitation is approximately 290 mm, ranging from 180 – 410 mm rainfall per year. The hottest month in the summer is January and the coldest month in the winter is July. The predominant wind direction is from the north-west. The incidence of frost is relatively high with between 20 to 50 frost days recorded per year.

7.2 Topography, Geology and Soils

The site and surrounds are characterised by a network of hills, mountains and ridges, interspersed by valleys below the high ground. The dominant orientation of the ridges within the site is north-south. The highest point within the site is 1 450 m above sea level. A wider, open valley with undulating hills lies to the east of the site at approximately 1 000 – 1 200 m above sea level.

Soils are often gravelly and are mostly very shallow and contain variable amounts of clay depending on landscape position and weathering.

A map showing the agricultural potential (refer to Figure 7.1) indicates that the site is best suited for grazing in the Western Cape portion of the site, and a relatively small portion of land in the Northern Cape Province is well suited for commercial agriculture depending on water availability. Large portions of the land are well suited for conservation purposes.

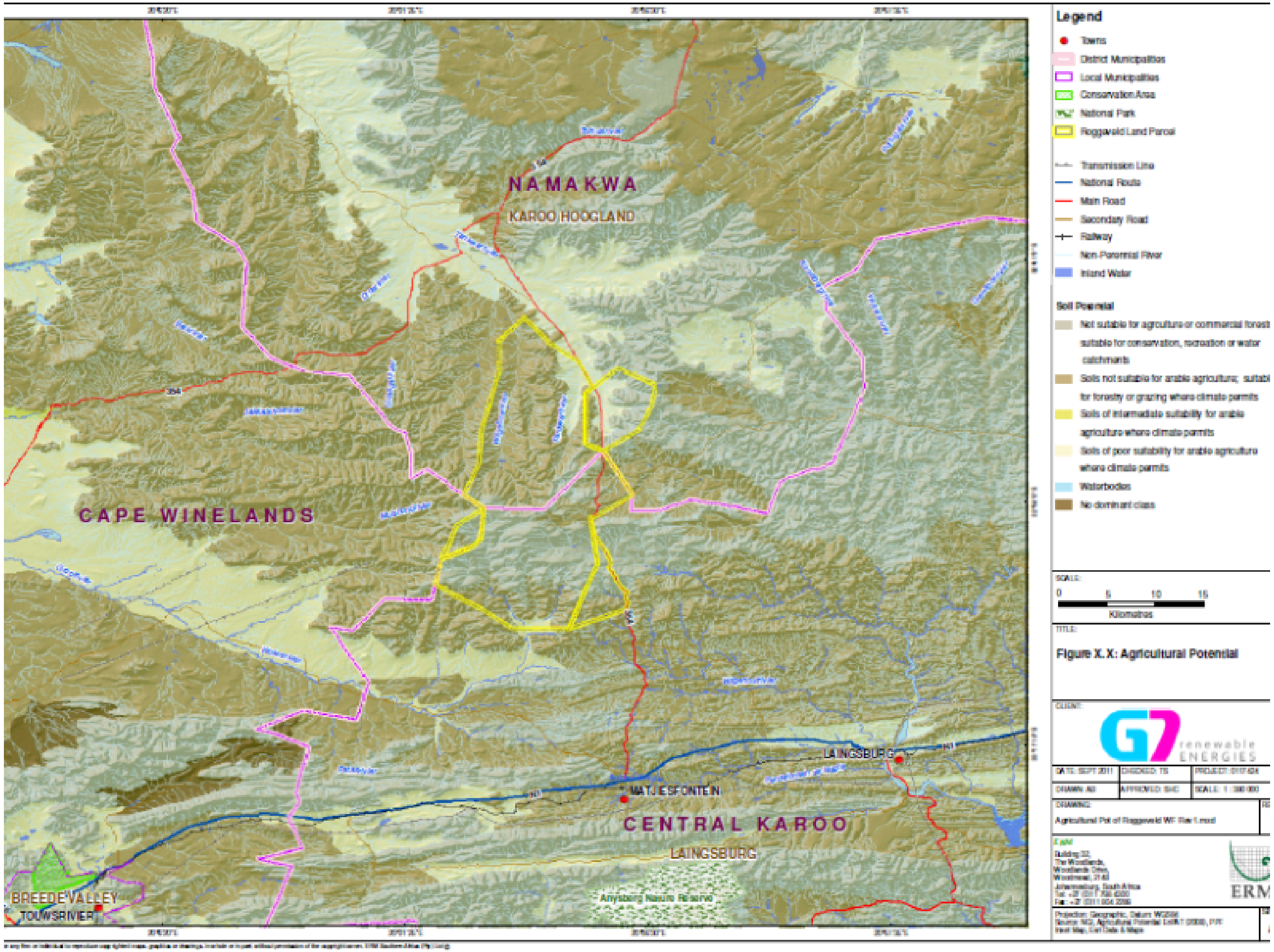


Figure 7.1: Map showing agricultural potential of the study area

7.3 General Water Catchments, Surface Water and Groundwater

The properties of the project site are located within two water management areas (WMA) demarcated by the Department of Water. A WMA is an area within which catchment management agencies conduct the protection, use, development, conservation, management and control of the country's water resources. The WMAs are managed at regional or catchment level. The boundaries of WMAs are broadly based on different levels of drainage region boundaries (primary, secondary, tertiary and quaternary), but also include some administrative demarcations.

The southern part of Phase 1 (Western Cape) falls under the Gouritz water catchment area, while the northern section (Northen Cape) of the site falls under the Olifants-Doorn catchment area. Both the Gouritz and Olifants-Doorn WMAs are managed by the Western Cape region.

The quaternary drainage regions demarcated by DWA determine the restrictions and permissible use water in terms of the National Water Act and applicable General Authorisations. The quaternary regions for the project site are (Olifants/Doorn)E23A, E22A, (Gouritz) JD11 and J11E (as shown in Figure 7.2).

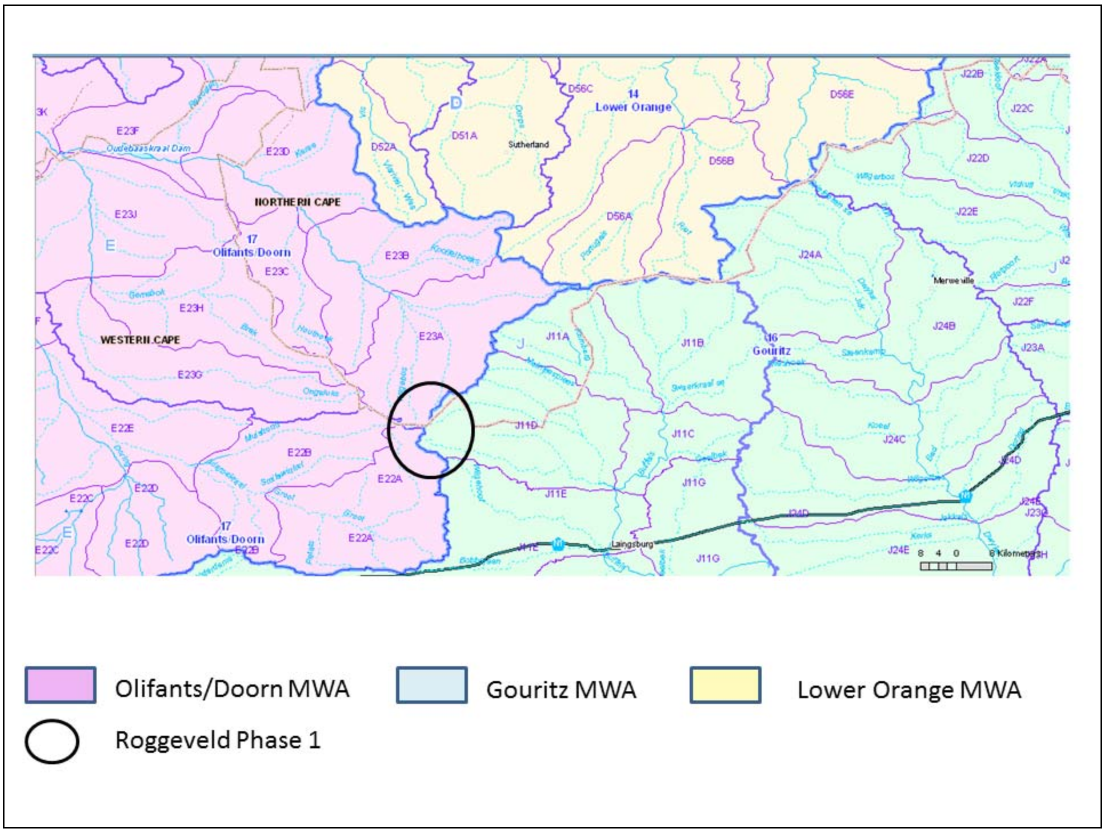


Figure 7.2: Map showing the quaternary drainage regions of the study area

The aquifer located beneath the site is classified as a fractured aquifer which has a groundwater yield potential of between 0.5 to 2.0 l/s and electrical connectivity values vary between 20 to 795 mS/m. The aquifer is fractured and groundwater is associated with joints and fractures of dolerite contact zones with country rock, decomposed dolerite and zones of semi-weathered dolerite. DWA classifies the regional aquifer as a major aquifer with moderate vulnerability (likelihood of contaminants reaching a receptor) and low susceptibility (potential significance of contaminants reaching a receptor).

Farm dams occur also within the site area. There numerous non-perennial watercourses that flow from areas of high ground into and along valleys within the site. Tributaries of two perennial rivers, the Wilgebosrivier and Furrowrivier flow from within the site to beyond in the north and south of the site respectively. Other perennial watercourses that are located in the broader study area (outside of the Roggeveld site itself) include the following:

» Kereekloofrivier (approximately 2 km west of site);
» Matjiesfontein se Kloof (approximately 5 km west of the site); and
» Roggeveldrivier (approximately 5 km east of the site).

7.4 Flora and Fauna

The Roggeveld site occurs within an area in which the Succulent Karoo Biome overlaps in areas with the Fynbos Biome. The vegetation types found on and around the site are described below and are shown in Figure 7.3.

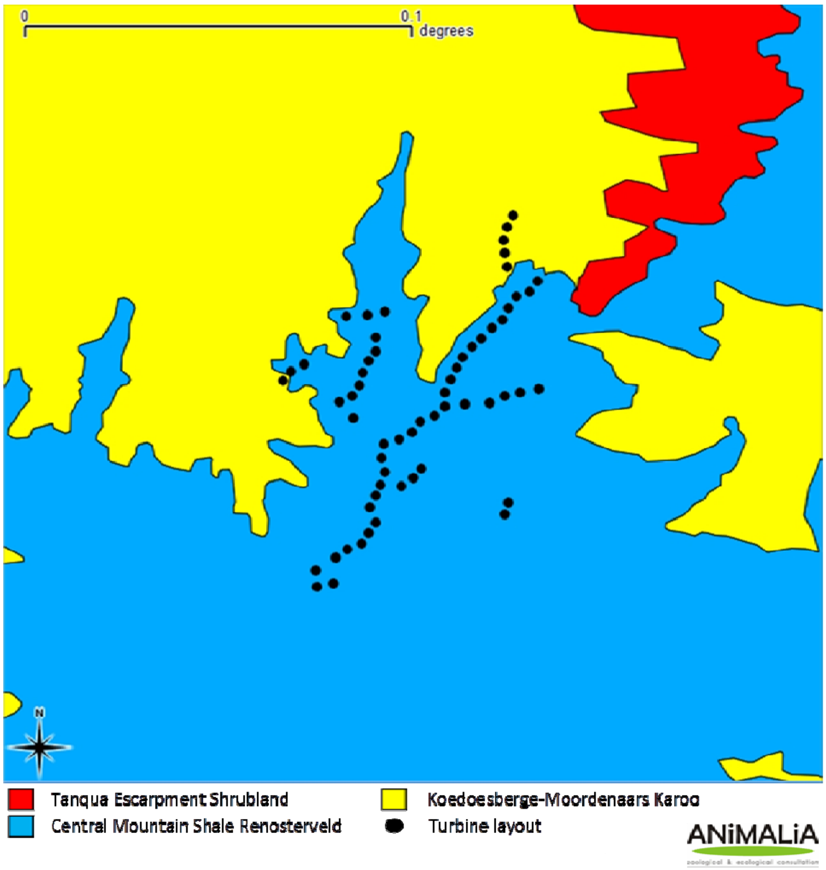


Figure 7.3: Vegetation units on the site (Mucina & Rutherford, 2006).

Central Mountain Shale Renosterveld is predominant on the site for Phase 1 of the Roggeveld Wind Farm. Hill slopes and broad ridges support tall shrubland dominated by renosterbos and non-succlent Karoo shrubs. Geophytic flora occurs in more open, wetter, rocky habitats. This vegetation type is considered to be least threatened (Rouget et al. 2004).

Koedoesberge-Moordenaars Karoo occurs in a broad area of the Karoo, predominantly on the northern portion of the site. Low succulent scrub with scattered tall shrub and patches of 'white' grass typify this vegetation type, and it is considered to be least threatened (Rouget et al. 2004).

During site visits, it was confirmed that the habitats of the site and surrounds are dominated by open Karoo shrub land. Based on site investigations the site is considered to be a suitable foraging site for birds of prey which are known to use ridges and escarpments (and their associated wind conditions such as updrafts) for soaring flight activities during hunting and territorial display. The valley and lower ground within the site are likely to support breeding and foraging birds and small mammals such as buck. Lower-lying areas of the site are considered to be suitable foraging habitats for bats.

The tops / listed species known to occur in the area based on previous studies is provided from the SANBI SIBIS database. According to the SIBIS database 1209 species are known from the quarter degree squares 3220 CD, DC and 3320 AB, BA. This is an exceptionally high number of species given the relative aridity of the area. Of these species, 70 are of conservation concern and of these 26 are priority species that are listed as Critical, Endangered or Vulnerable. Species listed as Threatened (CR, EN and VU) are regulated under the Biodiversity Act (Act No. 10 of 2004), by the Threatened and Protected Species regulations (ToPS) promulgated under the Act. Any activities which have a direct or indirect impact on ToPS-listed species (Table 7.2) require a ToPS permit.

Not a large proportion of the listed species were observed during the various site visits that have taken place. A proportion of the species of conservation concern are associated with the dry lowlands, such as the two listed Tanquana species and are not likely to be impacted by the development. In addition, the fynbos species such as *Protea convexa* and *Leucodendron teretifolium*, were not observed in the area and it is likely that these species are restricted to the ridges towards the N1 and do not actually occur within the study area as such.

Table 7.1: Summary of the conservation status of the different species known from the broad area surrounding the proposed Roggeveld site

Status	**Number of Species**
CR	3
EN	5
VU	18
NT	10
Rare	25
Declining	3
DDD	6
DDT	18
LC	908
Not evaluated	213
Grand Total	1209

Table 7.2: The species listed below are regulated as Threatened Species under the ToPS regulations

Family	Species	Status	QDS
ASPHODELACEAE	*Gasteria disticha*	CR	4
MESEMBRYANTHEMACEAE	*Tanquana hilmarii*	CR	2
PROTEACEAE	*Protea convexa*	CR	7
CRASSULACEAE	*Adromischus mammillaris*	EN	>30
FABACEAE	*Amphithalea villosa*	EN	9
FABACEAE	*Lotononis comptonii*	EN	4
FABACEAE	*Lotononis gracilifolia*	EN	2
MESEMBRYANTHEMACEAE	*Lampranthus amoenus*	EN	25
AMARYLLIDACEAE	*Brunsvigia josephinae*	VU	18
APOCYNACEAE	*Duvalia parviflora*	VU	4
ASPHODELACEAE	*Astroloba herrei*	VU	2
ASTERACEAE	*Euryops namaquensis*	VU	26
COLCHICACEAE	*Wurmbea capensis*	VU	19
FABACEAE	*Amphithalea spinosa*	VU	5
FABACEAE	*Lotononis densa subsp. congesta*	VU	5
FABACEAE	*Lotononis venosa*	VU	1
FABACEAE	*Xiphotheca fruticosa*	VU	13
HYACINTHACEAE	*Drimia arenicola*	VU	6
HYACINTHACEAE	*Lachenalia martinae*	VU	4
IRIDACEAE	*Geissorhiza karooica*	VU	2
IRIDACEAE	*Moraea aspera*	VU	5
IRIDACEAE	*Romulea eburnea*	VU	1
MESEMBRYANTHEMACEAE	*Antimima hamatilis*	VU	2
MESEMBRYANTHEMACEAE	*Tanquana archeri*	VU	5
POLYGALACEAE	*Muraltia karroica*	VU	7
RUTACEAE	*Acmadenia argillophila*	VU	7

The majority of turbines are located within the Central Mountain Shale Renosterveld and some occur within Koedoesberge-Moordenaars Karoo. Although these vegetation types are not well protected within formal conservation areas, they have not been highly impacted by intensive agriculture and both Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld are 99%intact.

The site straddles the planning domain of two different Biodiversity Assessments. Those parts of the site within the Western Cape fall within the Biodiversity Assessment of the Central Karoo District Municipality (Skowno et al. 2009). While those parts of the site which lie within the Northern Cape fall within the Namakwa District Biodiversity Sector Plan (Desment & Marsh 2008).

7.5 Critical Biodiversity Areas (CBAs)

Within the study area, the extensive CBA within the Western Cape portion of the site is based on several different criteria, some of which show significant overlap with one another, indicating that some areas qualify for CBA status on several different grounds. A large proportion of this CBA has been identified as a priority area within the National Protected Area Expansion Strategy for South Africa (NPAES) (Government of South Africa 2008). This area was identified as priority area on that grounds that apart from being an extensive tract of unfragmented natural vegetation, it is also an area of high climate and landscape variation which is likely to be resilient to climate change. Such areas are likely to be more climatically stable over time, providing refugia where plants and animals can persist. The Roggeveld is also a known centre of plant endemism (van Wyk & Smith 2001) and the western portion of the site falls within an area identified by experts as being an important area of plant diversity and endemism (SKEP Expert Map - Plants SKEP 2002).

The NPAES focus area is broad-scale, national-level analysis which identifies extensive areas of unfragmented habitat in situations of topographic diversity, with the assumption that such areas will be resilient to climate change impacts. The NPAES does not take fine-scale biodiversity patterns into account. The distribution of biodiversity in the area is very poorly understood, and the NPAES captures the broad-scale biodiversity value of the region, but says little about the fine-scale biodiversity pattern within the area.

There are also several technical issues regarding the delineation of CBAs in this area. The site lies along the Northern Cape – Western Cape provincial boundary and falls within two separate biodiversity assessments. The whole of the Western Cape section of the site is classified as a CBA, while only the south-facing slopes are classified as CBA in the Northern Cape. There are no differences in biodiversity between the two areas, so the difference relates to the manner in which the fine-scale conservation plans in the two areas have been implemented. The disparity across the provincial boundary raises some serious questions about the utility and validity of the respective CBAs. Neither case is considered representative of the situation on the ground, and have not been ground-truthed. Areas mapped as CBAs should have a demonstrated high biodiversity value, while areas providing connectivity between such areas or providing for broad-scale ecological processes should be mapped as Ecological Support Areas.

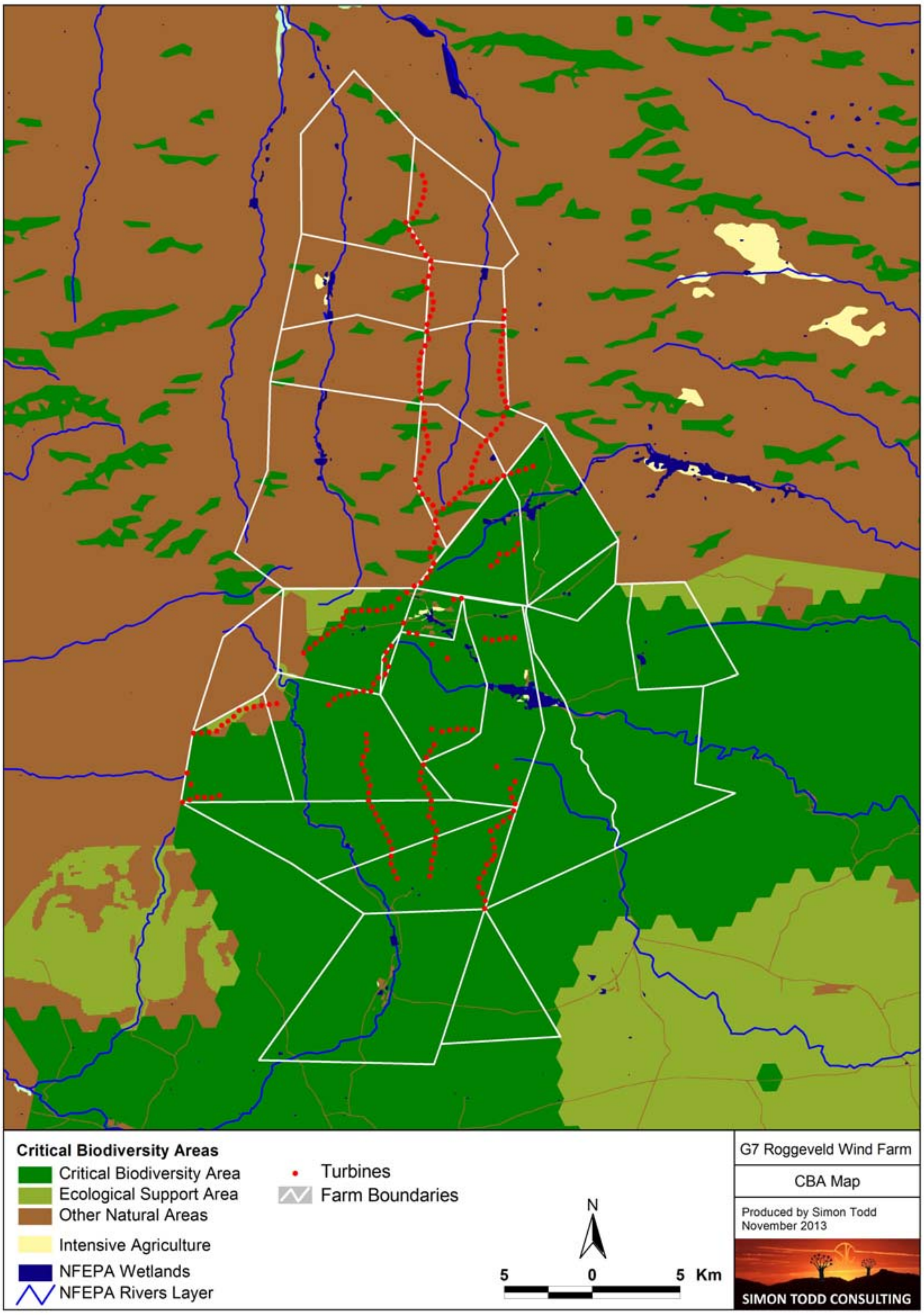


Figure 7.3 Map showing CBA on and around the Roggeveld Site

7.6 Avifauna

The description of the avifauna is based on information collected during the pre-construction bird monitoring undertaken by African Insight cc for Phase 1 of the Roggeveld Wind Farm. Both the diversity and number of birds seen along the Roggeveld ridges during the pre-construction bird monitoring programme was small. The total number of bird species seen along or passing over the ridges was 52, compared with an overall number of 121 species seen in the broader region (most of which were seen in the lower areas despite far less time being spent there than on the ridges). In many ridge-top vantage hours, and some transect walks, no birds at all were recorded especially during strong winds. Except for some early morning periods, generally fewer than 10 individual birds from all species were seen in any hour and these often likely included individuals seen repeatedly as they moved about foraging.

A broader ecological approach has been used to consider the degree to which the proposed wind farm may impact the avifauna of the Roggeveld. The site is not located within 50 km of any of the currently registered national Important Bird Areas (Barnes 1998). The 121 recorded bird species were first divided into 7 broad eco-groupings. These were:

1) birds of prey and carrion;
2) other non-passerines;
3) aerial insectivores;
4) ground foraging invertivores;
5) bush foraging invertivores;
6) granivores; and
7) waterbirds.

The 50 bird species that were seen along or over the ridges fell into two categories:

- Species that were recorded flying at turbine blade swept area heights (refer to Table 7.3).
- Species whose members seldom, if ever, fly at turbine blade heights. Of the 50 ridge-top species, 38 fell in this category. Most were passerines associated with the local scrubland habitats. When flushed, or foraging, these birds seldom flew more than 3 m above the scrubby bushes. On more purposeful cross-ridge flights they still flew at less than 10 m. During spring several species exhibited display flights in which they flew to 20-40 m above the ridges. However, the number of individuals in displaying species was low, all or most display flights would be well below turbine blade swept area, and most displays were over the rim of the ridges i.e. off the top of the ridges and over the upper-most slopes where nesting is most likely to occur.

Table 7.3: Bird species recorded along the ridges and their flight relative to turbine blade height

SPECIES	Flight relative to turbine blade swept area	
	Below	Within
Yellow Canary	X	
Cape Bunting	X	
Black-headed Canary	X	
White-throated Canary	X	
Lark-like Bunting	X	
Grey-backed Cisticola	X	
Bokmakierie	X	
Southern Banded Sunbird	X	
Layard's Tit-babbler	X	
Karoo Eremomela	X	
Spotted Prinia	X	
Rufous-eared Warbler	X	
Malachite Sunbird	X	
Cape Penduline Tit	X	
Cape Bulbul	X	
Fairy Flycatcher	X	
Yellow-bellied Eremomela	X	
Large-billed Lark	X	
Mountain Wheatear	X	
Karoo Long-billed Lark	X	
Sickle-winged Chat	X	
Cape Clapper Lark	X	
Karoo Scrub Robin	X	
Familiar Chat	X	
Karoo Chat	X	
Karoo Lark	X	
Long-billed Pipit	X	
Pale-winged Starling	X	
Rock Martin	X	
Alpine Swift		X
White-rumped Swift		X
Little Swift		X
Namaqua Sandgrouse		X
Grey-winged Francolin	X	
Speckled Pigeon	X	
Quail	X	
Ludwig's Bustard	X	

Verreaux's Eagle		X
Rock Kestrel		X
White-necked Raven		X
Pied Crow		X
Black Harrier	X	
Booted Eagle	X	
Martial Eagle		X
Jackal Buzzard	X	
Peregrine Falcon		X
Sacred Ibis		X
Hadeda Ibis	X	
Karoo Shelduck		X
Crowned Plover	X	
TOTALS	**38**	**12**

Species that occasionally fly at blade height

Ten of the ridge occurring species either often, or occasionally, flew at heights which would potentially bring them into turbine blade swept area (Table 7.3). All were diurnal foragers. Accordingly they have good vision and should not be subject to collision with turbines. Their numbers were small and even in these species most observed flights along the ridges were below turbine blade heights. Also in stronger winds fewer birds flew at blade heights so that when the blades rotate quickly and may appear to blur the likelihood of birds flying into them will be lower.

Bird species of concern

Six species are considered of potential conservation concern. Of these two are rated as Vulnerable [to extinction] - Ludwigs Bustard and Martial Eagle (Barnes 2000). Only a single **Ludwig's Bustard** was recorded crossing the ridges. Given the stony conditions and the paucity of large invertebrate prey it is probable that this species is only an occasional, generally non-breeding, visitor to the Roggeveld region. Probably the only two individuals seen, both in November, reflect a movement into the Roggeveld following the unusually heavy winter rainfall and the consequent increase in prey resources. **Martial Eagles** were seen on several occasions flying at heights that would coincide with turbine blade arcs. All observations were of these eagles flying over adjacent valleys well away from the proposed turbine layout (Figure 7.4). Neither of these two vulnerable species can be considered at particular risk of mortality through collision with the proposed turbines.

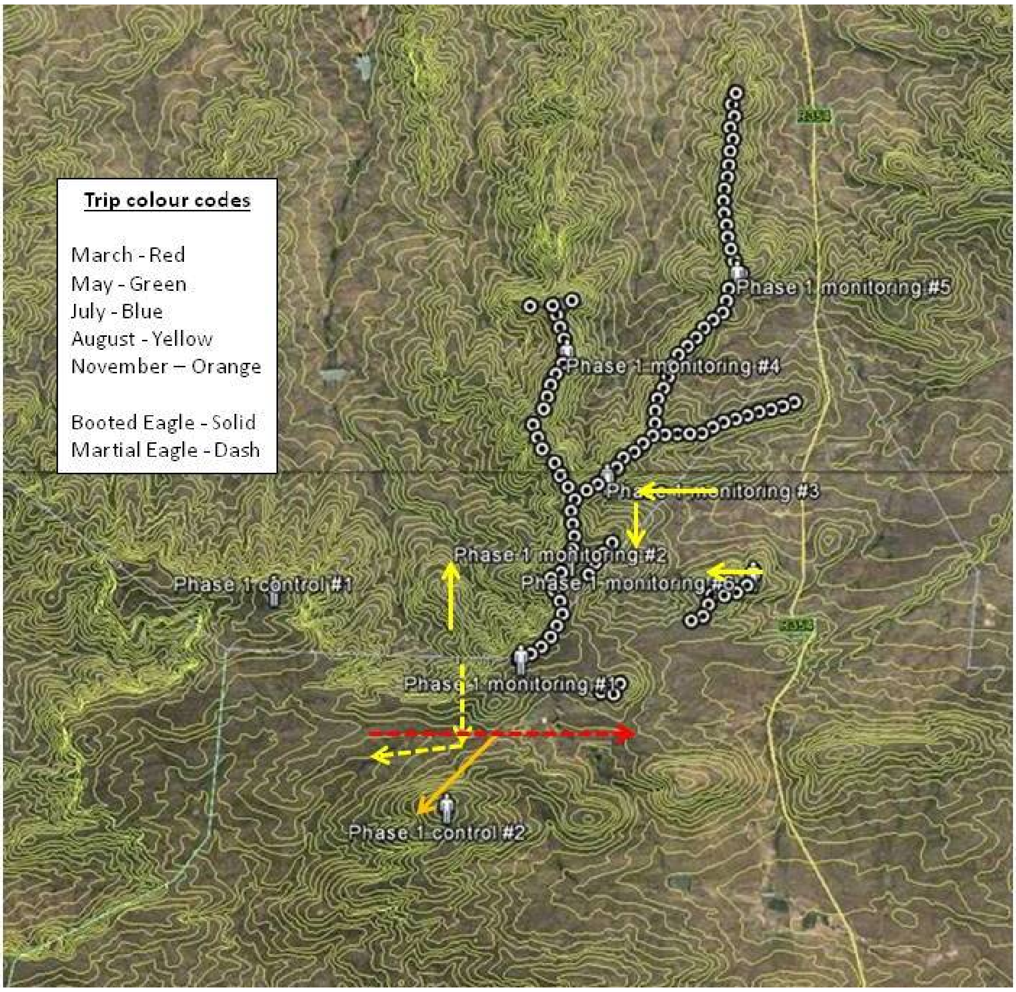


Figure 7.4: Recorded flight paths of Booted and Martial Eagles

The three species of swifts and the Pied Crows recorded over the ridges are widespread and common species of no particular conservation concern. This leaves four species which may be considered of particular risk to collision mortality with the Roggeveld proposed turbines. These are the Namaqua Sandgrouse, Verreaux's Eagle, Rock Kestrel and White-necked Raven and each merits comment, provided below:

» **Namaqua Sandgrouse:** This species was more common than expected. In September small flocks of 10-20 individuals flew along the ridges at heights that sometimes would have taken them into the predicted lowest blade arc. These sandgrouse fly at speeds of 60 km/h and are known to die from collision with telephone wires so must be considered a potential collision risk on the Roggeveld ridges. However the species is currently considered of Least Concern in the latest IUCN appraisal. It is likely that numbers seen were larger than usual in response to the flush of seed-producing plants following the unusually heavy rains.

» **Verreaux's Eagle**: It is likely that many of the observations made during monitoring were repeat sightings of the same individuals and overall probably concern a maximum of six or fewer individuals. Their distribution is presented in Figure 7.5. Although rated as of Least Concern by Birdlife International (www.birdlife.org/datazone/speciesfactsheet3539) this eagle is for two reasons considered the keystone species relative to the proposed wind farm. These reasons are: 1) that flights by these eagles led to other species – Rock Kestrel and White-necked Raven - flying up into blade swept area heights to harass the eagles; and 2) a pair are noted to be breeding at the northern end of the proposed turbine layout. This pair had two large nests on cliffs on the western side of Beacon Top. Neither nest was used for breeding in 2013 but the pair was often seen in the vicinity including carrying nest materials. Probably, as is known for these eagles in the karoo, there had been no breeding because of a poor prey basis in the preceding year(s). It is likely that the predicted increase in prey following the heavier than usual rains in 2013 will result in breeding in 2014.

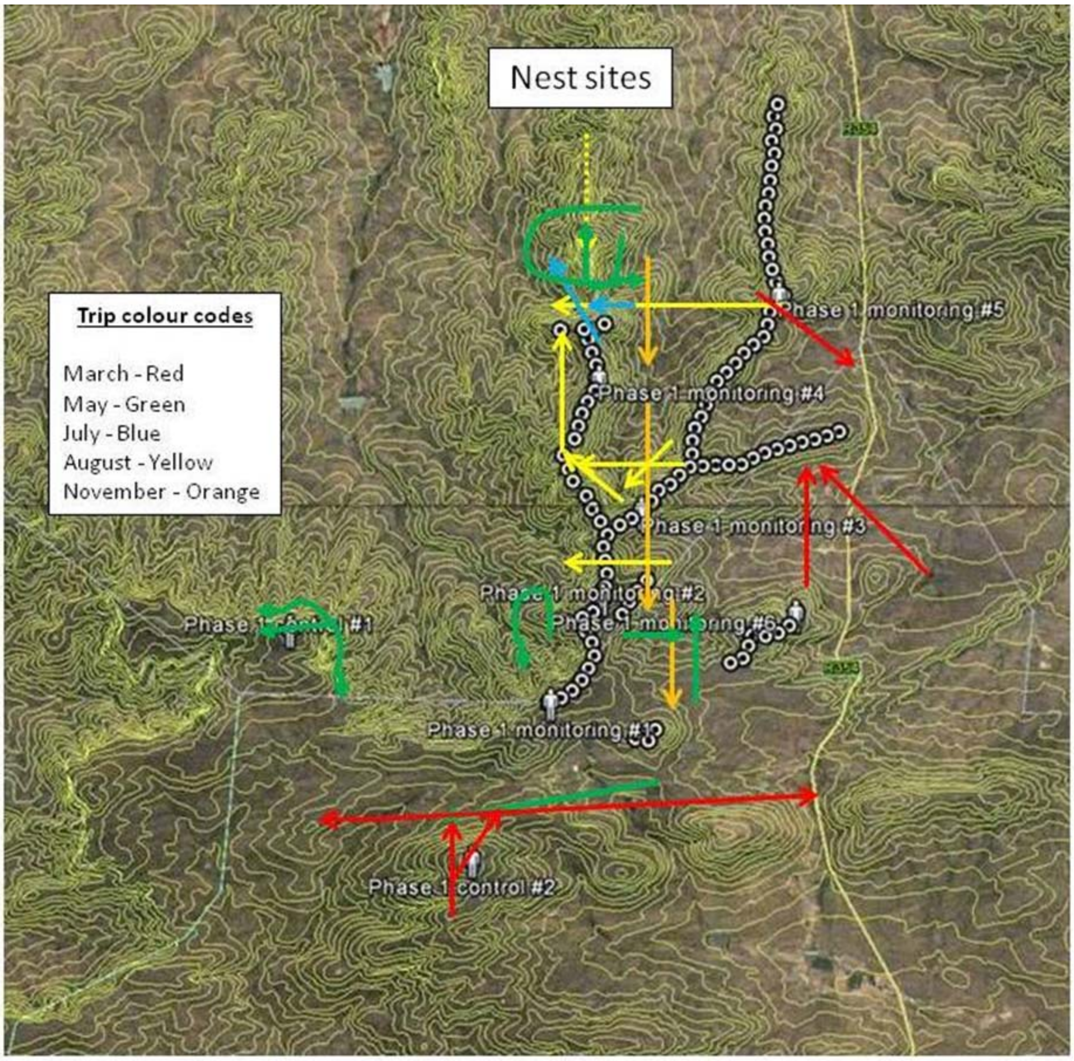


Figure 7.5: Recorded flight paths of Verreaux's Eagles

- **Rock Kestrel**: Most observations were of individuals using updraughts to hover over the upper slopes i.e. off the ridge-tops. Kestrels seen over the ridges were generally flying outside/below the turbine blade swept area as they flew low to seek prey or crossed the ridge from one valley to another. Only when they flew up to harass eagles did these kestrels enter potential collision risk heights.
- **White-necked Raven**: This was the species most often seen flying at turbine blade heights. Ravens are winter breeders. If, as in other better studied raven species, newly fledged juveniles birds feed on large invertebrates found while walking, then in spring White-necked Ravens that have bred successfully must move to lowland areas where, for the juvenile ravens to cope, walking is easier and suitable prey are more abundant.
- **Night active birds**: Diurnal monitoring provides little or no information about the potential risk of birds colliding with turbines at night. There are two fundamental types of night activity by birds: foraging and other localized activities by locally resident species – owls, nightjars and thick-knees; and transient, cross-country, movements. There is unlikely to be any substantial nocturnal use of the ridge-top areas by locally active nocturnal bird species as the food resources are too poor to sustain them and the frequent strong winds will deter them. Owls are the most likely to occur but most will remain in the valley bottoms, or forage along the lower slopes, where prey is more abundant. Nor are there many cliff sites that potentially offer safe nesting and roosting sites for them. Furthermore, owls are unlikely to fly at turbine blade heights. The two species known or likely to occur in the region take their prey off the ground. They forage in low light conditions when detection of prey, either visually or through hearing, requires them to remain close to the ground.

Birds which are transient across turbine lines are considered at greater risk of collision mortality than birds resident in the immediate vicinity of turbines and the risk to transients is increased when their movement is at night. Long distance migrants often fly by night but most do so at heights that will keep them well above turbines even those on ridges. Nor is there any particular attraction which would lead them to descend towards this part of the Karoo.

The main area of concern is the potential for regionally resident birds dispersing at night. This particularly applies to waterbirds of which a surprising number and diversity (31 species) were recorded on dams in the valleys around the ridges. Most waterbirds move between wetlands at night in order to avoid predatory eagles. There is the possibility that, in moving between dams, they would fly across ridges. It is likely that they fly high at night to be able to survey for wetland areas reflecting moonlight. They would therefore potentially fly at blade heights. However, in this area the dams lie in relatively deep valleys. It is more likely that, when dispersing, these birds initially fly downstream and so would not cross ridges where the turbines are planned. Their reconnaissance excursions are also likely to be during clear nights and especially during full moon when waterbodies reflect the light and so are more readily detected by birds in flight. These conditions will also illuminate turbines. Overall, at this stage of our understanding, the risk of nocturnal collisions is considered to be low and within acceptable levels. Nor are most of the species likely to be involved of particular current conservation concern.

The cliff lines, which are restricted either to the high ridges or to the steeply incised valleys of the larger watercourses, are small and broken, but hold at least one resident, breeding pair of Verreaux's Eagle *Aquila verreauxii* within the development area (nest site at 32º52.035 S, 20º30.216 E), and at least one other just off the R354 to the south-east, and may also support multiple breeding pairs of Rock Kestrel *Falco tinnunculus*, Jackal Buzzard *Buteo rufofuscus*, Booted Eagle *Aquila pennatus* and Cape Eagle Owl *Bubo capensis*, and possibly pairs of Peregrine Falcon *Falco peregrinus* and Lanner Falcon *Falco biarmicus*. Nests have been identified on the and immediately adjacent of Verreaux Eagle, Martial Eagle and Black Harrier.

Bird Nests

Three pairs of Martial Eagle *Polemaetus bellicosus* nest on towers on the Droërivier-Muldersvlei (DRO-MVL tower 542; 32º54.950 S, 20º37.140) and Bachus-Droërivier (BA-DRO towers 530 and 50; 32º58.720 S, 20º24.945 and 32º59.430 S, 20º19.440 respectively) 400 kV transmission lines, although none of these sites has been occupied and active in recent years (Jenkins *et al.* 2007). Also notable is the location of a known Black Harrier nesting area along the upland watercourse in the Kabeltou/Brand Valley area. At least two pairs of this threatened endemic have been recorded as breeding in this area simultaneously in the last 5-10 years, presumably in particularly wet years. None were seen during the site visit which should have coincided with the late breeding season in this species (Curtis *et al.* 2004).

Additional important restricted range and/or endemic species which certainly or probably occur in the area include Karoo Korhaan *Eupodotis vigorsii*, Karoo Long-billed Lark *Certhilauda subcoronata*, Black-eared Sparrowlark *Eremopterix australis*, Layard's Titbabbler *Parisoma layardii*, Namaqua Warbler *Phragmacia substriata*, African Rock Pipit *Anthus crenatus* and Black-headed Canary *Serinus alario*.

Nine priority species are recognized as key in the assessment of avian impacts of the proposed Roggeveld wind farm. These are mostly nationally and/or globally threatened species which are known to occur, or could occur in relatively high numbers in the development area and which are likely to be, or could be, negatively affected by the wind farm project.

Overall, the most important aspects of the avifauna on the Roggeveld wind farm site, and those most relevant to this impact assessment, are:

(i) Resident and breeding raptors, in particular Verreaux's Eagle, Martial Eagle and Black Harrier (likely to occur regularly on site, and definitely breeds within it in wet years – Curtis *et al.* 2004), and possibly Cape Eagle-Owl *Bubo capensis*. All are scarce or threatened species, potentially susceptible to collision with and displacement from the area by the turbine arrays. Perhaps the main threat to raptors is the risk of exposure to turbine collisions when gliding along the most prominent ridge-lines. Such locations are likely to attract and concentrate the activities of all slope soaring species in the area, and turbines should be placed well back from the edge of steep slopes to minimise this potential negative impact.

(ii) Seasonal influxes of Ludwig's Bustard. This is a nomadic, nationally 'Vulnerable' and globally 'Endangered', near-endemic species, highly susceptible to collision mortality on power lines (Jenkins *et al.* 2010, Jenkins *et al.* 2010 in prep.), probably susceptible to turbine collision mortality, and possibly susceptible to disturbance and displacement by the wind farm. As a plains species it is not likely to frequent the high relief areas of the site, but could occur in the flatter, more open northern section and/or along the wider sections of the river valleys.

7.7 Bats

This section on bats is based on information collected during the pre-construction bat monitoring undertaken by Animalia for Phase 1 of the Roggeveld Wind Farm.

Literature Based Species Probability of Occurrence

Table 7.3 provided a list of bat species that may be roosting or foraging on the study area, the possible site specific roosts, and their probability of occurrence based on literature (Monadjem et al., 2010). The column of "Likely risk of impact" describes the likelihood of risk of fatality from direct collision or barotrauma with wind turbine blades for each bat species. The risk was assigned by Sowler & Stoffberg (2012) based on species distributions, altitudes at which they fly and distances they traverse; and assumes a 100% probability of occurrence.

Table 7.3: List of bat species that may be roosting or foraging on the study area, the possible site specific roosts, and their probability of occurrence based on literature(Monadjem et al., 2010).

Species name	**Common Name**	**Conservation status**	**Probability of occurrence**	**Possible Roosting Sites Occupied in Study Area**	**Foraging Habits (indicative of possible foraging sites in study area)**	**Likely Risk of Impact (Sowler & Stoffberg, 2012)**
Rhinolophus clivosus	Geoffroy's horseshoe bat	Least Concern	Very low	Culverts, rock hollows and any other suitable hollow. Usually roosts in caves and mine adits, no known caves or mine adits close to site,	Clutter forager, may be found near dwellings and in denser vegetative valleys.	Low
Nycteris thebaica	Egyptian slit-faced bat	Least Concern	Very low	Hollows and culverts under roads. No known caves or mine adits close to site,	Clutter forager, may be found near dwellings and in denser vegetative valleys.	Low
Tadarida aegyptiaca	Egyptian free-tailed bat	Least Concern	Confirmed by passive systems	Caves, rock crevices, under exfoliating rocks, in hollow trees, and behind the bark of dead trees	Open-air forager	**High**
Miniopterus natalensis	Natal long-fingered bat	**Near Threatened**	Confirmed by passive systems	Cave and hollow dependent, but forage abroad. Also take refuge in culverts and vertical hollows, holes.	Clutter-edge forager	Medium - High
Eptesicus hottentotus	Long-tailed serotine	Least Concern	Confirmed by passive systems	Roosts in rock crevices	Clutter-edge forager	Medium - High
Myotis tricolor	Temmink's myotis	Least Concern	Medium	Usually roosts gregariously in caves, and sometimes culverts or other hollows. No known caves or mine adits close to site.	Clutter-edge forager	Medium - High
Neoromicia capensis	Cape serotine	Least Concern	Confirmed by passive systems	Roosts under the bark of trees and under roofs of houses. Very common bat	Clutter-edge forager	Medium - High

Ecology of Bat Species Most At Risk

» ***Miniopterus natalensis***

Miniopterus natalensis, commonly called the Natal - clinging bat, occurs widely across the country but mostly within the southern and eastern regions. It is listed as a Near Threatened conservation category. It is a cave-dependent species, such that the presence of suitable roosting sites in an area may be more important in predicting its presence than the vegetation. However, personal observations have proved this species to also utilise culverts as roosts, either singly or in very low numbers. This species assembles in large numbers to roost within caves. It utilises separate caves for winter hibernating activities and summer maternity behaviour. Winter hibernacula generally occur in more temperate areas of the country and at higher altitudes, while summer maternity roosts are warmer and lower altitudes (Monadjem *et al*., 2010). For this particular site, if a suitable roosting cave is located near to the site it would most likely be used as a summer maternity roost. But no locations of any caves or mine adits are known within the area of the site.

Miniopterus natalensis undertake short migratory journeys between hibernacula and maternity roosts. Due to this migratory behaviour, they are considered to be at high risk of fatality from wind turbines, if a wind farm is placed within a migratory path. The mass movement of bats during migratory periods could result in large kill-offs if wind turbines happen to be positioned right on a mass migratory route, and such turbines are not effectively mitigated. The problem lies in that very little is known about bat migratory behaviour and paths in South Africa for this species, and such migrations can be up to 150 kilometres in distance. There is a pressing need for research in this direction. However, if the site is located within a migratory path the bat detecting system should detect high *Miniopterus natalensis* numbers and activity during over the 12 month monitoring survey. No signs of mass migrations have been detected on site.

Sowler & Stoffberg (2012) advise the likelihood of risk of fatality affecting *Miniopterus natalensis*, is that of Medium – High risk. Their evaluation was of the risk was based on broad ecological features, excluding migratory tendencies. A study of the habitat preference for foraging activities of *Miniopterus natalensis* showed that urban areas were by far the most used habitat category (54.0%), followed by open areas (19.8 %), woodlands (15.5%), orchards and parks (9.1 %), and water bodies (1.5 %). On a finer scale, preferred foraging habitats were mainly urban areas (types of artificial lighting effects unmeasured) and deciduous or mixed woodlands, followed by crops and vineyards, pastures, meadows and scrublands, delimited by hedgerows or next to woodland, orchards and parks and water bodies (Vincent *et al.,* 2011). The areas of wooded and agricultural habitats were prioritised in the sensitivity maps as this species has a higher vulnerability to mortality from turbines in these areas. Several North American studies indicate the impact of wind turbines to be highest on migratory bats, however there is evidence to the impact on resident species. Fatalities from turbines increase during natural changes in the behaviour of bats leading to increased activity in the vicinity of turbines. Increases in non migrating bat mortalities around wind turbines in North America corresponded with when bats engage in mating activity (Cryan & Barclay, 2009). This long term assessment will also be able to indicate seasonal peaks in species activity and bat presence.

Mating and fertilisation generally occur in March–April, followed by a period of delayed embryo development until July–August and birth in October–December (Van der Merwe, 1979). Females congregate at maternity roosts where each one gives birth to a single young. The results of the monitoring study will determine whether the same pattern of high activity for this species occurs during March-April (mating season)

» ***Neoromicia capensis***

Commonly called the Cape Serotine, *Neoromicia capensis* has a Least Concern conservation category as it is widespread over much of sub-Saharan Africa in high numbers. High mortality rates of this species due to wind turbines would be a cause of concern as *Neoromicia capensis* are abundant and widespread and therefore, have more significant roles to play within the local ecosystem than the rarer bat species.

It roosts individually or in small groups of two or three bats in a variety of shelters, such as under the bark of trees, at the base of aloe leaves, and under the roofs of houses. They will utilise most man-made structures as day roosts (Monadjem *et al*., 2010). These types of roosting sites on the farms must be considered as sensitive. They do not undertake migrations and therefore are considered residents of the site.

They are tolerant of a wide range of environmental conditions as they survive and prosper within arid semi-desert areas to montane grasslands, forests, and savannas; inferring that they may occupy several habitat types across the site, and are adaptable towards habitat changes. They are however clutter-edge foragers, meaning they prefer to hunt on the edge of vegetation clutter mostly, but may occasionally forage in open spaces.

They are thought to have a Medium – High likelihood of risk of fatality due to wind turbines (Sowler & Stoffberg, 2012).

Mating takes place from the end of March until the beginning of April. Spermatozoa are stored in the uterine horns of the female from April until August, when ovulation and fertilisation occurs. They give birth to twins during late

October and November (van der Merwe, 1994). Although twins are common, singletons, triplets and even quadruplets have been recorded (Lynch, 1989).

» ***Tadarida aegyptiaca***

The Egyptian Free-tailed Bat, *Tadarida aegyptiaca*, is a Least Concern species as it has a wide distribution and high abundance throughout South Africa. It occurs from the Western Cape of South Africa, north through to Namibia and southern Angola; and through Zimbabwe to central and northern Mozambique (Monadjem *et al*., 2010). This species is protected by national legislation in South Africa (ACR, 2010).

They roost communally in small (dozens) to medium-sized (hundreds) groups in caves, rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. *Tadarida aegyptiaca* has also adapted to roosting in buildings, in particular roofs of houses (Monadjem *et al*., 2010). Thus man-made structure and large trees on the site would be important roosts for this species.

Tadarida aegyptiaca forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem *et al*., 2010).

The Egyptian Free-tailed bat is considered to have a High likelihood of risk of fatality due to wind turbines (Sowler & Stoffberg, 2012). Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause of concern as these species have more significant ecological roles than the rarer bat species. The sensitivity maps are strongly informed by the areas that may be utilised by this species.

After a gestation of four months, a single young is born, usually in November or December, when females give birth once a year. In males, spermatogenesis occurs from February to July and mating occurs in August (Bernard and Tsita, 1995). Maternity colonies are apparently established by females in November (Herselman, 1980).

7.8 Heritage Resources

Findings: Archaeology

Figure 7.6 shows the distribution of recorded heritage sites on and around the site. None of these heritage artefacts/sites occur within the proposed wind turbine development footprint.

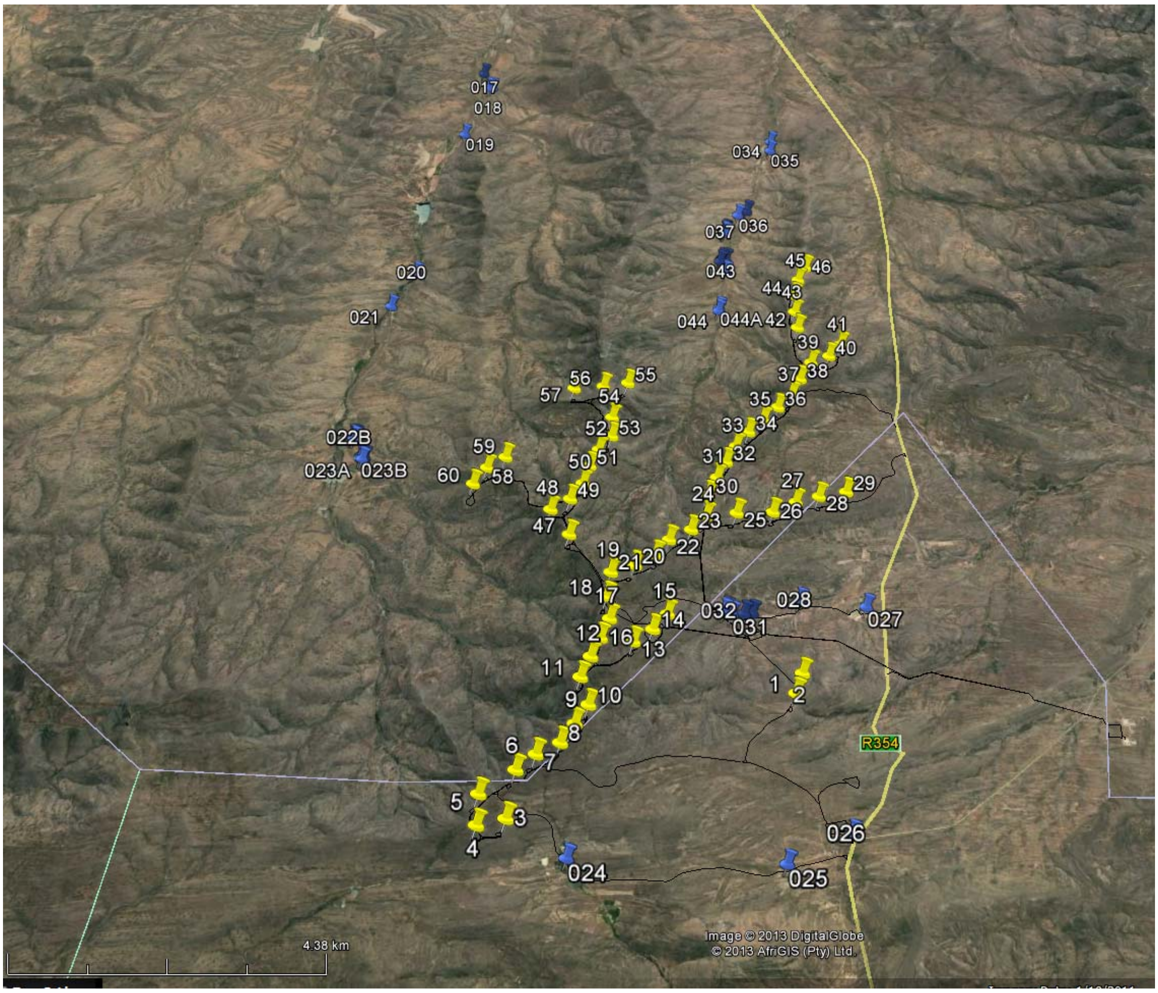


Figure 7.6: Distribution of recorded heritage sites (blue) and proposed turbine layout for Phase 1 of the Roggeveld Wind Farm

Stone Age artefactual material

The actual turbine sites are situated on the tops of very high ridges where the wind conditions are optimal. Within the study area the ridges are devoid of rock shelters, rock outcrops but are covered in stones and low shrubs. They are extremely in-hospitable in that they contain no foci where people could shelter from the elements. Rock shelters in this area are entirely absent, water sources are scarce. These harsh conditions were evidently experienced in the pre-colonial past as almost no evidence of any archaeological material at all was located. Even Middle Stone Age material with is normally ubiquitous throughout the karoo was almost entirely absent. These observations are not the function of a thin search pattern over a vast area, as half of the turbine sites were easily accessible by off-road vehicle. Very large tracts of the country were traversed. As has been demonstrated by other recent studies in the area, pre-colonial heritage tends to occur in the valley bottoms close to watercourses and springs which may explain why the high ridges of the study contains so little evidence for pre-colonial occupation.

Other pre-colonial indicators

There are very few caves or shelters within the study area that could have supported occupation (few exhibited any form of sediment trap), and those that do exist, are generally formed in soft rock strata resulting in constant exfoliation. Two small rock shelters were inspected, however these contained no habitable floors or archaeological deposits.

Graves

A collection of stone piles were recorded in the Ekkraal Valley. These do not appear to be associated with any other archaeological material which would assist in identifying them. They are provisionally described as graves as they could be culturally associated with pre-colonial occupation. It is not expected that the stone features will be impacted by the proposed activity.

Figure 7.7: Stone pile (possible grave) near Ekkraal.

Built Environment and colonial heritage

The built environment of the study area is limited to farms, farm houses, stone walls, walled kraals and secondary roads. Given the remoteness of this area, even these are sparsely distributed. Virtually all farm infrastructure is situated in the low lying areas between the ridges. Most are several kilometres from proposed turbine locations which mean that direct impacts are not expected. Characteristically, locales of colonial settlement seem to be concentrated in three areas – namely the farms known as Ekkraal Valley, Ou Mure, and the Hartjieskraal-Barendskraal valley somewhat south of the study area.

<u>Ekkraal Valley</u>
The most significant collection of heritage resources in the entire area is confined to a single remote valley at the entrance to which lies the farm Ekkraal. The valley forms a geographically delineable cultural landscape consisting of ruined 19^{th} century farms, stone walled kraals, fragments of stone walling. The shallow Ekkraal valley lies between two of the large longitudinal ridges which form the main turbine rows. Along the gently sloping valley floor the team recorded some 16 occurrences of historical material, all evidently dating to the 19^{th} century. The rivulet which runs down the valley bottom was evidently a wetland which attracted *trekboer* agriculture. The presence of at least two *trapvloers* (threshing floors) and remnant of disturbed landscapes and ruined stone and mud-brick homesteads indicate that the area produced some harvests of wheat. Today there is very little evidence of any fields in this essentially wilderness landscape.

The existing Ekkraal Farm (absentee owner) is a humble corrugated iron roofed building which dates from the 19^{th} century. It is probably worthy of Grade IIIC status. The structure is not under threat and evidently well maintained. The closest turbine are well in excess of 1 km from the site, which means that no direct impacts will result from the turbines themselves. Others elements of the built environment consist of dams, kraals and two out-buildings, one of which is built from stone and has a Dutch hearth. The existing vehicle track up the valley will be upgraded and widened to allow heavy vehicles to pass. Since many of the ruined features lie very close to this track, impacts could occur.

The significance of Ekkraal valley lies in the intactness of the archaeological signature of early colonial occupation. The pattern of kraals, farm buildings, artefact scatters and walling remains highly legible. The area can be considered to be archaeologically sensitive and worthy of preserving in terms of its research potential. The heritage of the valley is not a tourism resource, and not well known to anyone other than the local populous. In these terms it does not constitute visually sensitive heritage. The revised layout for phase 1 is more sympathetic to the heritage qualities of the Ekraal Valley in terms of both visual impacts and physical impacts as the valley has been largely left free of infrastructure or access roads.

Ou Mure area

The farm known as Ou Mure is consists of a complex of structures, most noticeable of which is the late 19th century/early 20th century farmstead with its associated dry stone walled garden area and lands. The house (double bayed with central veranda) appears to have originally been built of stone but has seen extensive changes in the early 20th century. While the farm and its surrounds are of heritage interest, the presence of 2 pairs of 400 kV Eskom transmission lines (some 380 m from the house) has negatively impacted the heritage and aesthetic qualities of the setting.

While it is not expected that Ou Mure will be directly impacted by the proposed activity, there will be periods in which the immediate surrounds of the farm we be subject to increased usage as a proposed access road into the turbine area could see upgrading of some of the roads around the farm.

The nearest proposed turbines to Ou Mure are to be constructed roughly 1km from the farm on surrounding ridges.

Within the study area there are a number of distinct cultural landscape areas that have been identified, and described previously – notable of these within the study area is the Ekkraal Valley. To the south and west of the study area is the Barendskraal-Hartjieskraal farm areas which contain collections of interesting heritage sites and buildings. The Ekkraal Valley is the most significant within the study area, however fortunately it is minimally impacted by the stage 1 proposal. Although this is a highly scenic area, it is very remote and not celebrated as a place with visual heritage qualities.

In overall terms the study area represents a remote wilderness landscape, which even in prehistoric times appears to have been marginally inhabited. Colonial occupation of the area was also sparse being limited to valley bottoms. The predominant presence is that of open wilderness. While the area is highly scenic, within the project boundary there are no major tourism enterprises and is very seldom visited by persons other than those directly involved in farming.

Findings: Palaeontology

The stratigraphy, lithology and palaeoenvironments of the rocks of the site are summarised in the table below.

Table 7.4: Summary of stratigraphy and lithology

AGE	GROUP	FORMATION	LITHOLOGY	PALAEOENVIRONMENT
Permian	Beaufort	Abrahamskraal	sandstone channel + crevasse splay deposits, interbedded mudstones	subaerial upper delta plain, aerially exposed mudflats, backswamps,
Permian	Ecca	Waterford	sandstone, greywacke, shale	shallow water, delta-front
Permian	Ecca	Fort Brown	mudstone, minor sandstone	prodelta and delta-front
Permian	Ecca	Tierberg	dark shale, mudstone	settling from suspension in deep water, shallowing towards the top

The outcrops of the Waterford Formation in the south were not searched, but trace fossils in the form of burrows, trails and tubes are common in this formation, with rare bivalves and fragmentary fish remains (Thamm & Johnson, 2006; Johnson *et al.,* 2006). Plant fragments (*Glossopteris*) are also reported to be common and in places pieces of stem fragments of the tree genus *Dadoxylon* occur (Theron *et al.,* 1991).

The only fossils found in the rocks of the Abrahamskraal Formation were trace fossils in the form of sand-filled vertical burrows in sandstone. These were in a loose block adjacent to a packed stone ruin in the Ekkraal valley) and may have been transported from elsewhere as building material.

Figure 7.8: *Trace fossils consisting of sand-filled vertical burrows in sandstone, from Ekkraal Farm (width of rock ca. 200 mm)*

The Abrahamskraal Formation contains terrestrial vertebrate fossils, fish remains, non-marine molluscs and silicified wood (Johnson *et al.,* 2006). The lowest biozone of the Beaufort Group is the *Eodicynodon* Assemblage Zone, recently recognised in the southwestern part of the Karoo basin by Bruce Rubidge. This zone is characterised by fossils of *Eodicynodon*, a small primitive tetrapod reptile. Fossils of other primitive reptiles are also found in this biozone (MacRae, 1999). These are extremely important fossils documenting the rise of reptiles and evolution of mammal-like reptiles (therapsids), for which the Karoo is the pre-eminent locality.

The *Eodicynodon* Assemblage Zone is not recorded in this area and the Study Area lies within the *Tapinocephalus* Assemblage Zone. The zone is named after a therapsid (the mammal-like reptile *Tapinocephalus atherstonei*) restricted to this zone. Fossils of a wide variety of other tetrapods, both herbivores and carnivores, including early precursors to the line that gave rise to mammals, have been found in this zone (MacRae, 1999). There are very few records of vertebrate fossils in the part of the *Tapinocephalus Assemblage Zone* covered by the Study Area, and what has been found is sparse but diverse, so anything found would be of considerable significance (J. Almond pers. comm.).

7.9 Social

The proposed Phase 1 of the Roggeveld wind farm is located within two Provinces, namely the Northern Cape and Western Cape. The Northern Cape portion of the site falls within the Namakwa District Municipality (DM) and in the Karoo Hoogland Local Municipality (LM). The Western Cape portion of the site is located within the Central Karoo DM and in the Laingsburg LM. The Namakwa DM has six local municipalities and covers a geographic area of approximately 126 747 km^2. The Central Karoo DM comprises of three local municipalities and it is the largest District in the Western Cape Province at 38 853 km^2. Figure 7.9 displays the proposed Roggeveld Wind Farm comprising several Individual farms outlined in red located along the R354 between Matjiesfontein and Sutherland. The provincial boundary between the Western and Northern Cape is shown in pink.

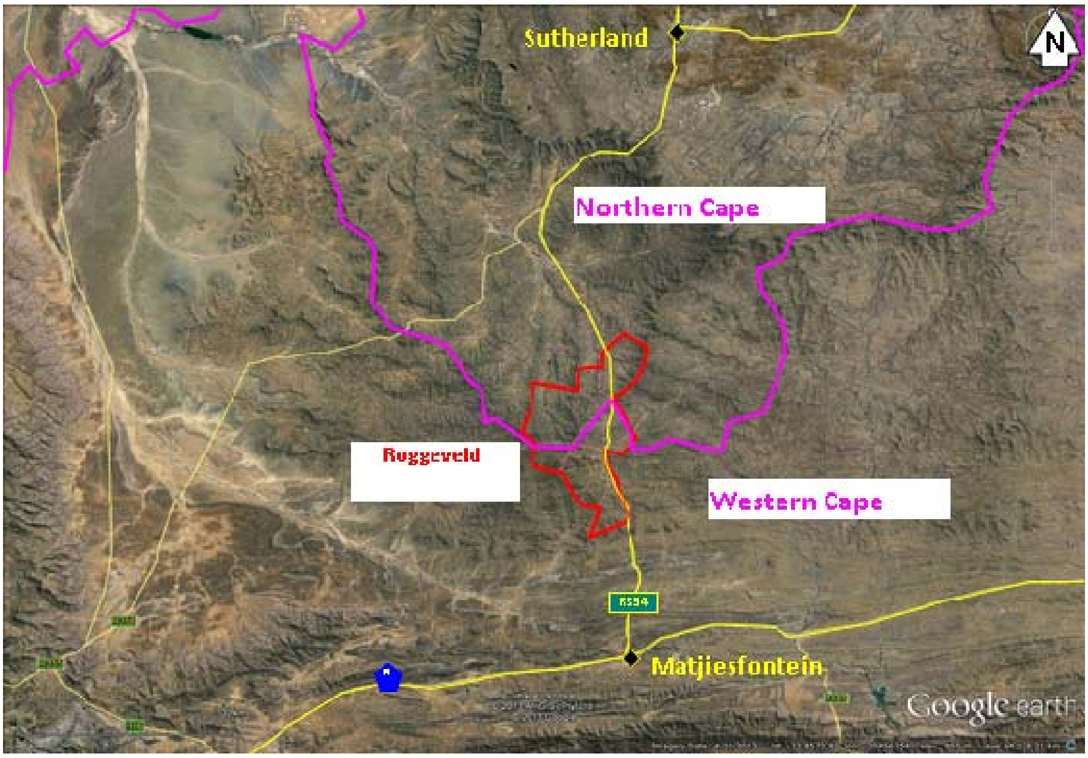


Figure 7.9: Location of Phase 1 of the Roggeveld Wind Farm

Demographic Profile

Karoo Hoogland Local Municipality, Northern Cape:

The population of the Karoo Hoogland LM was 10,424 in 2007, showing a slight decrease from the population recorded in 2001. The age profile for the LM illustrates a developing population dominated by youth (32%between 15 and 34 years). There are similar numbers of children (31% below 14 years) and middle aged (31% between 35 and 64 years) and the elderly population (above 65 years of age) comprise the remaining 6%. The racial composition is predominantly Coloured (79%), followed by Whites (18%), and Blacks/Africans (3%).

Laingsburg Local Municipality, Western Cape:

The population of the Laingsburg LM is highly urbanised, with 91% of the population living in the urban area and the remaining nine percent residing in rural areas. The ages of the population within the LM vary greatly. The population aged between 35 and 64 years is slightly higher than the other groups at 32 percent, followed by the youth (31% between 15 and 34 years), and those below 14 years (29%). The elderly comprise eight percent of the population. The racial composition of the Laingsburg LM shows Coloured people as being the most dominant group at 83%, followed by the White population (15%) and then Black/African (2%).

Project Site:

The living arrangements of the farmers and their workers vary considerably. Most farmers have more than one farm and therefore generally do not live permanently on the site. Only four of the farmers, and their workers, live permanently on the farms that form part of the project area. The majority of the farmers stay permanently off-site and visit the farms intermittently when the livestock activities are based at the site. The workers spend more time on the farms with the livestock than the farmers do. The workers generally only live on the farm during the week and visit their family homes on weekends in Laingsburg. The number of workers living on the farms varies depending on the seasons and the farming activities. The farmers employ seasonal workers that may live on the farm for a short period. The most activity at the Roggeveld site is during winter as the site is predominantly used in the winter months.

Due to the remote location of the farms in relation to schools, many of the farmers' children (who are of school going age) attend boarding school and only visit the farm during the school holidays. Usually if the workers have young children then the wife and the children generally live on the farm, but as soon as the children start school, the wives and children generally move to Laingsburg in order to be close to schools. All the farm owners are White and the workers are Coloured.

Education

Illiteracy levels in the local municipalities are relatively high with 28% of the population the Karoo Hoogland LM without any schooling. In Laingsburg LM, illiteracy is higher than that of Karoo Hoogland.

Health

There are a lack of medical facilities in the Namakwa DM; primarily given the scattered settlement pattern in the area. The most prevalent illnesses experienced by the population of the DM are HIV/AIDS, TB and substance abuse. There used to be an asbestos mine in the DM; those who were exposed to the asbestos are likely to get ill from further exposure to asbestos. Unfortunately, the healthcare facilities do not keep any records of these incidences.

The Central Karoo DM has four provincial Hospitals, 14 mobile clinics, nine built clinics and one Community Health Care centre (CHC). Laingsburg LM has a Provincial hospital, clinic and mobile clinic which service the rural areas. The most common illnesses in both municipalities are TB, HIV/AIDS and substance abuse. There are many problems hindering the delivery of medical services to the communities including inadequate staffing and other medical resources in both local municipalities.

Social Ills Affecting the Community

Alcohol and drug abuse is causing/exacerbating many of the social problems facing the broader community. The increasing levels are substance abuse are pushing farmers to seek alternatives to local labour, and leading to increased levels of foetal alcohol syndrome, HIV, unwanted pregnancies, physical abuse and increasing school drop-out rates.

Economic Profile

Namakwa District Municipality Economy

The Namakwa DM's economy is characterised by an undiversified economy, with a high dependency on mining (52.7%). The relative contribution of this sector is, however, declining. The sector had an average annual growth rate of 0.3% between 2001 and 2007. Wholesale and retail trade, catering and accommodation is the next largest contributor to the GDP (13.2%), followed by finance and business services (7.8%), general government services (6.7%) and community, social and personal services (5.9%). Other sectors not mentioned contributed less than 5% including agriculture.

Central Karoo District Municipality Economy

The economy of the Central Karoo DM was one of the biggest contributors to the GDP of the Western Cape Province in 2004 with an annual growth rate of 4,2%. The growth of the economy was largely driven by fast growing sectors such as transport and manufacturing, financial and business services, wholesale and retail, communications, and construction.

Laingsburg Local Municipality

The agricultural sector is the largest contributor to the Laingsburg LM's economy. The agricultural sector is, however, not optimally exploited, as natural resources are sold in their raw form and processed elsewhere. The sector accounts for 23.2% of Laingsburg's GDP and has an average annual growth rate of between 6% and 8%. The Laingsburg LM is currently investigating ways of growing this sector further through localised processing of raw materials.

The other key economic sectors of the Laingsburg LM are wholesale and retail trade; catering and accommodation; and transport, communication and manufacturing.

Project Area

Approximately 75% of the landowners have two or more farms (not necessarily in the immediate vicinity). For five of the 13 landowners, both/all of their farms are within the Roggeveld area. The Roggeveld site is predominantly a winter rainfall area, as such; farmers keep their sheep on the Roggeveld farm during the winter months and move them during the summer months. Where a landowner only has land within the Roggeveld area, the sheep are rotated between the farms/camps as dictated by water availability and the condition of the vegetation on the individual farms. The individual camps on each farm are fenced off and gated in order to manage the grazing impact in a particular area. The sheep are walked from one farm to the next farm over a number of days; this can take up to 3.5 days and sheep can walk up to 40 km per day. There are kraals en route which the sheep are kept in overnight.

The carrying capacity of the land is approximately one sheep per six hectares. The number of sheep (ewes) per farmer ranges from 300 to 2,000. Some farmers grow animal fodder such as lucerne (alfalfa) and oats to supplement animal feed. This allows farmers to increase the number of sheep beyond the carrying capacity. To mitigate against overgrazing farmers alternate between farms during the winter and summer months. Farmers that do not use animal fodder to supplement grazing generally farm sheep below carrying capacity, especially given the water scarcity in the area. The Karoo vegetation is very sensitive and is reported to take up to 50 years to rehabilitate.

Depending on water availability, a number of the farmers also grow crops such as onion seed, onions, lucerne and oats, amongst others. One of the main constraints to agricultural activities in the area is water; however, some of the farms have boreholes and/or springs while others do not have access to water. Irrigation systems are expensive and are therefore not an option for a number of farmers. The onion seed is grown for the export market and the other crops are for own use and/or sold on the local market.

Other land uses in the area include game farming, tourism (e.g. guesthouses) and ‘lifestyle farming’. ‘Lifestyle’ or ‘weekend farmers’ refers to those people who live in the cities but own farms in the Karoo as a means of escaping the city and enjoying the peace and tranquillity. They generally reintroduce animals (including predators) as part of their plans to rehabilitate the land and conserve naturally occurring animals and habitat.

The property prices are reported to have increased dramatically in recent years. One farmer reported that the value of his land increased by 400% in one year. This rapid increase in price was attributed to the increased demand in land by the ‘lifestyle farmers’ who buy relatively small farms for recreational purposes. The average value of the land for grazing is approximately R1 000 per hectare. Due to the high cost of land, the majority of the landowners are unable to expand their farming activities. This, together with the loss of stock resulting from the increased predators and lack of water is forcing many of the farmers out of business.

In general, livestock farming in the Karoo is not an easy lifestyle. Farmers in the area face many challenges but the main problems are associated with labour, predators, stock theft and water scarcity.

Challenges Faced by Local Farmers

- Labour: Many of the landowners indicated that alcohol and drug abuse are prevalent in the area and that many of the workers are unreliable and unproductive as a result. Although some farmers are fortunate to have committed workers who have worked for them for many years, other farmers have to contend with high staff turnover, low productivity, and a lack of interest in growth and development.
- Predators: There has been an increase in the number of predators in the area and, in turn, an increase in associated stock losses. The main predators are jackal, rooikat and baboons. It is suspected that jackal and rooikat breed on the farms of the 'lifestyle farmers', the increasing number of 'lifestyle farmers' is threatening the financial viability of stock farming. The baboons are increasingly attacking baby lambs and sheep due to the lack of rain and thus alternate food sources. One farmer reported that stock losses have increased between 40% and 60% as a result of predators. The farmers are currently in negotiation with Cape Nature to identify means of controlling predators.
- Stock Theft: Stock theft is reported to be a problem in the area and has been raised as one of the key concerns associated with the project. Some of the theft is opportunistic and once-off while it seems that there are also syndicates operating in the area that steal large numbers of sheep at one time.
- Water Scarcity: The area is water scarce and is prone to drought. Due to the unpredictability of rainfall in the area farmers are limited in the type of crops that they can cultivate and the number of stock they can keep. All of the farmers who cultivate crops rely on borehole water for irrigation and consumption. One farmer raised the concern that he thinks that the ground water levels are dropping posing a serious threat to farming.

Employment, Unemployment and Household Income

Employment and Unemployment

Approximately 45% of the population in the Karoo Hoogland LM are employed, while about 18% are unemployed and 37% are not economically active. In the Laingsburg LM approximately 16.3% of the population are unemployed, 40% being employed and 43.7% being economically inactive.

Household Income

Approximately nine percent of the households in the Karoo Hoogland LM have no income and 35% live on a monthly income of between R1 and R9600. The majority of households in the Laingsburg LM (44.3%) earn an income of between R4 812 and R9 600 per month, followed by 16.4% that earns between R12 and R4 800 a month, and 15.1% that earns between R9,612 and R19,200 a month.

Government grants (e.g. child support, disability and pension grants) have resulted in high levels of dependency on the State. These grants are often the only source of household income, given the high unemployment rate in the area.

Remuneration of Farm Workers

General farm workers are paid minimum wage and supervisors/farm managers are paid more. The monthly pay varies between R1 200 and R2 000 per month. The farmers raised concern that the majority of workers spend all their money immediately after payday (Friday) on alcohol and drugs and therefore do not have any money left to meet their basic needs.

Permanent farm workers also receive benefits from the farmers. The benefits vary but the standard benefits include free accommodation, electricity (where infrastructure is available), water and sanitation (where water is available), and wood for cooking purposes. Some of the farmers provide additional benefits, such as transportation to town/ school, work clothes, a bonus at the end of the year, additional income for killing predators such as jackal and Rooikat (approximately R300-400 per animal), other foodstuff including milk and vegetables from the farm, substantially discounted/ free meat, skin and wool of slaughtered sheep, and some workers are allowed to keep their own sheep and/or goats as well as to grow their own vegetable gardens on the property.

Farm Workers

Sheep farming is not labour intensive; eight of the thirteen farmers employ less than five permanent workers on their farms. Four farmers employ between six and ten permanent workers and one farmer employs 13 permanent workers. The intensity of farming activities increases for about four months every year for seasonal tasks (e.g. sheep shearing, harvesting); during this time the farmers employ casual labour from Laingsburg and surrounding areas. The wives of permanent workers are also employed for this seasonal work. Some farmers will not use local labour because of the labour challenges; as an alternative, they contract the services of Cape Mohair and Wool (CMW) for sheep shearing services; farmers noted that they prefer to use the services of CMW because they are reliable and professional.

The employment tenure of workers varies considerably. For the majority of the farmers, the employment time range from a few months to several years. Some farmers have long-term employees. For example, one farmer has two workers that have been employed on the farm for 20 years and 30 years respectively. There is no clear trend regarding the length of employment. Employment depends on the individual circumstances of the worker and the farmer as the pay and worker benefits are relatively similar.

Tourism and Heritage

The Namakwa DM has been experiencing growth within this sector from tourists travelling through the Cape tourism route and those travelling to Namibia . This growth is reflected on other economic sectors such as guest houses, arts and craft, communications and others dependent on an influx of people. The DM is rich in heritage of the Khoi San/Nama people. This is reflected in activities such as the Annual Namakwa Festival of Culture and Light pays tribute to this heritage. The main attraction in the LM is the town of Sutherland, where tourists can visit the observatory (seven telescopes and SALT) and flowers in the spring. The succulent route is open annually from mid July to end October.

There are a few select tourism attractions in the Laingsburg LM. In Matjiesfontein there is the Rietfontein Private Nature Reserve which offers visitors 4x4 trails, hiking, bird watching, game viewing from open Land Rover, and bushman painting. The town of Laingsburg has the Flood Museum which documents the devastating flood of 1981. The museum houses the Wolfaardt collection; featuring artefacts from the Great Trek and the Anglo-Boer War, as well as prehistoric items and historical weapons used by the Khoi-San. Other historical features found in the area are the Anglo-Boer War blockhouse and buildings dating back to the 1800's and early 1900’s.

Some of the farms in the area have been in the families since the 1800s. Many farms show evidence of old stone walled sheep kraals. One farmer noted that he has Bushmen paintings on his farms and stone tools. Most of the farm houses are more than 100 years old. Farmers see their farming practise as an important part of their heritage. There are graves on some of the farms; these are located in close proximity to the farm houses.

General Infrastructure and Services

Existing Site Infrastructure

The infrastructure on the farms is directly related to the land use (i.e. livestock and crop farming). The basic infrastructure found on the farms varies between farms but includes the following:

- perimeter and camp fencing;
- farm roads;
- sheds and storage;
- boreholes;

- wind pumps;
- solar powered water pumps;
- worker accommodation;
- the main farm house;
- farm dams;
- pivot and other irrigation systems; and
- various types of pumps to pump water from boreholes.

General Municipal Infrastructure and Services

Water

Water is limited in both the District Municipalities and is not adequate to meet the demands of proposed large-scale economic developments that require large quantities of water. Water shortages have an impact on local economic activities as it costs farmers more to transport livestock for processing. Water shortages also limit the addition of new economic sectors. The source of water for the project would be boreholes and, to a limited extent, surface water (ie dams) located on the project properties.

In Karoo Hoogland LM 85.4% of the population within the LM have access to piped water, 13.3%percent access their water from boreholes and 1.3% access water from rain, rivers and water tanks. Laingsburg LM has a relatively high number of households with access to tap water (93.6%) compared to Karoo Hoogland. Another 6.4% of the population have no access to piped water and receive water from rain, boreholes and dams.

Sanitation

Access to sanitation facilities in the Karoo Hoogland LM is low, with only 57.3% of households having access to flush toilets. A further 36.9% use dry, chemical and ventilated (VIP) toilets, 2.3% use the bucket system and 3.5% have no toilets. The Laingsburg LM has delivered toilets to 94.5% of the communities; this is significantly high compared to Karoo Hoogland's provision of sanitation facilities. In both the Karoo Hoogland and Laingsburg local municipalities there are still households without sanitation facilities (3.5% and 3.5%, respectively) and those who are using the buckets system (2.3% and 2.1%, respectively) .

Housing

In the Karoo Hoogland LM 76 percent of households live in formal houses and approximately 23% live in hostels or live in informal housing. The Laingsburg LM has a higher percentage of the population living in formal housing compared to Karoo Hoogland at 96.9%. Approximately 3.1% of the population in Laingsburg LM are living in informal housing such as shacks and backyard rooms.

Energy

In Karoo Hoogland LM 82.4% of households have electricity. Another 11.3% use candles, 3.3% use solar and 2.9% use other sources of energy. In the Laingsburg LM approximately 84.6% of the population have access to electricity. Approximately 10.2% of the population use candles, 1.6% use solar energy and 3.6% use other sources of energy such as firewood and coal.

Roads

In the Namakwa DM, the current backlog on re-graveling was estimated to be R70 million for the District. Many complaints were received by the department regarding the worsening condition of the road network. The information from the gravel road management system report indicated that about 1072 km of the roads in the district are without any gravel (that is, dirt/earth roads). The condition of the gravel road network was rated as fair, with 22% of the roads considered to be in poor to very poor condition.

The roads in the Central Karoo DM are critical to the transport sector; the largest GDP contributor. There are a total of 96km of trunk roads, 726km of Main Roads, 1 725km of Divisional roads and 4 256km of access roads. The National and provincial roads are well financed and maintained, whereas those that are the responsibility of the District and Local Municipalities are not as well maintained.

Policing

Some landowners reported that there is a sense of lawlessness in the area because people are aware that the police are not very strong in the area. The police officers are Black/African and do not speak the local language therefore there seems to be a breakdown in communication between the police and community making enforcement and assistance/support more difficult.

South African Large Telescope

The Roggeveld site lies approximately 50km from South African Large Telescope (SALT). SALT is the largest telescope in the Southern Hemisphere, is credited as the most important contributing factor to the growth of the tourism sector in Sutherland.

ASSESSMENT OF IMPACTS: CHAPTER 8

PHASE 1 OF THE ROGGEVELD WIND FARM & ASSOCIATED INFRASTRUCTURE

Environmental impacts associated with the proposed Phase 1 of the Roggeveld wind farm are expected to be associated with the construction, operation and decommissioning of the facility. The significance of impacts associated with a particular wind energy facility is dependent on site-specific factors, and therefore impacts can be expected to vary significantly from site to site.

The construction of a wind energy facility project includes 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 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 barotrauma; and light and illumination issues.

These and other environmental issues were identified through the scoping evaluation and assessment phase. Potentially significant impacts identified for Phase 1 of the Roggeveld wind farm have now been assessed within this Final EIA Report. 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.

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/s 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 Programme (refer to **Appendix M**).

In order to assess the impacts associated with the proposed Phase 1 of the Roggeveld 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. The study area for Phase 1 of the Roggeveld wind farm site (~265 km^2) is being considered as a larger study area for the construction of the proposed wind energy facility. The area to be occupied by turbines and associated infrastructure is illustrated in **Figure 8.1** below, and includes the area covered by the following thirteen farm portions:

Farm Name	Farm No	Portion No	Local Municipality	Province
Ekkraal	199	1	Karoo Hoogland Municipality	Northern Cape
Ekkraal	199	0	Karoo Hoogland Municipality	Northern Cape
Bon Espirange	73	1	Laingsburg Municipality	Western Cape
Bon Espirange	73	0	Laingsburg Municipality	Western Cape
Rietfontein	197	0	Karoo Hoogland Municipality	Northern Cape
Appelsfontein	201	0	Karoo Hoogland Municipality	Northern Cape
Ou Mure	74	1	Laingsburg Municipality	Western Cape
Fortuin	74	0	Laingsburg Municipality	Western Cape
Fortuin	74	3	Laingsburg Municipality	Western Cape
Brandvallei	75	0	Laingsburg Municipality	Western Cape
Nuwerus	284	0	Laingsburg Municipality	Western Cape
Standvastigheid	210	2	Karoo Hoogland Municipality	Northern Cape
Aprils Kraal	105	0	Laingsburg Municipality	Western Cape

Phase 1 of the Roggeveld Wind Farm will include the following infrastructure:

» Up to 60 2MW - 3.3MW wind turbines with a foundation of 20m in diameter and 3m in depth.
» Permanent compacted hardstand areas / crane pads for each wind turbine (60mx50m).
» Electrical turbine transformers (690kV/33kV) at each turbine (2m x 2m typical but up to 10 x 10m at certain locations).
» Internal access roads up to 12 m wide.
» Approximately 11km of 33kV overhead power lines; and approximately 6km of 400kV overhead power line to Eskom's Komsberg Substation.
» Electrical substations (an on-site 132/400 kV substation (100m x 200m) and a 400 kV substation (200m x 200m) adjacent to the existing Eskom Komsberg Substation.

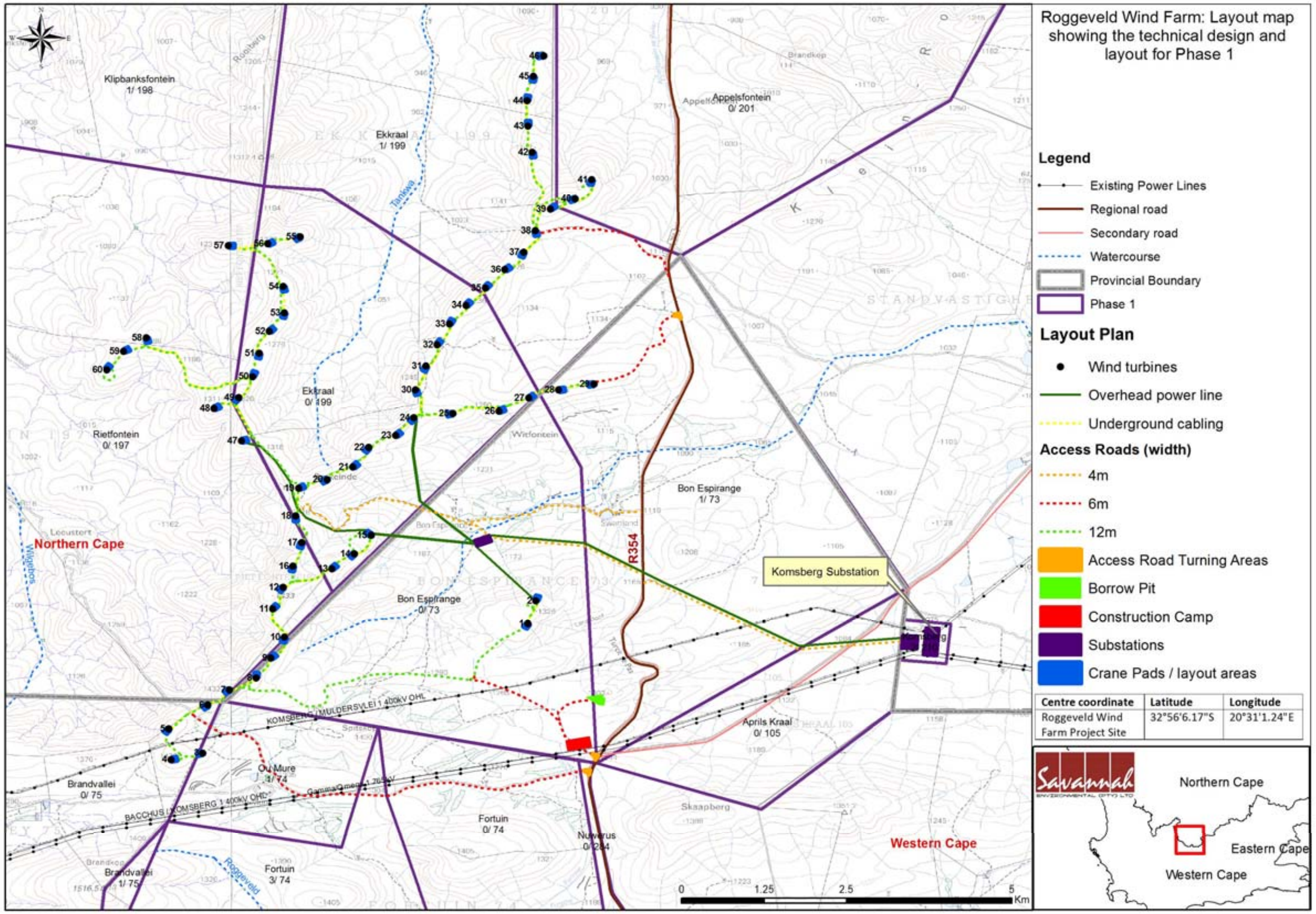


Figure 8.1: Layout map showing the technical design and layout for Phase 1 of the Roggeveld Wind Farm

» An operations and maintenance building (O&M building) next to the smaller substation.
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction phase includes construction lay down areas and a construction camp up to 4.5ha (150m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~2.2ha).

The assessment presented within this chapter of the report is on the basis of a layout provided by the developer. This layout indicates 60 wind turbines as well as associated infrastructure. The assessment of issues presented within this chapter (and within the specialist studies attached within **Appendices F – L**) considers the worst-case scenario in terms of potential impacts. The wind turbines and associated infrastructure is assessed in this chapter. Chapter 10 assesses cumulative impacts.

8.1 Assessment of Potential Impacts on Ecology

8.1.1. Ecological Sensitivity of the Site

The broad-scale ecological sensitivity map of the site is depicted in Figure 8.2. The wind turbines are proposed to be located along elevated ridgelines traversing the site. The adjacent slopes are considered sensitive. There are, however, some parts of the development site, especially in the south, which are within areas considered, at a broad-scale to be relatively of high ecological sensitivity. The proposed on-site substation is located within a previously ploughed area and is not considered sensitive.

As the ridgelines where the turbines would be located are fairly flat, the risk of erosion is relatively low and the major impact associated with the development would be from the construction of access roads. The total length of access road required for the development is ~58 km and although some of these would be on existing roads, the majority would be new roads or significant upgrades from the existing tracks (which are not considered ecologically significant). The total development footprint (including roads and turbine service areas) would be ~80ha (within a footprint of 26 500ha), which on its own would not be considered highly significant. However, the development is dispersed across a large area, the majority of which is currently impacted little by human activity. Disturbance to fauna would occur across a greater extent than the physical footprint and to provide an indicative footprint for species vulnerable to human disturbance, ~1000ha of the site is within 100m of the access roads, while more than ~4500ha is within 500m. While it is unlikely that many fauna would impacted at a distance of 500m, the habitat loss experienced by larger fauna is likely to be in the order of 1000ha.

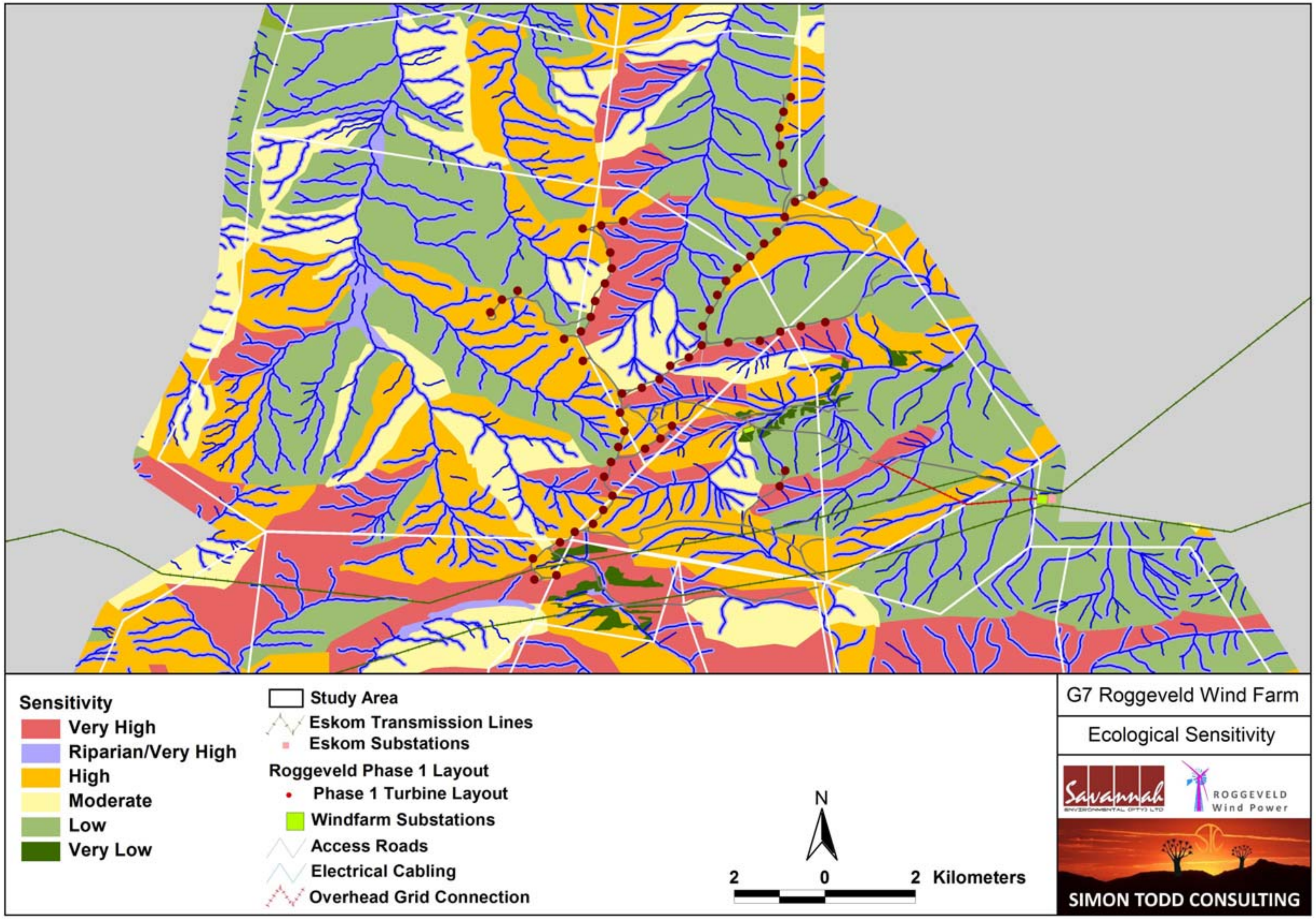


Figure 8.2: Broad-scale ecological sensitivity map of Phase 1 of the Roggeveld Wind Farm

8.1.2. Fine-Scale Ecological Sensitivity

The ecological walk-through survey of the final layout, by Mr Simon Todd (ecological specialist), of Phase 1 of the Roggeveld wind farm revealed that the majority of the turbines were located within physically and ecologically acceptable areas. The majority of the ridges within the development footprint are relatively wide flat-topped ridges with sufficient space to accommodate the turbines and service areas without impacting the adjacent slopes. In addition, there are not many rocky outcrops or other sensitive edaphic features along the tops of the ridges that might be impacted by the development.

A section within the central part of the site was, however, found to have some turbines (Turbine 52 and 57) within sensitive environments. Turbine 52 is proposed to be located within a rock field, which is an exceptional and unique habitat at the site and no other similar areas are present in the area. No doubt, to the uninitiated, this area appears to harbor little diversity, but there are numerous geophytes, small succulents and forbs among the rocks, some of which were not observed elsewhere at the site. Turbine 57 is proposed to be located along a narrow ridge that was not wide enough to accommodate the turbine and service area without considerable damage to the ridge, and the access road was also problematic as it traversed a steep slope.

8.1.3. Impact Assessment

Potential ecological impacts resulting from the development of Phase 1 of the Roggeveld Wind Farm would stem from a variety of different activities and risk factors associated with the preconstruction, construction and operational phases of the project including the following:

- » Pre-construction Phase
  - ∗ Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purpose.
  - ∗ Site clearing and exploration activities for site establishment would have a negative impact on biodiversity if this was not conducted in a sensitive manner.
- » Construction Phase
  - ∗ Vegetation clearing for access roads, turbine pads, electrical trenches etc could impact listed plant species as well as high-biodiversity plant communities. Vegetation clearing will also lead to habitat loss for fauna and potentially the loss of sensitive faunal species, habitats and ecosystems.
  - ∗ Increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may impact

downstream riparian and wetland habitats if a lot of silt enters the drainage systems.

- Presence and operation of construction machinery on site. This will create a physical impact as well as generate noise, pollution and other forms of disturbance at the site.
- Increased human presence can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.

» Operational Phase

- The operation of the facility will generate noise and disturbance which may deter some fauna from the area.
- The facility will require management and if this is not done appropriately, it could impact adjacent intact areas through impacts such as erosion, alien plant invasion and contamination from pollutants, herbicides or pesticides.

» Cumulative Impacts

- The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets.
- Transformation of intact habitat with CBAs could compromise the ecological functioning of the CBAs and would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

The assessment of likely ecological impacts associated with the Roggeveld Wind Farm follows. The facility and associated infrastructure is assessed as a whole and the different elements such as roads, turbines or grid connection are not considered separately in the assessment as the development requires all elements and the facility is restricted to a reasonably homogenous environment and assessing the different components separately would have little utility.

Construction Phase

The major impacts during the construction phase are associated with disturbance associated with this phase of the development. Due to all the construction activity at the site, the disturbance intensity is considered high, but this is a transient phase and many of the impacts would be significantly reduced during operation. The transformation and habitat loss created during construction is, however, a near-permanent impact.

Construction Impact 1: Impacts on vegetation and listed or protected plant species

Impact 1. Destruction and Loss of Vegetation and Listed Plant Species

Nature: The construction phase will require the construction of a large number of access roads as well as the clearing of vegetation for the turbines, their service areas and for buildings and temporary construction areas. The loss of vegetation from the development footprint is an unavoidable consequence of the development, while the presence of numerous listed plant species at the site suggests that at least some of these are likely to be impacted by the development.

Impact Magnitude – Moderate-High

Extent: Local, the extent of the impact will be limited to the development footprint and near surroundings. The footprint of the development in terms of direct habitat transformation and destruction will be around 100 ha.
Duration: The duration of the impact will be long-term as the majority of impact will remain until the project is decommissioned.
Intensity: Since this results in the total loss of vegetation within affected areas, the intensity is seen to be Moderate-High.
Likelihood: As this infrastructure is required for the operation and construction of the facility, this impact will definitely occur.

Impact Significance: Major (-ve)

Degree of Confidence: High. Based on the project description, this impact will definitely occur.

Mitigation:

» Preconstruction walk-through of the development footprint for identification of species of conservation concern that can be translocated.
» Since a large proportion of the listed species at the site are geophytes or succulent species, the potential for successful translocation is high. Therefore, it is recommended that before construction commences individuals of listed species within the development footprint should be marked and translocated to similar habitat outside the development footprint under the supervision of an ecologist or someone with experience in plant translocation. Permits will be required from the relevant provincial authorities to relocate listed plant species.
» Permits will be required from the relevant provincial authorities to destroy all listed plant species which cannot be translocated.
» Any individuals of protected species observed within the development footprint during construction (ie. Individuals that were missed during initial sweeps), should be translocated under the supervision of the ECO.
» Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc.
» Demarcate all areas to be cleared with construction tape or similar material. However caution should be exercised to avoid using material that might entangle fauna.

- » ECO to provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place.
- » Ensure that lay down areas, construction camps and other temporary use areas are located in areas of low sensitivity and are properly fenced or demarcated as appropriate.
- » All vehicles to remain on demarcated roads and no driving in the veld should be allowed.
- » Regular dust suppression during construction, especially along access roads which are used frequently.
- » Demarcating and labelling no-go areas in proximity to the development footprint, such as drainage areas or sensitive habitats.
- » Crossing of drainage lines should be specifically designed not to impede or disrupt the direction and flow of the water.
- » Crossing of drainage lines should be placed in areas without extensive water courses and preferably in rocky areas where the risk of disruption and erosion is low. All drainage line crossings should be inspected as part of the pre-construction activities to ensure that the optimal and acceptable locations have been chosen for river crossings.
- » No plants may be translocated or otherwise uprooted or disturbed for rehabilitation or other purpose without express permission from the ECO.
- » No fuel wood collection on site.
- » No fires should be allowed on-site.
- » The use of herbicides should be restricted for the control of alien species that cannot easily be controlled manually and should be applied according to the relevant instructions and by appropriately trained personnel.

Construction Impact 2. Direct faunal impacts during construction

Impact 2. Direct Faunal Impacts Due To Construction Disturbance

Nature: The construction phase will result in a lot of physical disturbance at the site as well as habitat destruction for resident faunal species. This will result in direct mortality for smaller fauna unable to move away from the construction activities and a loss of faunal habitat in general. The human activity and noise generated by the construction will also frighten most medium and larger fauna away from the construction area.

Impact Magnitude – Moderate

Extent: Local, the extent of the impact will be limited to the site and near surroundings.

Duration: The duration of the impact will be short term or as along as construction is underway. The impact with regards to habitat loss is considered part of the operational phase.
Intensity: The large amount of activity at the site and the associated disturbance resulting from clearing and construction will constitute a Moderate to High disturbance intensity.
Likelihood: There is a very high likelihood that this impact will occur in and around construction areas.

Impact Significance: Moderate (-ve)

Degree of Confidence: Definite. Based on the project description, this impact will occur to a greater or lesser extent.

Mitigation:

- All vehicles at the site should adhere to a low speed limit.
- Personnel should not be allowed to roam into the veld.
- All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and owls which are often persecuted out of superstition.
- Regular dust suppression during construction, especially along access roads which are used frequently.
- No activity should be allowed at the site between sunset and sunrise.
- Ensure that the cabling and electrical infrastructure at the site is buried sufficiently deeply to avoid being excavated by fauna and that where such infrastructure emerges above-ground that it is sufficiently protected from gnawing animals such as porcupines and springhare, which may seek such material out.
- Any dangerous fauna (snakes, scorpions etc) that are encountered during construction should not be handled or molested by the construction staff and the ECO or other suitably qualified persons should be contacted to remove the animals to safety.
- No litter, food or other foreign material should be thrown or left around the site and should be placed in demarcated and fenced rubbish and litter areas.
- Holes and trenches should not be left open for extended periods of time and should only be dug when needed for immediate construction. Trenches that may stand open for some days, should have places where the loose material has been returned to the trench to form an escape ramp present at regular intervals to allow any fauna that fall in to escape.
- If there is any part of the site that needs to be lit at night for security reasons, then this should be with low-UV emitting types which do not attract insects.

Construction Impact 3. Increased erosion risk during construction

Impact 3. Increased Erosion Risk During Construction

Nature: During construction, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. As some of the roads and other infrastructure will traverse steep areas, the potential for erosion is very high. Furthermore, roads even on low slopes may capture overland flow, concentrating the water from a large area onto the road which would then be vulnerable to severe erosion. The turbine service areas may also cause or be vulnerable to erosion if they are compacted and create a lot of runoff. Erosion is probably one of the greatest risk factors associated with the development and it is therefore critically important that proper erosion control structures are built and maintained over the lifespan of the project.

Impact Magnitude – Moderate

Extent: Local, the extent of the impact will be largely limited to the site, but downstream and adjacent areas may also be affected.
Duration: Should severe erosion occur then the duration of the impact will be **long-term** as such erosion is not easily remedied.
Intensity: The intensity of the impact is potentially high as there are a large number of steep slopes at the site which would be vulnerable to extensive and severe erosion.
Likelihood: Based on the large number of roads that will be required at the site and the fact that they will probably not be built along the contour, there is a high likelihood that erosion would occur if mitigation measures are not taken.

Impact Significance: Moderate (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Mitigation:

- A rehabilitation and re-vegetation plan developed as part of the EMPr to be implemented.
- Roads should be constructed and routed in manner which minimises their erosion potential. Roads should therefore follow the contour as far as possible and roads parallel to the slope direction should be avoided as much as possible.
- All roads should have water diversion structures present with energy dissipation features present to slow and disperse the water into the receiving area.
- Regular monitoring of the site (minimum of twice annually) for erosion problems is recommended, particularly after large summer thunderstorms have been experienced.

- » Any erosion problems observed should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.
- » All bare areas should be revegetated with locally occurring species, to bind the soil and limit erosion potential.
- » Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.
- » Silt traps should be used where there is a danger of topsoil or material stockpiles eroding and entering streams and other sensitive areas.
- » Topsoil should be removed and stored separately and should be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas.
- » Phased development and vegetation clearing so that cleared areas are not left unvegetated and vulnerable to erosion for extended periods of time.
- » Construction of gabions and other stabilisation features on steep slopes to prevent erosion.
- » Reduced activity at the site after large rainfall events when the soils are wet. No driving off of hardened roads should occur immediately following large rainfall events until soils have dried out and the risk of bogging down has decreased.

Operational Phase

Operational Impact 1: Impacts on fauna due to operation

Impact 1. Impacts on fauna due to presence and operation of the facility

Nature: Major risk factors during operation are likely to be poaching and hunting on the site by personnel or due to increased access to the area, pollution risk largely from vehicles but possibly from turbines as well and direct negative impacts from vehicle collisions with fauna. The noise generated by the turbines will also have an impact on some fauna.

Impact Magnitude - Moderate

Extent: Local, the extent of the impact will be limited to the site.
Duration: The duration of the impact will be long-term as the roads will remain in place for the foreseeable future.
Intensity: As this impact will be concentrated on a few targeted species, the impact on these species could be of high intensity.
Likelihood: There is a high probability that this would occur if appropriate mitigation measures are not taken.

Impact Significance: Moderate (-ve)

Degree of Confidence: Moderate. This impact can be assessed with a moderate degree of certainty.

Mitigation:

» Access to the site should be strictly controlled.
» All vehicles at the site should adhere to a low speed limit and any fauna on roads should receive right or way or can be moved off the road in the direction that the animal was moving in the case of slow-moving fauna such as tortoises.
» Personnel should not be allowed to roam into the veld.
» All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and owls which are often persecuted out of superstition.
» Any chemical spills at the site should be handled in the appropriate manner as determined by the nature of the spill.
» No maintenance activities should be allowed at the site between sunset and sunrise.
» If any parts of the facility need to be fenced off then no electrical fencing should be placed within 40cm of the ground to avoid impacts on tortoises.
» If there is any part of the site that needs to be lit at night for security reasons, then this should be with low-uv emitting types which do not attract insects.
» Given the sensitivity of the site in terms of it falling within CBAs and NFEPA focus areas, a faunal monitoring programme should be developed in order to understand whether the presence of the facility has an impact on faunal activity. This can rely on passive approaches such as the use of camera traps which can be left in the veld for an extended period of time between retrieving the data or replacing batteries.

Operational Impact 2. Increased erosion risk during operation

Impact 2. Increase erosion potential during operation

Nature: Disturbance created during construction will take several years to fully stabilise and the presence of an extensive area of hardened surface from roads, turbine crane pads etc. will generate a lot of runoff which will pose a significant erosion risk. Particular areas of concern would be roads traversing steep slopes as well as any infrastructure on steep or gentle slopes with erodible soils. Erosion is probably one of the greatest risk factors associated with the development and it is therefore critically important that proper erosion control structures are built and maintained over the lifespan of the project.

Impact Magnitude – Moderate - High

- Extent: Local, the extent of the impact will be largely limited to the site, but downstream and adjacent areas may also be affected.
- Duration: Should severe erosion occur then the duration of the impact will be long-term as such erosion is not easily remedied.
- Intensity: The intensity of the impact is potentially high as there are a large number of steep slopes at the site which would be vulnerable to extensive and severe erosion.

Likelihood: Based on the large number of roads that will be required at the site and the fact that they will probably not be built along the contour, there is a high likelihood that erosion would occur if mitigation measures are not taken.

Impact Significance: Moderate - High (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Mitigation:

» Regular monitoring of the site (minimum of twice annually) for erosion problems is recommended, particularly after large summer thunder storms have been experienced.
» Any erosion problems observed should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.
» All bare areas should be revegetated with locally occurring species, to bind the soil and limit erosion potential.
» Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.

Operational Impact 3. Increased alien plant invasion during operation

Impact 2. Alien Plant Invasion

Nature: The large amount of disturbed and bare ground that is likely to be present at the site after construction will leave the site vulnerable to alien plant invasion for some time. The presence of alien plants may prevent the natural recovery of the natural vegetation, reduce plant and animal diversity at the site as well as result in various other negative ecosystem consequences. Furthermore, the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.

Impact Magnitude - Moderate

Extent: Local, the extent of the impact will be largely limited to disturbed areas of the site, but adjacent areas may also become affected if invasion is severe.

Duration: Should alien plants become established this would be considered to have a long-term impact as these plants would probably persist at the site for years or decades and once a seed bank has established, alien plants may be difficult to eradicate.
Intensity: The intensity of the impact is likely to be of moderate intensity as the soils at the site are generally quite nutrient poor which would reduce the potential for alien plant invasion.
Likelihood: Since the development of the site will result in a fairly extensive disturbance, it is highly likely that some alien plant invasion will occur.

Impact Significance: Moderate (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Mitigation:

- Regular monitoring for alien plants at the site should occur and could be conducted simultaneously with erosion monitoring.
- When alien plants are detected, these should be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur.
- Clearing methods should themselves aim to keep disturbance to a minimum.
- No planting or importing any alien species to the site for landscaping, rehabilitation or any other purpose.

Decommissioning

During the decommissioning phase the project is likely to face similar issues generated by the construction phase; that is negative impacts related to disturbance and human presence at the site. The decommissioning phase should attempt to rehabilitate the site with as little disturbance as possible. The major risk associated with the decommissioning phase would be that the site is not adequately restored to its previous potential and a degraded and disturbed ecosystem is left behind.

Decommissioning Impact 1: Inadequate rehabilitation of the site.

Impact 1. Inadequate rehabilitation of the site.

Nature: Decommissioning will involve a large amount of disturbance at the site as the majority of infrastructure will need to be removed and some roads will need to be rehabilitated. This will leave the site vulnerable to erosion and alien plant invasion. If the site is not adequately restored at decommissioning, a degraded ecosystem would persist at the site for decades.

Impact Magnitude - Moderate

Extent: Local, the extent of the impact will be largely limited to disturbed areas of the site, but adjacent and downstream areas could also be affected in the case of erosion problems.
Duration: Should erosion occur and alien plants become established this would be considered to have a long-term impact as the problems would probably persist at the site for years or decades.
Intensity: The intensity of the impact is likely to be of low to moderate intensity as it is likely that the weedy species present at the site will colonise the disturbed areas and reduce the potential extent and severity of erosion and alien plant invasion.
Likelihood: Since the decommissioning of the site will result in a fairly extensive disturbance, it is highly likely that some erosion and alien plant invasion will occur if mitigation measures are not implemented.

Impact Significance: Moderate (-ve)

Degree of Confidence: There is a high degree of confidence in the assessment of this risk.

Mitigation:

» All hard infrastructure should be removed from the site.
» All disturbed areas should be rehabilitated with locally-sourced seed of indigenous species.
» The site should be monitored for a period of at least five years after the infrastructure has been removed to ensure that rehabilitation is successful and that areas that do not recover adequately can be identified and remedied.

Cumulative Impacts

There is a high density of proposed renewable energy facilities in the area and the potential for cumulative effects may therefore be high, depending on the number of facilities which are constructed. Cumulative impacts on the Central Mountains Shale Renosterveld vegetation type is highlighted as a particular concern. However, wind energy facilities do not have a very large footprint in terms of direct transformation, so the actual amount of vegetation lost cannot be considered significant in its own right when considered in the light of the low level of transformation this vegetation type has experienced to date. Therefore, the major concern with regards to cumulative impacts is likely to centre on the potential impact on broad-scale ecological processes such as the disruption of movement and migration pathways of fauna, and the broad scale fragmentation of habitat.

Cumulative Impact 1. Reduced ability to meet conservation targets.

Impact 1. Reduced ability to meet conservation targets

Nature: The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets. The area has been identified as National Protected Areas Expansion Strategy focus area, indicating that it represents a large currently intact extent of habitat which is considered to have a high biodiversity value. Although all of the vegetation types in the study area are classified as Least Threatened, they are mostly poorly protected and certain habitats or communities may be disproportionately affected.

Impact Magnitude – Low

Extent: Local, the extent of the impact will be limited to the site and surroundings.
Duration: The duration of the impact will be long-term as the effect would persist as long as the facility was present.
Intensity: Since the facility occupies a relatively small proportion of landscape, the intensity is deemed to be Moderate to Low.
Likelihood: The impact is likely to occur.

Impact Significance: Minor-Moderate (-ve). The development will not impact the majority of the landscape and there is little to suggest that these areas would be impacted by the development at least for the majority of biodiversity components.

Degree of Confidence: This effect can be assessed with a moderate to low degree of confidence as little is known about how the local fauna is likely to respond to the presence of wind turbines.

Mitigation:

» Preconstruction walk-through of the facility, especially the roads and turbine locations to ensure that sensitive habitats are avoided.
» Minimise the development footprint as far as possible.
» Reduce the footprint of the facility within sensitive habitat types as much as possible (the relocation of parts of the facility due to the results of this study meets this mitigation goal).

Cumulative Impact 2. Impact on critical biodiversity areas and broad-scale ecological processes

Impact 2. Impact on Critical Biodiversity Areas

Nature: Transformation within CBAs would potentially disrupt the functioning of the CBA or result in biodiversity loss. In addition, the presence of the facility and associated infrastructure could potentially contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions. There are a number of other renewable energy facilities in the broad area the cumulative impact of these on habitat loss and the broad scale disruption of landscape connectivity is a potential concern.

Impact Magnitude – Moderate-High

Extent: Local, the extent of the impact will be largely limited to the site, but broader implications would occur if the ecological functioning or biodiversity value of CBAs were compromised.
Duration: The impact would persist for the lifespan of the project and is thus considered long-term.
Intensity: The intensity of the impact is likely to be moderate.
Likelihood: This impact is highly likely to occur as a large proportion of the development lies within CBAs.

Impact Significance: Moderate to High (-ve)

Degree of Confidence: There is a moderate to high degree of confidence in the assessment of this risk.

Mitigation:

» An open space management plan for the development should be developed.
» Preconstruction walk-through of the facility, especially the roads and turbine locations to ensure that sensitive habitats are avoided and that species of conservation concern can be translocated.
» Minimise the development footprint as far as possible.
» Stringent construction-phase monitoring of activities at the site to ensure that mitigation measures are adhered to and that the overall ecological impact of the development is maintained at a low level.
- The use of structures which may inhibit movement of fauna, such as mesh and electric fencing should be avoided.

Power Line and Substations

The proposed on-site substation is located within a previously cultivated area and is not sensitive. The substation adjacent to the Eskom Komsberg substation is also located within an area of relatively low sensitivity and no species of conservation concern were observed in this area. Therefore, the impact of the two substations on ecology will be of a low significance. The two substation positions are located in ecologically acceptable areas.

The overhead power line which is proposed to connect the facility to the Komsberg substation is not likely to generate significant impact on the environment. Although the power line traverses several drainage lines, it is only the pylon foundations that generate significant impact and the placement of these can be adjusted where necessary to avoid impact to drainage lines or any other sensitive features. The impact of the power line is likely to be low and no deviations to the route are recommended at this stage. A pre-construction walk-through for the power line is recommended.

8.1.4. Conclusions & Recommendations

A summary of the pre and post mitigation significance ratings for the various impacts as identified is provided in Table 8.1.

Table 8.1: Summary of pre and post mitigation impact significance ratings for the ecological impacts and risk factors identified for Phase 1 of the Roggeveld Wind Farm.

Phase	Impact	Significance Pre Mitigation	Residual Impact Significance
Construction	Impacts on vegetation and listed or protected plant species	Major	Moderate
	Direct faunal impacts during construction	Moderate	Minor
	Increased erosion risk during construction	Moderate	Minor
Operation	Impacts on fauna due to operation	Moderate	Minor
	Increased erosion risk during operation	Moderate-High	Minor
	Increased alien plant invasion during operation	Moderate	Minor
Cumulative Impacts	Reduced ability to meet conservation targets.	Moderate-Minor	Minor
	Impact on critical biodiversity areas and broad-scale ecological processes	Moderate-High	Moderate
Decommissioning	Inadequate rehabilitation	Moderate	Minor

Most of the impacts associated with the development can be mitigated to minor significance except for the impacts on vegetation and Critical Biodiversity Areas. The vegetation at the site is considered to be of moderate to high sensitivity given the high diversity of the area and the abundance of listed species. Similarly, the area is considered important from a conservation planning perspective due to the high diversity of the area as well as the topographic diversity which offers climate buffering capacity. As the area currently has very little development, the wind farm would significantly increase the anthropogenic impact in the area. The impact on the Critical Biodiversity Areas is considered potentially high and cannot be effectively mitigated as the majority of the impact results from the direct loss of habitat and the presence of the facility. Cumulative impacts on the Central Mountains Shale Renosterveld is highlighted as a particular concern as there are a number of different wind farm developments in the area which would potentially impact this relatively limited vegetation type. In this regard it is also important to bear in mind that wind farm developments are not spread randomly across the landscape, but tend to be concentrated within the higher-lying areas, with the result that these habitats may be disproportionately impacted. This is of concern as these areas often contain the highest abundance of species of conservation concern.

When considered in isolation, the development of the Roggeveld Wind Farm is likely to generate impacts of minor to moderate post-mitigation significance. The majority of the development footprint is concentrated along the ridges of the site, which are generally fairly broad and flat, with the result the risk of collateral damage to these areas should be relatively low with the implementation of standard mitigation measures to limit erosion and the footprint of the development. Similar habitat is available to the south and to the west of the current development area and a relatively small proportion of the total extent of this habitat would be impacted by the current phase of the development. The potential for significant cumulative impact with additional phases of the development is however high and the levels of mitigation and avoidance implemented would need to increase significantly if additional phases were to be implemented. Due to the relatively limited extent of the current phase, the overall impact of the development on the receiving environment is considered to be moderate. A pre-construction walk-through for the power line is recommended.

8.2 Assessment of Potential Impacts on Avifauna

The avifaunal impact assessment is based on information collected during the pre-construction bird monitoring undertaken by African Insight cc for Phase 1 of the Roggeveld Wind Farm.

8.2.1. Results of the Pre-Construction Bird Monitoring Programme

Conditions on the elevated ridges within the site were generally of strong breezes to light gales. As most birds prefer not to fly at wind speeds greater than 7 m/second (R. Millikin *pers. comm*.) there were often periods of one to several hours when few, if any, birds were observed on the site. The combination of poor food resources and strong winds reduced bird use of the ridges and bird activity was especially reduced as winds increased in strength during the latter part of most mornings.

Table 8.2: Occurrence of bird groups - along the ridges by month and overall in adjacent valleys

Bird group	**March ridges**	**May ridges**	**July ridges**	**September ridges**	**November ridges**	**Overall Valleys**
Birds of prey & carrion	4	4	6	8	6	16
Other non-passerines	1	1	3	3	5	13
Aerial insectivores	3	1	1	3	3	8
Ground invertivores	4	3	8	8	8	20
Bush foraging invertivores	3	4	7	8	10	22
Seed-eaters	2	2	5	5	5	11
Waterbirds	0	0	1	1	1	31
Totals	**17**	**15**	**31**	**36**	**38**	**121**

The general site conditions support the low diversity and number of birds observed along the Roggeveld ridges. The total number of species seen along or passing over the ridges during the five monitoring iterations was 50, compared with the overall number of 121 species seen in the Roggeveld region (Table 8.2), most of which were seen in the lower areas. This was despite far less time being spent in the lower areas than on the ridges. In many ridge-top vantage hours, and some transect walks, no birds at all were recorded especially in strong wind conditions. Except for some early morning periods, generally fewer than 20 individual birds from all species were seen in any hour and these were likely to have included repeated sightings of the same individuals as they moved about foraging.

A broader ecological approach has been used to consider the degree to which the proposed wind farm may impact the avifauna. For simplicity, of the 121 recorded bird species were first divided into 7 broad eco-groupings. These were: 1) birds of prey and carrion; 2) other non-passerines; 3) aerial insectivores; 4) ground foraging invertivores; 5) bush foraging invertivores; 6) granivores; and 7) waterbirds. These groupings, whose totals are summarised in Table 8.2.

The 50 bird species that were seen along or over the ridges fell into two categories according to whether they were ever recorded flying within the turbine blade swept area.

Species whose members seldom, if ever, fly at turbine blade heights.

Of the 50 ridge-top species 38 fell in this category. Most were passerines associated with the local scrubland habitats. When flushed, or foraging, these birds seldom flew more than 3 m above the scrubby bushes. On more purposeful cross-ridge flights they still flew at less than 10 m. During spring several species exhibited display flights in which they flew to 20-40 m above the ridges. However, the number of individuals in displaying species was low, all or most display flights would be well below turbine blade arcs, and most displays were over the rim of the ridges i.e. off the top of the ridges and over the upper-most slopes where nesting is most likely to occur.

Table 8.3: Bird species recorded along the ridges and their flight relative to turbine blade height (birds of particular conservation concern are shown in bold)

SPECIES	Flight relative to turbine blade arc	
	Below	Within
Yellow Canary	X	
Cape Bunting	X	
Black-headed Canary	X	
White-throated Canary	X	
Lark-like Bunting	X	
Grey-backed Cisticola	X	
Bokmakierie	X	
Southern Banded Sunbird	X	
Layard's Tit-babbler	X	
Karoo Eremomela	X	
Spotted Prinia	X	
Rufous-eared Warbler	X	
Malachite Sunbird	X	
Cape Penduline Tit	X	
Cape Bulbul	X	
Fairy Flycatcher	X	
Yellow-bellied Eremomela	X	
Large-billed Lark	X	
Mountain Wheatear	X	
Karoo Long-billed Lark	X	
Sickle-winged Chat	X	

SPECIES	Flight relative to turbine blade arc	
	Below	**Within**
Cape Clapper Lark	X	
Karoo Scrub Robin	X	
Familiar Chat	X	
Karoo Chat	X	
Karoo Lark	X	
Long-billed Pipit	X	
Pale-winged Starling	X	
Rock Martin	X	
Alpine Swift		X
White-rumped Swift		X
Little Swift		X
Namaqua Sandgrouse		X
Grey-winged Francolin	X	
Speckled Pigeon	X	
Quail	X	
Ludwig's Bustard	X	
Verreaux's Eagle		X
Rock Kestrel		X
White-necked Raven		X
Pied Crow		X
Black Harrier	X	
Booted Eagle	X	
Martial Eagle		X
Jackal Buzzard	X	
Peregrine Falcon		X
Sacred Ibis		X
Hadeda Ibis	X	
Karoo Shelduck		X
Crowned Plover	X	
TOTALS	38	12

Species that sometimes fly at blade heights

Ten of the ridge occurring species either often, or occasionally, flew at heights which would potentially bring them into turbine blade swept area (Table 8.3). All were diurnal foragers. Accordingly they have good vision and should not be subject to collision with turbines. Their numbers were small and even in these species most observed flights along the ridges were below turbine blade heights. Also in stronger winds fewer birds flew at blade heights so that when the blades rotate quickly, and so may appear to blur, the likelihood of birds flying into them will be lower.

Bird species of particular concern

Three red listed-species endemic to southern Africa were recorded. These were Black Harrier, Blue Crane, and Ludwig's Bustard.

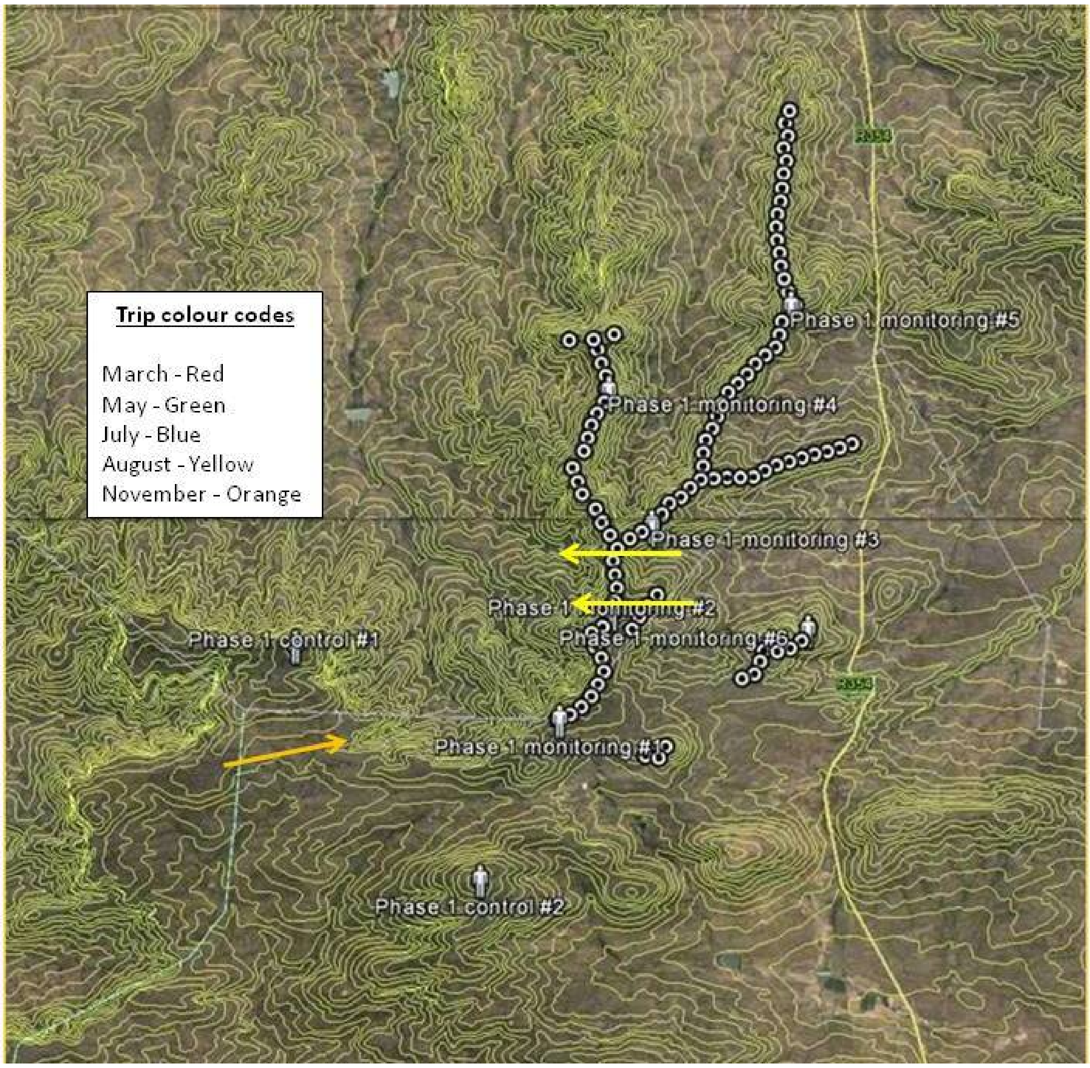


Figure 8.3: Recorded flight paths of Black Harriers

- **Black Harrier** (Near threatened): These were seen on several occasions mostly in the valleys or lower slope areas and when they occurred along the ridges they were quartering and so flying well below proposed turbine blade height.
- **Blue Crane** (Vulnerable): A single transient individual was seen at a farm dam in November.
- **Ludwig's Bustard** (Vulnerable): Two individuals were seen in November. Given the stony conditions and the paucity of large invertebrate prey it is probable that this species is only an occasional, generally non-breeding, visitor to the Roggeveld region. Their November occurrence probably reflects a limited movement into the Roggeveld following the unusually heavy winter rainfall and

the consequent increase in prey resources. One individual used a saddle area to fly across one of the ridges.

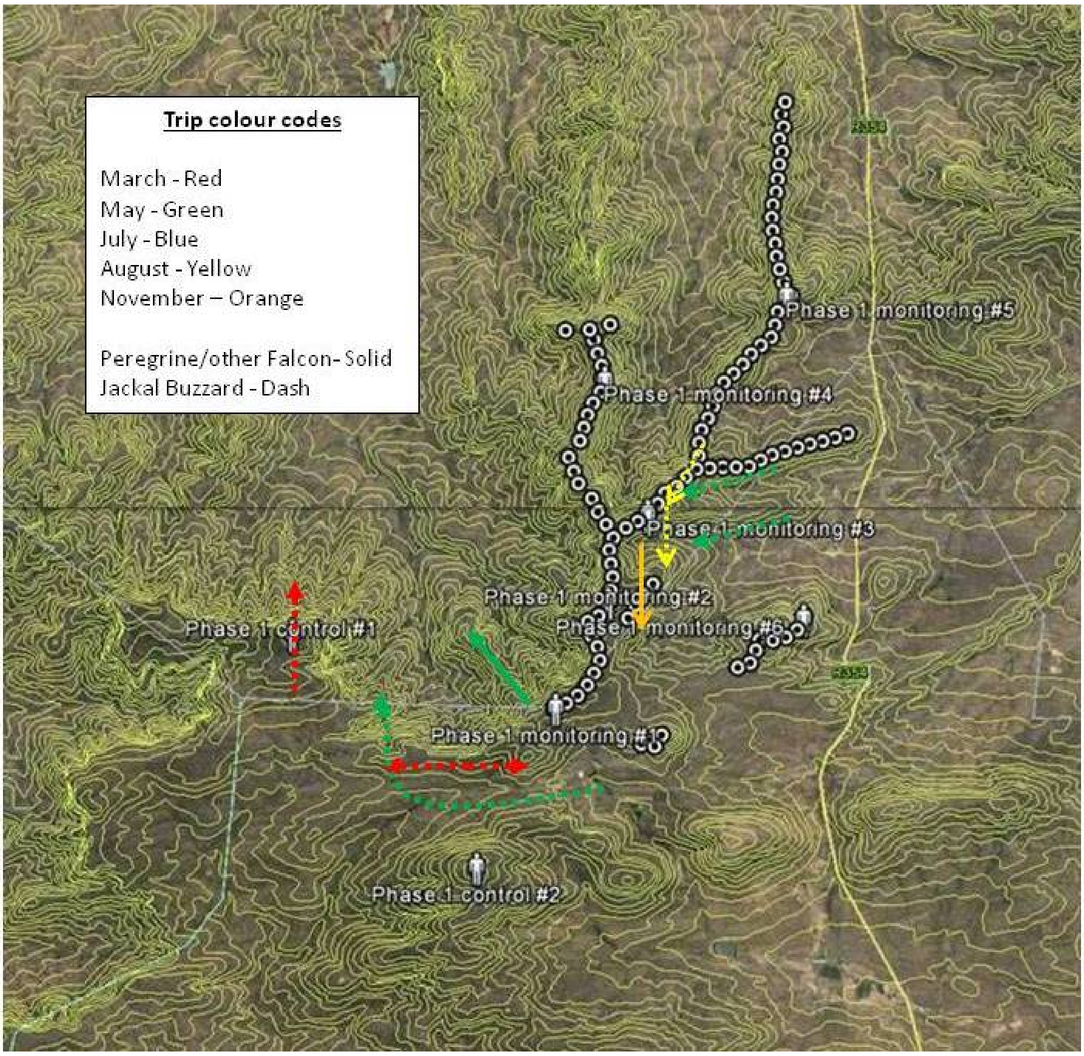


Figure 8.4: Recorded flight paths of Peregrine Falcons and Jackal Buzzards

» Two raptor species of potential concern, **Jackal Buzzard** and **Booted Eagle**, were seen in almost all cases along the hill slopes below the ridges. None were reported flying at turbine blade height above the ridges.

» **Martial Eagles** (Vulnerable): were seen on several occasions flying at heights that would coincide with turbine blade swept area. However all observations were of these eagles flying over adjacent valleys well away from the proposed turbine layout.

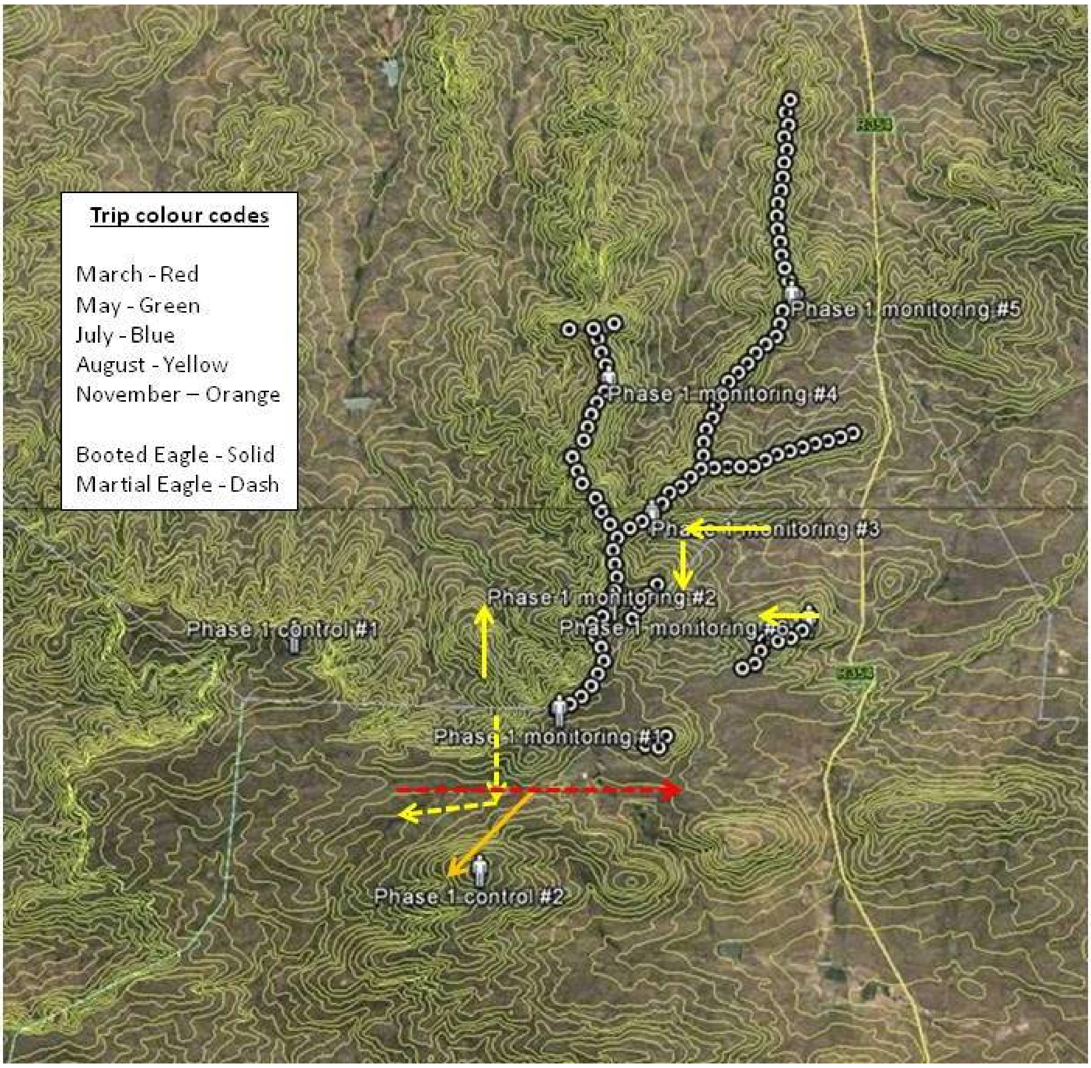


Figure 8:: Recorded flight paths of Booted and Martial Eagles

» None of the aerial foraging swifts, swallows and martins were numerous and most foraged on the upper hillside slopes rather than over the ridges. Pied Crows sometimes transited the ridges. The species concerned are all widespread, common and not considered of especial conservation concern.

This leaves four species which may be considered of particular potential risk to collision mortality with the proposed Roggeveld wind farm turbines. These are the Namaqua Sandgrouse, Verreaux's Eagle, Rock Kestrel and White-necked Raven and each merits comment.

» **Namaqua Sandgrouse:** The occurrence of this species was more common than anticipated. In September, small flocks of 10-20 individuals flew along the ridges at heights that sometimes would have taken them into the predicted lowest blade arc. These sandgrouse fly at speeds of 60 kmph and are known to die from collision with telephone line wires, so must be considered a potential collision risk on the Roggeveld ridges. However the species is currently considered of Least Concern in the latest IUCN appraisal. It is likely that numbers seen were larger than usual in response to the flush of seed-producing plants following the unusually heavy rains.

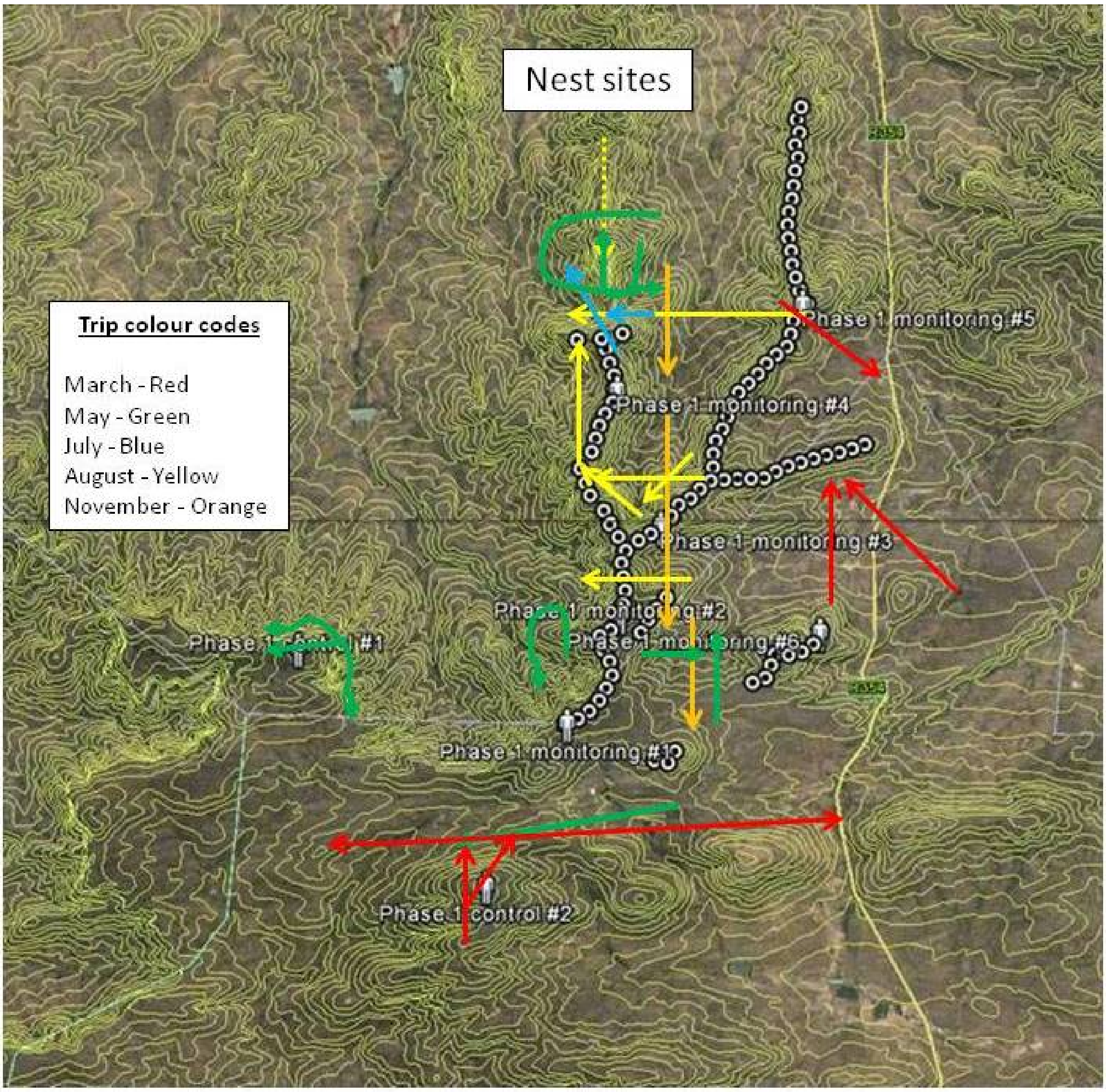


Figure 8.6: Recorded flight paths of Verreaux's Eagles

» **Verreaux's Eagle** (Near threatened): It is likely that many of the observations made during monitoring were repeat sightings of the same individuals and overall probably concern a maximum of six or fewer individuals. Their distribution is mapped. Although rated as of Least Concern by Birdlife International (www.birdlife.org/datazone/speciesfactsheet 3539) this eagle is for two reasons considered the keystone species relative to the proposed wind farm. These reasons are: 1) that flights by these eagles led to other species – Rock Kestrel and White-necked Raven - flying up into the blade swept area to harass the eagles; and 2) a pair bred at the northern end of the proposed turbine layout. This pair had two large nests on cliffs on the western side of Beacon Top. Neither nest was used for breeding in 2013 but the pair was often seen in the vicinity including carrying nest materials. Probably, as is known for these eagles in the karoo, there had been no breeding because of a poor prey basis in the preceding year(s). It is likely that the predicted increase in prey following the heavier than usual rains in 2013 will result in breeding in 2014. Accordingly no turbines should be erected nearer than the ridge which forms the southern boundary of the saddle 1.3 km south of the two eagle nests.

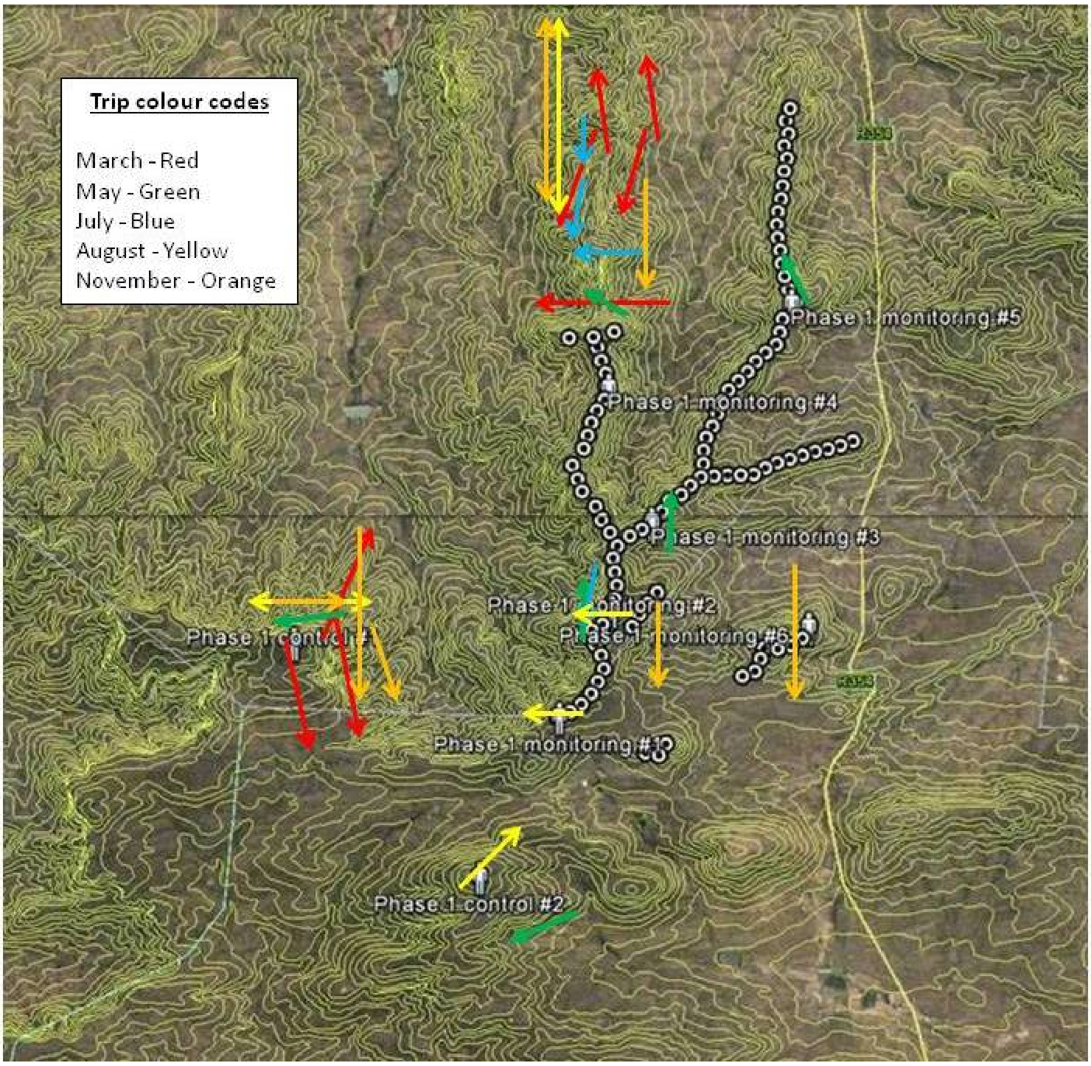


Figure 8.7: Recorded flight paths of Rock Kestrels

» **Rock Kestrel**: Most observations were of individuals using updraughts to hover over the upper slopes, i.e. off the ridge-tops. Kestrels seen over the ridges were generally below turbine blade arc heights as they flew low to seek prey or crossed the ridge from one valley to another. Only when they flew up to harass eagles did these kestrels enter potential collision risk heights.

» **White-necked Raven**: This was the species most often seen flying at turbine blade heights. Ravens are highly intelligent birds adept at coping with strong and variable winds in mountainous areas. It is considered highly unlikely that they will experience significant mortality through collision with turbine blades.

In November the number of ravens seen was considerably lower than in previous monitoring iterations. Ravens are winter breeders. In other, better studied, raven species, newly fledged juveniles birds feed on large invertebrates found while walking. If this applies to White-necked Ravens then in spring those that have bred successfully must move to lowland areas where, for the juvenile ravens to cope, walking is easier and suitable prey are more abundant. Since collisions are more likely among juvenile than adult birds the evident removal of recently fledged ravens from the ridges will reduce overall collision mortality risk.

» **Night active birds:** Diurnal monitoring provides little or no information about the potential risk of birds colliding with turbines at night. There are two fundamental types of night activity by birds: foraging and other localised activities by locally resident species – owls, nightjars and thick-knees; and transient, cross-country, movements.

There is unlikely to be any substantial nocturnal use of the ridge-top areas by locally active nocturnal bird species as the food resources are too poor to sustain them and the frequent strong winds will deter them. Owls are the most likely to occur but most will remain in the valley bottoms, or forage along the lower slopes, where prey is more abundant. Furthermore, even if they do fly over the ridges, owls are unlikely to fly at turbine blade heights. The two species known or likely to occur in the region take their prey off the ground. They forage in low light conditions when detection of prey, either visually or through hearing, requires them to remain close to the ground.

» **Nocturnal transients**: Birds which are transient across turbine lines are considered at greater risk of collision mortality than birds resident in the immediate vicinity of turbines and the risk to transients is increased when their movement is at night. Long distance migrants often fly by night but most do so at heights that will keep them well above turbines even those on ridges. Nor is there any particular attraction which would lead them to descend towards this part of the Karoo.

The birds of potentially greatest concern are regionally resident birds that disperse at night. This particularly applies to waterbirds of which a surprising number and diversity (31 species) were recorded on dams in the valleys around the proposed wind farm ridge. Most waterbirds move between wetlands at night in order to avoid predatory eagles. There is the possibility that, in moving between dams, they would fly across ridges. It is likely that they fly high at night to be able to survey for wetland areas reflecting moonlight. They would therefore potentially fly at blade heights. However, in this area the dams lie in relatively deep valleys. It is more likely that, when dispersing, these birds initially fly downstream and so would not cross ridges with their turbine arrays. Their reconnaissance excursions are also likely to be during clear nights and especially during full moon when waterbodies reflect the light and so are more readily detected by birds in flight. These conditions will also illuminate turbines. Overall, at this stage of our understanding, the risk of nocturnal collisions is considered to be low and within acceptable levels. Nor are most of the species likely to be involved of particular current conservation concern. It is likely that, especially in headwind conditions, night dispersing birds cross ridges at their lowest points, saddles.

8.2.2. Potential Impacts

Wind farms have three forms of impact on birds – habitat destruction, population displacement, and, in particular, mortality through collisions.

Habitat destruction and displacement

Development of the footprint inevitably causes the loss of foraging and nesting habitat for most locally resident species of birds. Birds displaced by this loss of habitat must find alternative suitable habitat, which may be less favourable. The displaced birds must compete for resources with the established population of birds of the same or other species potentially to the detriment of both. The result is a reduction in the local population of most small birds. Habitat destruction is scarcely an issue for the proposed Roggeveld Wind Farm as a high proportion of the ground along the ridges is bare and or rock covered and so of limited attraction to birds. Nor is population displacement a major issue for most resident bird species since the population of birds using the ridges is small and all their needs can be reasonably fulfilled on adjacent slopes where most already breed. Development of access roads and power lines on hill sides and in valleys will have a greater impact in terms of habitat destruction and bird displacement.

Construction period disturbance and subsequent maintenance are also unlikely to have substantial negative effects on resident bird populations since the species will temporarily avoid the area largely by moving down the hillsides which are already their preferred habitat. A new Eskom 400 kV power line is being constructed within 1-5 km of the southern part of the proposed turbine layout and close to the Brandkop control point. Despite considerable vehicle and human activity birds of prey still traversed the area.

Noise:

A potentially negative issue is the effect turbine noise may have on birds accustomed to generally quiet habitats. Turbines create noise that can be heard by humans up to 2 km distant. Studies of birds along roads have shown that due to traffic noise some bird species are less common, or even absent, within 2-5 km of major roads (Forman & Deblinger 2000, Rheindt 2003). To date there has been no assessment anywhere in the world on the effect that turbine noise may have on local bird populations. Where, as in the Roggeveld, turbines are erected on ridges noise is considered to have little effect on the hillsides and may be beneficial in deterring bird use of the ridges and so keeping them away from the turbines.

Collision mortality

The crucial issue of concern is mortality of birds through collision with the turbine rotor blades and the degree to which such mortality is acceptable for particular groups or species of birds. The risk of collision mortality varies in several general ways and these affect the manner in which collision mortality can be mitigated. Birds flying in daylight have a better chance of seeing and avoiding turbines than those flying at night, hence the concern raised over the night moving transients. Daylight fliers may have an increased risk of collision in periods of fog or mist when visibility is severely reduced. In the Roggeveld low clouds often cover the ridges in fog. It is unclear to what extent birds fly over the ridges in such conditions. The other factors that affect bird collision with turbines are: 1) the degree to which birds fly at heights equivalent to the turbine rotor blades – planned to be 40-160 m above ground level; 2) their ability to manoeuvre in flight – which is lower for larger and heavier bird species, and for most birds in headwinds; 3) the degree to which birds may be pre-occupied - i.e. through chasing prey or in courtship display – and so pay less attention to moving rotor blades; 4) familiarity with the location of turbines; 5) the frequency with which they place themselves at risk of collision; and 6) the angle of approach, since rotor blades are more conspicuous seen head on than from the side.

8.2.3. Impact of the Power Line on Avifauna

Power lines can cause bird injury and/ mortality resulting from collisions with power lines and electrocution. The power lines will run from the main ridge down into the Bonne Esperance farm valley and thence south to connect with Eskom lines. A total of 10 slow drives were made through the valley in the course of the five monitoring periods. Three groups of birds might be at particular risk of collision mortality with these power lines: large ground birds (bustards, secretary birds etc.); water birds (geese, ducks etc.); and, here in particular, birds of prey (including ravens). No large ground birds were seen in the Bonne Esperance valley, nor is the terrain and vegetation suitable for such birds. There were variable numbers of water birds on the small farm dams in the valley including, on one occasion only, a red-listed Blue Crane. To minimize collision risk for these birds the power lines should be kept uphill, and as far, from the dams as is feasible. The greatest risk concerns the bird of prey group as these especially forage by flying along the upper valley slopes. When doing so they are focused on seeking prey and so probably less observant of obstructions. The risk of collision where the power line cross upper valley slopes is considered greater for this group of birds than at the turbines on the ridges. This situation must be mitigated by installing markers at 3 m intervals on each wire to make them more visible. With the use of mitigation measures the impact of the power line on birds will be of medium-low significance.

8.2.4. Impact Tables

Construction and Operational Phase

Habitat Loss for birds

Nature: Construction activities will result in a negative direct impact on the avifauna
Impact Magnitude: Low
Extent: Local (ridge-wide)
Duration: Medium term – the ecology is unlikely to recover within the 20 year operational phase
Intensity: Minimal loss of habitat for any bird species.
Magnitude: Low.
Likelihood: There is a high likelihood that areas of habitat will be lost
Impact Significance (Pre-Mitigation) – Low

Degree of confidence: High

Mitigation: See Section 8.2.4

Disturbance to birds

Nature: Construction activities will result in a negative direct impact on the wind farm site avifauna
Impact Magnitude: Low
Extent: Local
Duration: Short-term

Intensity: No threatened species will be particularly impacted. The magnitude will be low
Likelihood: There is a medium likelihood that birds will be disturbed
Impact Significance (Pre-Mitigation) – Low to Medium
Degree of confidence: High
Mitigation: See Section 8.2.4

Operational Impacts Disturbance and Displacement of birds

Nature: Negative direct impact on birds
Impact Magnitude: Low
Extent: Local
Duration: Long-term but in short-term bursts
Intensity: The magnitude is low
Likelihood: There is a low likelihood that any key species will be disturbed or displaced
Impact Significance (Pre-Mitigation) – Low
Degree of confidence: Medium
Mitigation: See Section 8.2.4

Collision Mortality during the Operational Phase

Nature: Operations will result in negative direct impact on birds
Impact Magnitude: Low –medium,
Extent: Local
Duration: Long-term i.e. throughout the operational life of the wind farm
Intensity: Low.
Likelihood: There is low likelihood that key species will be killed
Impact Significance (Pre-Mitigation) – Low
Degree of confidence: Medium (due to uncertainty about nocturnal bird activities)
Mitigation: See Section 8.2.4

Impact of the Power Line on Birds during the Operational Phase

Nature: The power line can result in bird injury/ mortality
Impact Magnitude: Medium
Extent: Local
Duration: Long-term i.e. throughout the operational life of the wind farm
Intensity: Low.
Likelihood: There is low-medium likelihood that key species will be killed
Impact Significance (Pre-Mitigation) – Medium
Degree of confidence: Medium (due to uncertainty about nocturnal bird activities)

Mitigation: Installing markers at 3 m intervals of the power line so that they are more visible to birds.

Pre- and post- mitigation significance for avifauna

Phase	Impact	Pre-mitigation significance	Residual Impact Significance
Construction	Habitat Loss	Low	Low
	Disturbance	Low	Low
Operation	Displacement	Low	Low
	Mortality due to turbines	Medium	Low
	Mortality due to power line	Medium	Low - Medium

8.2.5. Mitigation of Collisions

Maximisation of turbine visibility

Understanding collision risk requires appreciation of how human vision differs from that of birds. Human eyes are situated on the front of the skull and provide good forward binocular, but poor lateral and weak downward, vision. The eyes of most open country birds are on the side of the skull and provide good lateral and downward, but limited forward binocular, vision (Martin 2011). To maximise wind flow most wind farms are situated in open habitats precisely where, once in flight, local birds have no expectation of obstacles, have weak forward vision, and so even in broad daylight are prone to collision with turbines and power lines (Martin & Shaw 2010). The best means to mitigate bird collisions in wind farms is to make structures – towers, rotor blades and above ground power lines - more visible both by day and by night.

Avoidance of ridge saddles

Birds of many species, including the Vulnerable Ludwig's Bustard, often use saddles (the lowest areas along ridge sections) when crossing ridges, especially when this requires them to fly into headwinds. Most of the ridges do not end abruptly but curve relatively gently into steeper sloped lower hillsides. Birds use updraughts on windward slopes to hover or idle over the upper slopes and often rise abruptly to heights that could bring them into the turbine collision risk zone. This potential cause of mortality could especially impact Verreaux's Eagles, Rock Kestrels and White-necked Ravens. The risk of collision mortalities in these situations can be mitigated in two ways:

» By siting turbines along the centre of ridges as at such sites they will be sufficiently away from the ridge rim whichever side the wind is blowing from; and

» Never locating turbines on ground sloping at more than 15 degrees.

Avoidance of ridge rims

Most of the ridges do not end abruptly but curve relatively gently into steeper sloped lower hillsides. Birds use updraughts on windward slopes to hover or idle over the upper slopes and often rise abruptly to heights that could bring them into the turbine collision risk zone. This potential cause of mortality, which could especially impact Verreaux's Eagles, Rock Kestrels and White-necked Ravens, can be mitigated by siting turbines along the centre of ridges. At such sites they will be sufficiently away from the ridge rim whichever side the wind is blowing from.

Avoidance of eagle nests

To minimise the risk of disturbance to, and collision mortality risk of, Verreaux's Eagles no turbines should be erected nearer than the ridge which forms the southern boundary of the saddle 1.3 km south of the two eagle nests.

Night illumination

The degree to which birds fly at night is insufficiently appreciated. In many bird species individuals moving beyond their normal daily operational zone – on migration, dispersing to, or reconnoitring, other localities - do so at night. There are several broad benefits from night-time movement. The birds: avoid avian predators whilst in unfamiliar situations; benefit from more favourable temperature or wind conditions; and minimise loss of daylight time for feeding.

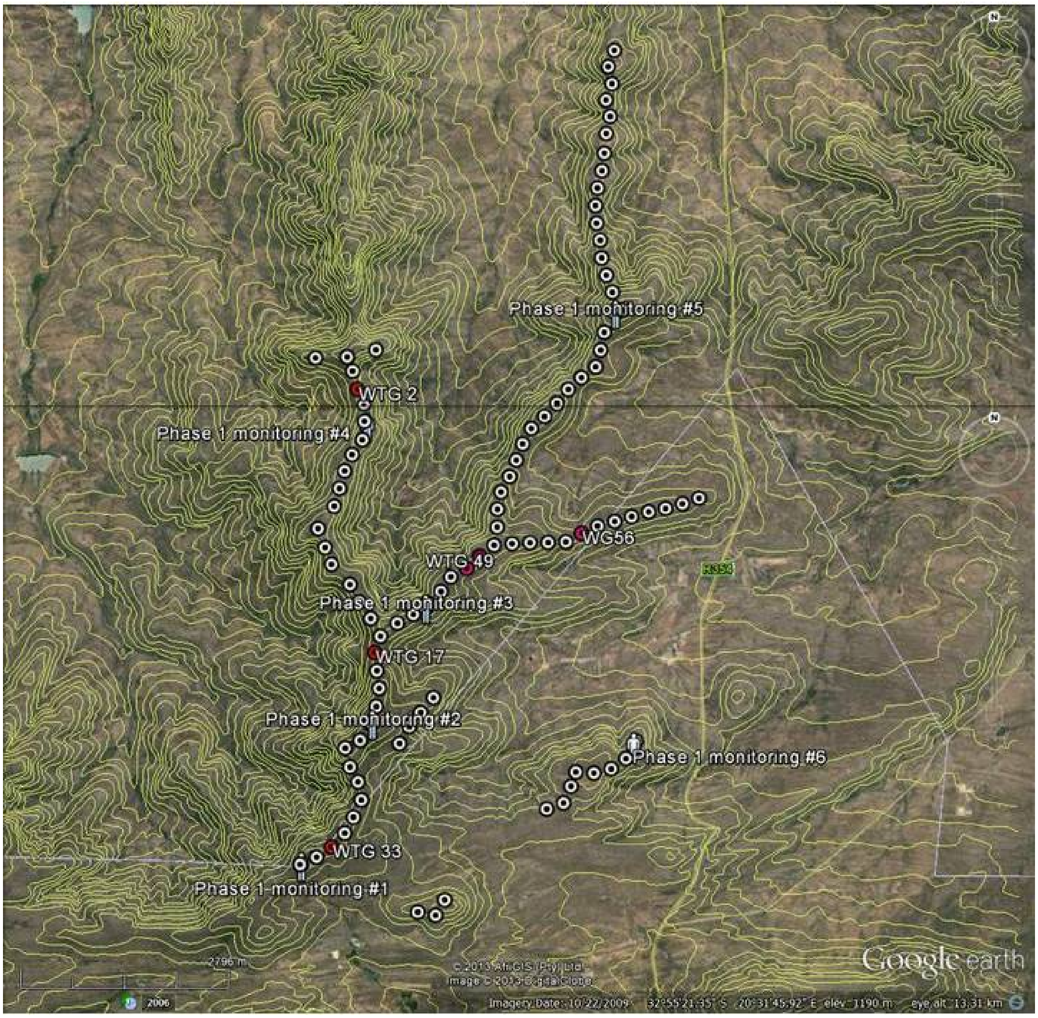


Figure 8.8: Turbines shown as red circles indicate those that have saddles where it is recommended that a minimum 100m gap between turbines be observed

The avifaunal study recommended that the rotor-blades of each wind turbine should be illuminated at night. The lights normally used are either red for airplane warning or white for general lighting. Birds have sensitive, magnetite-based, receptors housed in specialized photo pigments. These receptors mediate magnetic "map" information that enables birds to determine their position. This navigational sense is important for birds during long-distance migration and especially nocturnal movements. Wavelengths of light interact with the magnetite particles in birds' photo-pigment receptors. Short-wavelength green and blue lights have little or no effect on the receptors but long-wavelength red and white lights can affect the receptors and bird's orientation (Wiltschko *et al*. 1993, Deutschlander *et al*. 1999, Poot *et al*. 2008). It is therefore preferable, if acceptable from civil aviation and Sutherland observatory standpoints, that the lights at the top of the Roggeveld turbines be green or blue short-wavelength type. However realistically, it must be understood that this may not be possible.

8.2.6. Cumulative Effects

There are several forms of cumulative effects relative to wind farm developments. One is when a bird species resident in a proposed wind farm is likely to be affected by not one but several impacts. Another is the effect of impacts in the immediate neighbourhood of the proposed farm. This may be from the development of other wind farms – as are proposed for areas around the Roggeveld farm – or other significant land use changes. A third is when changes at some distance (even continentally) have the effect of depressing the population of a bird species which is then further impacted through loss of habitat or collision mortality at the wind farm. All these cumulative effects can be subject to further cumulative effect over time.

For several reasons cumulative effects are not considered to be of a serious nature at the Roggeveld site: 1) Most birds are local residents and occur primarily on the hillsides and in the valleys away from turbine locations; 2) Other than the limited ridge-top footprint for turbine installation and maintenance there are no likely changes in land use on or near the ridges that will affect local bird distribution; and 3) The Karoo climate in the medium term is progressive getting drier. This will reduce both bird populations and diversity and so decrease the potential impacts of wind farms.

8.2.7. Conclusions & Recommendations

The impacts of the proposed Phase 1 of the Roggeveld wind farm will have a negligible effect on the majority of bird species that occur on the property. The turbines will be established on ridge tops and far from sensitive habitats. The only feature of concern is potential mortality through collisions with rotor blades. This especially applies to waterbirds flying across the ridges at night. The degree to which this happens is unknown but is not considered a serious impediment. The means of mitigating the impacts on birds of the proposed wind farm development are simple but limited.

Based on the bird-depauperate habitat, the low overall number of birds, and the small number of species that, at least by day, fly over the ridges at potential collision height there is minimum probable impact on the local avifauna whether in terms of habitat loss, disturbance, or collision risk. This site is likely to cause substantially less impact on birds than a wind farm of equivalent size in a lowland situation. There is no particular reason from an avifaunal perspective to object to this wind farm development and authorisation is recommended.

8.3 Assessment of Impacts on Bats

This impact assessment section on bats is based on information collected during the pre-construction bat monitoring undertaken by Animalia for Phase 1 of the Roggeveld Wind Farm.

8.3.1. Results of the Pre-Construction Bat Monitoring Programme

Four different species were detected by the two passive monitoring systems installed on the site during the 12-month monitoring programme, with only *Miniopterus natalensis* having a Near Threatened conservation status. *Neoromicia capensis* and *Tadarida aegyptiaca* are the most common and abundant insectivorous bat species found across South Africa. They dominated the bat assemblage detected by all of the monitoring systems. The common and more abundant species are of large value to the local ecosystems as they provide greater ecological services than the more rare species, due to their greater abundance. These two species have a conservation category of Least Concern.

According to the data gathered, the migrating species, *Miniopterus natalensis*, may be undertaking a migration during late April to early May at the ROG 5 and ROG 3 meteorological mast passive bat detection systems, with activity lingering longer around system ROG 3 meteorological mast passive bat detection systems in the valley before it completely disappears again. It is possible that this may indicate a migrational event where a colony moves slowly (possibly while foraging) over a period of 1 or 2 weeks, on their way to a winter hibernacula cave. Since the peak in activity at ROG 5 meteorological mast passive bat detection systems precedes that of ROG 3 meteorological mast passive bat detection systems slightly, it may be assumed that the general movement was from the east towards the north to north-west passing by ROG 5 and ROG 3 only.

However it is very important to note that **no** *M. natalensis* calls were recorded at 59m height and only at 10m on ROG 5, this indicates that the migrating bats were flying low while passing over the ridge where met mast ROG 5 is situated. Although unlikely, the possibility of undetected migrating bats far above 59m must not be ignored during post construction monitoring.

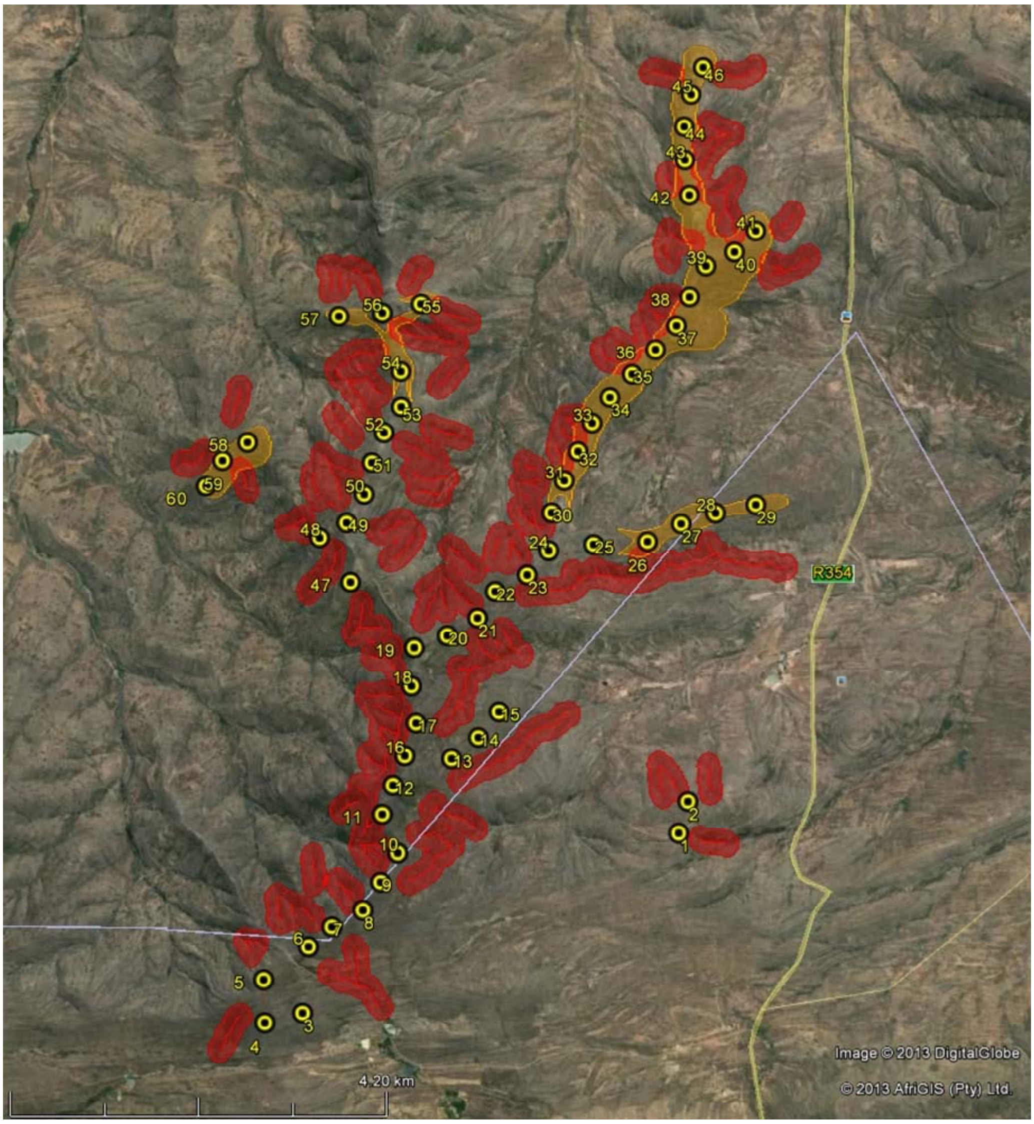
8.3.2. Bat Sensitive Areas

Figure 8.9 depicts the bat sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are confirmed and most probable to occur on site. Therefore, the sensitivity map is based on species ecology and habitat preferences. This map can be used as a pre-construction mitigation in terms of improving turbine placement with regards to bat preferred habitats on site.

Table 8.4: Description of sensitivity categories utilized in the sensitivity map

Sensitivity	**Description**
Moderate Sensitivity	Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology, with an expected relative higher risk of impacting on local bats. Turbines within or close to these areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and mitigation measures, if any is needed.
High Sensitivity and their buffers	Areas that are deemed critical for resident bat populations, capable of elevated levels of bat activity and support greater bat diversity than the rest of the site. These areas are 'no-go' areas and turbines must not be placed in these areas.

No proposed turbines are located within high bat sensitive areas and their respective buffer zones. Turbines within moderate bat sensitivity areas and buffer zones must be prioritised for mitigation; however other turbines must be observed during post construction monitoring.



High sensitivity | High sensitivity buffer | Moderate sensitivity
Proposed turbines

Figure 8.9: Bat sensitivity of the Roggeveld Phase 1 site

Last iteration	October 2013
High sensitivity buffer	100m from blade tip to nearest feature of High sensitivity (based on 117m rotor diameter and 92m hub height). On a flat surface the distance from the base of a turbine must be 128m from a sensitivity to maintain 100m from the blade tip, thus 128m buffer has been applied to all High sensitive features. However, in cases where 128m overlapped with a proposed turbine position, the difference in elevation between the turbine position and sensitivity has been incorporated in the formula which effectively increases that specific turbines hub height (in relation to the sensitivity).

	Formula used: b= $\sqrt{(100+bl)^2-(hh+sd)^2}$, derived from Mitchell-Jones & Carlin(2009) Where: *b*= horizontal buffer distance to turbine base *bl* = blade length *hh*= hub height *ed*= elevation difference between turbine base and sensitivity
Moderate sensitivity buffer	None
Features used to develop the sensitivity map	Drainage lines closest to proposed turbine positions, especially when exposed rock that can be used as roosting space is visible in the drainage line
	Clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. Mostly in drainage lines
	Most prominent horizontal ridges of exposed rock on hill slopes can offer roosting space.
	Valleys and lower altitudes is expected to offer more sheltered terrain for bat prey (insects) as well as foraging bats, therefore all terrain with proposed turbine position below 1250m has been demarcated as Moderate bat sensitivity. 1250m has been selected based on the difference in bat activity found at ROG 5 and ROG 1 (total bat passes of 1631 and 195 respectively), with ROG 5 being below 1250m and ROG 1 above 1250m.

There are no South African guidelines for the consideration of specific buffer zone distances for bats in relation to wind farms. Guidance can be taken from other guidelines:

» Gauteng Department of Agriculture and Rural Development recommend a 500m buffer for natural bat caves and a 200m buffer on conservation important vegetation.

» The Eurobats Guidance (Rodrigues *et al.,* 2008) proposes a minimum buffer distance of 200m from forest edges.

According to current proposed turbine layout:

Turbines in high bat sensitivity	**None**
Turbines in high bat sensitivity buffer	None
Turbines in Moderate bat sensitivity area	26 - 29, 31 - 46,54, 55, 57, 58 - 60

8.3.3. Impact Assessment

Bat mortalities during foraging

Extent: Local
Duration: Long term
Intensity: Medium
Impact Significance (Pre-Mitigation): Moderate
Degree of confidence: Medium
Mitigation: See Section 8.3.4

Bat mortalities during migration

Extent: Regional
Duration: Long term
Intensity: Medium
Impact Significance (Pre-Mitigation): Minor
Degree of confidence: Medium
Mitigation: See Section 8.3.4

Loss of bat foraging habitat

Extent: On-site
Duration: Long term
Intensity: Negligible
Impact Significance (Pre-Mitigation): Minor
Degree of confidence: Medium
Mitigation:

» The proposed development footprint for all associated infrastructure should adhere to the sensitivity map as far as it is practical.

Destruction of bat roosts

Extent: On-site
Duration: Long term
Intensity: Negligible
Impact Significance (Pre-Mitigation): Negligible
Degree of confidence: Medium
Mitigation:

» The proposed development footprint for all associated infrastructure should adhere to the sensitivity map as far as it is practical.

8.3.4. Proposed Mitigation Measures

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area, and should be considered as the preferred option for mitigation. The tables below are based on the passive data collected. They infer mitigation be applied during the peak activity periods and times, and when the advised wind speed and temperature ranges are prevailing (considering conditions in which 80% of bat activity occurred). A maximum curtailment cut in speed of 10 m/s is applied to scenarios where the data implies more than >10 m/s as a mitigation cut in speed.

Relation of bat activity with environmental conditions at meteorological mast passive bat detection systems ROG 5 is used for inferring below parameters, due to the fact that ROG 5 had a relatively higher up-time in recording and is situated on the same elevation and area than the turbines preliminarily effected by proposed mitigations. Bat activity at 10m height is used, since bat are expected to move in an upwards fashion towards turbine blades (bat activity negatively correlated with height above ground). Therefore bat activity at the first point of contact with blades needs to be considered.

The times of implementation of mitigation measures is preliminarily recommended (considering more than 80% bat activity) as follows:

	Terms of mitigation implementation
Winter peak activity (times to implement curtailment/ mitigation)	None
	N/A
Environmental conditions in which turbines are allowed to operate without any mitigation	N/A
Spring peak activity (times to implement curtailment/ mitigation)	Late October to late November
	• Time of sunset to midnight • 01:30 to 03:00
Environmental conditions in which turbines are allowed to operate without any mitigation	**Turbines 26 - 29, 31 - 46, 54, 55, 57, 58 - 60:** Above 9 m/s at 15 m agl; Below 10°C

Summer peak activity (times to implement curtailment/ mitigation)	Early December to mid-January Time of sunset to midnight
Environmental conditions in which turbines are allowed to operate without any mitigation	**Turbines 26 - 29, 31 - 46, 54, 55, 57, 58 - 60:** Above 7 m/s at 15 m agl; Below 16.5°C
Autumn peak activity (times to implement curtailment/ mitigation)	Month of March Time of sunset to 23:00
Environmental conditions in which turbines are allowed to operate without any mitigation	**Turbines 26 - 29, 31 - 46, 54, 55, 57, 58 - 60:**Above 8.5 m/s at 15 m agl; Below 17.5°C

Where mitigation by location is not possible, other options that may be utilised include curtailment, blade feathering, blade lock, acoustic deterrents or light lures. The following terminology applies:

» **Curtailment:** Curtailment is defined as the act of limiting the supply of electricity to the grid during conditions when it would normally be supplied. This is usually accomplished by locking or feathering the turbine blades.

» **Cut-in speed:** The cut-in speed is the wind speed at which the generator is connected to the grid and producing electricity. For some turbines, their blades will spin at full or partial RPMs below cut-in speed when no electricity is being produced.

» **Feathering or Feathered:** Adjusting the angle of the rotor blade parallel to the wind, or turning the whole unit out of the wind, to slow or stop blade rotation. Normally operating turbine blades are angled almost perpendicular to the wind at all times.

» **Free-wheeling:** Free-wheeling occurs when the blades are allowed to rotate below the cut-in speed or even when fully feathered and parallel to the wind. In contrast, blades can be "locked" and cannot rotate, which is a mandatory situation when turbines are being accessed by operations personnel.

» **Increasing cut-in speed:** The turbine's computer system (referred to as the Supervisory Control and Data Acquisitions or SCADA system) is programmed to a cut-in speed higher than the manufacturer's set speed, and turbines are programmed to stay locked or feathered at 90° until the increased cut-in speed is reached over some average number of minutes (usually 5 – 10 min), thus triggering the turbine blades to pitch back "into the wind" and begin to spin normally and producing power.

Blade stalling or feathering that render blades motionless below the manufacturers cut in speed, and not allow free rotation without the gearbox engaged, is more desirable for the conservation of bats than allowing free rotation below the manufacturers cut in speed.

Acoustic deterrents are a developing technology and will need investigation closer to time of wind farm operation.

Light lures refer to the concept where strong lights are placed on the periphery (or only a few sides) of the wind farm to lure insects and therefore bats away from the turbines. The long term effects on bat populations and local ecology of this method is unknown.

Habitat modification, with the aim of augmenting bat habitat around the wind farm in an effort to lure bats away from turbines, is not recommended. Such a method can be adversely intrusive on other fauna and flora and the ecology of the areas being modified. Additionally it is unknown whether such a method may actually increase the bat numbers of the broader area, causing them to move into the wind farm site due to resource pressure.

Currently the most effective method of mitigation, after correct turbine placement, is alteration of blade speeds and cut-in speeds under environmental conditions favorable to bats.

A basic "6 levels of mitigation" (by blade manipulation or curtailment), from light to aggressive mitigation:

1. No curtailment (free-wheeling is unhindered below **manufacturers** cut in speed so all momentum is retained, thus normal operation).

2. Partial feathering (45 degree angle) of blades below **manufacturers** cut-in speed in order to allow the free-wheeling blades half the speed it would have had without feathering (some momentum is retained below the cut in speed).

3. 90 Degree feathering of blades below **manufacturers** cut-in speed so it is exactly parallel to the wind direction as to minimize free-wheeling blade rotation as much as possible without locking the blades.

4. 90 Degree feathering of blades below **manufacturers** cut-in speed, with partial feathering (45 degree angle) between the **manufacturers'** cut-in speed and **mitigation** cut-in conditions.

5. 90 Degree feathering of blades below **mitigation** cut in conditions.

6. 90 Degree feathering throughout the entire night.

Preliminarily it is recommended that curtailment mitigation initiates at Level 3 for the months, times and weather conditions outlined in the table above, then depending on the results of the post construction mortality monitoring the mitigation can be either relaxed or intensified up to a maximum intensity of Level 5. This is an adaptive mitigation management approach that will require changes in the mitigation plan to be implemented immediately and in real time during the post construction monitoring. Information gathered during the preconstruction assessment of Roggeveld phase 2 will also inform proposed mitigation measures, affected turbines, and times of implementation and the initial level of curtailment to be used.

8.1.5. Conclusions & Recommendations

Further pre-construction monitoring carried out for phase 2 of the development will also be used to understand the temporal and spatial distribution of bat activity for Phase 1 of the Roggeveld Wind Farm. The close proximity and similar weather and geographical features of the two areas allow findings of phase 2 monitoring to be applied to phase 1 mitigation measures. This will compensate for monitoring problems encountered over this study.

The impact on bats in general is expected to be moderate without mitigation since the proposed localities of turbines are located in areas of lower bat activity relative to the larger site area, however the long-term duration of these impacts can have detrimental effects on local bat populations if left unmitigated and unmonitored. With regards to impacts on bats the proposed development may be authorised to go ahead on condition that the proposed mitigation measures be implemented initially, in parallel with impact/mortality monitoring, and thereafter adapted as deemed necessary and justifiable by the results of the impact/mortality monitoring.

8.4 Impacts on Soils, Hydrology and Hydrogeology

The proposed Phase 1 of the Roggeveld wind farm may impact the soils, surface water and groundwater in the area and these potential impacts are summarised in Table 8.5.

Table 8.5: Impact Characteristics: Impacts on Soils, Surface Water and Groundwater

Summary	Construction	Operation	Decommissioning
Project Aspect/ Activity	Soil compaction, removal of topsoil and erosion associated with site clearance and preparation, road construction, laydown and assembly area etc. Impact on surface water and groundwater resulting from fuel, oils or cement spills. Increase in sediment load in drainage channels and surface water bodies as a result of erosion.	Soil erosion around cleared areas and roads Impact on surface water and groundwater resulting from fuel and oil spills. Increase of sediment load in drainage channels and surface water bodies as a result of erosion. Reduction of groundwater recharge due to sealed surfaces.	Impact on surface- and groundwater resulting from fuel and oil spills during removal of equipment. Reduced soil erosion and compaction and sediment loads after rehabilitation. Increased groundwater recharge after rehabilitation.
Impact Type	Direct	Direct	Direct
Receptors Affected	Soils on site underlying construction areas, turbines, roads etc. Surface and groundwater quality at or near the site.	Soils in the vicinity of cleared areas or roads and turbines. Surface and groundwater quality at or near the site.	Soils on site. Surface and groundwater quality at or near the site.

A detailed list of the expected activities to take place during the lifetime of the project and the nature of the potential impact is presented in Table 8.6.

Table 8.6: Interaction and Nature of the Potential Impacts between Project Activities and Receiving Environment

Project Activities	Impact: Soil Erosion	Soil Compaction	Soil Contamination	Surface Water Quality	Groundwater Quantity	Groundwater Quality
Pre-construction and Construction						
Vegetation Clearance	(red)			(red)		

Erection of Fencing						
Construction of Access Roads						
Construction of Site Office and Storage Facilities						
Levelling of Hard Standing Areas						
Laying of Turbine Foundations						
Laying of Underground Cables						
Stringing of Overhead Transmission Lines						
Substation Construction						
Wind Turbines Delivery and Erection						
Operation						
Wind Farm Operation						
Use of Access Tracks						
Use of Buildings						
Site Maintenance						
Decommissioning						
Removal of Wind Turbines						
Removal of Foundations						
Removal of Access Roads						
Removal of Underground and Overhead Cables						
Site Restoration & Rehabilitation						

Key: Red box indicates a potential negative impact, green box a potential positive impact and white box no interaction between the project and resource or receptor.

8.4.1. Loss of Topsoil, Soil Compaction and Erosion

Construction Phase

Preparation of the site for the establishment of turbines, underground cables, access roads, lay-down areas, substation site and operation and maintenance building during the construction phase will result in vegetation clearance, removal of topsoil and subsoil to varying depths and soil compaction.

A total of 60 wind turbines is proposed. The deepest excavations will be for turbine foundation which will extend up to 3m depth. Areas cleared of vegetation in preparation for the establishment of the wind farm are prone to erosion by wind or rain. The vegetation cover is the most important physical factor influencing soil erosion. An intact cover reduces impact from rain-drops on the soil, slows down surface run-off, filters sediment and binds the soil together for more stability. However, the intensity of potential erosion is also influenced by precipitation which is generally low in this arid region with an annual rainfall of 250mm.

In addition, although the area directly affected may be small, the effects of potential soil erosion and increased sediment load in surface runoff may extend to other areas onsite if appropriate controls are not in place.

Compaction of soils results in lower permeability resulting in decreased infiltration and increased runoff. Permanent removal of the topsoil horizon changes the soil profile which may inhibit rehabilitation which may, in turn, increase the erosion potential of the soil.

Soils may be impacted as a result of spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks. These impacts are dependent on the size of the spill and the speed with which it is addressed and cleaned up. The likelihood of a spill is also associated with the volume of product that may be stored onsite. Usually, above ground storage tanks for diesel and varying amounts of hydraulic oils, transformer oil and used oils will be required on-site during the construction phase.

Construction Impact: Loss of Topsoil, Soil Compaction and Soil Erosion

Nature: The loss of topsoil, changes in the soil profile through compaction, potential soil erosion and contamination will have a **negative direct** impact on the soils of the site.
Impact Magnitude –Medium
Extent: The extent of the impact is **local** since the impacts are predominantly limited to the boundaries of the site but may extend beyond the site.
Duration: The duration would be **long-term** since although removal of topsoil and compaction will occur largely during the construction phase, the effect may continue through the project lifecycle.
Intensity: The intensity is **medium** since although topsoil removal and soil compaction may be limited to specific areas of the site, potential erosion may affect a larger area.
Likelihood – There is a **medium** likelihood that this impact will occur.
Impact Significance (Pre-mitigation) – MODERATE (-ve)
Degree of Confidence: The degree of confidence is **medium**.
Mitigation: See Section 8.4.2

Operational Phase

Soil erosion caused by stormwater or surface water runoff may occur during the operational phase as a result of additional impervious surfaces on-site resulting in increased runoff. And, although the disturbance associated with the construction phase is over, unless measures are undertaken loss of topsoil may continue during the operational phase of the project. No additional topsoil clearing is anticipated during routine operation and maintenance of the facility. Soil compaction may occur during the operational phase if heavy vehicles leave the roads and hard standing areas.

Soil contamination associated with leaks and spills are reduced during the operation phase since only limited on-site storage of hydrocarbons will take place and site activities will be reduced.

Operational Impact: Loss of Topsoil, Soil Compaction and Soil Erosion

Nature: Routine operational and maintenance activities may result in a **negative direct** impact on the soils of the site.
Impact Magnitude –Low
Extent: The extent of the impact is **local,** the impacts are predominantly limited to the site boundaries but may extend to the immediate vicinity of the site.
Duration: The duration would be **long-term** as the soils may be affected at least until the project stops.
Intensity: The intensity is **low** since the impact will be limited to areas that are already disturbed or to areas in close proximity.
Likelihood – There is a **medium** likelihood that these impacts will occur.
Impact Significance (Pre-mitigation) – MINOR (-ve)
Degree of Confidence: The degree of confidence is **medium**.
Mitigation: See Section 8.4.2

Decommissioning

Once the facility has reached the end of its life the wind turbines may be refurbished or replaced to continue operating as a power generating facility, or the facility can be closed and decommissioned. If decommissioned, all the components of the wind farm would be removed and the site would be rehabilitated.

Removal of site equipment including turbines, buildings, underground cables and access roads, will induce more disturbance to the site and have a potential for soil contamination as a result of spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks if managed inappropriately. This impact would be **negative direct** and the significance would be **minor**.

However, the concrete foundations of the turbines may be removed to below ground level and would be covered with topsoil and be replanted to allow a return to agricultural land use (cultivation and grazing) which could have a **positive direct** impact on the soils on site.

8.4.2. Mitigating Loss of Topsoil, Soil Compaction and Erosion

Mitigation measures are possible to address the majority of the potential impacts outlined above in order to contribute to reducing the significance of the residual impacts associated with loss of topsoil, soil compaction and erosion to an acceptable level.

Proposed mitigation measures are detailed below for each of the project phases and will be further detailed in the Environmental Management Programme (EMPr) to ensure mitigation measures are followed.

Construction Phase

- » Restrict removal of vegetation and soil cover to those areas necessary for the development;
- » Implement soil conservation measures such as stockpiling topsoil for remediation of disturbed areas;
- » Stockpiles should be vegetated or appropriately covered to reduce soil loss as a result of wind or water to prevent erosion;
- » Proper drainage controls such as culverts and cut-off trenches discharging into drainage channels present on site should be used to ensure proper management of surface water runoff to prevent erosion;
- » Disturbed areas should be rehabilitated as soon as possible to prevent erosion;
- » Work areas should be clearly defined and demarcated, where necessary, to avoid unnecessary disturbance of areas outside the development footprint;
- » Fuel, oil and used oil storage areas should have appropriate secondary containment (i.e. bunds);
- » Spill containment and clean up kits should be available on site and clean-up from any spill should be appropriately contained and disposed of;
- » Construction vehicles and equipment should be serviced regularly and provided with drip trays if required; and
- » Construction vehicles should remain on designated and prepared roads.

Operational Phase

The following mitigation measures are proposed to be implemented during the operational phase:

- » Laydown or infrastructure assembly areas which should not be required during the operational phase of the facility should be re-vegetated with indigenous vegetation to prevent erosion;
- » Bi-annual monitoring of erosion in the vicinity of roads, turbines and other hard-standing surfaces should be conducted before and after the rainy season to ensure erosion sites can be identified early and remedied; and
- » Establishing an Environmental Management System (EMS) to monitor compliance, check quality controls and ensure the EMP is being followed.

Decommissioning Phase

The following mitigation measures are proposed to be implemented during the decommissioning phase:

» Work areas should be clearly defined and demarcated, where necessary, to avoid unnecessary disturbance or areas outside the development footprint;
» Fuel, oil and used oil storage areas should have appropriate secondary containment (i.e. bunds);
» Spill containment and clean up kits should be available onsite and clean-up from any spill should be appropriately contained and disposed of; and
» Construction vehicles and equipment should be serviced regularly and provided with drip trays, if required.

8.4.3. Impact on Surface Water and Groundwater

Construction Phase

Soil compaction and vegetation clearance may increase the intensity and volume of surface water runoff as a result of a decrease in water infiltration recharging the groundwater. This may impact the non-perennial drainage channels on site by exacerbating erosion features and increasing the sediment load of the water entering these channels when they are flowing.

Surface- and groundwater may be impacted as a result of run-off and infiltration of contaminants associated with spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks. These impacts are dependent on the size of the spill and the speed with which it is addressed and cleaned up as well as the vulnerability and susceptibility of the aquifer (least vulnerability[13] and low susceptibility[14]). The likelihood of a spill is also associated with the volume of product that may be stored on site. Usually, above ground storage tanks for diesel and varying amounts of hydraulic oils, transformer oil and used oils will be required on site during the construction phase.

(1) [13] Tendency or likelihood for contaminants to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer.

(2) [14] Qualitative measure of the relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities and includes both aquifer vulnerability and the relative importance of the aquifer in terms of its classification.

Construction Impact: Impact on Surface and Groundwater

Nature: Surface and groundwater impacts resulting from soil compaction, increased sediment load or through leaks or spills would result in a negative direct impact.
Impact Magnitude Low
Extent: The extent of the impact is local since the impacts are limited predominantly to the boundaries of the site or in the vicinity of the site.
Duration: The duration for water quality impacts would be short or long-term depending on the size or nature of the spill and long-term for impacts from soil compaction.
Intensity: The intensity is low since runoff is expected to be low and the quantity of dangerous goods stored onsite will be relatively small.
Likelihood – There is a medium likelihood that this impact will occur.
Impact Significance (Pre-mitigation) – MINOR (-ve)
Degree of Confidence: Medium
Mitigation: See Section 8.4.4

Operational Phase

Soil erosion caused by stormwater or surface water runoff may occur during the operational phase and result in an increase in the sediment load of onsite drainage channels. Surface- and groundwater impacts associated with leaks and spills are reduced during the operation phase since only reduced on-site storage of hydrocarbons will take place and site activities will be reduced. Due to sealed surfaces, compacted soil (access roads and lay down areas) and turbines covering parts of the site, recharge to groundwater from rainfall is expected to be reduced on site.

Operational Impact: Impact on Surface- and Groundwater

Nature: Increased sediment loads in drainage channels, spills and leaks during routine operational and maintenance activities and reduced groundwater recharge may result in a **negative direct** impact on surface- and groundwater.
Impact Magnitude –**Low**
Extent: The extent of the impact is **local** since the impacts are limited predominantly to the boundaries of the site or in the vicinity of the site.
Duration: The duration for contamination would be **short to long-term** depending on the size of the spill. The duration for increased sediment loads and reduced groundwater recharge would be **long-term**.
Intensity: The intensity is **low** since the size of a spill is likely to be small given the limited volume of product to be stored onsite. Intensity for increased sediment

load will be **medium** and for reduced groundwater recharge **low** since the natural groundwater recharge from rainfall in the area is low.
Likelihood – There is a **medium** likelihood that this impact will occur.
Impact Significance (Pre-mitigation) – MINOR (-ve)
Degree of Confidence: The degree of confidence is **medium**.
Mitigation: See Section 8.4.4

Decommissioning

Removal of site equipment including turbines, buildings, underground cables and access roads, would have a potential for surface- and groundwater contamination related to run-off and infiltration of contaminants as a result of spills or leaks of fuels, oils and lubricants from construction vehicles or storage tanks if managed inappropriately. This impact would be **negative direct** and the significance would be **minor**.

However, the rehabilitation of the entire site would reduce erosion and therefore decrease sediment loads in surface water courses on site. Groundwater recharge would increase as a result of reduction of sealed surfaces and rehabilitated soils. In general, decommissioning would have a **positive direct** impact on surface- and groundwater if managed appropriately.

8.4.4. Mitigating Impacts on Surface and Groundwater

Construction Phase

» Soil stockpiles should be protected from wind or water erosion through placement, vegetation or appropriate covering;
» Proper drainage controls such as culverts, cut-off trenches should be used to ensure proper management of surface water runoff to prevent erosion;
» Cleared or disturbed areas should be rehabilitated as soon as possible to prevent erosion;
» Fuel, oil and used oil storage areas should have appropriate secondary containment (i.e. bunds);
» Spill containment and clean up kits should be available onsite and clean-up from any spill should be appropriately contained and disposed of; and
» Construction vehicles and equipment should be serviced regularly and provided with drip trays, if required.

Operational Phase

The following mitigation measures are proposed to be implemented during the operational phase:

- Fuel, oil and used oil storage areas should have appropriate secondary containment (i.e. bunds);
- Areas disturbed during construction should be re-vegetated with indigenous vegetation to prevent erosion; and
- Establishing an Environmental Management System (EMS) to monitor compliance, check quality controls and ensure the EMP is being followed.

Decommissioning Phase

The following mitigation measures are proposed to be implemented during the decommissioning phase:

- Work areas should be clearly defined and demarcated, where necessary, to avoid unnecessary disturbance or areas outside the development footprint;
- Fuel, oil and used oil storage areas should have appropriate secondary containment (i.e. bunds);
- Spill containment and clean up kits should be available onsite and clean-up from any spill should be appropriately contained and disposed of; and
- Construction vehicles and equipment should be serviced regularly and provided with drip trays, if required.

8.4.5. Conclusions and Recommendations

Impact summaries are shown in the tables below:

Table 8.7: Pre- and Post-Mitigation Significance: Loss of topsoil, soil compaction and erosion

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**Moderate (-VE)**	**Minor (-VE)**
Operation	**Minor (-VE)**	**Minor (-VE)**
Decommissioning	**Minor (-VE)**	**Minor (-VE)**

Table 8.8: Pre- and Post-Mitigation Significance: Impacts on Surface and Groundwater

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**Minor (-VE)**	**Minor (-VE)**
Operation	**Minor (-VE)**	**Minor (-VE)**
Decommissioning	**Minor (-VE)**	**Minor (-VE)**

8.4.6. Conclusions and Recommendations

With correct and adequate soil management practices during all phases of development of the project, the impacts on soil will be of an acceptable level. Mitigation measures as contained in this section of the EIA report and the EMPr are to be implemented.

8.5 Assessment of Potential Visual Impacts

The issues below are not seen as impacts, but merely as concerns regarding visual issues associated with the wind farm development.

Table 8.9: Visual Issues associated with the Roggeveld wind farm

Potential visual intrusion on sense of place	The relatively large proposed wind farm of some 60 turbines would be located in rugged Karoo wilderness and rural farming terrain, the industrial energy facilities potentially having a significant effect on the existing landscape.
Potential effect on landscape features and scenic resources	The wind farm is located on mountain ridgelines of the Kleinroggeveldberge and will therefore be visible on the skyline for large distances in the surroundings. The sheer scale of the wind farm would probably have some effect on the scenic resources of the area.
Potential effect on local inhabitants, visitors to the area and on tourism	The proposed wind turbines would be visible to a number of scattered farmsteads, and also from the R354 arterial road between Matjiesfontein and Sutherland over a distance of about 9.5km. Both of these destinations have tourism importance, the route being used by both local and international visitors to the Sutherland Astronomical Observatory. The navigational lights on the turbines would also be potentially visible for a considerable distance at night.
Potential effect of the scale of the project	The scale of the proposed energy facilities, involving some 60 wind turbines, along with a number of electrical substations, would have visual implications for the surrounding area. These effects are assessed by means of visual simulations for the energy facilities.
Potential effect of lights at night	Security and navigational lights at night could have an effect on the 'dark skies' for which the Karoo is renowned. These could be particularly visible on the mountain skyline.
Potential effect of construction and de-commissioning	The scale of the project could have significant visual effects relating to the construction of access roads, haul roads, borrow pits, as well as the use of cranes and other heavy construction machinery. At the end of the life of the project, many of the foundations and roads may remain visible in the relatively arid landscape.

A series of both quantitative and qualitative criteria are used to determine potential visual impacts. These are rated to determine both the expected level and significance of the visual impacts:

(1) Viewpoints

Viewpoints were selected based on prominent viewing positions in the area, where uninterrupted views of the proposed energy facilities could be obtained, including potentially sensitive viewpoints (refer to Figure 8.10). The proposed facilities would be potentially visible from the R354 arterial road, and a number of farmsteads.

(2) Visibility

Visibility tends to be determined by distance between the proposed energy facilities and the viewer. Given the size of the wind turbines, visibility tends to be significant up to distances of 5km. Distance radii are shown in Figure 8.10 to assist in quantifying visibility of the proposed facilities.

Degrees of visibility in relation to distance tend to be as follows for the wind turbines, based on field observations and photographic panoramas. Visibility is increased by the location of the turbines on a mountain skyline:

Highly visible:	Clearly noticeable within the observer's viewframe 0 to 5km
Moderately visible:	Recognisable feature within observer's viewframe 5 to 7.5km
Marginally visible:	Not particularly noticeable within observer's viewframe 7.5 to 10km
Hardly visible:	Practically not visible unless pointed out to observer 10 to 15km+

(3) Visual Exposure

Visual exposure is determined by the 'viewshed' or 'view catchment', being the geographic area within which the project would be visible. The viewshed boundary tends to follow ridgelines and high points in the landscape. Some areas within the view catchment area fall within a view shadow, and would therefore not be affected by the proposed energy facilities. The zone of visual influence tends to fade out beyond 5km distance.

(4) Visual Sensitivity

Visual sensitivity is determined by topographic features, steep slopes, protected areas, rivers, scenic routes or airfields. The Roggeveld site includes mountain ridgelines, steep mountain slopes and a regional arterial road.

(5) Landscape Integrity

Visual quality is enhanced by intactness of the landscape, and lack of other visual intrusions. The Roggeveld area currently has few visual intrusions, although existing Eskom 400kV and 765kV power lines cross the site and the R354 Route. The existing Komsberg Substation lies some 3.4km to the east of the R354. The upper mountain slopes and ridges still have an open wilderness character for which the Karoo is renowned.

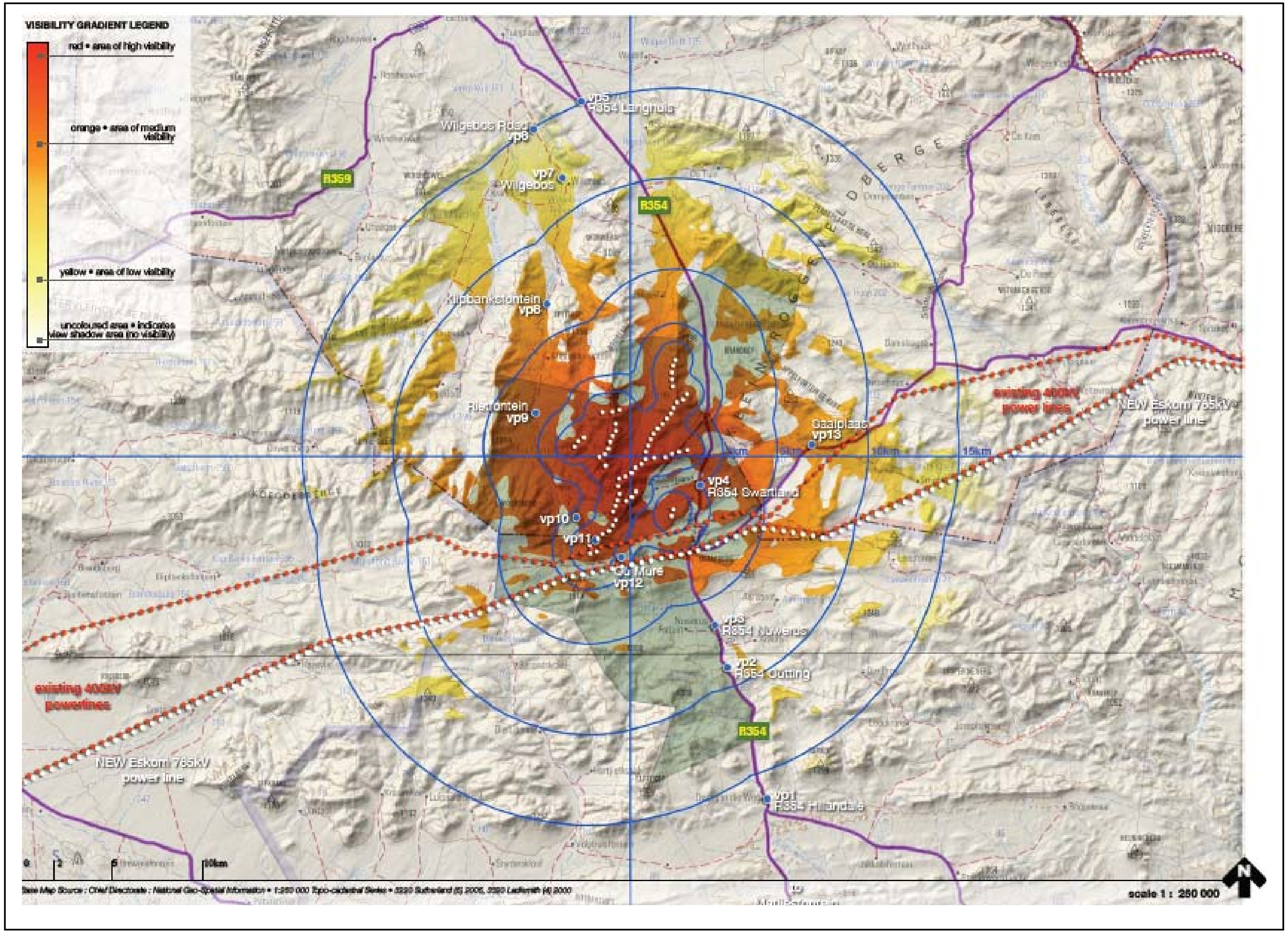


Figure 8.10: Viewshed for Phase 1 of the Roggeveld Wind Farm

(6) Cultural Landscape

Besides natural attributes, landscapes have a cultural value, enhanced by the presence of historical settlements, old routes, graves and farmsteads. Refer to the detailed heritage impact assessment undertaken by ACO Associates (2013).

(7) Visual Absorption Capacity

This is the potential to screen the project. Given the scale of the proposed facilities, their siting on a mountain skyline and the open nature of the landscape, there is little opportunity for screening.

(8) Cumulative Visual Impact

This is the accumulation of visual impacts in the area, particularly in relation to other existing or proposed wind energy farms and industrial-type facilities. Wind energy facilities are proposed in the region. Future phases 2 and 3 are also planned for the Roggeveld site itself. The criteria above are considered in combination to give an indication of the potential visual impacts in Table 8.10.

Table 8.10: Potential Visibility

View Pt	Location	Distance	Comments
VP1	R354 at Hillandale	16.42 km	Not visible because of distance and view shadow.
VP2	R354 at road cutting	8.99 km	Not visible because of view shadow.
VP3	R354 at Nuwerus	6.26 km	Marginally visible behind ridgeline.
VP4	R354 at Swartland	1.90 km	Highly visible in the foreground.
VP5	R354 at Langhuis	15.21 km	Not visible because of view shadow.
VP6	Wilgebos Road	14.83 km	Practically not visible because of distance.
VP7	Wilgebos	11.87 km	Practically not visible because of distance.
VP8	Klipbanksfontein	6.84 km	Recognisable in the distance on the ridgeline.
VP9	Rietfontein	3.00 km	Clearly visible on the ridgeline.
VP10	road pass	2.01 km	Clearly visible on the ridgeline.
VP11	ridge boundary	0.26 km	Highly visible in foreground.
VP12	Ou Mure	0.96 km	Highly visible, some in the foreground.
VP13	Saaiplaas	6.90 km	Recognisable in the distance on the ridgeline.

Photomontages have been prepared with these being regarded as the most significant from a visual perspective (refer to Figure 8.11). Viewpoints from the western side of the proposed project are considered to be less significant. A fourth photomontage from the Ou Mure viewpoint has been included for illustrative purposes, being one of the included properties.

Figure 8.11: Photomontages

8.5.1 Impact Assessment

Table 8.11: Assessment Criteria and Potential Visual Impacts / Benefits

Criteria	Comments	Wind turbine impacts	Substations / O&M bldg impacts
Visibility of facilities Distance from selected viewpoints	Views of wind turbines from the R354 tend to be the most significant. These range in distance from 1.07 to just over 7km. Farmsteads range from 1 to 6km.	Medium-high	Medium-low (partly screened by ridges)
Visibility of lights at night	Depends on number of turbines with navigation lights, and amount of security lighting at the substation/O&M buildings. Indicated that navigation lights would have reflectors.	Medium-high	Medium
Visual exposure Zone of visual influence or view catchment	The Phase 1 viewshed is smaller than that of the previously proposed layout of the overall project, and visible from the R354 Route over a shorter distance, without taking future Phases 2 and 3 into account.	Medium-high	Medium-low (smaller viewshed)
Visual sensitivity Effect on landscape features and scenic value	Exposed Karoo landscape and visually sensitive skyline. The turbines create a distinctive feature in the rugged Karoo landscape. Sparsely populated area.	High	Medium (smaller in scale)
Landscape integrity Effect on character of the area	Contrasts with rural / wilderness landscape. Existing and planned power lines cross the site. There are existing and planned substations.	High	Medium-high
Cultural landscape Heritage value of the landscape	Historical farmsteads and a number of ruins occur within the viewshed, as well as the R354 scenic/tourist route to Sutherland.	Medium-high	Medium
Visual absorption capacity (VAC) Lack of concealment	Low potential of open landscape and exposed ridgeline to visually absorb wind turbines. Prominent position of the turbines on the skyline.	High	Medium (largely located in valleys)
Cumulative impacts Accumulation of impacts in the area	Additional wind energy farms are proposed within a 30km radius, but are not necessarily visible from the Roggeveld site. Layouts for future phases at the Roggeveld site have not been determined at this stage, and are not assessed.	Medium-high	Medium
Overall impact rating		Range is Med-high to High	Range is Med-low to Med-high

Table 8.12: Synthesis of Visual Impacts / Benefits

Criteria	Comments	Wind Turbines	Substation/ O&M
Intensity or magnitude of impact Degree of visual impact.	-	Med-high to High	Med-low to Med-high
Spatial extent Degree of influence over a geographic area - local, district, regional or national.	Marginal visual effect beyond 5km.	Local to district scale.	Local
Duration Projected life-span of the proposed project.	Potentially longer than 15 years. (Projected to be ±25 years).	Long-term	Long-term
Probability Degree of possibility of the impact occurring.	Little or no opportunity to screen wind turbines.	Highly probable	Highly probable
Confidence Degree of confidence in predictions.	Based on available information and photomontages.	High	High
Overall significance	Synthesis of criteria	Med-high to High	Med-low to Med-high

8.5.2 Impact Tables

Significance of visual impacts before and after mitigation:

Impact Significance	Comments	Significance before mitigation	Significance after mitigation
Significance: wind turbines	Significance is increased by the large number of turbines, the open Karoo landscape and the exposed mountain skyline. Significance is decreased by remoteness of the site.	Med-high to High significance (based on intensity/ magnitude)	Med-high to Medium significance Assumes setback along R354 and peaks avoided.
Significance: power lines	Significance is increased by the need for connecting pylons, which also cross the R354. Significance is moderated by the fact that there are existing power lines.	Medium	Medium
Significance: substations, O&M buildings	Significance is increased by the open, exposed landscape and the scale of the structures.	Medium significance	Medium-low significance (Assumes buildings/ transformers grouped and screened).

Impact Significance	Comments	Significance before mitigation	Significance after mitigation
Significance: Lights at night	Significance is increased by the open landscape and high elevation on ridgeline.	Medium-high Significance.	Medium-low significance (Assumes reflectors used for navigation and other lights).
Significance: Construction phase	Turbines manufactured off-site, but erection requires large equipment. Short duration of construction period would reduce significance. Temporary construction area and borrow pit are relatively close to the R354. Borrow pit to be rehabilitated.	Medium-high significance, but short duration.	Medium significance, but short duration. (Assumes mitigations).
Significance: Cumulative Impacts	Additional wind energy farms are proposed within a 30km radius, but would not necessarily be visible from each other. Future phases at the proposed site are not known and are not currently being assessed.	Medium-high Significance.	Medium-high Significance.
Status		Negative	Negative

8.5.3 Potential to Mitigate Visual Impacts

Planning Phase regarding micro-siting of the wind turbines

Regional criteria for wind farms provided by the Provincial Government of the Western Cape and CNdV Africa (2006) were used as a starting point. These criteria are, however, not legislated and are general rather than place-specific. The criteria have therefore been compared with actual conditions at the Roggeveld site and mapping at the project level, with recommended buffers as indicated in the mitigations below.

The following are recommended as mitigation measures to reduce the visual impact of the wind farm:

1) Wind turbines should be concentrated in large groups or lines where possible, and scattered turbines avoided to minimise visual clutter in the landscape. Therefore 2 of the turbines in the south-east should be relocated, as indicated on Figure 8.12.
2) A visual buffer of 500m for the wind turbines from district roads and farmsteads is recommended, as currently proposed.
3) A visual buffer of 500m is recommended for the substation and O&M buildings from the R354, local roads and farmsteads, as currently proposed.
4) The substation and O&M buildings to be grouped together, as currently proposed.

5) The substation transformers, which have a high degree of visual intrusion, to be screened by buildings and tree planting where possible.
6) The design of the buildings to be compatible in scale and form with buildings of the surrounding area, preferably using the regional Karoo architectural style. All yards and storage areas to be enclosed by masonry walls.
7) Signage related to the enterprise to be discrete and confined to the entrance gates. No other corporate or advertising signage, particularly billboards, to be permitted.
8) The navigation lights on the wind turbines to be fitted with reflectors so that the lights are not visible from below.

Provided these mitigation measures are employed, the visual impact ratings could be reduced.

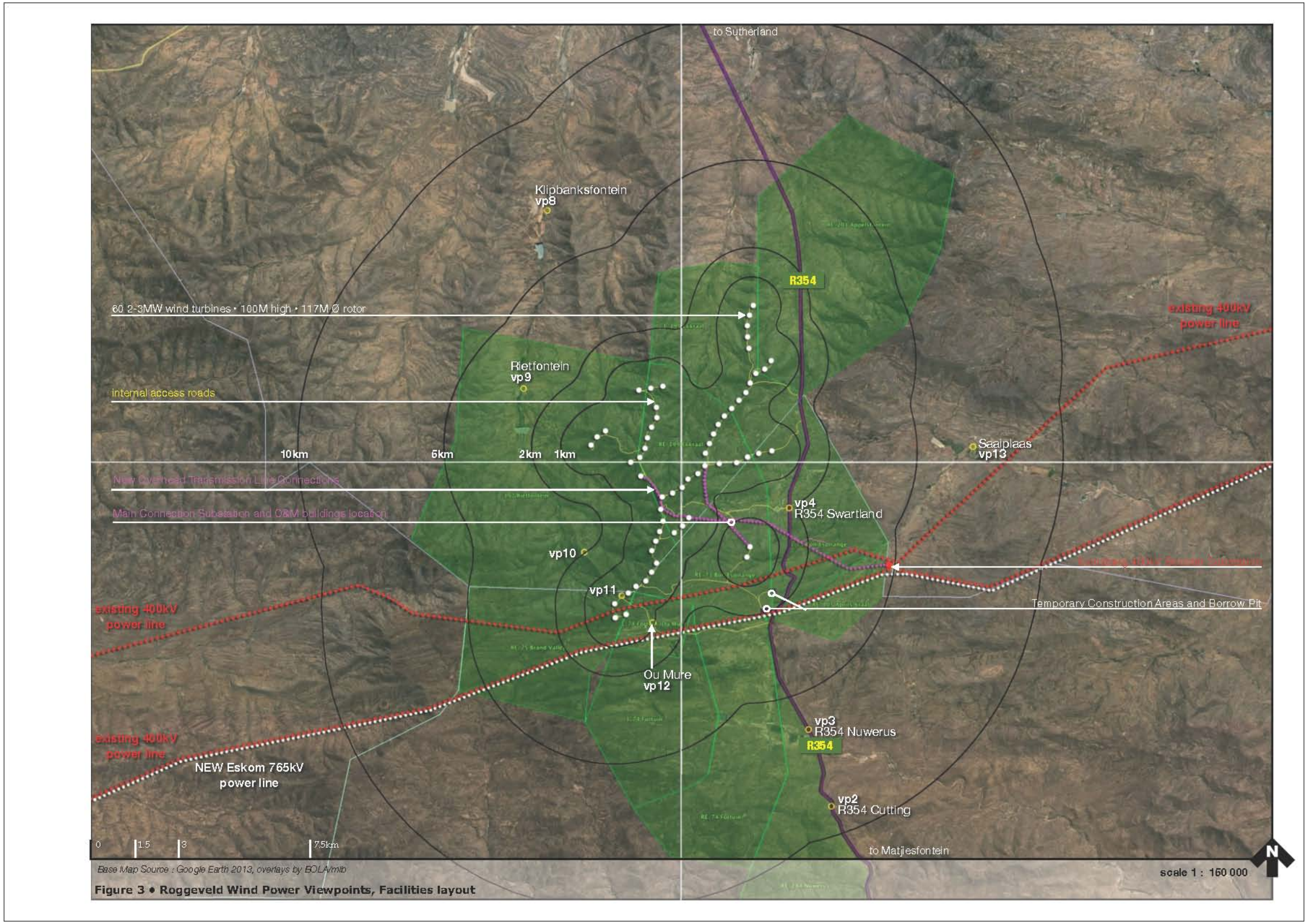


Figure 8.12: Wind turbine layout showing turbines that the visual impact assessment report proposes to be relocated

Construction Phase Mitigation

- The construction camp, material stores and lay-down area should be located as far as possible out of sight of the R354, possibly in the vicinity of the proposed substation and O&M buildings.
- The extent of the construction camp and stores should be limited in area to only that which is essential.
- Disturbed areas rather than pristine or intact landscape areas should preferably be used for the construction camp.
- Measures to control wastes and litter should be included in the contract specification documents.
- Provision should be made for rehabilitation/ re-vegetation of areas damaged by construction activities.

Operational Mitigation Measures

- The footprint of the operations and maintenance facilities, as well as parking and vehicular circulation, should be clearly defined, and not be allowed to spill over into other areas of the site.
- The operations and maintenance areas should be screened by buildings, walls, hedges and/or tree planting where possible, and should be kept in a tidy state to minimise further visual impact.

Table 8.12: Criteria for Visual Buffers at the Roggeveld Site

Criteria	**PGWC Regional Level Mapping : Recommended Buffers (2006)**	**Local Project Level Mapping for the Roggeveld Site: Suggested Buffers**
Urban Areas	800m	n/a
Residential Areas, including rural dwellings	400m	400m
National Roads	13km buffer. Depends on scenic value. Can be reduced.	n/a No national roads in the area.
Local Roads (district roads)	500m Review if high scenic value.	500m
Provincial Tourist Route	4km buffer. Statutory scenic drives.	n/a
Local Tourist Route	2.5km Assumption. Can be reduced.	2.5km The R354 is a regional tourist route. (The SEA currently being prepared indicates a 2km buffer).
Railway lines	250m	n/a
Local airfield	To be confirmed with CAA.	An aerodrome is located near Sutherland about 35km to the northeast. A small local landing strip is located 15km to the south at Aasvoelbos.
National Parks,	2km	2km.

Provincial Nature Reserves	Should be eliminated at regional level.	There are no National Parks or reserves in the immediate area.
Private Nature Reserves (Rietpoort game farm)	500m Could be negotiated at local level.	500m
Coastlines of Scenic Value	4km Should be eliminated at regional level.	n/a
Rivers	500m Perennial rivers at regional level. Hydrology to be determined at site level.	Hydrologist to determine site level buffers.
External farm boundaries	No indication	500m visual buffer (in the case of tourist facilities).

8.5.4 Conclusions and Recommendations

The visual impact assessment has identified the need for mitigation in order to reduce potential visual impacts arising from the project. The visual assessment revealed that the current layout for Phase 1 only would result in less severe visual impacts than those for the previous layout assessed for this project (refer to the VIA dated October 2011), and is therefore the preferred layout with mitigation measures. Phase 1 would have fewer turbines and correspondingly a smaller view catchment than the previous proposal for the overall project. It would also be visible over a significantly shorter distance along the R354 route. However, if Phases 2 and 3 are added at a later stage, the visual implications could be similar to those in the previous proposal for the overall project.

Taking into account cumulative visual impacts the current VIA indicates that potential visual impacts for the proposed wind turbines will be of medium-high to high significance before mitigation and medium-high to medium after mitigation. Possible mitigations are the relocation of several of the proposed turbines, including those on the highpoints, as well as those within a visual setback zone of the R354.

The siting of the turbines is constrained by wind measurements and technical considerations. Further mitigation is therefore limited to the re-location of turbines, or reduction in the number of turbines, which is in turn related to project feasibility.

The potential visual impacts for the associated infrastructure, including substations, and operations and maintenance buildings would be of medium significance before mitigation and medium-low significance after mitigation. The potential visual impacts for the connecting power lines would be of medium significance before and after mitigation, given that there are existing power lines in the study area.

The cumulative impacts are difficult to assess as no information on Phases 2 and 3 was available, although their location would probably be similar to the previously proposed layout of the overall project. Additional wind facilities are being considered in the general area, the combined effect of which could change the character of the Karoo landscape. The Roggeberg site falls within the Sutherland wind study area identified in the first phase of the SEA, currently being prepared for the DEA by the CSIR. Fine-scale mapping of the SEA area has however yet to be completed.

8.6 Assessment of Potential Noise Impacts

The environmental noise impact investigation and assessment of the noise emanating from the wind farm was conducted in accordance with Section 8 of SANS 10328:2008.

8.6.1 Residual Sound Levels

A residual L_{Aeq} of 33 dBA was measured on a farm track more than 2 000 m from the R354 between 17h00 and 17h30 on a Saturday during a light wind with an average wind speed of approximately 2 m/s. The sound level spectrum is displayed by the bottom graph in Figure 8.13. No road traffic or other man made noise was audible. The only audible sound was that of the occasional chirping of a bird in the distance. The measured level was considered to be representative of that on all land far removed from the R354.

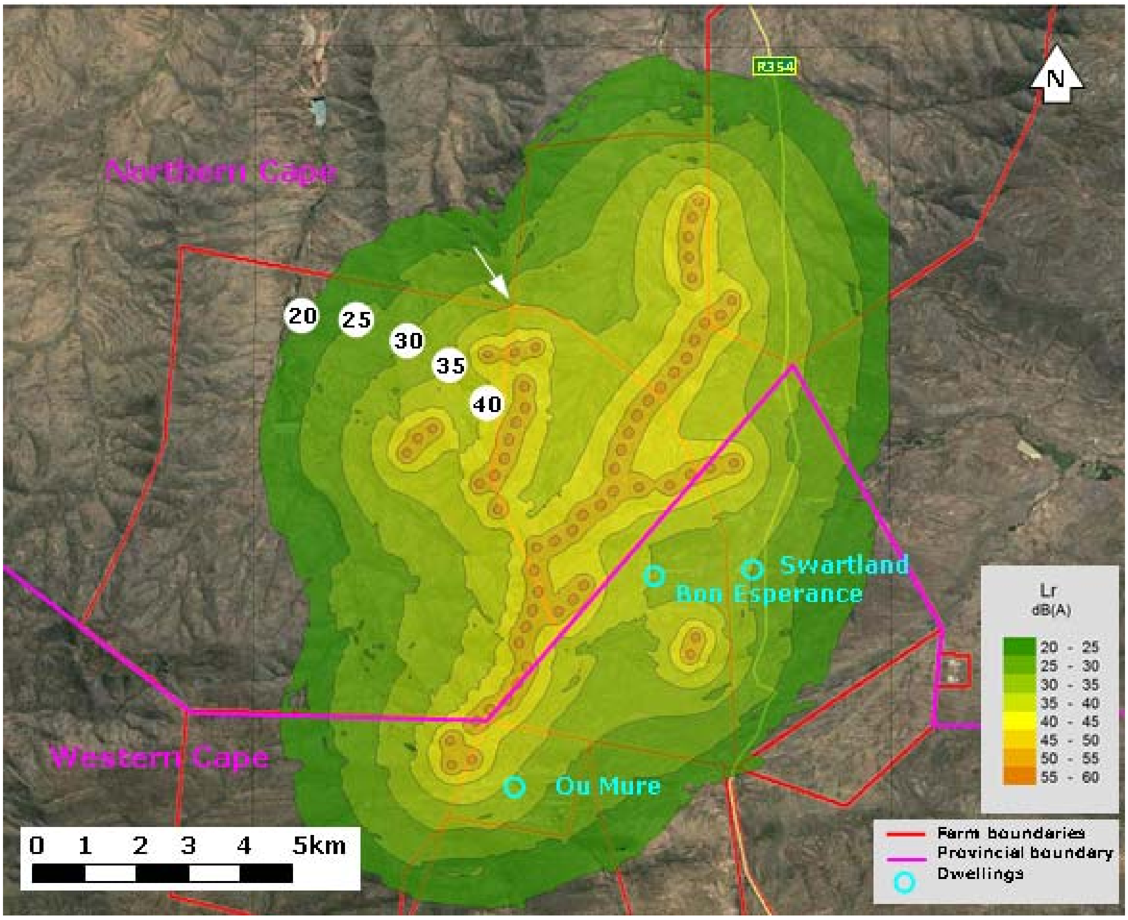


Figure 8.13: Phase 1 of the Roggeveld wind farm (site boundaries demarcated by red lines; farm dwellings demarcated by blue circles; provincial boundary in pink; and calculated L_{Aeq} contours due to noise from wind turbines)

The Swartland dwellings, located approximately 300 m west of the R354, are exposed to low levels of noise from sporadic road traffic. It was estimated that the daytime $L_{Req,d}$ was 35 dBA and the night-time $L_{Req,n}$ less than 30 dBA

8.6.2 Results of Wind Turbine Noise Calculations

The predicted L_{Aeq} contours at a height of 2 m above local ground level due to operation of the wind turbines during a wind speed of 7 m/s are displayed in Figure 8.13. The respective contour L_{Aeq} values have been denoted by numerals on a white background with a lowest value of 20 dBA. This is well below the residual L_{Aeq} value measured in the study area. Areas that would be exposed to levels less than 20 dBA contain no colour shading.

8.6.3 Noise Impact on surrounding land

From Figure 8.10 it is apparent that the predicted L_{Aeq} would be less than 33 dBA on all land beyond the wind farm boundaries with an associated **negligible** intensity of noise impact. An exception is a small portion of land indicated by a white arrow upon which the L_{Aeq} would be 35 dBA on the wind farm northern boundary. The intensity of noise impact would be **Low** on a small area of land close to the boundary at the top of the mountain ridge. In terms of the NCR-WC and NCR-N no noise mitigation procedures would need to be implemented.

Table 8.13 contains a summary of predicted noise impact on land beyond the Roggeveld Phase 1 Wind Farm site boundaries.

Table 8.13: Summary of predicted noise impact on land beyond Phase 1 of the Roggeveld Wind Farm site boundaries

CRITERIA	SIGNIFICANCE
Cumulative impact	None
Nature	Neutral
Extent	Local
Duration	Long term
Intensity	Negligible to Low
Likelihood	Unlikely
Significance	Negligible
Confidence level	High

8.6.4 Noise impact at dwellings within the site boundaries

Table 8.14 summarises the calculated L_{Aeq} due to wind turbine noise at the identified dwellings, the excess over the measured residual level of 33 dBA and the predicted intensity of noise impact.

Table 8.14 Summary of predicted noise impact on dwellings within Phase 1 of the Roggeveld Wind Farm site boundaries

Dwellings	Turbines L_{Aeq},dBA	Excess, dB	Noise impact
Swartland	30	-	Negligible
Bon Espirance	35	2	Low
Ou Mure	34	1	Low

All three overall, single-figure L_{Aeq} values would comply with the NCR-WC and NCR-N. Therefore no noise mitigation procedures would need to be implemented at any of the dwellings.

However, the single-figure values contain no information with which to determine whether the wind turbine noise at a receptor (dwelling) would still be audible or whether it would be masked by the residual noise. A more detailed analysis would be required as outlined in the next paragraph.

The equivalent continuous A-weighted sound pressure level in each 1/3rd octave frequency band (noise level spectrum) was calculated at each of the identified dwellings within Phase 1 the Roggeveld Wind Farm site boundaries. The results ogether with the average measured daytime residual sound level spectrum on "Karoo" land. The overall, single-figure L_{Aeq} value for each of dwellings appears in the legend. Figure 8.14 below provides a comparison of the noise level spectrum of wind turbine noise at each dwelling location with that of the average daytime residual noise for wind speeds up to 5 m/s measured on "Karoo" land. This comparison was considered to represent a best estimate assuming that the wind speeds at the wind turbines, located on elevated land at least 200 m above that of the dwellings, would be higher than at the dwellings.

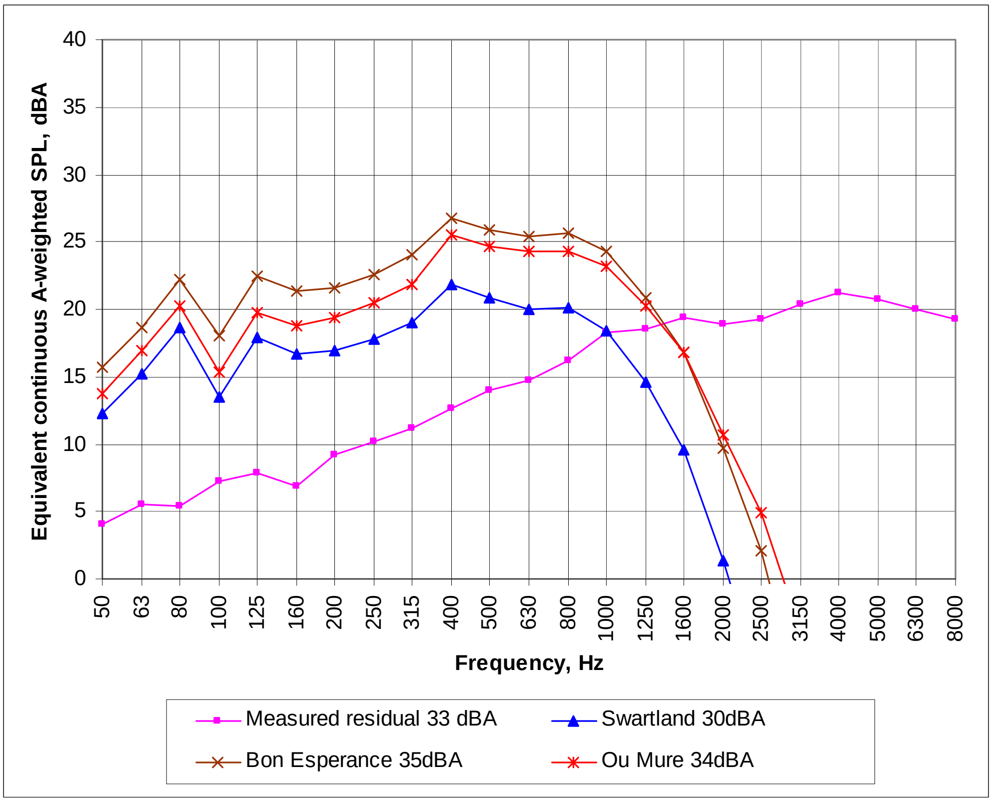


Figure 8.14: Calculated noise level spectrum of wind turbine noise at each of three residential dwellings and average measured daytime noise level spectrum of residual noise.

Inspection of the results of the noise modelling indicate that at Bon Esperance the outdoor spectrum levels due to turbine noise would significantly exceed that of the residual noise by more than 10 dB for all frequencies below 500 Hz. Under such conditions low frequency turbine noise might be audible outside of the dwellings. The probability would be less at the other two locations.

8.1.6. Conclusions & Recommendations

The results of the NIA indicated that the predicted L_{Aeq} values on land surrounding the Phase 1 the Roggeveld Wind Farm boundaries as well as at the noise sensitive receptors (dwellings) within the property boundaries would comply with the NCR-WC and NCR-N legal requirements. Therefore no noise mitigation procedures would need to be implemented. Notwithstanding the legal compliance, a more detailed analysis indicated that low frequency turbine noise might be audible outside of the dwellings of Bon Esperance located within the Wind Farm boundaries.

8.7 Assessment of Potential Impacts on Archaeology, Palaeontology and Cultural Heritage Resources

8.7.1 Findings of the Heritage Survey

Archaeology

Figure 8.15 shows the distribution of recorded heritage sites on and around the site. None of these heritage artefacts/sites occur within the proposed wind turbine development footprint. These heritage artefacts/sites are briefly described below:

» **Stone Age artefactual material –** Little evidence for pre-colonial occupation.
» **Other pre-colonial indicators -** Two small rock shelters were inspected, however these contained no habitable floors or archaeological deposits.
» **Graves -** A collection of stone piles were recorded in the Ekkraal Valley. These do not appear to be associated with any other archaeological material which would assist in identifying them. It is not expected that the stone features will be impacted by the proposed activity.
» **Built Environment and colonial heritage -** Characteristically, locales of colonial settlement seem to be concentrated in three areas – namely the farms known as Ekkraal Valley, Ou Mure, and the Hartjieskraal-Barendskraal valley somewhat south of the study area. The heritage of the valley is not a tourism resource, and not well known to anyone other than the local populous. In these terms it does not constitute visually sensitive heritage. The revised layout for phase 1 is more sympathetic to the heritage qualities of the Ekraal Valley in terms of both visual impacts and physical impacts as the valley has been largely left free of infrastructure or access roads. The Ekkraal Valley where there is a concentration of historical archaeological sites will not be impacted in terms of the current proposed layout.

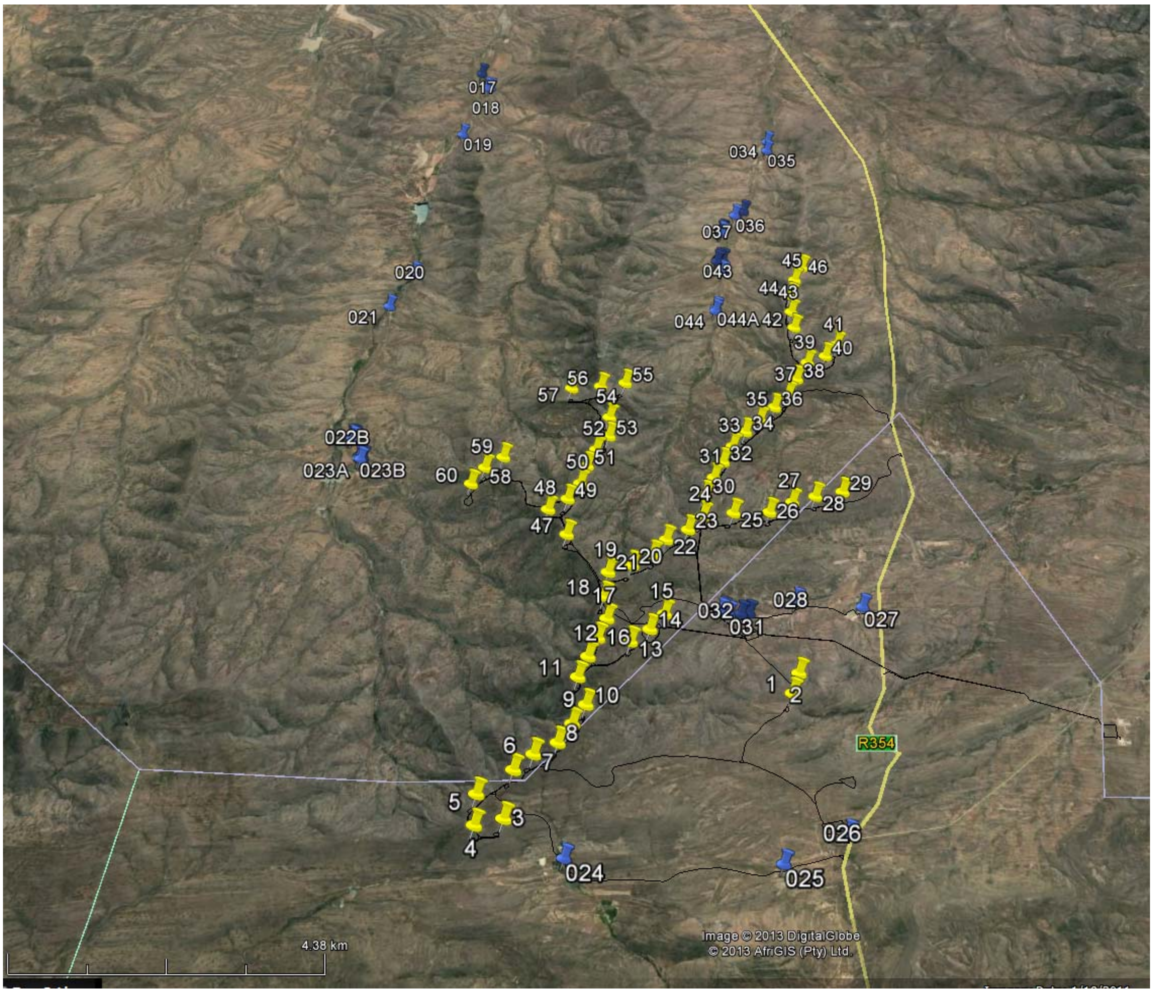


Figure 8.15: Distribution of recorded heritage sites (blue) and proposed turbine layout for Phase 1 of the Roggeveld Wind Farm

Palaeontology

The only fossils found in the rocks of the Abrahamskraal Formation were trace fossils in the form of sand-filled vertical burrows in sandstone. These were in a loose block adjacent to a packed stone ruin in the Ekkraal valley) and may have been transported from elsewhere as building material.

8.7.2 Impacts of the Wind Turbines

The areas selected for the proposed construction of wind turbines are the tops of the large longitudinal ridges that are generally orientated north-south through the study area. These wind swept mountain tops are generally remote, exposed and inhospitable. During the course of this study many kilometres of ridge top landscape were traversed and found to be largely sterile of any form of human made heritage material.

The turbines rows will be highly visible from the R354 between Sutherland and Matjiesfontein occupying some 14 linear km of landscape on the western side of the road. While the R354 is not a heritage resource as such, it does link two heritage rich communities which are strongly contextually linked with the Karoo experience, hence the proposed development could impact the sense of place associated with both towns. The degree to which this potential impact will be perceived by people depends on the perceptions and aesthetic inclinations of the user of the R354. The historic pass to Sutherland via Karoopoort lies about 18km to the east of the closest turbine row. The impact to this heritage resource and scenic route will be minimal as the turbines will only be marginally visible under the clearest of conditions.

The proponent has avoided locating turbines on high mountain tops within the Western Cape boundary, however high ridges with the Northern Cape boundary are utilised. The proponent has also indicated that they unable to honour the 3 km buffer requested by SAHRA with respect to the regional road. 21 turbines are proposed within the 3km buffer (most of these are within the Northern Cape, and only 4 on the Western Cape side) while no turbines are proposed within 1 km of the R354.

The study area has little amenity or intrinsic active tourism value at the present time (although it is highly scenic) which means that assigning a high degree of impact in terms of sense of place is unjustified. On the other hand, it is these very qualities that impart the area its wilderness value. It must be noted that the development proposal will potentially sterilise the area in terms of any future development of wild life experiences or outdoors orientated tourism, while the visual impact from the R354 will change the experience of people using the route to Sutherland, a locality that has become a popular tourist destination on account of SALT (South African Large Telescope).

There area is fossiliferous which means that palaeontological material may be impacted by excavation of footings for turbines. Provided that suitable mitigation is carried out, this is not necessarily a negative impact as gains in terms of contributions to scientific knowledge may result from any new observations made. If mitigation is not carried out, negative impacts will result as potentially significant scientific evidence will be lost.

8.7.3 Substations

Impacts on heritage resources due to the substations are not expected however new industrial intrusions may impact aesthetic qualities of farms. Final substation footprints must be surveyed prior to construction commencing.

8.7.4 Connecting Electrical Lines

Power lines will be required to connect substations with the existing Eskom 400 kV transmissions that pass through the study area. Turbines in turn will need to be connected with substations by means of a network of underground cables. Impacts to person made heritage are not expected. Impacts to the landscape may occur as a result of the introduction of new industrial elements, scarring of the landscape will result from excavation of trenches. Impacts to palaeo-heritage could result from the process of trench excavation. Provided that suitable mitigation is carried out, this is not necessarily a negative impact as gains in terms of contributions to scientific knowledge may result from any new observations made. If mitigation is not carried out, negative impacts will result as potentially significant scientific evidence will be lost. Final power line alignments must be surveyed prior to construction.

8.7.5 Access Roads

A network of roads will be needed for construction and servicing of turbines. The proposal is to use as many existing farm roads as possible to limit damage to the veld. New roads will need to be constructed to gain access to the high ridges and turbine rows. Farm roads will need to be upgraded to a width of 12m in places. Cuttings in slopes may be needed to produce gradient that are negotiable for heavy vehicles and abnormal loads. The overall effect will be increased visibility of the road system on the landscape and scarring of hill slopes. Final road alignments must be surveyed prior to construction.

8.7.6 Impact Description and Assessment

Construction Phase

The excavation of the turbine and substation foundations, road construction and installation of cables has the potential to destroy or damage archaeological and palaeontological resources. If appropriate mitigation is implemented, potentially positive impacts may be caused with new palaeontological discoveries.

Archaeology

The pre-colonial heritage of the area as evident by archaeological traces is extremely sparse. The colonial archaeological heritage of the study area is also sparse, but forms two distinct clusters. Areas along river banks and valleys appear to have been the focus of settlement during the last two centuries. The most important colonial archaeological sites in the study area are associated with Ekkraal where an access road is proposed up the valley.

Construction Impact: Destruction or Disturbance of Pre-colonial and Colonial Archaeology

Nature: Construction activities could result in a **negative direct** impact on archaeological interests on the Wind Farm site.
Impact Magnitude – **Medium**
Extent: The extent of the impact is **local**.
Duration: The duration would be **permanent** as these resources are non-renewable and once destroyed, they cannot be replaced.
Intensity: Loss of heritage resources will be permanent, so the magnitude of the change will be **medium-high**.
Likelihood – It is **likely** that localised archaeological resources would be lost.
Impact Significance (Pre-Mitigation) – MODERATE (-ve)
Degree of Confidence: The degree of confidence is **medium to high**.
Mitigation: Refer to Section 8.7.7

Built Environment

The built environment of the study area is limited to farms, farm houses, stone walls, walled kraals and secondary roads. Given the remoteness of this area, even these are sparsely distributed. Virtually all farm infrastructure is situated in the low lying areas between the ridges. Most are several kilometres from proposed turbine locations which mean that direct impacts are not expected.

The existing Ekkraal Farm is of importance as it has corrugated iron roofed building which dates from the 19th century which could be worthy of Grade IIIC status. The structure is not under threat and evidently well maintained. The closest turbines are well in excess of 1 km distant which means that no direct impacts will result from the turbines themselves. Other elements of the built environment at Ekkraal Farm consist of dams, kraals and two out-buildings, one of which is built from stone and has a Dutch hearth. The existing vehicle track up the valley will be upgraded and widened to allow heavy vehicles to pass. Since many of the ruined features lie very close to this track, impacts could occur. The pattern of kraals, farm buildings, artefact scatters and walling remains highly legible. The area can be considered to be archaeologically sensitive and worthy of preserving in terms of its research potential.

It is acceptable to utilise farm buildings for the project, however if renovation or changes to structures is envisaged, a heritage professional with experience in historical structures should be consulted to assist with sensitive re-adaptation or restoration. Kraals, walls, stone features and ruins must be left in-tact on the landscape.

Potential impacts to cultural heritage would be of local extent, and since cultural heritage resources are considered non-renewable, impacts would be of a permanent nature. Due to any loss being permanent, the intensity of potential impacts to existing heritage structures is considered medium-high.

If heritage structures were impacted, considering the local extent of importance, the permanent loss of the resource and the medium-high intensity of the potential impact, the magnitude of the potential impact is considered to be medium. Unless mitigated and heritage structures are set aside as no-go areas, there is a definite likelihood that cultural heritage resources could be impacted. Taking into account the medium magnitude and the likely potential impact, the overall significance of the potential direct negative impact on cultural heritage resources is considered to be moderate.

Construction Impact: Destruction or Disturbance of the Built Environment

Nature: Construction activities would result in a **negative direct** impact on built environment of the Study Area.
Impact Magnitude – **Low**
Extent: The extent of the impact is **local**.
Duration: The duration would be **permanent** as these resources are non-renewable and once destroyed, they can not be replaced.
Intensity: Loss of heritage resources will be permanent, so the magnitude of the change will be **low**.
Likelihood – It is **unlikely** that localised cultural heritage resources could be lost.
Impact Significance (Pre-Mitigation) – Moderate (-ve)
Degree of Confidence: The degree of confidence is **medium to high**.
Mitigation: Refer to Section 8.7.7

Buried Graves

Human remains can occur at any place on the landscape, but are particularly likely to be found on or close to archaeological sites and settlements. In addition to the identified ones with typical surface identifiers such as cairns and/or head stones, there are likely to be others that never had any, or which have been lost over time. The single identified formal cemetery will not be affected by the proposed activity. However human remains are usually exposed during construction activities. Such remains are protected by a plethora of legislation including the Human Tissues Act (Act No 65 of 1983), the Exhumation Ordinance of 1980 and the National Heritage Resources Act (Act No 25 of 1999). Ekkraal valley is a particular area of concern where a collection of stone piles were recorded. In the case of unmarked graves, work in the immediate area should cease and the find reported to the heritage authority and an archaeologist. Human remains must not be removed from the find site, but the area cordoned off until a formal exhumation and investigation can be put in place.

Taking into account the local importance of buried graves, the permanent nature of any loss of human remains and the potential impact's medium-high intensity, the magnitude of loss of human remains through buried grave discovery is considered medium.

Construction Impact: Destruction or Disturbance of Buried Graves

Nature: Construction activities would result in a **negative direct** impact on cultural heritage of the Study Area.
Impact Magnitude – **Medium**
Extent: The extent of the impact is **local**.
Duration: The duration would be **permanent** as these resources are non-renewable and once destroyed, they cannot be replaced.
Intensity: Loss of heritage resources will be permanent, so the intensity of the change will be **medium-high**.
Likelihood – It is **likely** that buried graves will be damaged or disturbed.
Impact Significance (Pre-Mitigation) – Moderate (-VE)
Degree of Confidence: The degree of confidence is **medium to high**.
Mitigation: Refer to Section 8.7.7

Palaeontology

All the geological horizons in the Study Area are potentially fossiliferous. Consequently, all excavations, whether for road cuttings or foundations, may reveal fresh fossiliferous rock. There is a low but significant likelihood of important new discoveries in the Abrahamskraal Formation.

The proposed activity is likely to impact fossil bearing rock. Without mitigation this would constitute a negative impact, however if mitigation is carried out a positive impact of potentially moderate to major significance could result, particularly if rare specimens are encountered and described therefore making a contribution to the body of locally scientific information. Without mitigation, irreversible losses could result. Considering the above, there is a definite likelihood rating given for potential paleontological resources impacts.

Palaeontological material may be impacted by the proposed construction of underground electrical lines connecting the turbines.

The extent of the potential impact on paleontological resources would be considered a local impact as similar paleontological resources may not occur within a 20 km radius of the site. Any potential negative impacts would be permanent, as these resources are non-renewable, and the loss of paleontological resources is predicted to be of medium-high intensity. Taking into account the local extent, permanent nature and medium-high intensity of palaeontological impacts, the magnitude of the potential impact is regarded as medium.

Given the medium intensity and fact that palaeontological impacts are likely to occur, the overall significance of potential direct negative impacts on paleontological resources is considered moderate-high. Note that if proper palaeontological surveys are conducted during excavation the potential finding of palaeontological resources for furthering scientific knowledge could have a positive impact.

Construction Impact: Destruction or Disturbance of Palaeontology

Nature: Construction activities would result in a negative direct impact on paleontological interests on the Wind Farm site. However, with mitigation the activities would result in a positive direct impact.
Impact Magnitude – **Medium**
Extent: The extent of the impact is **local**.
Duration: The duration would be **permanent** as these resources are non-renewable and once destroyed, they cannot be replaced.
Intensity: Loss of heritage resources would be permanent, so the intensity of the change would be **medium-high**.
Likelihood – It is **likely** that localised paleontological resources could be lost.
Impact Significance (Pre-Mitigation) – Moderate (-ve)
Degree of Confidence: The degree of confidence is **medium to high**.
Mitigation: Refer to Section 8.7.7

Visual or Sense of Place Heritage Impact during the operational phase

It should be noted that this section deals with Visual Impacts from a Cultural Heritage perspective only, while the visual impact assessment section deals with visual impacts on a broader scale. The impacts of wind turbines on cultural landscape can be serious, both in physical terms and with respect to the intangible and aesthetic qualities of a given locality. Impacts of wind energy facilities can therefore cause direct physical damage to heritage resources through the establishment of infrastructure, and by their presence can change the aesthetic and intangible values of the broader cultural landscapes in which the heritage resources exist.

Within the study area there are a number of distinct cultural landscape areas that have been identified, i.e the Ekkraal Valley and Hartjieskraal to Barendskraal area which contains evidence of concentrations of historic farming activity. The Ekkraal Valley lies between 2 turbine rows. Although this is a highly scenic area, it is very remote and not celebrated as a place with visual heritage qualities. The Hartjiekraal- Barendskraal complex of heritage sites is situated in the deeper portions of valleys – the turbines will be mostly more than two kilometres from structures and sites, with the exception of the farm Hartjieskraal where they will be closer. This situation could be mitigated through the exclusion or re-siting of two turbines.

The proposed energy facility will not be visible from any major transport routes (N1) but there will be visibility from tertiary roads in the area and especially the R354 between Matjiesfontein and Sutherland, a scenic tourism route. This will affect the sense of wilderness of a large chunk of the region. Conservation-worthy buildings or places of celebrated heritage significance are limited.

In overall terms the study area represents a remote wilderness landscape, which even in prehistoric times appears to have been marginally inhabited. Colonial occupation of the area was also sparse being limited to valley bottoms. The predominant presence is that of open wilderness. While the area is highly scenic, within the project boundary there are no major tourism enterprises and is very seldom visited by persons other than those directly involved in farming. Taking into account the local extent, long-term duration and the medium intensity of the potential impact, the magnitude is rated as medium.

Given the medium-high magnitude and considering that the impact has a definite likelihood of occurring if the project were to go ahead, the overall significance of the direct negative potential impact on visual or sense of place heritage is rated as moderate.

Operational Impact: Visual or Sense of Place Heritage Impact

Nature: Operation of the Wind Farm would result in a **negative direct** visual impact on cultural heritage sites of interest.

Impact Magnitude – Medium

Extent: The extent of the impact is **local**, since the visual influence would extend beyond the site.

Duration: The duration would be **long-term** as the visual character of the site would be altered at least until the project stopped operating.
Intensity: The high visibility of the turbines along the ridge would result in a **medium** intensity.
Likelihood – There is a **definite** likelihood that the sense of place would be impacted by the presence of the turbines in the study area.
Impact Significance (Pre-Mitigation) Moderate (-ve)
Degree of Confidence: The degree of confidence is **high**.
Mitigation: There is no mitigation possible for this impact.

8.7.7 Mitigating for Damage or Destruction of Archaeology, Palaeontology and Cultural Heritage Interests

The objective of mitigation is to minimise impacts on palaeontological, archaeological and heritage resources and ensure opportunities to identify overall heritage interests are maximised.

Design Phase

» Mitigation of the colonial archaeology should involve a final walk down of the proposed route of the road alignment in the Ekkraal Valley. Heritage resources should be identified and flagged and avoided during construction activities.
» Substations should not be built in prominent positions or within sight of historic farms. These areas should be avoided for power line routes where possible.
» Mitigation of the built environment should involve micro siting turbine positions and associated infrastructure to avoid placing turbines or infrastructure directly over built environment features and buildings or bisecting coherent settlement complexes.

Construction Phase

» Cuttings for the access roads should be inspected by a suitably qualified palaeontologist, as it would be an economical transect for representative sampling.
» Any substantial excavations, such as borrow pits, opened for road making, providing material for berms, footings of turbines or any other construction, similarly need to be checked by a qualified palaeontologist for material of potential scientific importance.
» Should any human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to Heritage Western Cape. The developers, site managers, and any operators of excavation equipment, need to be alerted to this possibility. If fossil material is encountered, the palaeontologist must be given sufficient time and access to resources to

recover at least a scientifically representative sample for further study. If it cannot be studied immediately, the costs of housing the material should be borne by the developers. In the event of human bones being found on site, SAHRA must be informed immediately and the remains removed by an archaeologist under an emergency permit. This process will incur some expense as removal of human remains is at the cost of the developer. Time delays may result while application is made to the authorities and an archaeologist is appointed to do the work.

» The sensitive reuse of vacant buildings is encouraged (as long as advice is sought on heritage sensitivities) as this will help sustain them.

8.7.8 Conclusion and Recommendations

A summary of the impacts on heritage resources is provided in the table below.

Pre- and Post-Mitigation Significance: Damage or destruction to cultural Archaeology, Palaeontology and Cultural Heritage interests

Phase	**Significance (Pre-mitigation)**	**Residual Impact Significance**
Construction - Palaeontology	**Moderate-High (-VE)**	**ModeratE (+VE)**
Construction – Archaeology	**Moderate (-VE)**	**Minor (-VE)**
Construction – Built Environment	**Minor (-VE)**	**Minor (-VE)**
Construction – Buried graves	**Moderate (-VE)**	**Minor (-VE)**
Operation - Cultural Heritage Visual or Sense of Place	**Moderate (-VE)**	**Moderate (-VE)**

Palaeontology

All the geological horizons in the study area are potentially fossiliferous. Consequently, all excavations, whether for road cuttings or foundations, may reveal fresh fossiliferous rock. There is a low but significant likelihood of important new discoveries in the Abrahamskraal Formation.

The likelihood of encountering Cenozoic fossils in valley fill sediments is considered to be low, but if excavations for infrastructure take place in the Ekkraal or Wilgebosrivier valleys, there is a possibility of fossil mammalian bones being encountered. In this case the South African Heritage Resources Agency will have to be notified immediately.

Road cuttings, particularly into hill slopes for access roads to the ridge tops where wind turbines would be located, should be investigated by a suitably qualified and experienced Karoo palaeontologist. Any substantial excavation exposing fresh bedrock, like borrow pits, similarly should be investigated palaeontologically.

If fossil material is encountered, the palaeontologist must be given sufficient time, access and resources to recover a scientifically representative sample for further study. If it cannot be studied immediately, the costs of housing the material should be borne by the developers. If this recommendation is followed, then from a palaeontological point of view, the development of the proposed Roggeveld wind farm will constitute a positive intervention, providing greater insight into the palaeontological heritage of South Africa.

Archaeology

The pre-colonial heritage of the area as manifested by archaeological traces is extremely sparse. Very little material was identified and no particular mitigation is suggested. The colonial archaeological heritage of the study area is also sparse, but forms two distinct clusters. As a general comment, areas along river banks, and valleys appear to have been the focus of settlement during the last two centuries. Within the study area is the Ekkraal Valley which will not be directly be affected by the proposed activity.

If plans change and the Ekkraal Valley is to be impacted, then this area to be thoroughly surveyed and all heritage sites recorded and mapped on the landscape. Sensitive areas must be flagged so that these can be protected from construction related activities.

Graves

Graves tend to be located close to settlements. In addition to the identified ones with typical surface identifiers such as cairns and/or head stones, there are likely to be others that never had any, or which have been lost over time. The single identified formal cemetery will not be affected by the proposed activity.

If human remains/burials are uncovered during the construction phase, work in the specific location should cease, and HWC/SAHRA should be notified. They would in all likelihood request an archaeologist to investigate and implement mitigation, in the form of exhumation. The mitigation of human remains from the colonial period requires a permit to be issued by the SAHRA Burials Unit.

Buildings

It is acceptable to utilise farm buildings for the project, however if renovation or changes to structures is envisaged, a heritage professional with experience in historical structures should be consulted to assist with sensitive re-adaptation or restoration. Kraals, walls, stone features and ruins must be left in-tact on the landscape.

Landscape and built environment

The built environment of the study area is limited and sparse. Although virtually every farm has generally protected material in its confines, none of these have anything beyond moderate local heritage significance. Direct impacts to any structures are expected to be very limited (the best example of a karoo historical house lies well outside the study area some 5 km to the south).

The greatest impact, which is not a heritage impact but a landscape impact has been identified in the independent visual baseline assessment by Oberholzer and Lawson. This is the industrialisation of a very large expanse of natural landscape adjacent to the R534 which is considered a scenic route. Combined with the impact of up to 5 other similar facilities planned in the general area, the natural amenity qualities of the region will be negatively impacted.

On purely heritage alone, there is no justifiable reason for not supporting the proposal.

8.8 Assessment of Potential Social Impacts

The potential issues/impact identified by the socio-economic assessment includes:

» Benefits for the local economy;
» Increased social ills linked to influx of workers and job-seekers;
» Disruption of agricultural activities;
» Loss of agricultural land;
» Impact on tourism activities;
» Impact on property values;
» Impact on sense of place;
» Impact on road infrastructure.

These socio-economic impacts associated with Phase 1 of the Roggeveld wind farm are discussed in further detail below.

8.8.1 Benefits for the Local Economy

The development of the wind farm will result in significant spending in South Africa having a positive impact on the national, regional and local economy to varying degrees. Direct benefits such as employment and procurement associated with the project will have the most significant impact when compared to indirect and induced impacts. However, over time as the renewable sector develops additional benefits to the national economy may accrue as the supply chain to the renewable energy sector develops. The direct impacts will be most significant during the construction phase of the project, and are likely to have the largest influence on the local economy.

Impact Characteristics: Benefits for the Local Economy

Summary	Construction	Operation
Project Aspect/ activity	Employment and Procurement of Local contractors. Lease Agreements with directly affected farmers.	Employment and Procurement of Local contractors. Lease Agreements with directly affected farmers. Development of the supply chain for the wind energy sector.
Impact Type	Direct, positive impact.	Direct, indirect and induced positive impact.
Stakeholders/ Receptors Affected	Local community, Local Municipality, and Directly Affected Landowners.	Local community, Local Municipality, suppliers throughout South Africa and Directly Affected Landowners.

Construction Phase Impacts

The capital investment required for the wind farm is high, estmated at approximately R2.4-2.8 billion which will be spent over several stages of a 24 months period for Phase 1. During the construction phase the civil and other construction, specialised industrial machinery and building construction sectors would benefit the most. Local procurement will primarily benefit the civil and construction industry, hospitality and service industries, such as accommodation, catering, cleaning, transport, vehicle servicing and security services.

The highly specialised machinery required for the project will, however, require that the majority of the technical components associated with the wind turbines will be imported from specialist suppliers. The renewable energy sector is still relatively small in South Africa and at this stage appropriate supplies and service providers are not currently available in the country; this may, change over time. It is estimated that 70% of the project spend will be on turbines which will be imported, 20% will be on the balance of plant (buildings, substations etc.) and 10% on development. While the value of imports is high, it is likely that the majority of the balance of the plant will be sourced from South Africa, resulting in a significant spend in the national economy.

It is estimated that approximately and overall 270 and 300 direct temporary site construction jobs will be created for the duration of the construction and commissioning phases which is estimated to be 24 months. Additional indirect jobs will be created in other affected sectors such as the catering and hospitality industry through the presence of the project in the area.

There are high levels of unemployment in the project area (between 16% and 18%) and while the most common skills are related to the farming sector, there are some people involved in construction work with Eskom and road construction. It is intended that the developer and their contractors will source the majority of the unskilled workers from the surrounding municipal area with the remainder being sourced regionally, where they are not available locally. In the local municipal context, this translates into a significant benefit to the local unemployed population, even though these opportunities will only be for the short-term i.e. for the duration of the construction phase.

While the intention is to source unskilled jobs locally, there may be some unintended impacts on local farmers, should the relatively skilled farm labourers be recruited for the construction phase of the project. The project may result in raised wage expectation of workers from farmers assuming the project will be able to offer workers a better salary. This may result in strained relationships between the developer and local farmers. This could also have an unintended impact on the livelihoods of the skilled farm labourers who may lose their permanent job, and associated security, for a short term job.

It is unlikely that there are many people with the required skills available to fill highly-skilled and semi-skilled opportunities at the local municipal level. There may be more suitably highly and semi-skilled people available at the provincial and national levels.

Initial recruitment and training for local personnel will take place prior to and during the construction phase, in conjunction with contractors. Tasks on site will require skills in a number of areas, including working at height, electrical safety, specific maintenance and troubleshooting, isolation for maintenance, etc. The construction work will create an opportunity for ‘on-the-job’ training therefore increasing general skills levels. The opportunities for skills development and training would extend through from skilled to unskilled personnel. The developer will notify identified representatives of the local municipality of the specific jobs and the skills required for the project. This will give the local population time prior to the beginning of construction and operation to enable them to attain the relevant skills/qualifications.

Furthermore, the developer anticipates that during construction 50 indirect jobs will be created by the proposed project. These will be jobs created by the presence of the construction teams’ need for accommodation, food and other essentials.

Construction Impact: Benefits for the Local Economy

Nature: The benefit to the local economy will be **direct** via employment and procurement of services and **indirect** employment in other industries affected by the project such as accommodation and catering industries; as well as via spending in the local economy due to increase in wages etc.
Impact Magnitude – **Medium**
Extent: Employment and procurement of service will be created for South African's at a **local, provincial and national** level depending on skills and capacity availability.
Duration: Employment generated during the construction phase will take place over a 12 to 24 month period and will therefore be **short-term**.
Intensity: The intensity will be **medium** as there will be approximately 100 jobs created with approximately 30 percent of the total investment being spent on goods and services in South Africa during the construction phase.
Likelihood – This impact will **definitely** occur.
Impact Significance (Pre-Enhancement) – Moderate (+ve)
Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this project.

Operational Phase Impacts

Direct benefits

Similar to the construction phase, the majority of goods and services will be highly specialised and technical in nature with up to 70% of the operational expenditure being initially imported in the form of expatriate engineers. Locally procured services will include maintenance work for balance of plant facilities, 24-hour security and cleaning contracts resulting in an ongoing investment injection. Over time, as businesses develop locally to meet the needs of the renewable energy sector, levels of procurement may increase.

Turbine operation is largely automated with routine scheduled services taking place on average twice per annum. There will be a dedicated operations team comprising approximately 30 full time personnel operating the facility in daytime hours.

In addition, there will be a number of contract jobs including skilled balance of plant maintenance personnel for electrical balance of plant works and crane operators/crew. There are likely to be additional jobs including a number of personnel to cover 24-hour site security, as well as some cleaning contracts. These personnel will be sourced locally at the municipal level where possible. If the appropriate skills are not available at the municipal level these services will be sourced regionally.

General training will be provided in management systems, wind turbine performance review. Much of the knowledge regarding wind turbine operations and maintenance will be acquired 'on-the-job'. It is envisaged that operations personnel will be increasingly trained up and qualified to high levels over a five to six year timeframe, consistent with demonstrated capability and ambition.

The farmer will receive payments from the developer for the use of the land for the life of the Project and the values of the directly affected farms are likely to increase as a result of the added income stream. The wind farm will occupy approximately 2% to 3% of the farm area, allowing the existing farm activities to continue. This will enable the landowner to supplement his existing income as opposed to replacing it; this is possible given that the majority of the farm is being used for grazing activities.

Indirect and induced benefits

Apart from the direct benefits resulting from the operational spend and direct jobs created, the spending of those employed directly would result in a positive indirect impact on the local and regional economy.

The landowners have plans to increase production on their farms by investing the capital received from the developer into improving farming infrastructure, such as irrigation systems and improving existing buildings.

These planned improvements and intensification of farming methods will create employment opportunities on the farm and increase spending on goods and services. Especially in cases where the farmers intend to expand cultivation activities. Two of the farmers noted that they wanted to decrease the number of livestock, and increase the area under cultivation by installing irrigation systems.

The supplemental income that the landowners receive for the wind farm will enable them to sustain the farms through difficult years, making their farms, and therefore their livelihoods, more sustainable.

The potential for the proposed project and other future projects to result in greater impacts on local economies and the South African economy as a whole is primarily dependent on economies of scale. Initially import content will be high. However, if the sector grows in size it should provide opportunities for growth of the local supply chain and the additional benefit that would flow from this. The introduction of a large-scale renewable energy programme could provide local economic opportunities for component manufacture, and with an appropriate industrial policy it would be possible to leverage South Africa's relatively cheap steel resources. The distance from other international manufacturers will also confer a competitive advantage, especially for less-specialised large-scale components such as steel towers.

Operational Impact: Benefits for the Local Economy

Nature: The benefit to the local economy will be **direct** via employment and procurement of services and **indirect** and induced benefits via the spend in the local economy due to increase in wages; local supply chain etc.
Impact Magnitude – Medium
Extent: Employment and procurement of service will be created for South African's at a **local, provincial and national** level depending on skills and capacity availability.
Duration: Employment and procurement of services will be generated during the operational phase over a period of 25 years and will therefore be **long-term**.
Intensity: The intensity will be **low-medium** in the short term as the majority of services will be imported. As the sector matures, the intensity is likely to increase with additional benefits to the economy through the increased employment of local suppliers, increase job opportunities on the farms and increase in the local turbine manufacturing sector.
Likelihood – This impact will definitely occur.
Impact Significance (Pre-Enhancement) – Moderate (+ve)
Degree of Confidence: The degree of confidence is **medium** given that actual figures are not yet available due to the early stage of this Project.

Mitigation and Enhancement

The objective of enhancement is to optimise opportunities for employment and procurement of local labour and services, wherever possible, or alternatively procurement at a regional or national level.

Community Development:

» The developer should continue, as is their stated intention, to explore ways to enhance local community benefits with a focus on broad-based BEE through mechanisms such as community shareholding schemes and trusts. At this preliminary stage, and in accordance with the relevant BEE legislation and guidelines, up to 4% of after tax profit could be used for community development over and above that associated with expenditure injections into the area.
» The developer should establish a Community Development Trust for the advancement of local development needs; specifically at the farm level and for

the advancement of local development needs; specifically at the local municipality level.

- » Depending on the electricity tariff the project will be elected with, the project will contribute towards the local community within or above the required criteria set by the DoE (Department of Energy).
- » Projects will be identified in collaboration with the Local Municipality and community representatives to ensure alignment with the key needs identified through the Integrated Development Planning process.

Employment and procurement:

It is important to recognise that the nature of the project dictates that large proportions of specialist skills and materials will have to come from outside of South Africa as well as the local municipal area with a high portion of international imports. However, the objective of enhancement is to optimise opportunities for employment/procurement of local people/suppliers or alternatively that employment and procurement opportunities are enhanced on a regional or national basis, where possible.

The following measures will be implemented to ensure that employment of local people is maximised and procurement of local, regional and national services is maximised:

- » The developer will establish a recruitment and procurement policy which sets reasonable targets for the employment of South African and local residents /suppliers (originating from the local municipalities) and promote the employment women as a means of ensuring that gender equality is attained. Criteria will be set for prioritising, where possible, local (local municipal) residents/suppliers over regional or national people/suppliers. All contractors will be required to recruit and procure in terms of the developer's recruitment and procurement policy.
- » The developer will work closely with relevant local authorities, community representatives and organisations to ensure that the use of local labour and procurement is maximised. This may include:
  - ∗ Sourcing and using available databases on skills/employment-seekers that local authorities may have;
  - ∗ Advertising job opportunities and criteria for skills and experience needed through local and national media; and
  - ∗ Conducting an assessment of capacity within the Local Municipalities and South Africa to supply goods and services over the operational lifetime of the proposed project.
- » No employment will take place at the entrance to the site. Only formal channels for employment will be used.
- » All skill requirements to be communicated to the local communities via appointed people prior to the commencement of the construction phase.

- The project developer to work closely with the wind turbine suppliers to provide the requisite training to the workers. The training provided will focus on development of local skills.
- Ensure that the appointed project contractors and suppliers have access to Health, Safety, Environmental and Quality training as required by the Project. This will help to ensure that they have future opportunities to provide goods and services to the sector.

The implementation of the above measures would ensure that the construction impacts remain of moderate significance and ensure that the significance of the operation impact remains a moderate positive. The pre- and post- enhancement impacts are compared in the table below.

Pre- and Post- Enhancement Significance: Benefits for the Local Economy

Phase	Significance (Pre-enhancement)	Residual Impact Significance
Construction	**Moderate (+VE)**	**Moderate (+VE)**
Operation	**Moderate (+VE)**	**Moderate (+VE)**

8.8.2 Increased Social Ills Linked to Influx of Workers and Job-Seekers

The introduction of construction activity in remote, rural environments can sometimes bring about social change. This change is typically due to an influx of workers and job-seekers into the area. As a worst-case scenario, these changes have been known to increase levels of crime, drug and alcohol abuse, increased incidence of sex workers, and domestic violence.

The proposed project area is located outside town in a predominantly rural setting. The population density of the immediate area is low and the majority of land is farmland. The only people living on the proposed project site and on the neighbouring farms are the landowners and their farm workers. An influx of ‘outsiders’ could pose a risk to existing family structures and social networks.

The table below provides a summary of the increased social ills impact at the construction and operational phases of the proposed project as well as an indication of the stakeholders that may be affected.

Impact Characteristics: Increased Social Ills

Summary	Construction	Operation
Project Aspect/ activity	Construction staff on site and potential influx of job-seekers.	Operation staff on site.
Impact Type	Direct and indirect, negative	Direct, negative impact

	impact	
Stakeholders/ Receptors Affected	Local residents of the area, more specifically landowners of directly affected farms and neighbouring farms.	Local residents of the area, more specifically landowners of directly affected farms and neighbouring farms.

Construction Phase Impacts

Due to the early phase of this proposed project, specific arrangements have not yet been made regarding worker accommodation and terms of employment, however farmers have requested that construction workers do not stay on the farms. Given that the proposed project is located along the arterial road R354, it is likely that the workers (from outside the area) will be accommodated in/close to the town of Laingsburg. This will increase the levels of interaction with the local communities. The majority of workers are likely to be male and living away from their families. There are existing problems associated with substance abuse in the community. The increased disposable income from the jobs that will be created could be spent on drugs and alcohol, exacerbating social ill affecting the community.

The most likely social ills that may occur as a result of the increased number of workers and job-seekers are described below.

» Theft of livestock is already problematic on farms located close to towns, roads and in areas where construction work is taking place. It is likely that stock theft will continue and possibly increase during the construction phase. Landowners believe that there are syndicates operating in the area. This has led to some farmers hiring full time guards to walk the fences of their farms weekly. The improved road network proposed for the project site will allow for increased access to the site, thus potentially exacerbating the problem of stock theft.
» Petty crimes (e.g. theft of tools, household items and farm materials) on the project affected farm and neighbouring farms could occur.
» An increase in disposable income within the project area (among workers) could result in an increase in alcohol and drug abuse, increased incidences of prostitution and casual sexual relations. These sexual relations could result in increased incidents of HIV/AIDS and increased numbers of unwanted pregnancies.

The skilled workers are likely to be housed in formal accommodation facilities and are unlikely to exacerbate this impact and the low skilled workers are likely to be local residents and as such already part of the community social structures and family networks.

Construction Impact: Increased Social Ills

Nature: The social ills likely to accompany the Project would be regarded as an **indirect, negative** impact. Livestock theft is likely to increase as a result of improved road access and increased activity on the farms. Social ills such as drug and alcohol abuse as well as petty crime may increase due to increased disposable income.
Impact Magnitude – **Medium**
Extent: It is anticipated that the potential social ills will have impacts at the **local** scale.
Duration: The social ills likely to accompany the proposed project are expected to be **short-term,** for the duration of the construction phase of the project.
Intensity: The intensity will be **high** as people may struggle to adapt in relation to stock theft as well as other social ills.
Likelihood – It is **likely** that this impact will occur during the construction phase.
Impact Significance (Pre-Mitigation) – Moderate (-VE)
Degree of Confidence: The degree of confidence is **medium** given that the extent of the influx of job-seekers is unknown.

Operation Phase Impacts

During the operational phase, there are going to be a limited number of workers and/or contractors on site. As such, it is unlikely that there will be any social ills linked to the project activities.

Stock theft will probably decrease dramatically in the operation phase as farmers would have taken the necessary steps to curb stock theft. The improved access roads will continue to ease access to the farms for the duration of the lifespan of the project.

Operational Impact: Increased Social Ills

Nature: The social ills (including stock theft) likely to accompany the proposed project would be regarded as an **indirect, negative** impact.
Impact Magnitude –**Low**
Extent: It is anticipated that the potential social ills and stock theft will have impacts at the **local** scale.
Duration: The social ills likely to accompany the proposed project are expected to be **temporary**.

Intensity: The intensity will be **Low** as people should be able to adapt with relative ease. **Likelihood –** It is **likely** this impact will occur during the operation phase. **Impact Significance (Pre-Mitigation) – Minor (-VE)** **Degree of Confidence:** The degree of confidence is **medium** given that the extent of the influx of job-seekers is unknown.

Mitigation

Mitigation measures include:

» The developer and its appointed contractors to develop an induction programme, including a Code of Conduct, for all workers (the developer and contractors including their workers) directly related to the project. A copy of the Code of Conduct to be presented to all workers and signed by each person.
» The Code of Conduct must address the following aspects:
    * respect for local residents;
    * respect for farm infrastructure and agricultural activities;
    * no hunting or unauthorised taking of products or livestock;
    * zero tolerance of illegal activities by construction personnel including: unlicensed prostitution; illegal sale or purchase of alcohol; sale, purchase or consumption of drugs; illegal gambling or fighting;
    * compliance with the Traffic Management Plan and all road regulations; and
    * description of disciplinary measures for infringement of the Code and company rules.
» If workers are found to be in contravention of the Code of Conduct, which they signed at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. Stock theft should be noted as a dismissible offence.
» The developer will implement a grievance procedure that is easily accessible to local communities, through which complaints related to contractor or employee behaviour can be lodged and responded to. The developer will respond to all such complaints. Key steps of the grievance mechanism include:
    * circulation of contact details of 'grievance officer' or other key developer contacts;
    * awareness raising among local communities (including all directly affected and neighbouring farmers) regarding the grievance procedure and how it works; and
    * establishment of a grievance register to be updated by the developer, including all responses and response times.
» The project developer and its contractors will develop and implement an HIV/AIDS policy and information document for all workers directly related to

the project. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS. The developer will make condoms available to employees and all contractor workers.

» The construction workers (from outside the area) should be allowed to return home over the weekends or on a regular basis to visit their families; the contractor should make the necessary arrangement to facilitate these visits.

The implementation of the above mitigation measures could ensure that the construction impacts decrease from moderate to minor significance and the operation impacts reduce from minor to negligible significance. The pre- and post-mitigation impacts are compared in the table below.

Pre- and Post- Mitigation Significance: Increased Social Ills

Phase	**Significance (Pre-mitigation)**	**Residual Impact Significance**
Construction	**Moderate (-VE)**	**Minor (-VE)**
Operation	**Minor (-VE)**	**Minor (-VE)**

8.8.3 Disruption to Agricultural Activities

The primary activity is sheep farming but some farmers also practice crop farming such as onion seeds, onions, lucerne (alfalfa), and oats, depending on the availability of water on the individual farms. The Roggeveld site is predominantly a winter rainfall area, as such; farmers keep their sheep on the Roggeveld farm during the winter months and move them during the summer months. Where a landowner only has land within the Roggeveld area, the sheep are rotated between the farms/camps as dictated by water availability and the condition of the vegetation on the individual farms. The individual camps on each farm are fenced off and gated in order to manage the grazing impact in a particular area.

The table below provides a summary of the disruption to agricultural facilities impact at the construction and operational phases of the proposed project as well as an indication of the stakeholders that may be affected.

Impact Characteristics: Disruption to Agricultural Activities

Summary	**Construction**	**Operation**
Project Aspect/ activity	Construction activities. Access through farm gates. Employment of local workers.	Operation activities. Access through farm gates.
Impact Type	Direct, negative impact.	Direct, negative impact.
Stakeholders/ Receptors	Directly affected farmers, and	Directly affected farmers, and

Affected	neighbouring farmers.	neighbouring farmers.

Construction Phase Impacts

Construction phase activities include site clearance, road construction, assembly and installation of wind turbines, as well as the construction of associated infrastructure. During construction, the farmers will need to keep their livestock in alternate camps to the construction area in order to ensure that the stock are not harmed or lost as a result of the intensive construction activities.

The farms are divided into camps and in order to access the full proposed project site it will be necessary for the construction team to travel between camps; requiring them to open and close gates as they move. They will, at times, also be required to travel across/alongside neighbouring farms to reach the selected sites. It is critical that the gates are always closed once the team has passed in order to secure the stock.

The high traffic volumes of light and heavy vehicles that will be passing through the farm camps are likely to cause damage to the gates and fencing. Any damage to this infrastructure could also lead to stock losses.

Construction Impact: Disruption to Agricultural Activities

Nature: The disruption to agricultural activities would be regarded as a **direct, negative** impact.
Impact Magnitude – **Medium**
Extent: It is anticipated that the disruption to agricultural activities will be experienced at the **local** level.
Duration: The disruptions will be experienced during the construction phase and as such will be **short-term**.
Intensity: The intensity will be **medium** as the farmers will have some difficulty adapting to the disruption without some degree of support and compromise.
Likelihood – This impact will **definitely** occur during the construction phase.
Impact Significance (Pre-Mitigation) – Moderate (-ve)
Degree of Confidence: The degree of confidence is **high.**

Operation Phase Impacts

The disruption of farm activities during the operational phase is going to be significantly less. There will be substantially fewer vehicles on site and the stock will not be limited to the camps that are unaffected by the proposed project. During operation, the stock will be able to graze in all the camps as the proposed project activities will not affect their ability to graze. As with the construction phase, access to the site will be through a range of gates that separates farms and camps and it is imperative that operational staff be vigilant in closing gates in order to protect against stock losses.

Operational Impact: Disruption to Agricultural Activities

Nature: The disruption to agricultural activities would be regarded as a **direct, negative** impact.
Impact Magnitude – **Low**
Extent: It is anticipated that the disruption to agricultural activities will be experienced at the **local** level.
Duration: The disruptions will be experienced throughout the operation phase and as such will be **long-term**.
Intensity: The intensity will be **low** as the farmers will be able to adapt with relative ease during the operational phase.
Likelihood – It is **likely** that this impact will occur during the operational phase.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high.**

Mitigation

Mitigation measures include:

- Construction schedule should be determined in consultation with individual farmers such that they have forewarning to adapt farming practises and minimise disturbances. Given the area is predominantly used during the winter months it may be preferential to farmers if the schedule could take this into account.
- All workers will agree to the Code of Conduct and be aware that contravention of the Code could lead to dismissal.
- All directly affected and neighbouring farmers will be able to lodge grievances with the developer using the Grievance Procedure.

The implementation of the above mitigation measures would reduce the construction impacts from moderate to minor significance and the operation impacts from minor to negligible. The pre- and post-mitigation impacts are compared in the table below.

Pre- and Post- Mitigation Significance: Disruption to Agricultural Activities

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**ModeratE (-VE)**	**Minor (-VE)**
Operation	**Minor (-VE)**	**Negligible**

8.8.4 Loss of Agricultural Land

Currently, there are three relevant pieces of legislation that apply to the change of land use; they are the Western Cape Land Use Planning Ordinance 15 of 1985, the Western Cape Planning and Development Act No 7 of 1999 and the Subdivision of Agricultural Land Act No 70 of 1970. The Department is reviewing the suitability of the current 'land departure' application for changes in land use from agriculture to an increasingly greater number of renewable energy facilities. There is a possibility that a new section will be added to the ordinance that will address land rezoning and land departures to accommodate wind facilities.

In addition, the Department of Energy, National Department of Agriculture Forestry and Fisheries (DAFF) guidelines for the regulation of wind farm uptake of agricultural land has relevance. The guidelines state the following: No wind farming structures, its footprint, service area, supporting infrastructure or access routes in any form or for any purpose will be allowed:

» On high potential or unique agricultural land as has been determined or identified by DAFF or the relevant provincial Department of Agriculture through its existing or future developed spatial information data sets and /or through a detail agricultural potential survey.
» On areas currently being cultivated (cultivated fields/ production areas) or on fields that have been cultivated in the last ten years. This is relevant to cultivated land utilised for dry land production as well as land under any form of irrigation.
» To intervene with or impact negatively on existing or planned production areas (including grazing land) as well as agricultural infrastructure (silos, irrigation lines, pivot points, channels, feeding structures, dip tanks, grazing camps, animal housing, farm roads etc).
» To result in a degradation of the natural resource base of the farm or surrounding areas. This include, but are not limited to, the limit of soil degradation or soil loss through erosion or any manner of soil degradation, the degradation of water resources (both quality and quantity) and the degradation of vegetation (composition) and condition of both natural or established vegetation.

The agricultural potential of the site is limited and low. The table below provides a summary of the loss of agricultural land impact at the construction and operation phases of the proposed project as well as an indication of the affected stakeholders.

Impact Characteristics: Loss of Agricultural Land

Summary	**Construction and Operation**
Project Aspect/ activity	Land take for the construction and operation of facility.
Impact Type	Direct, negative impact.
Stakeholders/ Receptors Affected	Directly affected land owners, Local, Provincial and National Government.

The construction and operation of the proposed wind farm will require that approximately 2% to 3% of the identified land parcel/s will be taken for the construction and operation of the wind farm.

The damage to vegetation as a result of construction activities was one of the key concerns landowners expressed. Despite supplementing grazing, farmers rely heavily on natural grazing vegetation. The natural vegetation is sensitive to disturbance and damage to it will have long-lasting impacts.

Construction and Operation Impact: Loss of Agricultural Land

Nature: The impact on agricultural land is going to be experienced as a **direct, negative** impact.
Impact Magnitude – Low
Extent: The impact on agricultural land resulting from the construction and operation activities will occur at the **local/regional** level.
Duration: This impact will occur for the duration of the construction and operation phases and will therefore be **long-term**.
Intensity: The intensity will be **low** as limited agricultural land will be lost.
Likelihood – This impact will **definitely** occur.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high**.

Mitigation

The objective of mitigation is to minimise the loss of agricultural land resulting from project related activities during construction and operational phases. Specific measures include:

- Design the infrastructure layout in a manner that limits the footprint of the facility and all associated infrastructure.
- Provide the farmers with GPS coordinates of the areas that will be affected such that farmers can actively monitor affected areas.
- Community Development Fund will seek to increase the extent of farming or the intensity of farming practice in order to counter the effects of land loss.
- Minimise the damage caused by construction activities to the farmland by ensuring strict compliance with construction plans and worker 'Code of Conduct'.
- Any damage to vegetation will be rehabilitated in accordance with mitigation proposed for the rehabilitation of natural vegetation.

The implementation of the above mitigation measures would ensure that the construction and operation impacts remain of minor significance. The pre- and post-mitigation impacts are compared in the table below.

Pre- and Post- Mitigation Significance: Loss of Agricultural Land

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction and Operation	**MinoR (-VE)**	**Minor (-VE)**

8.8.5 Tourism Activities

The tourism sector is reported to have experienced growth although the tourism activities in close proximity to the site are limited. The tourist attractions in the areas mainly relate to heritage and natural beauty of the area. The arterial road, R354 is an important scenic and tourist route.

Impact Characteristics: Tourism Activities

Summary	Construction	Operation
Project Aspect/ activity	Construction of the wind farm.	Operation of the wind farm.
Impact Type	Direct, negative impact	Direct, positive impact.
Stakeholders/ Receptors Affected	Directly affected landowner, neighbouring landowners (including 'lifestyle farmers'), road users, and interested people.	Tourists to the area, directly affected landowners, neighbouring landowners (including 'lifestyle farmers'), road users, and interested people.

Construction Phase Impacts

The construction of the wind farm will result in noise, visual, traffic and a changed sense of place. These factors are unlikely to have a significant impact on tourism in the area due to the proximity of the site to tourist facilities in the affected local municipalities.

Construction Impact – Negative Tourism Activities

Nature: The impact on tourism activities could be experienced as a **direct, negative** impact by tourists using the arterial road R354 and the subsequent loss to the scenic value of some places along the route.
Impact Magnitude – **Low**
Extent: The impacts on tourism linked to the construction activities will occur at the **local** level.
Duration: This impact will occur throughout the construction phase, and will therefore be **temporary**.
Intensity: The intensity will be **low** as those who are directly affected will be able to adapt with relative ease.
Likelihood – It is **likely** that this impact will occur during the construction phase.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **medium** given that there are no recorded experiences relating to similar developments in South Africa or other developing countries.

Operation Phase Impacts

Operation of the wind farm is not predicted to have a generally negative impact on tourism-related activities in the area. It is most likely that the proposed project will have a positive impact in terms of attracting interest from passing travellers and interested people. Given the lack of information, it is not known how long this will remain an attraction.

The site is located alongside the R354 arterial road and is fairly isolated from tourist attractions such as the heritage site village of Matjiesfontein and the Tankwa Karoo National Park. The visual impact assessment notes that the wind farm will be highly visible from the R354 which is an important tourist route, with a high scenic value in places. There are no tourism facilities on the proposed project site, but landowners have mentioned the development of tourism activities as one of their expansion plans.

The area is valued by the 'lifestyle farmers' who own neighbouring farmland; they use their farms for recreational purposes, conservation and as a peaceful escape from the city (this is discussed in the section: 'Sense of Place').

Operational Impact - Positive: Tourism Activities

Nature: The impact on tourism activities is most likely going to be a **direct, positive** impact for most receptors. It will, however be experienced as a **direct, negative** impact by 'lifestyle farmers' who use their farms for tourism and some tourists that will not value the change to the area

Impact Magnitude – Low

Extent: The impacts on tourism linked to the operational activities will occur at the **local** level.

Duration: This impact will occur throughout the operational phase, and will therefore be **long-term**.

Intensity: The intensity will be **medium** as those who are directly affected will experience positive impacts that they will adapt to a benefit from directly.

Likelihood – It is **likely** that this impact will occur during the operational phase. The likelihood rating is influenced by the positive international experience.

Impact Significance (Pre-Enhancement) – Minor (+ve)

Degree of Confidence: The degree of confidence is **medium** given that there are no recorded experiences relating to similar developments in South Africa or other developing countries

Operational Impact - Negative: Tourism Activities

Nature: The impact on tourism activities could be experienced as a **direct, negative** impact by 'lifestyle farmers' who will not value the change to the area. It is, however, most likely going to be a **direct, positive** impact for most receptors.

Impact Magnitude – Medium

Extent: The impacts on tourism linked to the operational activities will occur at the **local** level.

Duration: This impact will occur throughout the operational phase, and will therefore be **long-term**.

Intensity: The intensity will be **medium** as those who are directly affected will be able to adapt with some difficulty. No significant tourist sites currently exist in the immediate area and the site.

Likelihood – It is **unlikely** that this impact will occur during the operational phase. This rating is largely based on perceptions/ feedback of some directly affected and interested stakeholders.

Impact Significance (Pre-Mitigation) – MINOR (-ve)

Degree of Confidence: The degree of confidence is **medium** given that there are no recorded experiences relating to similar developments in South Africa or other developing countries.

Mitigation

The objective of mitigation is to enhance the positive impacts and minimise the negative impacts of the wind farm on tourism activities in the area.

Specific measures include:

» Apply all mitigation measures to reduce the noise and visual impacts as presented in Sections 8.5 and 8.6).
» The developer will work with the Local Municipality and local tourism organisations to raise awareness about the wind farm.
» The developer will establish an information kiosk/notice board on the site boundary or entrance to facilitate educating the public about the need and benefits of the project. This is aimed at instilling the concept of sustainability and creating awareness by engaging the community and local schools. Information brochures and posters will be made available at the kiosk to provide more information about the facility. These should be presented in the appropriate languages to maximise the benefits.

The implementation of the above mitigation measures should enhance the positive operational impacts from minor to moderate (positive) significance and the negative operation impacts from minor to negligible (negative) significance. The pre- and post-mitigation impacts are compared below.

Pre- and Post- Mitigation Significance: Tourism Activities

Phase	**Significance (Pre-mitigation)**	**Residual Impact Significance**
Construction NEGATIVE	**Minor (-VE)**	**Negligible**
Operation POSITIVE	**Minor (+VE)**	**Moderate (+VE)**
Operation NEGATIVE	**Minor (-VE)**	**Negligible**

8.8.6 Property Prices and Desirability of Property

There are relatively few wind farms in developing countries and certainly no studies reviewing the impacts of wind farms on property prices in developing countries. As such, we rely heavily on learnings from research that has been undertaken in developed countries.

The table below provides a summary of the impact on property prices and desirability for the construction and operation phases of the proposed project as well as an indication of the stakeholders that may be affected.

Impact Characteristics: Property Prices and Desirability of Property

Summary	**Construction and Operation**
Project Aspect/ activity	Existence and Operation of the wind farm.
Impact Type	Direct, negative impact (for neighbouring landowners). Direct, positive impact (for directly affected landowners).
Stakeholders/ Receptors Affected	Neighbouring property owners and directly affected landowners.

Construction and Operation Phase Impacts

According to personal communication with a property evaluator from the Land Bank [15], it is believed that the market value of the directly affected farms will increase because of the increased revenue generated from the wind turbines. Depending on the amount of land used for the development, the production value (burden that the property can carry) of the farms is likely to remain the same for the directly affected farms and the neighbouring farms. Farm values are primarily calculated according to the production value and farm infrastructure. The directly affected landowners will be receiving a steady income from leasing a portion of the farm.

There is often an assumption that the presence of wind farms in an area has a negative impact on nearby property prices. There is, however, little evidence to support this assumption. Given that there are no large-scale fully operational wind facilities in South Africa, we have to rely on international research that has been undertaken in terms of the value of property prices in relation to wind energy facilities.

A study was undertaken by Poletti and Associates for Invenergy Wind LLC in the states of Wisconsin and Illinois, USA. The aim of the study was to compare sales of homes and farming properties within an area close to wind energy facilities to other properties (with similar characteristics) in an area far from wind energy facilities [16]. The study looked at property sales from 1998 through to 2006. The results of the studies were:

- Area 1 which was located in Wisconsin had two operational wind farms active since 1998. The results indicated that there were no measurable differences in

(15) Personal Comms, Mr Riaan Veragie, Beaufort West Land Bank, July 2010.

(16) A Real Estate Study of the Proposed White Oak Wind Energy Centre, McLean and Woodford Counties, Illinois, January 2007. http://amherstislandwindinfo.com/propertyvaluestudy.pdf

home values in close proximity to the facility to those located further away from the wind farm [17]. These results were based on the analysis of 87 residential and farmland sales for the areas.

- Area 2, located in the state of Illinois had one wind farm which had been operating since 2003. The analysis of 69 residential and farmland property sales revealed that there were no measurable difference in the home values between the area close to a wind farm and the area further away from a wind farm [18].

A follow up investigation in 2007 of the same two study areas was conducted. The investigation revealed that the property prices continued to increase and the local government had approved the construction of new houses in the area close to the wind farm. These new houses were selling very well and fast.

It is very difficult to apply the findings of these studies to the South African context. The lessons learnt internationally can provide us with some understanding of what might happen but the reality is that we cannot be certain. The assessment of this impact is conservative given the high level of uncertainty.

The presence of lifestyle farming in the project area has caused the property values to increase and in some cases the size of the land parcels to decrease. Given the tough farming conditions, many farmers were forced to sell portions of their farms for additional income. The demand by 'lifestyle farmers' for land and the development of new infrastructure has resulted in increased land prices; however, the agricultural value of the land has generally remained the same.

The introduction of the wind farms will cause a dramatic increase in the value of the directly affected farms. It is not clear exactly how the wind farm will affect the neighbouring farms but it is unlikely to change the value of the land from an agricultural perspective. It is possible that the land will be less attractive to 'lifestyle farmers'; however, the research has shown that property prices will continue to increase despite the presence of the wind farm.

Construction and Operational Impact: Property Prices and Desirability of Property

(17) A Real Estate Study of the Proposed White Oak Wind Energy Centre; McLean and Woodford Counties, Illinois, January 2007. http://amherstislandwindinfo.com/propertyvaluestudy.pdf
(18) A Real Estate Study of the Proposed White Oak Wind Energy Centre; McLean and Woodford Counties, Illinois, January 2007. http://amherstislandwindinfo.com/propertyvaluestudy.pdf

Nature: The impact on property prices is going to be experienced as a **direct, negative** impact on indirectly affected properties initially. It is not certain how this will change over time.
Impact Magnitude – Low
Extent: The impact on property prices resulting from the operation of the wind farm will occur at the **local** level.
Duration: This impact will occur for the duration of the operation phase and will therefore be **long-term**.
Intensity: The intensity will be **low** as research shows that there is unlikely to be a decrease in property prices.
Likelihood – It is **likely** that this impact will occur.
Impact Significance (Pre-Mitigation) – Minor (-VE)
Degree of Confidence: The degree of confidence is **low** given the high levels of uncertainty and lack of South Africa specific information.

** The directly affected farms are likely to experience a direct, positive impact - this has not been assessed given that their contracts with the project development company and the associated benefits are private. All pros and cons of the proposed development would have been considered in a private capacity.*

Mitigation

The objective of mitigation is to minimise the negative impacts on property prices. Specific measures include:

» Design the infrastructure layout in a manner that limits the footprint of the facility and all associated infrastructure.
» Apply all mitigation measures to reduce the noise and visual impacts.
» Prepare a site Rehabilitation Plan that will be implemented as part of the decommissioning phase.
» All directly affected and neighbouring farmers will be able to lodge grievances using the Grievance Procedure.

The implementation of the above mitigation measures should ensure that the significance rating remains one of minor significance during the construction/operation phases. The pre- and post-mitigation impacts are compared in the table below.

Pre- and Post- Mitigation Significance: Property Prices and Desirability of Property

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction and Operation	**Minor (-VE)**	**MINOR (-VE)**

8.8.7 Sense of Place

The proposed project site at Roggeveld is located in an area that is relatively undisturbed. It lies alongside an Arterial Road (R354), between Matjiesfontein and Sutherland. The farm is rural and isolated in parts. The farm is neighboured by 'lifestyle farmers' who place a high value on the peaceful nature of the area; they use their farms for recreational purposes and as a peaceful escape from the city.

Wind farms and their associated infrastructure can change the visual and acoustic character of an area by introducing large-scale structures and machinery into previously undeveloped areas, particularly in rural areas. This includes the wind turbines themselves, as well as power lines, substation, maintenance staff, vehicles and maintenance equipment.

Impact Characteristics: Sense of Place

Summary	**Construction**	**Operation**
Project Aspect/ activity	Clearing and stripping of vegetation and topsoil for construction of proposed project infrastructure. Increased traffic. Visual and noise disturbances. Influx of workers and job-seekers.	Operation of wind farm and associated infrastructure - visibility of built structures, lighting, noise, operational traffic. Traffic slowing resulting from people looking at the facility.
Impact Type	Direct, negative impact (as related to project activities). Indirect, negative impact (as related to non-project activities e.g. influx of workers and jobseekers).	Direct, negative impact (as related to project activities). Indirect, negative impact (as related to non-project activities e.g. traffic slowing).
Stakeholders/ Receptors Affected	Directly affected landowners, neighbouring landowners (including 'lifestyle farmers'), local communities, tourists, and drivers passing on the Arterial Road (R354).	Directly affected landowners, neighbouring landowners (including 'lifestyle farmers'), local communities, tourists, and drivers passing on the Arterial Road (R354).

Construction Phase Impacts

During the construction phase, there will be a significant increase in the number of people (workers), noise generated, visual disturbances and traffic resulting directly from the construction activities. It is likely that there will also be an increase in the number of people as a result of an influx of job-seekers.

These factors are going to further disturb the area alongside the arterial road. The R354 is the primary access route to the site used by local farmers and construction phase activities will substantially increase the traffic volume in the area. The relative speeds of road users compared to heavy construction vehicles could pose a risk to increase road accidents in the area. The construction period is limited in time; as such, these disturbances should not continue for longer than 24 months for Phase 1.

Construction Impact: Sense of Place

Nature: The impact on sense of place is most likely going to be experienced as a **direct, negative** impact by the affected stakeholders.
Impact Magnitude – **Low**
Extent: The impact on sense of place linked to the construction activities will occur at the **local** level.
Duration: This impact will occur for the duration of the construction phase, approximately 24 months, and will therefore be **short-term**.
Intensity: The intensity will be **low** as those who are directly affected will be able to adapt with relative ease; they are willingly participating in the proposed project.
Likelihood – It is **likely** that this impact will occur during the construction phase.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high**.

Operation Phase Impacts

Given the relatively undisturbed area in which the proposed project will be located, there were concerns raised regarding the visual and noise impacts related to the facility. Concerns were raised by directly affected land owners as well as selected groups of stakeholders who do place a high value on the land, namely neighbouring landowners (most notably the 'lifestyle farmers').

Most of the directly affected landowners were not concerned about the transformed visual environment and did not think that the turbines would make much noise. Another development planned for the area is the Space Geodesy Observation. According to Prof. Combrinck the area was chosen because of "the clean, clear skies, low horizon for satellite laser ranging purposes and for being relatively free of radio frequency interferences". However, given that the Roggeveld site is approximately 25 km form the planned Space Geodesy Observation site it is anticipated that this would not pose an impact.

The majority of receptors are unlikely to experience disruptions to the sense of place as they are located relatively far from the proposed project site. Those receptors that are passing through the area are mostly likely going to value the experience of viewing the wind farm en route to other destinations.

Operational Impact: Sense of Place

Nature: The impact on sense of place is most likely going to be experienced as a **direct, negative** impact by the directly affected stakeholders.
Impact Magnitude – **Medium**
Extent: The impact on sense of place linked to the operation activities will occur at the **local** level.
Duration: This impact will occur for the duration of the operation phase and will therefore be **long-term**.
Intensity: The intensity will be **high** for the small number of receptors who value the peaceful nature of the area as it will be difficult for them to adapt to the change. For the remainder of the stakeholders, the intensity will be negligible.
Likelihood – It is **definite** that this impact will occur during the operation phase.
Impact Significance (Pre-Mitigation) – Moderate (-ve)
Degree of Confidence: The degree of confidence is high.

Mitigation

The objective of mitigation is to minimise, wherever possible, the impacts on sense of place by ensuring that all visual and noise impacts (amongst others) are addressed during construction and operation.

Specific measures include:

» Apply all mitigation measures to reduce the visual and noise impacts.
» The construction activities will be undertaken in accordance with a schedule that will be approved by the landowners.
» All workers will agree to the Code of Conduct and be aware that contravention of the Code could lead to dismissal.
» All directly affected and neighbouring farmers will be able to lodge grievances with the project developers using the Grievance Procedure.

The implementation of the above mitigation measures would reduce the construction impacts from minor to negligible significance and the operation impacts from moderate to minor negative significance. The pre- and post-mitigation impacts are compared in the table below.

Pre- and Post- Mitigation Significance: Sense of Place

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**Minor (-VE)**	**Negligible**
Operation	**Moderate (-VE)**	**Minor (-VE)**

8.8.8 Road Infrastructure

The site straddles the Northern Cape and Western Cape Provinces. It is located approximately 40km south of Sutherland and approximately 20km north of Matjiesfontein; it is accessed from the R354 arterial road.

The table below provides a summary of the impact on the infrastructure for the construction and operation phases of the proposed project as well as an indication of the stakeholders that may be affected.

Impact Characteristics: Road Infrastructure

Summary	Construction	Operation
Project Aspect/ activity	Construction activities, including the transport of abnormal loads by heavy vehicles. Upgrade of construction roads and construction of new roads to enable access to proposed project site.	Operation activities, including site inspection, maintenance and repairs. Road maintenance.
Impact Type	Direct (as linked to project activities). Indirect (as linked to increased road users).	Direct (as linked to project activities). Indirect (as linked to increased additional road users).
Stakeholders/ Receptors Affected	Current road-users, most notably the directly affected landowners, the neighbouring landowners, farm workers and service providers.	Current road-users, most notably the directly affected landowners, the neighbouring landowners, farm workers and service providers.

Construction Phase Impacts

The construction of the proposed wind farm and associated infrastructure will increase the amount of traffic on local roads during the construction phase as the majority of deliveries will be road freighted to site.

The roads in the area will need to be upgraded to facilitate the movement of these large vehicles (potentially requiring widening, removing corners, levelling). A number of new roads will need to be constructed to enable access to the site and between the individual wind turbines on site. These will be constructed in accordance with the wind turbine supplier requirements.

The developer will maintain the local roads in good working order during the construction phase. The developer will engage with the local roads authority prior to the road upgrades and construction to ensure that their requirements are being met. The majority of the local roads that are going to be upgraded and maintained by the developer are private farm roads that are not used by commuters or tourists. The upgrades to these roads may result in increased numbers of road users.

The existing roads are gravel and sand roads that are often impassable as a result of heavy rains or excessive use. The large numbers of heavy construction vehicles and potentially the increased number of road users will create further damage to the existing farm roads.

Construction Impact: Road Infrastructure

Nature: The pre-mitigation impact of traffic on local road users will have a **direct, negative** impact in terms of road quality.
Impact Magnitude – **Medium**
Extent: An increase in traffic will affect local roads, and is therefore **local** (as per the scope of this study).
Duration: This increase in construction traffic and road deterioration will be for the construction phase, and will thus be for the **short-term**.
Intensity: The intensity will be **high** as those who are directly affected will not be able to continue current activities without intervention.
Likelihood – It is **definite** that this impact will occur during the construction phase.
Impact Significance (Pre-Mitigation) – Moderate (-ve)
Degree of Confidence: The degree of confidence is **high**

Operation Phase Impacts

During the operational phase, there are unlikely to be a large number of project vehicles accessing the site. The vehicles will be associated with regular site checks and maintenance and repair vehicles. These are unlikely to be large vehicles; however, when large-scale maintenance or upgrades are required, heavy vehicles will be required to access the site.

During the operation phase, the on-site access roads will be maintained by operations personnel. It is not anticipated that significant amount of public road upgrades will be required during the operations phase. Where the proposed facility causes damage to the road during the operation phase the developer will promptly repair the damage. The maintenance of the roads were a key concern raised by land owners as they fear that should the roads not be sufficiently maintained it could lead to considerable erosion damage. The upgrades to, and maintenance of, these roads will benefit a small number of people given that the roads are primarily private farm roads.

Operational Impact: Road Infrastructure

Nature: The pre-mitigation impact of traffic on local roads users will have a **direct, negative** impact in terms of road quality.
Impact Magnitude – **Low**
Extent: An increase in traffic will affect local roads, and is therefore **local** (as per the scope of this study).
Duration: The traffic will continue for the full operational phase, and will therefore be for the **long-term**.
Intensity: The intensity will be **negligible** as those who are directly affected will be able to adapt with relative ease given that the proposed project vehicles will be small and relatively infrequent as compared to the construction phase.
Likelihood – It is **definite** that this impact will occur during the operation phase.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high**.

Mitigation

The objective of mitigation is to minimise impacts on roads in the local area and as far as possible improve the state of existing roads, thus creating a positive contribution in terms of improving road infrastructure.

Specific measures include:

- Construct new roads in the local area and on the farms to enable access to the site and implement recommendations of the vegetation specialist.
- Upgrade existing roads that will be used during the construction and operational phases of the proposed project.
- All road construction and upgrades will be undertaken with the consent of the directly affected landowners and where relevant, the Local Municipality.
- All roads that will be used during the operational phase of the project will be maintained by the project developer throughout the life of the proposed project.

The implementation of the above mitigation measures would convert the construction impacts from moderate negative to minor positive significance and the operation impacts from minor negative to minor positive. The reason that the post-mitigation impact is one of minor significance and not higher is that the positive impact will only be experienced by a limited number of people. The pre- and post-mitigation impacts are compared in the table below.

Pre- and Post- Mitigation Significance: Road Infrastructure

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**Moderate (-VE)**	**Minor (+VE)**
Operation	**Minor (-VE)**	**Minor (+VE)**

8.8.9 Conclusions & Recommendations

The development of Phase 1 of the Roggeveld wind farm will have positive and negative social impacts. Positive economic impacts are expected. The social impacts can be managed and enhanced to benefit local communities and society at large.

ASSESSMENT OF OTHER IMPACTS ASSOCIATED WITH PHASE 1 OF THE ROGGEVELD WIND FARM: CHAPTER 9

This chapter of the final EIA report deals with other impacts (apart from those identified in Chapter 8) associated with Phase 1 the Roggeveld Wind Farm. This information is derived from and acknowledged from the Final EIR compiled by ERM.

9.1 Air Quality

Impact Description and Assessment

This section considers the impacts to air quality during the construction and operation of Phase 1 of the Roggeveld Wind Farm. Potential impacts likely to arise during the construction and the operational phases of the development are summarised in Table 9.0, below. It should be noted that development of wind-powered electrical generation, such as the proposed Phase 1 of the Roggeveld Wind Farm would result in an improvement to air quality by offsetting emissions created by fossil-fuel-burning power plants. However, during construction there may be short-term localised air quality impacts. Temporary, minor adverse impacts to air quality may result from the operation of construction equipment and vehicles. Impacts to ambient air quality are likely to arise from the following:

» dust generated during clearing of vegetation and by the preparation of site surfaces by earthworks;
» dust generated from vehicles on site travelling along unpaved access roads; and
» exhaust emissions from vehicles during construction.

Table 9.0 Impact Characteristics: Air Quality

Summary	Construction	Operation
Project Aspect/ activity	Vehicle movement on gravel / dirt roads. Soil disturbance and excavating. Emissions from construction vehicles and equipment.	Vehicle movement on gravel roads.
Impact Type	Direct negative	Direct negative
Stakeholders/ Receptors Affected	• Affected landowners • Road users • Construction personnel	• Affected landowners

Construction Phase Impacts

Dust-producing activities are likely to be more common during the early phases of construction, and mainly include site leveling (including blasting), the handling of spoil from leveling and clearing activities and vehicle movements. It is likely that dust generation would result from vehicles travelling along the secondary roads and the site's internal road network.

The increased dust and emissions would likely not be sufficient to significantly impact local air quality. However, increased dust can be a nuisance to site users, landowners and nearby receptors. Airborne dust could potentially be deposited on neighboring properties and vegetation in and around the site. In extreme cases, dust can cause respiratory problems for site users through inhalation, although this is not likely to occur at this site since construction activities will be progressive.

Dust becomes airborne due to the action of winds on material stockpiles and other dusty surfaces, or when thrown up by mechanical action, for example the movement of tyres on a dusty road or activities such as excavating. The levels of dust are expected to be highly variable and dependent on the time of year, the intensity of the activity and the prevailing winds at the time of construction. The quantity of dust released during construction depends on a number of factors, primarily:

» the type of construction activities occurring (e.g. crushing and grinding);
» volume of material being moved;
» the area of exposed materials;
» the moisture and silt content of the materials;
» distances travelled on unpaved surfaces; and
» the mitigation measures employed.

Dust emissions are exacerbated by dry weather and high wind speeds. During summer months, the area can be relatively dry and consequently, dust levels are high from the surrounding area and unpaved track roads. The impact intensity of dust also depends on the wind direction and the relative locations of dust sources and receptors.

There is potential for dust emissions during construction to impact on residential receptors or sensitive habitats, if these are within 200 m of an activity causing dust production. Potential receptors on and around the site include:

» neighbouring properties and agricultural lands;
» secondary public road users; and
» internal road network users.

The activities resulting in increased dust levels would be limited to the early stages of the construction phase (preparation of construction surfaces), and would be limited in time and space (in the order of one to several months in one given location).

Construction Impact: Roggeveld Wind Farm – Dust

Nature: Site levelling, vehicle movement on farm and public roads and other construction activities that generate dust would result in a **negative direct** impact on receptors in the area.
Impact Magnitude – Low
Extent: The extent of the impact is **local,** limited to within 200 m of construction activities, potentially impacting neighbouring farms.
Duration: The duration would be **short-term** for the 24 months duration of site preparation and construction.
Intensity: Increased dust is unlikely to impact any sensitive receptors, due to the position of the receptors in relation to construction activities, therefore the intensity can be considered **low.**
Likelihood – There is a **definite** likelihood of dust generation from clearance of vegetation, earthworks and from vehicles travelling on the roads within and outside the site.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high**.

Site preparation and construction work requires the use of a range of equipment, such as excavators, piling equipment and cranes to erect turbines as well as on-site generators and hand tools. Many of these lead to a direct emission of exhaust gas. Such emissions would enter the atmosphere and are likely to disperse quickly depending on weather and wind speeds. The level of emissions generated is not predicted to be high. However, these emissions have the potential to impact people living in the area. Degradation of air quality from the increase in emissions is not anticipated, given the short nature of the site preparation and construction works (i.e. intermittently for 24 months) and the nature of the proposed activities. Therefore, impacts to local residents are not expected and the impact is considered to be **negligible**.

Operational Phase Impacts

Minimal dust and emission generation is expected to occur during the operational phase of the project by maintenance vehicles along the gravel access roads, which would be infrequent. Therefore, impact of dust and emissions generated during the operation phase is not considered any further.

Mitigation Measures

Inherent to the management of construction activities and according to construction best practice, typical dust mitigation measures should be in place and are listed below. It should be noted, however that as the site is located in a water-scarce area, wetting of surfaces to minimise dust is not recommended during any phase of the development.

Construction phase

- Vehicles travelling on unpaved or gravel roads must not exceed a speed of 40 km/hr;
- Stockpiles of dusty materials to be be enclosed or covered by suitable shade cloth or netting to prevent escape of dust during loading and transfer from site;
- Vehicles are to be kept in good working order and serviced regularly to minimise emissions; and
- All directly affected and neighbouring farmers and local residents must be able to lodge grievances with Roggeveld Wind Power using the Grievance Procedure (included in the EMPr) regarding dust emissions that could be linked to the project.

Operation phase

- Vehicles travelling on unpaved or gravel roads must not exceed a speed of 40 km/hr.

Residual Impacts

Impacts from dust and emissions are anticipated to be negligible during the operational phase. Impacts related to an increase in dust during the site preparation and construction phase would be minor should suggested mitigation be implemented.

Table 9.1 Pre- and Post- Mitigation Significance: Roggeveld Wind Farm – Dust and Emissions

Phase	**Significance (Pre-mitigation)**	**Residual Impact Significance**
Construction (dust)	**Minor (-VE)**	**Minor (-VE)**
Construction (emissions)	**Negligible**	**Negligible**
Operation (dust & emissions)	**Negligible**	**Negligible**

9.2 Traffic Impact

Impact Description and Assessment

Potential impacts to traffic and road users likely to arise during the construction and the operational phase of the Roggeveld Wind Farm are summarised in Table 9.2, below.

Table 9.2 Impact Characteristics: Traffic

Summary	**Construction**	**Operation**
Project Aspect/ activity	Delivery of turbine components and construction equipment. Delivery of concrete. Construction personnel commuting to and from site.	Operational personnel commuting to and from site. Delivery of replacement turbine components.
Impact Type	Direct negative	Direct negative
Stakeholders/ Receptors Affected	• Road users • Affected landowners	• Road users • Affected landowners

Construction Phase Impacts

During the construction phase of the Roggeveld Wind Farm, there would be an increase in vehicle movement to and from the site. This has the potential to impact on traffic along the transport route and within the site boundaries. It is assumed that wind turbine components and other equipment would be brought in by road freight, from the Port of Cape Town, the Port of Saldanha or whichever port might be finally found suitable in respects of capacity, location and accessibility at the time of construction. The site is accessed via the N1 National road and the R354. A transport study would be undertaken prior to the commencement of construction in order to determine the most appropriate route to transport the equipment from the selected port to site.

The turbines and other construction materials would be delivered to site on low-bed trucks. The trucks delivering turbine components would be considered to be carrying abnormal loads in terms of the Road Traffic Act (Act No 29 of 1989). Approximately eight truck loads would be required per turbine:

» One for the nacelle;
» Three for the turbine tower;
» One for the hub; and
» Three for the blades.

Up to 480 vehicles would be required to deliver the wind turbine components for the proposed turbines. Additional heavy vehicle deliveries would be required to transport cables, machinery and construction material for the proposed hard standing area and substation.

An on-site batching plant is likely to be developed (subject to the appropriate permits) to mix concrete on-site. In addition, Roggeveld Wind Power will require aggregate material that is likely to be sourced from opening one or more new borrow pits on site. The presence of an on-site batching plant and borrow pit would minimise the number of vehicle movements required to and from the site. In the event that a batching plant is not developed, each foundation would take between 80 and 90 loads of concrete (assuming each load is approximately 6 m^3), resulting in approximately eight deliveries per hour for a day for each turbine foundation.

The increase in traffic, especially from heavy loads, could create noise, dust and safety impacts for other road users and people living or working within close proximity to the roads selected as transport routes. In addition, the increased volume of traffic along the final transport route would increase the wear and tear on these roads and possibly lead to deterioration in road conditions.

Construction Impact: Roggeveld Wind Farm – Traffic

Nature: Vehicles required for the transport of infrastructure (e.g. turbines and cables) and materials would result in a **negative direct** impact on the roads used and road users.
Impact Magnitude – **Medium**
Extent: The extent of the impact is **regional** as the potential impact will extend along the selected transport route.
Duration: The duration would be **short-term** for the duration of construction, up to 24 months.
Intensity: The intensity is likely to be **medium** given that the increase in traffic would be temporary, but may create a nuisance and impact on the safety of other road users.
Likelihood – There is a **definite** likelihood of increased traffic.
Impact Significance (Pre-Mitigation) – Moderate (-ve)
Degree of Confidence: The degree of confidence is **medium** as the exact number of vehicles visiting the site is not known.

Operation Phase Impacts

There would be a dedicated operations team to operate the facility. These employees would have to commute to and from the site on a daily basis. Maintenance staff would visit the site several times a month requiring one or two vehicles. In addition, infrequent deliveries of replacement parts may be made during the lifespan of the Wind Farm. Potential traffic impacts associated with the operation of the facility would be largely limited to the site and the local access road, therefore having the potential to impact the farm owners and users of the access roads to the site and the road network on the site.

Operation Impact: Roggeveld Wind Farm – Traffic

Nature: Increased traffic from workers travelling to and from the site would result in a **negative direct** impact on people who use the access roads to the site, and the road network used on the site.
Impact Magnitude – **Low**
Extent: The extent of the impact is **local** as impact would be restricted to the immediate vicinity of the site.
Duration: The duration would be **long-term** for the operation of the Wind Farm, up to 25 years.
Intensity: The intensity is likely to be **low** given that the increase in traffic would be minimal.
Likelihood – There is a **definite** likelihood of increased traffic in the area surrounding the site and onsite.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high.**

Mitigation Measures

Design

» A transport study will be undertaken prior to the commencement of construction to determine the most appropriate route from port to site. All necessary transportation permits will be applied for on the basis of the results of the study;
» Roggeveld Wind Power will develop a Traffic Management Plan including strict controls over driver training, vehicle maintenance, speed restrictions, appropriate road safety signage, and vehicle loading and maintenance measures; and
» Roggeveld Wind Power to develop a policy and procedure for assessing all damages and losses (e.g. damage to property, injury or death of people or livestock) resulting from project vehicles.

Construction

» During construction, arrangements and routes for abnormal loads must be agreed in advanced with the relevant authorities and the appropriate permit must be obtained for the use of public roads; and

» All directly affected and neighbouring farmers and local residents must be able to lodge grievances with Roggeveld Wind Power using the Grievance Procedure regarding dangerous driving or other traffic violations that could be linked to the project.

Operation

» During operation, if abnormal loads are required for maintenance, the appropriate arrangements must be made to obtain the necessary transportation permits and the route agreed with the relevant authorities to minimise the impact on other road users.

Impacts from an increase in traffic during the construction and operational phase would be reduced to minor and negligible respectively should the proposed mitigation measures be implemented.

Table 9.3 Pre- and Post- Mitigation Significance: Roggeveld Wind Farm - Traffic

Phase	**Significance (Pre-mitigation)**	**Residual Impact Significance**
Construction	**Moderate-Major (-VE)**	**Minor (-VE)**
Operation	**Minor (-VE)**	**Negligible**

9.3 Waste and Effluent

This section focuses on the potential impacts associated with waste and effluent generated during the construction and operational phase of the Roggeveld Wind Farm development.

Impact Description and Assessment

The project would lead to the generation of several waste streams. Table 9.4 identifies the origin of waste and effluent associated with the construction and operational phase of the Roggeveld Wind Farm and the stakeholders or receptors likely to be affected.

Table 9.4 Impact Characteristics: Waste and Effluent

Summary	**Construction**	**Operation**
Project Aspect/ activity	Waste and/or effluent originating from: construction activities including excavation of foundations and roads, unpacking of turbine equipment, general ablution, eating office and maintenance facilities on-site.	Waste and/or effluent originating from: maintenance activities and general office facilities.

Impact Type	Direct negative	Direct negative
Stakeholders/ Receptors Affected	• Affected landowners • Surrounding habitat	• Affected landowners • Surrounding habitat

Construction Phase Impacts

Inevitably, the construction of the Wind Farm would result in the production of a variety of waste streams being generated. During site clearance and levelling, solid waste would be generated from vegetation clearance and soil overburden. Construction rubble would be produced throughout the construction phase from activities such as the construction or upgrade of access roads, laydown and maintenance areas, the new substation facility and concrete pouring. Packaging material would be accumulated from unpacking of turbine equipment and off cuts would be produced through various construction activities. General waste would be produced by site personnel including wrapping from food, bottles and cans. Effluent would be produced from toilet facilities (temporary chemical toilets) which would be located on-site for construction workers.

It is anticipated that waste and effluent would be temporarily stored on site before it is removed by an appropriate contractor. There is potential for waste and effluent stored on site to leach into the soil and/ or groundwater, causing harm to the natural environment and potentially contaminating the soil and/ or groundwater.

Construction Impact: Roggeveld – Waste and Effluent Pollution

Nature: Construction activities that produce waste and effluent would result in a **negative direct** impact on the site.
Impact Magnitude – **Low**
Extent: The extent of the impact is **onsite** as impact would be restricted to the site.
Duration: The duration would be **short-term** as impacts could persist after the construction of the Wind Farm.
Intensity: The intensity is likely to be **low** as the construction phase is temporary and the site is not inhabited.
Likelihood – It is **unlikely** that waste and effluent generated on site will impact on the soil and/ or groundwater and other site users.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high.**

Operation Phase Impacts

General waste, such as office waste, and effluent from on-site toilet facilities would be produced during the operation phase of the Wind Farm by on-site personnel. However, this would be limited to permanent personnel on site and a small team of personnel expected during maintenance activities. Maintenance activities may result in the collection of used oil and hydraulic fluid, it is anticipated that this will be temporarily stored on site before being removed by an appropriate contractor. Waste produced during the operation phase would be minimal.

Operation Impact: Roggeveld Wind Farm–Waste and Effluent Pollution

Nature: Operation activities that produce waste would result in a **negative direct** impact on the site.
Impact Magnitude – **Low**
Extent: The extent of the impact is **onsite** as impact would be restricted to the site.
Duration: The duration would be **long-term** during the operation of the Wind Farm which will be up to 25 years.
Intensity: The intensity is likely to be **low** as all oils and hydraulic fluids and waste from toilet facilities would be carefully managed and the onsite activities would be limited.
Likelihood – It is **unlikely** that small quantities of spilled oil and hydraulic fluid and small quantities of general waste generated on site from the 20 or so permanent personnel would cause soil or water pollution.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high.**

Mitigation Measures

The potential impacts associated with the generation of waste and effluent can be minimised through careful mitigation measures, as described below.

Design

» A suitable area for waste skips must be selected, away from watercourses, and included in the site layout plan.

Construction

» All waste must be separated into skips for recycling, reuse and disposal;

- Vegetative material must be kept on site and mulched after construction to be spread over the disturbed areas to enhance rehabilitation of the natural vegetation;
- Effluent from temporary staff facilities must be collected in storage tanks, which must be emptied by a sanitary contractor;
- Effluent from concrete washings from the on-site batching plant must be contained within a bunded area;
- All solid and liquid waste materials, including any contaminated soils, must be stored in a bunded area and disposed of by a licensed contractor;
- Effluent and stormwater run-off must be discharged away from any watercourses;
- Steel off-cuts must be re-used or recycled, as far as possible; and
- Materials that cannot be re-used or recycled must be placed in a skip and removed from site to a licensed municipal disposal site.

Operation

- Used oil stored on site must be stored in an impervious container, within a bunded area; and
- General waste must be removed from site by a licensed contractor.

If mitigation measures given above and listed in the EMPr are implemented, the overall significance would remain low during the construction phase and negligible during the operational phase of the Roggeveld Wind Farm as outlined in Table 9.6 below.

Table 9.6. Pre- and Post- Mitigation Significance: Roggeveld Wind Farm – Waste and Effluent

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**Minor (-VE)**	**Minor (-VE)**
Operation	**Minor (-VE)**	**Negligible**

9.4 Health and Safety Linked to Construction and Operation Activities

Impact Description and Assessment

Potential impacts on construction and operational personnel, and road users likely to arise due to the Roggeveld Wind Farm development are summarised in Table 9.7. below.

Table 9.7. Impact Characteristics: Health and Safety

Summary	Construction	Operation
Project Aspect/ activity	Construction activities	Operational activities
Impact Type	Direct, negative impact	Direct, negative impact
Stakeholders/ Receptors Affected	Construction personnel	Landowner, other site users, onsite personnel.

Construction Phase Impacts

Construction activities would involve working with heavy machinery and large turbine components. During the construction phase there would be open excavation and possibly borrow pits on site, heavy vehicles moving on site and large, heavy components would need to be moved across the site, and lifted by a crane. These construction activities are potentially dangerous if not managed appropriately.

There is also potential for construction activities to cause driver distraction amongst road users. The large scale of the construction equipment used to install the wind turbines, together with the unfamiliar sight of such construction may attract driver curiosity and attention.

Construction Impact: Health and Safety

Nature: The impact on health and safety would be a **direct negative** impact.
Impact Magnitude – **Low**
Extent: The health and safety risks linked to the construction activities would occur at the **local** level.
Duration: This impact will be for the construction phase, and would therefore be **short-term**.
Intensity: The intensity would be **low** as those who are directly affected would (in most cases) be able to adapt.
Likelihood – It is **unlikely** that accidents would happen on site during the construction phase as potential accidents can be mitigated through a health and safety plan. It is **likely** that road users may become distracted by the sight of turbines being transported along the public roads.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **Medium.**

Operation Phase Impacts

It is recognised that the wind turbines may cause driver distraction among road users where the wind turbines are visible from a public road. This is particularly the case given that there are few commercial wind farms operating in South Africa at present, and the wind farm would be a novelty to many road users. The wind turbines would be visible from the R354 approximately 1-6km km south of the site. Based on the findings of the visual impact assessment, it is clear that drivers on the R354 would be able to see the turbines from a distance of approximately 2 km and they would gradually become clearer and more visible the closer one moved toward the Roggeveld Wind Farm. Driver distraction is more severe if the driver cannot see the wind farm upon approach, and as they come around a visual barrier (such as a corner or rise), the wind farm suddenly becomes visible. This is not the case with this site.

During the operation phase there is a danger of turbine failure, which may occur for a number of reasons. One of the most common causes of turbine failure is gear box failure, which can lead to a fire given the flammable nature of the composites used to make the turbines. Structural failure may result in the turbine collapsing or a blade becoming detached and flying off the structure, this is known as “blade throw.” If a turbine were to collapse onto a structure or road it could cause damage to property or harm to persons in the immediate vicinity. Modern wind turbines are fitted with electronic monitoring systems within the transmission system to reduce the risks of mechanical failure.

Operational Impact: Health and Safety

Nature: The impact on health and safety would be a **direct negative** impact.
Impact Magnitude – **Low**
Extent: The health and safety risks linked to the operational activities would occur on-site.
Duration: This impact will occur throughout the operational phase, and would therefore be for the long-term.
Intensity: The intensity would be low as damage or injury from turbine failure can be mitigated.
Likelihood – It is **likely** that drivers would suffer ‘driver distraction’ during the operational phase, however given that turbine construction would meet manufacturers specifications, failure of the turbines in **unlikely**.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high**.

Mitigation

The objective of mitigation is to manage construction and operation so that impacts on health and safety risks to local residents, contractors, employees and animals are reduced.

Design

» Turbines must be spaced at least a turbine and a half's distance from one another so that if one turbine collapses, it does not make contact with the nearest turbine.

Construction

» A health and safety plan must be developed prior to the commencement of construction to identify and avoid work related accidents. This plan must be adhered to by the appointed construction contractors and meet Occupational Health and Safety Act (OHSAct), Act 85 of 1993, requirements;
» Potentially hazardous areas must be clearly demarcated (i.e. unattended foundation excavations); and
» Appropriate Personal Protection Equipment (PPE) must be worn by all construction personnel.

Operation

- Regular maintenance of turbines and all other infrastructure must be undertaken to ensure optimal functioning and reducing the chance of gearbox failure; and
- Regular inspections of the turbine foundations, towers, blades, spinners and nacelle must be undertaken in order to check for early signs structural fatigue.

The implementation of the above mitigation measures would reduce the construction and operation impacts from minor to negligible. The pre- and post-mitigation impacts are compared in Table 9.8.

Table 9.8 Pre- and Post- Mitigation Significance: Health and Safety

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Construction	**Minor (-VE)**	**Negligible**
Operation	**Minor (-VE)**	**Negligible**

9.5 Shadow Flicker

Impact Description and Assessment

Under certain light conditions the moving shadow cast by revolving wind turbine blades can result in a flickering effect. This transient effect is known as shadow flicker and is experienced on the ground or inside dwellings with narrow aperture windows when the direction and angle of incident sunlight align. Shadow flicker is not a concern during the construction phase as it only has the potential to occur during operation of a wind farm.

Table 9.9 Impact Characteristics: Shadow Flicker

Summary	**Construction**	**Operation**
Project Aspect/ activity	N/A	Operation of wind turbines
Impact Type	N/A	Direct negative
Stakeholders/ Receptors Affected	N/A	Affected landowners or those living on site

Operation Phase Impacts

Shadow flicker can be a nuisance, particularly when the receptor is in a building, as the contrast between light and shade is most noticeable through windows and doors. Flickering and strobing can potentially trigger an epileptic fit in cases of photosensitive epileptic. A survey carried out by Epilepsy Action [19] in the UK, concluded that wind turbines may create circumstances where photosensitive seizures can be triggered, however it does appear that this risk is minimal. Furthermore they state that "*newer wind turbines are usually built to operate at a frequency of 1 Hz or less. These flicker rates are unlikely to trigger a seizure.*" [20]

The following physical circumstances need to apply simultaneously before shadow flicker can occur:

- the receptor must be within 10 turbine diameters of the turbine;
- there must be a sufficient level of sunlight;
- the wind turbine must be operating (wind speeds must therefore be at least about 2.5m s^{-1});
- the moving shadow cast by rotating blades must be seen from within a building, particularly when viewed through a narrow window;

(19) Epilepsy Action online, available at http://www.epilepsy.org.uk/campaigns/survey/windturbines
(20) Epilepsy Action online, available at http://www.epilepsy.org.uk/info/photosensitive/triggers

- the orientation of the turbine and its angle of elevation to the observer must coincide with the angle and the position of the sun in relation to the building so that the shadow falls onto the receptor; and
- since the origin of the effect is the sun, receptors that may be affected must lie to the south of the point where the sun rises and sets.

Where these circumstances pertain, the exact position of shadows can be calculated very accurately for each sensitive location for the key times of day and year to determine the potential for shadow flicker. The turbine diameter for the proposed Wind Farm would be approximately 117 m. A receptor would therefore need to be 900 m from the turbine to experience shadow flicker.

Operational Impact: Shadow Flicker

Nature: The impact of shadow flicker would be a **direct negative** impact on people within dwellings.
Impact Magnitude – Low
Extent: The shadow flicker would occur at the **onsite** level, as this impact would impact people within dwellings located within a 1 km radius of the proposed turbines.
Duration: This impact would be **long-term** throughout the operational phase of the Wind Farm, 25 years.
Intensity: The intensity would be **medium** as the dwellings are places of residence.
Likelihood – It is **unlikely** that this impact would occur during the operational phase, as the dwellings are located over 1km south of the proposed turbine locations.
Impact Significance (Pre-Mitigation) – Negligible
Degree of Confidence: The degree of confidence is **medium** as the exact locations of the proposed turbines have not as yet been micro-sited.

Mitigation

A shadow flicker study will be required if the final turbine layout results in turbines being located within 10 blade diameters of any dwellings or buildings within which people live or work. Mitigation may include re-siting the relevant turbines or planting indigenous trees to provide screening in front of windows or glass panelled doors.

Table 9.10 Pre- and Post- Mitigation Significance: Shadow Flicker

Phase	Significance (Pre-mitigation)	Residual Impact Significance
Operation	**NEGLIGIBLE**	**NEGLIGIBLE**

9.6 Electromagnetic Interference

Electromagnetic interference is not a concern during the construction phase and can only occur during the operation of the Wind Farm, when the turbines are in operation. Note: Some information gaps exist that will only become available once a final supplier has been identified.

Table 9.11 Impact Characteristics: Electromagnetic Interference

Summary	Construction	Operation
Project Aspect/ activity	N/A	Operation of the wind turbines
Impact Type	N/A	Direct negative
Stakeholders/ Receptors Affected	N/A	Users of communication systems

Operation Phase Impacts

Operating wind turbines can cause electromagnetic interference (EMI). This can potentially affect communication systems including TV, radio and mobile phone transmitters, microwave links, radar and aircraft navigation beacons.

For broadcast systems, such as television, a wind farm located between a television transmitter and a receiver aerial may cause loss of picture detail, loss of colour or buzz on sound. Viewers situated to the side of a wind farm may experience a delayed image or 'ghost' on the picture, liable to flicker as the blades rotate. In some cases, a wind farm can also affect the re-broadcast link (RBL) feeding the transmitter.

Broadcast radio transmissions are received at radio receivers after radio signals have travelled through free space and often through structures. Because of this method of transmission and reception, it can be concluded that the proposed wind farm would have no detrimental effects on national or local radio in the vicinity of the proposed development.

There is the potential for rotating turbine blades to generate unwanted returns on air traffic control and defence radar displays. This may affect wind turbine developments as much as 75 km away from a radar site.

The potential for interference is dependent on the positions of turbines in relation to incoming or outgoing signals as well as the specific characteristics of the signal. In addition, the nature of the material of the turbine rotors would result in impacts of varying magnitude i.e. those constructed of composite materials which have reduced potential for signal interference in comparison with metal blades. Roggeveld Wind Power has identified potential interested and affected parties and consulted with them in order to identify the potential impacts associated with electromagnetic interference at and around the Roggeveld site. The following service providers have been consulted with:

» Department of Defence;
» Eskom;
» MTN;
» SA Police;
» Sentech;
» Transnet;
» Telkom; and
» Vodacom.

To date, these service providers consulted have not highlighted any serious concerns although some are currently undertaking their own studies and awaiting results. Roggeveld Wind Power are aware that the possibility of interference although not expected to be an issue, can not be ruled out. During the operational phase, should interference occur, Roggeveld Wind Power would establish procedures to investigate any complaints of interference through an effective Grievance Procedure.

9.7 Climatic Effects

The potential impacts of wind farms on regional and local climatic conditions are presently poorly understood and little scientific research has been conducted in this regard. Further extensive research for peer reviewed studies was undertaken when assessing and evaluating potential impacts on micro- and regional climate from wind farm developments. In excess of 15 key authors in this field of research were established and research studies interrogated. Studies do not include potential positive impacts related to reduced carbon production and prevention of global warming effects in the simulation models, however, reference is made that such potential positive impacts not to be ignored or overlooked).

The generation of electricity using wind turbines is percentage-wise the fastest growing energy resource globally among current energy technologies with low or zero greenhouse gas (GHG) emissions (Wang and Prinn, 2010). Most of this growth is in the industrial sector, based on large utility-scale wind farms. Debates exist regarding the global-scale effects of wind farms; however, modelling studies indicate that wind farms can affect local-scale meteorology (Baidya Roy and Traiteur, 2010).

Solar energy absorbed by the Earth is converted into various forms of energy; namely latent heat (by evaporation), gravitational potential energy (by atmospheric expansion), internal energy (by atmospheric and oceanic warming, condensation) or kinetic energy (such as convective and baroclinic instabilities). If averaged globally, total atmospheric energy is comprised of the following percentages:

» Internal energy – 70.4%;
» Gravitational potential energy – 27.05%;
» Latent heat – 2.5%; and
» Kinetic energy – 0.05%.

Of the already relatively lower percentage of kinetic energy, only a small fraction is contained in the near surface winds that produce small-scale turbulent motions due to surface friction. These turbulent motions further downscale to molecular motions, and thus convert bulk air kinetic energy to internal energy. However, in considering the question of potential climatic impacts from wind farms, it is not the size of these energy reservoirs, but rather the rate of conversion from one to another that is more relevant. According to Wang and Prinn's (2010) model calculations, the global average rate of conversion of large-scale wind kinetic energy to internal energy near the surface is approximately 1.68 W/m^2 (860 TW globally). This only constitutes approximately 0.7 percent of the average net incoming solar energy of 238 W/m^2 (122 PW globally). The magnitude of this rate in the presence of wind turbines is expected to differ, but not by large factors (Wang and Prinn, 2010).

Wind turbines function by converting wind power into electrical power. Turbulence near the surface, however, also feeds on wind power. This turbulence is critical for driving the heat and moisture exchanges between the surface and the atmosphere, which play an important role in determining surface temperature, atmospheric circulation and the hydrological cycle (Wang and Prinn, 2010). The rate of energy extraction by wind farms from the atmosphere (approximately 1 W/m^2), although small compared to the kinetic and potential energy stored in the atmosphere, is comparable to time-tendency terms, for example the rate of conversion of energy from one form to another and frictional dissipation rate in the atmospheric energy balance equation. This indicates that influence to atmospheric and surface processes by wind farms is possible (Baidya Roy et al., 2004).

Potential Impacts on Local Climate

In a modelling study conducted by Baidya Roy et al. (2004), results indicated that the modelled wind farm significantly slowed down the wind at the turbine hub-height level. In addition to this, the turbulence generated in the wake of the rotors create eddies that can enhance vertical mixing of momentum, heat and scalars, usually leading to a warming and drying of the surface air and reduced surface sensible heat flux. The effect was found to be most intense during the early morning hours when the boundary layer is stably stratified and the hub-height level wind speed is the strongest due to the nocturnal low-level jet. The impact on evapotranspiration was found to be small.

A recent study conducted by Baidya Roy and Traiteur (2010), using field data and numerical experiments with a regional climate model, potential impacts of wind farms on surface air temperatures was investigated. Data showed that near-surface air temperatures downwind of the wind farm are higher than upwind regions during night and early morning hours, while the reverse held true for the rest of the day. Therefore the wind farm investigated has a warming effect during the night and a cooling effect during the day. Baidya Roy and Traiteur (2010) proposed an explanation for this using the hypothesis put forward in the Baidya Roy et al. (2004) work, that turbulences generated in the wake of the rotors enhance vertical mixing. Under stable atmospheric conditions when the lapse rate is positive, i.e. a warm layer overlies a cool layer, the enhanced vertical mixing mixes the warm air down and cooler air up, leading to a warming near the surface. While under unstable atmospheric conditions with a negative lapse rate, i.e. cool air lying over warmer air, the turbulent wakes mix cool air down and warm air up, thereby producing a cooling effect near the surface. The atmospheric model used supported the field data findings. The model simulations additionally indicated that the temperature change in wind farms was also a function of the mean ambient hub-height (second atmospheric layer) wind speed. Weaker impacts were found at higher wind speeds. Two factors may lead to this. Firstly, at wind speeds higher than 20m/s the rotors are designed to stop working. If average wind speed is high, it is likely that instantaneous wind speeds frequently exceed 20m/s, hence the rotors work only intermittently, reducing the mean impacts on the surface temperatures. Secondly, at high wind speeds the ambient turbulence is also relatively high, resulting in lower impacts.

Baiyda Roy and Traiteur (2010) state that as many of the wind farms are located on agricultural land, the impacts from wind farms on surface meteorological conditions are likely to affect agricultural practices, in some cases the impacts may be beneficial such as the nocturnal warming under stable atmospheric conditions protecting crops from frost. They additionally state that if the wind farms are sufficiently large, they may also affect downstream surface meteorology.

In response to the Baiyda Roy and Traiteur (2010) study, Bruce Bailey of AWS Truepower states that turbines in use today are technologically more advanced than the ones used in the study and differ in dimensions. Additionally, the spacing between turbines is different, currently being spaced at least five times wider apart than those used in the study. Wind developers are already taking the temperature effect into account because of the impact of the ‘upstream’ turbines buffeting the wind on ‘downstream’ turbines. Seemingly many wind farm projects map multiple weather data, including temperatures, and are aware of this effect (Biello, 2010).

Baiyda Roy and Traiteur (2010) put forward two options for reducing the above mentioned effects. One option is to have turbines designed to reduce the turbulence generated by the rotors. Rotors that generate more turbulence in their wakes are likely to have a stronger impact on near-surface air temperatures. The second option is to look for optimal siting solutions for wind farms. Taking their study findings into consideration, the impact of wind farms starts decreasing sharply as ambient surface kinetic energy dissipation rate becomes larger than 2.7 W/m^2 and becomes almost zero at dissipation rates higher than 6 W/m^2. Therefore, generally, the more turbulent the site is naturally, the lower the potential impact on surface temperatures by an introduced wind farm. As Biello (2010) states, it is in these naturally turbulent areas that wind farms tend to be located, as that is often where the wind is strongest.

Potential Impacts on Global Climate

There is currently a debate regarding the potential effects of large-scale wind farms on climate at a global scale. A study of climate –model simulations that addresses the possible climatic impacts of wind power at regional to global scales by using two general circulation models and several parameterizations of the interaction of wind turbines with the boundary layer by Keith et al. (2004) found that large-scale use of wind farms can alter local and global climate by extracting the kinetic energy and altering turbulent transport in the boundary layer. The study found that very large amounts of wind farm power generation can produce ‘non-negligible’ climatic change at continental scales. However, although large-scale effects are observed, the overall effect on global-mean surface temperature is negligible.

Barrie and Kirk-Davidoff’s (2010) General Circulation Model study, representing a continental-scale wind farm as a distributed array of surface roughness elements, showed that the extensive installation of wind farms would alter surface roughness and significantly impact the atmospheric circulation due to the additional surface roughness forcing. The model showed that disturbances caused by a step change in roughness grew within four and a half days, such that the flow is altered at synoptic scales. The authors recognize that wind farms on this scale do not exist, and as such view the work as a theoretical problem, with real applications in decades to come.

A further study conducted by Wang and Prinn (2010), using a three-dimensional climate model simulating the potential climate effects associated with the installation of wind turbines over large areas of land or coastal ocean, showed that in meeting 10 percent or more of the global energy demand in 2100 (approximately 140 EJ/year (4.4TW)), surface warming exceeding 1°C over land could be caused. While in contrast, surface cooling exceeding 1°C was computed over ocean installations. Significant warming or cooling remote from the land and ocean installations, and alterations of the global distributions of rainfall and clouds also occurred in the model simulations.

The obvious critique of the above studies is that they are purely theoretical and based on simulation models. These models are dependent on the accuracy of the model used and the realism of the methods applied in order to simulate the wind turbines (Wang and Prinn, 2010). Baiyda Roy in considering the question of climatic impacts on a global scale remains sceptical, stating that a subsequent study awaiting publication, indicates that these climatic impacts are restricted to a small area around the wind farms. Additionally stating that although the above studies indicate large scale wind farms having global climatic effects, if the wind farms are spaced sufficiently apart, they will not cause global scale effects (Baiyda Roy in Biello, 2010).

It should be noted that preliminary calculations using assumptions common in the models used by Keith et al. (2004), consistently show that by reducing CO_2 emissions, the indirect benefits of wind farms exceed the costs (or benefits) of use from their direct climatic effects. Therefore the greatest potential climatic impact on a global level may be the reduction of CO_2 in the atmosphere.

Conclusions

Modelling studies on the cumulative climatic effects of wind farms over entire countries or regions are inconclusive. On a local scale, only one known published modelling study has been supported by data collected in the field, but research suggests that wind farms have the potential to alter local-scale climatic conditions, and temperature in particular (Baidya Roy and Traiteur, 2010). It is reported that wind turbines and resulting changes to air flow patterns can alter local surface air temperatures, which may in turn alter local patterns of evaporation. It is not clear whether these changes are likely to have significant or noticeable impacts on local climatic conditions and site specific conditions are likely to play a major role in whether micro-climatic effects may occur. The potential significance of micro-climatic effects due to wind farms is currently unclear and further research is required to understand ecosystem level effects. In such a study, the following aspects should be considered within an integrated research programme; microclimatic changes, insect and pollination effects and other trophic level effects. This should not be coordinated by Roggeveld Wind

Power but by a research institute. Although such research falls beyond the scope of this EIA, Roggeveld Wind Power could possibly provide support to such a study. In order to contribute to longer term understanding, certain climatic data should be collected on site and at a control site to assist with interpreting additional data that is collected.

9.8 Impacts Related to the Storage and Handling of Dangerous Goods

Impact Description and Assessment

Fuel and other dangerous goods (such as fuel, oils or chemicals) will be used during construction and operations and will be stored and handled on-site. The facilities or infrastructure for the storage, or storage and handling of a dangerous good in containers will have a combined capacity of up to / not exceeding 80 cubic metres.

Construction Phase Impacts

During the construction phase dangerous goods (such as fuel, oils or chemicals) could cause environmental pollution if spillages occur.

Construction Impact: Roggeveld Wind Farm – Pollution due to spillages of fuel/ oil/ chemicals

Nature: Vehicles and construction activities could result in a **negative direct** impact on soil/ water bodies if dangerous goods are spilled on /around the site/
Impact Magnitude – **Medium**
Extent: The extent of the impact is **local.**
Duration: The duration would be **short-term** for the duration of construction, up to 24 months.
Intensity: The intensity is likely to be **medium.**
Likelihood – It is **unlikely** that small quantities of spilled oil and hydraulic fluid would cause major soil or water pollution.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high.**

Operation Phase Impacts

Operation Impact: Roggeveld Wind Farm – Pollution due to spillages of fuel/ oil/ chemicals

Nature: Vehicles and maintenance activities could result in a **negative direct** impact on soil/ water bodies if dangerous goods are spilled on /around the site/
Impact Magnitude – **Medium**

Extent: The extent of the impact is **local**.
Duration: The duration would be **short-term**.
Intensity: The intensity is likely to be **medium.**
Likelihood – It is **unlikely** that small quantities of spilled oil and hydraulic fluid would cause major soil or water pollution.
Impact Significance (Pre-Mitigation) – Minor (-ve)
Degree of Confidence: The degree of confidence is **high**

Mitigation Measures

Design

» A designated bunded area for storage of dangerous goods must be planned for and included on the final layout.

Construction

» Regular inspections of the bunded area for storage of dangerous goods must be undertaken.
» Vehicles must have access to spill kits.
» An emergency spill response plane must be developed by the contractor.
» Any spillages of dangerous substances must be remedied and cleaned up.

Operation

» Regular inspections of the permanent bunded area for storage of dangerous goods must be undertaken.
» Maintenance vehicles must have access to spill kits.
» An emergency spill response plan must be developed for the operational phase.
» Any spillages of dangerous substances must be remedied and cleaned up.

Table 9.12 Pre- and Post- Mitigation Significance: Roggeveld Wind Farm – Storage and handling of dangerous goods

Phase	**Significance (Pre-mitigation)**	**Residual Impact Significance**
Construction	**Minor (-VE)**	**Minor (-VE)**
Operation	**Minor (-VE)**	**Minor (-VE)**

ASSESSMENT OF CUMULATIVE IMPACTS: CHAPTER 10

Cumulative impacts in relation to an activity are defined in the Environmental Impact Assessment Regulations (Government Notice R543) as meaning "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".

There has been a substantial increase in renewable energy developments (and wind farms in particular) recently in South Africa as legislation is evolving to facilitate the introduction of Independent Power Producers (IPPs) and renewable energy into the electricity generation mix. The focus of the renewable energy developments have largely been in the Northern, Western and Eastern Cape provinces.

Due to the recent substantial increase in interest in wind farm developments in South Africa, it is important to follow a precautionary approach in accordance with NEMA to ensure that the potential for cumulative impacts are considered and avoided where possible.

It should however be noted that not all the wind farms presently under consideration by various wind farm developers will be developed. It is considered that not all proposed developments will be granted the relevant permits by the relevant authorities (DEA, DOE, NERSA and Eskom) and this is because of the following reasons:

» There are limitations to the capacity of the existing Eskom grid;
» Not all applications will receive positive environmental authorisation;
» There are stringent requirements to be met by applicants;
» Not all proposed wind farms will be viable because of the wind resource;
» Not all wind farms will be able to reduce negative impacts to acceptable levels or able to mitigate adequately;
» Not all wind farms will be granted a generation license by NERSA and sign a Power Purchase Agreement with Eskom; and
» Not all wind farms will be successful in securing financial support.

The Department of Energy has, under the REIPPP Programme released a request for proposals (RfP) to contribute towards Government's renewable energy target of 3 725 MW (1 850 MW of which allocated to wind energy) and to stimulate the industry in South Africa. The bid selection process will consider the suggested tariff as well as socio-economic development opportunities provided by the project and the bidder.

Wind farm developments have effects (positive and negative) on natural resources, the social environment and on the people living in a project area. The preceding impact assessment chapters have assessed the impacts associated with the wind farm at Roggeveld largely in isolation. It is important to, and there is a legislated requirement to, assess cumulative impacts associated with a proposed development. This chapter looks at whether the proposed project's potential impacts become more significant when considered in combination with the other known or proposed wind farm projects within the area.

10.1 Approach Taken to Assess Cumulative Impacts

Significant cumulative impacts that could occur due to the development of wind energy facilities in proximity to each other include impacts such as:

- visual intrusion;
- change in sense of place and character of the area;
- an increase in the significance of avifaunal impacts;
- an increase in the significance of the potential impact on bats;
- loss of vegetation; and
- temporary traffic impacts during construction.

Clarity on the environmental impact on birds and bats in terms of this and other wind farms proposed for the same area can only be reached once the recommended pre-construction monitoring has been completed across all considered projects and a commitment established for monitoring into the operational phase. The cumulative impact of all the proposed facilities throughout South Africa could have detrimental impacts on birds and bat populations, and directly affect other biodiversity through micro-climatic changes and habitat disturbance, however the extent of this impact is unknown at this time.

The cumulative impacts of the wind farm and other known wind energy developments, and the in-combination effects of the Roggeveld Wind Farm and other known developments will be qualitatively assessed in this Chapter. Figure 10.1 shows the proposed location of the Roggeveld Wind Farm in relation to all other known wind farm applications. These projects were identified using the Department of Environmental Affairs Geographic Information System digital data developed by the CSIR.

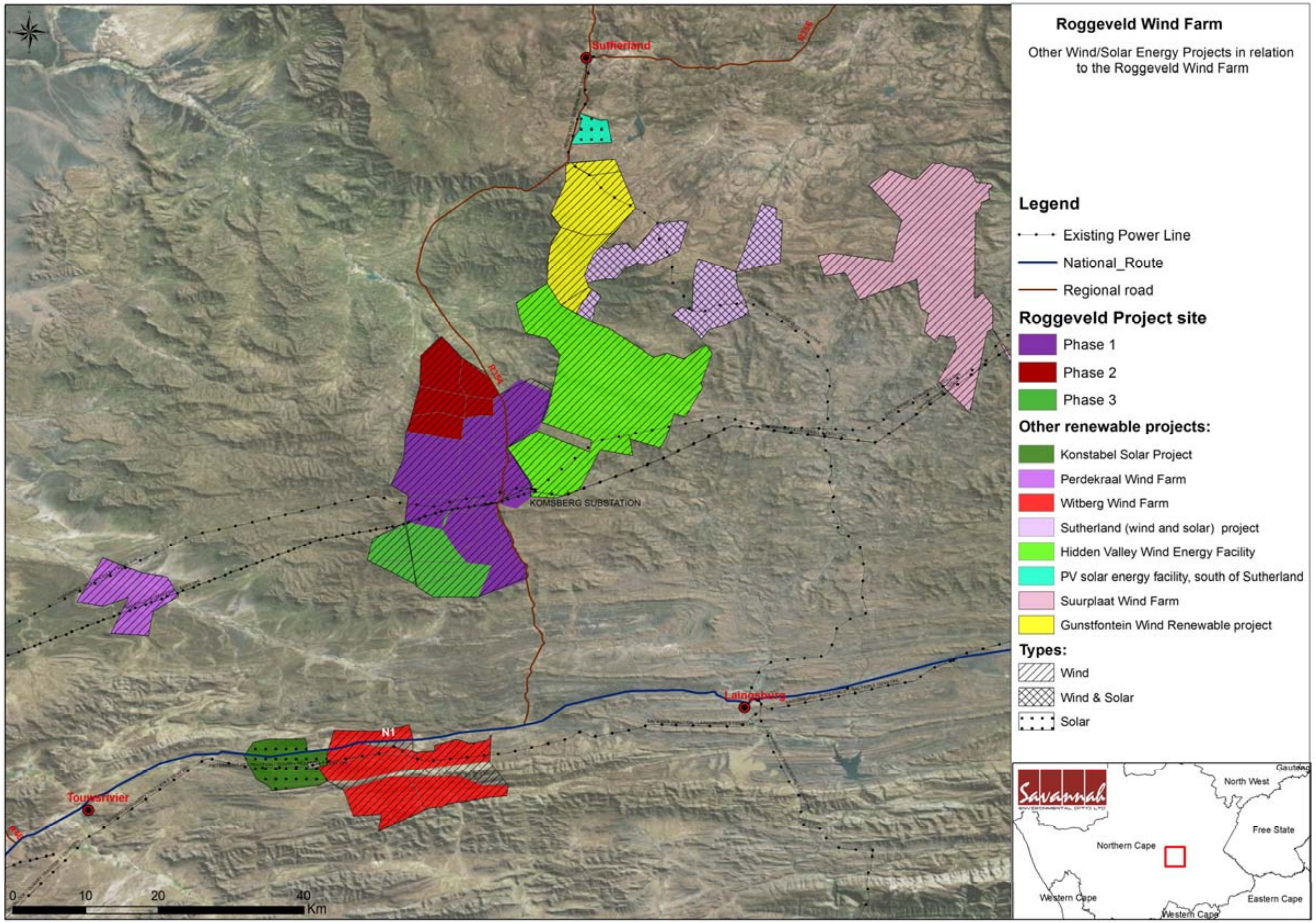


Figure 10.1: Proposed renewable energy facilities in the vicinity of Roggeveld

There are currently no existing commercial wind farms or preffered bidder wind projects in the vicinity of the Roggeveld project both on the Northern Cape and Western Cape side of the provincial boundary. There are wind projects that have been granted preferred bidder status in the Northern Cape, those that are far ahead with construction started in the Western Cape. This chapter focuses on any known and proposed wind farms in the vicinity of the Roggeveld project site. These developments are listed in Table 10.1 as well as the status of each within their development cycle at the time of this assessment.

Table 10.1: Proposed wind farm developments in the vicinity of the Roggeveld Wind Farm site

Wind Farm (Developer)	No. of turbines	Distance (km)	Status of the development	DEA Reference Number
1. Konstabel Solar Farm (Mainstream SA)	-	Approximately 30km south of Roggeveld	Authorisation received	12/12/20/1787
2. Perdekraal Wind Farm (Mainstream SA)	169 to 223	Approx. 40km southwest of Roggeveld	Authorisation received	12/12/20/1783
3. Witberg Wind Farm (G7 Renewable Energies)	Up to 27	Approx. 25km south of Roggeveld	Authorisation received	12/12/20/1966
4. Sutherland (wind and solar) (Mainstream SA)	293 to 386	Approx 35km north east o/f Roggeveld	Authorisation received	12/12/20/1782
5. Suurplaat Wind Farm 6. (Moyeng Energy)	Approximately 400	Approx 60km northeast of Roggeveld	Authorisation received	12/12/20/1583
7. Hidden Valley Wind Energy Facility (ACED Renewables)	Approximately 207	Adjacent to the Roggeveld site	EIA in process	12/12/20/2370
8. Gunstfontein	-	Adjacent to the Hidden Valley site	EIA in process	14/12 /16/3/3/2/399;

The combined effect of the various wind farms proposed for this area will have a cumulative visual impact and impact on the landscape character. The significance of this cumulative impact is uncertain as at the time the assessment was undertaken the details of the final layouts of adjacent or neighbouring facilities were not available and could therefore not be quantitatively assessed. The cumulative visual impact and impact on landscape character resulting from the other known wind farms in the vicinity is also difficult to assess but may be less significant due to the larger distances between the facilities. However, comparing projects with similar production capacities, the ones with fewer turbines or higher wind resources could be considered as having potentially less overall impact than other projects with more turbines.

As there is uncertainty as to whether all the above mentioned developments will be implemented, it is also difficult to quantitatively assess the potential cumulative impacts. It is however important to explore the potential cumulative impacts qualitatively as this will lead to a better understanding of these impacts and the possible mitigation that may be required. The assessment and implementation of mitigatory measures should be led by Government in collaboration with the renewable energy sector and relevant NGO's. As these cumulative impacts are explored in more detail the trade-offs between promoting renewable energy (and the associated benefits in terms of reduction in CO_2 emissions – a national interest) versus the local and regional environmental and social impacts and benefits (i.e. impacts on bird and bat populations, landscape, tourism, flora, employment etc.) will become evident. It is only when these trade-offs are fully understood, that the true benefits of renewable energy can be assessed.

The scale at which the cumulative impacts are assessed is important. For example the significance of the cumulative impact on the regional or national economy will be influence by wind farm developments throughout South Africa, while the significance of the cumulative impact on visual amenity may only be influence by wind farm developments that are in closer proximity to each other say 30 km to 50 km apart. At this stage it is not feasible to look at the wind farm developments at a national scale and for practical purposes a sub-regional scale has been selected.

In the sections below the potential cumulative impacts of several wind farms within a 50-60 km radius of the proposed Roggeveld Wind Farm are explored. The discussion and associated conclusions must be understood in the context of the uncertainty associated with the proposed developments and the qualitative nature of the assessment.

10.2 Cumulative Impact on Fauna (Excluding Avifauna and Bats) and Flora

The renewable energy facilities listed in Table 10.1 are located in the area where the Succulent Karoo Biome and the Fynbos Biome are intermixed. While the majority of the renewable energy sites are likely to be established on existing farms where some disturbance has already occurred, there may be numerous different plant communities present, each associated with different combinations of soil depth and texture, aspect and slope, creating a wide range of potential habitats for resident biota. The sensitivity and conservation worthiness of these areas may differ. At the landscape scale, the density of these developments is still relatively diffuse and each lies within different mountain ranges and vegetation types.

The total land take of each facility is likely to range between 2% to 3% of the total area allocated for the facility. The majority of these facilities are likely to be placed on existing farm lands where either crop farming or grazing takes place. A potential cumulative impact of wind farm developments identified by the specialists is the potential loss of connectivity of the landscape and the disruption of faunal movement pathways and a possible reduction in the ability of plants and animals to respond to climate variability and change. The nature and potential extent of this impact however, is very difficult to quantify. The current development is largely concentrated on the ridges of the site, which potentially impacts the functioning of the ridge as a corridor for faunal movement. It is feasible to mitigate potential site specific negative impacts on fauna and flora by avoiding sensitive patches of vegetation/habitat within specific site boundaries.

Cumulative impacts on the Central Mountains Shale Renosterveld vegetation type is highlighted as the key concern. However, wind energy facilities do not have a large footprint in terms of direct transformation, so the actual amount of vegetation lost cannot be considered significant in its own right, when considered in the light of the low level of transformation this vegetation type has experienced to date. Therefore, the major concern with regards to cumulative impacts is likely to centre on the potential impact on broad-scale ecological processes such as the disruption of movement and migration pathways of fauna, and the broad scale fragmentation of habitat.

The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country’s ability to meet its conservation targets. The area has been identified as National Protected Areas Expansion Strategy focus area, indicating that it represents a large currently intact extent of habitat which is considered to have a high biodiversity value. Although all of the vegetation types in the study area are classified as Least Threatened, they are mostly poorly protected and certain habitats or communities may be disproportionately affected. A reduction in the ability to meet conservation targets is considered to low in magnitude.

Transformation within CBAs would potentially disrupt the functioning of the CBA or result in biodiversity loss. In addition, the presence of the facility and associated infrastructure could potentially contribute to the disruption of broad-scale ecological processes such as dispersal, migration or the ability of fauna to respond to fluctuations in climate or other conditions.

While the cumulative impact is uncertain, dependant on the number of facilities which are constructed, and assuming site specific mitigation can avoid sensitive habitats, it is unlikely that the negative **cumulative impact on fauna** (excluding bats and birds) **and flora** resulting from the development of several renewable energy facilities in proximity to the proposed Roggeveld Wind Farm will be of a **moderate significance**.

On the positive side, farmers may become less reliant on income from stock and/or crop farming as a result of increased incomes accruing to them from leasing their land to renewable energy developers. This may result in a decrease in numbers of animals per hectare which could ultimately result in an improvement in the flora and surrounding habitat due to reduced grazing pressure. However, should farming intensity increase (additional stock or increase in crops lands/orchards) because of the increased income, some would argue that this could have a negative cumulative impact as additional land take may impact sensitive habitats. On the other hand the country is in need of increased agricultural productivity and food security and it could also be argued that positive impacts would result from increased agricultural activity as there will be more jobs created for the unemployed communities of the Laingsburg Local Municipality.

10.3 Cumulative Impacts on Birds

There are several forms of cumulative effects relative to wind farm developments. One is when a bird species resident in a proposed wind farm is likely to be affected by not one but several impacts. Another is the effect of impacts in the immediate neighbourhood of the proposed farm. This may be from the development of other wind farms – as are proposed for areas around the Roggeveld farm – or other significant land use changes. A third is when changes at some distance (even continentally) have the effect of depressing the population of a bird species which is then further impacted through loss of habitat or collision mortality at the wind farm. All these cumulative effects can be subject to further cumulative effect over time.

Bases on the pre-construction bird monitoring programme, **cumulative effects on avifauna** due to the Roggeveld project and others are not considered to be of a **low significance** as:

1) Most birds are local residents and occur primarily on the hillsides and in the valleys away from turbine locations;
2) Other than the limited ridge-top footprint for turbine installation and maintenance there are no likely changes in land use on or near the ridges that will affect local bird distribution; and
3) The Karoo climate in the medium term is progressively getting drier. This will reduce both bird populations and diversity and so decrease the potential impacts of wind farms.

10.4 Cumulative Impacts on Bats

The many proposed wind farms are significant in terms of potential cumulative impacts on bats, increasing the risks for fatalities. It also increases the risks for clashes with bat migration routes. Four different species were detected by the two passive monitoring systems, with only *Miniopterus natalensis* having a Near Threatened conservation status. *Neoromicia capensis* and *Tadarida aegyptiaca* are the most common and abundant insectivorous bat species found across South Africa. They dominated the bat assemblage detected by all of the monitoring systems. The common and more abundant species are of large value to the local ecosystems as they provide greater ecological services than the more rare species, due to their greater abundance. These two species have a conservation category of Least Concern.

According to the data gathered, the migrating species, *Miniopterus natalensis*, may be undertaking a migration during late April to early May at the ROG 5 and ROG 3 meteorological mast passive bat detection systems with activity lingering longer around system ROG 3 in the valley before it completely disappears again. It is possible that this may indicate a migrational event where a colony moves slowly (possibly while foraging) over a period of 1 or 2 weeks, on their way to a winter hibernacula cave. Since the peak in activity at ROG 5 meteorological mast passive bat detection system precedes that of ROG 3 meteorological mast passive bat detection systems slightly, it may be assumed that the general movement was from the east towards the north to north-west passing by ROG 5 and ROG 3 meteorological mast passive bat detection systems only.

However it is very important to note that **no** *M. natalensis* calls were recorded at 59m height and only at 10m on ROG 5, this indicates that the migrating bats were flying low while passing over the ridge where met mast ROG 5 met mast is situated. Although unlikely, the possibility of undetected migrating bats far above 59m must not be ignored during post construction monitoring. The **impact on bats** in general is expected to be **moderate significance**.

10.5 Cumulative Visual Impacts

Many of the sites and surrounds of the proposed Roggeveld Wind Farm have a wilderness or rural farmland character, typical of the Karoo landscapes. Most of the sites are remote and sparsely populated, which adds to their attraction as getaway destinations. The sheer scale of many of the wind farm projects could result in a loss of scenic views and inspiring open space related to these landscapes. The alteration of the landscape from wilderness or rural farmland character to a more industrial type character will have an impact on the sense of place which in turn could have an impact on tourisms and associated activities. A single renewable energy facility located in an area of wilderness or rural farmland character is likely to attract interest, resulting in some positive benefits. However, it could be argued that it is unlikely that several such facilities in relatively close proximity are likely to have the same outcome.

The degree of cumulative impact is a product of the number of and distance between individual wind farms, the inter-relationship between their Zones of Visual Influence (ZVI), the overall character of the landscape and its sensitivity to wind farms, and the siting and design of the wind farms themselves[21]. Cumulative impacts need to be considered from both a visual amenity and landscape character perspective, while the impact on these may also have a bearing on the enjoyment of the natural heritage.

The cumulative impacts on visual amenity of all the renewable energy facilities, should many of them be constructed, will be largely influenced by three factors[22]:

Combined effects: these occur where a static observer is able to see two or more developments from one view point within the observer's arc of vision at the same time;

Successive effects: these occur where two or more wind farms may be seen from a static view point but the observer has to turn to see them;

Sequential effects: these occur when the observer has to move to another view point, for example when travelling along a road or footpath, to see the different developments. Sequential effects may range from *frequent* (the features appear regularly and with short time lapses between, depending on speed and distance) to *occasional* (long time lapses between appearance due to the lower speed of travel and/or the longer distances between the view points.

In the context of the recommendations of the Provincial Government of the Western Cape's guideline document for wind energy developments[23] it is encouraged that large concentrated wind farms should be developed rather than small dispersed locations where the distance between large wind farms is at least 30km, and ideally exceeding 50km. Should all the proposed wind projects be constructed, the combined effect of the Roggeveld and the other wind farms listed in Table 10.1 will have a cumulative visual impact and impact on the landscape character. The **cumulative visual impact** and impact on landscape character

[21] Scottish Natural Heritage Guidance Cumulative Effects of Windfarms Version 2 revised 13.04.05

[23] Strategic Initiative to Introduce Commercial Land Based Wind Energy Development to the Western Cape Provincial Government of the Western Cape and CNdV Africa, 2006.

resulting from the other known wind farms in the surrounds of the Roggeveld Wind Farm is difficult to assess, but may be of **moderate-high significance**.

10.6 Cumulative Heritage Impacts

From a cultural heritage perspective cumulative impacts are a reason for concern. The many proposals for wind farms or renewable energy facilities in the Karoo surrounds has been argued to amount to an industrialisation of the Karoo, with potential consequences for the aesthetic qualities of the region. The need to conserve the South African landscape cannot be under-estimated. The vast horizons of the country and the variety and qualities of the landscape contribute significantly to our communal identity, and make the country a primary tourism destination. However, it is also critical that renewable energy is encouraged. It is therefore necessary to identify and conserve iconic landscapes, but also allow some latitude so that more marginal areas can be utilised. In terms of its landscape qualities the study area is deemed to be significant and contributes aesthetically to the region. Cumulative negative impacts on archaeological and paleotological resources may also occur. **Cumulative negative impacts on heritage resources** will be a **low significance**.

10.7 Cumulative Socio-Economic Impacts

Benefits to the local, regional and national economy through employment and procurement of services could be substantial should many of the renewable energy facilities proceed. This benefit will increase significantly should critical mass be reached that allows local companies to develop the necessary skills to support construction and maintenance activities and that allows for components of the renewable energy facilities to be manufactured in South Africa. Furthermore at municipal level, the cumulative impact could be positive and could incentivise operation and maintenance companies to centralise and expand their activities towards education and training and more closely to the projects.

The cumulative impact in terms of loss of agricultural land is unlikely to be significant due to the limited land take and in most cases agricultural activities would be allowed to proceed. Property prices in these areas are likely to increase as a result of the added value that energy generation offers. However, once the renewable energy sector is saturated, property prices that are dependent on the sense of place value rather than on the agricultural potential may be compromised due to the changes in landscape and sense of place. **Cumulative positive social and economic** impacts and **negative social impacts** (visual, sense of place, noise and disturbance during construction) will be of **moderate significance**.

10.8 Conclusion regarding Cumulative Impacts

Cumulative impacts and benefits on various environmental and social receptors will occur to varying degrees with the development of several renewable energy facilities in South Africa. The degree of significance of these cumulative impacts is difficult to predict without detailed studies based on more comprehensive data/information on each of the receptors and the site specific developments. This however, is beyond the scope of this study.

The alignment of renewable energy developments with South Africa's National Energy Response Plan and the global drive to move away from the use of non-renewable energy resources and to reduce greenhouse gas emissions is undoubtedly positive. The economic benefits of renewable energy developments at a local, regional and national level have the potential to be significant. However, there is a lack of understanding of the cumulative impacts on other environmental and social receptors such as birds and bats, visual amenity and landscape character of the affected areas.

There is a need for strategic planning and co-operation to better understand the cumulative impacts that may result from promoting renewable energy. In this regard the Department Environmental Affairs has recently initiated a Strategic Environmental Assessment to identify Renewable Energy Development Zones (REDZ). The Roggeveld project site is located within one of the study areas identified as part of the Strategic Environmental Assessment (SEA)[24]. The SEA project was initiated by the Department of Environmental Affairs (DEA) and being run by the CSIR with intent to "*identify geographical areas best suited for the rollout of wind and solar PV energy projects and the supporting electricity grid network".* Through consultation with various stakeholders including the wind energy industry, the CSIR identified prioritised locations that that are potential REDZ which projects a development timeline of 5, 10 and 15 years. The location of the Roggeved site is within the prioritised REDZ. Furthermore, the Endangered Wildlife Trust and BirdLife South Africa have facilitated working groups to engage the wind energy sector on these issues. In order to better understand cumulative impacts, it is helpful to understand location of the various proposed and approved wind farm developments at any one time. In this regard the South African Wind Energy Association is collating spatial information on the approved and proposed wind farm developments of its members.

It is also important to reiterate that it is unlikely that all proposed wind farms located in the 25 to 75km radius will be built due to capacity constraints on the Eskom grid and the limits placed on renewable energy targets.

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[24] http://www.csir.co.za/nationalwindsolarsea/

CONCLUSIONS AND RECOMMENDATIONS CHAPTER 11

Roggeveld Wind Power (Pty) Ltd proposes the establishment of a wind energy facility on a site located ~20km north of Matjiesfontein (referred to as the Roggeveld Wind Farm). The project development site falls within both the Western Cape and Northern Cape Provinces. The proposed facility would utilise wind turbines to generate electricity that will be fed into the National Power Grid. The facility is proposed to be developed in phases. This final **EIA report pertains to Phase 1 of Roggeveld Wind Farm** (**DEA Ref. No. 12/12/20/1988/1).** Phase 1 of the Roggeveld Wind Farm will have an energy generation capacity of up to 140 MW, which is in line with the bid submission threshold set by the Department of Energy (DoE) under the Renewable Energy Independent Power Producers Procurement (REIPPP) Programme.

The site for Phase 1 of the Roggeveld Wind Farm includes the following thirteen farm portions:

Farm Name	Farm No	Portion No	Local Municipality	Province
Ekkraal	199	1	Karoo Hoogland Municipality	Northern Cape
Ekkraal	199	0	Karoo Hoogland Municipality	Northern Cape
Bon Espirange	73	1	Laingsburg Municipality	Western Cape
Bon Espirange	73	0	Laingsburg Municipality	Western Cape
Rietfontein	197	0	Karoo Hoogland Municipality	Northern Cape
Appelsfontein	201	0	Karoo Hoogland Municipality	Northern Cape
Ou Mure	74	1	Laingsburg Municipality	Western Cape
Fortuin	74	0	Laingsburg Municipality	Western Cape
Fortuin	74	3	Laingsburg Municipality	Western Cape
Brandvallei	75	0	Laingsburg Municipality	Western Cape
Nuwerus	284	0	Laingsburg Municipality	Western Cape
Standvastigheid	210	2	Karoo Hoogland Municipality	Northern Cape
Aprils Kraal	105	0	Laingsburg Municipality	Western Cape

Phase 1 of the Roggeveld Wind Farm will include the following infrastructure:

» Up to 60 2MW - 3.3MW wind turbines with a foundation of 20m in diameter and 3m in depth.
» Permanent compacted hardstand areas / crane pads for each wind turbine (60mx50m).
» Electrical turbine transformers (690kV/33kV) at each turbine (2m x 2m typical but up to 10m x 10m at certain locations).
» Internal access roads up to 12 m wide.

» Approximately 11km of 33kV overhead power lines; and approximately 6km of 400kV overhead power line to Eskom's Komsberg Substation.
» Electrical substations (an on-site 132/400 kV substation (100m x 200m) and a 400 kV substation (200m x 200m) adjacent to the existing Eskom Komsberg Substation.
» An operations and maintenance building (O&M building) next to the smaller substation.
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction phase includes construction lay down areas and a construction camp up to 4.5ha (150m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~2.2ha).

The EIA process for the proposed Phase 1 of the Roggeveld Wind Farm has been undertaken in accordance with the EIA Regulations published in Government Notice GN33306 of 18 June 2010, in terms of Section 24(5) of NEMA (Act No. 107 of 1998).

As agreed with the competent authority (DEA), the current final EIA report has been revised to assess the impacts of Phase 1 of the Roggeveld Wind Farm only (applicable to DEA Ref. No.: 12/12/20/1988/1). The approach to this Final EIA Report included:

» Update of the existing EIA report, specialist studies and impact assessment utilising the revised layout for Phase 1 of the project.
» Consider and address DEA's additional requirements and requests for information.
» Incorporate the findings of the bird and bat pre-construction monitoring programmes for Phase 1 into the EIA report.
» Undertake the relevant public participation tasks required to inform the registered I&APs regarding the Final EIA report for Phase 1 of the project.

11.1 Evaluation of the Proposed Project

The preceding chapters of this report together with the specialist studies contained within **Appendices F - L** provide a detailed assessment of the environmental impacts on the social and biophysical environment as a result of Phase 1 of the Roggeveld Wind Farm. This chapter concludes the Final EIA Report by providing a summary of the conclusions of the assessment of the proposed site and layout for Phase 1 of the Roggeveld Wind Farm and the associated infrastructure, including the substation and overhead power line. In so doing, it draws on the information gathered as part of the EIA process and the knowledge gained by the environmental team during the course of the EIA and presents an informed opinion of the environmental impacts associated with the proposed project.

The assessment of potential environmental impacts presented in this report is based on a layout of the turbines and associated infrastructure provided by Roggeveld Wind Power (Pty) Ltd. This layout includes 60 wind turbines as well as all associated infrastructure. No environmental fatal flaws were identified to be associated with the proposed wind energy facility. However of the potential for impacts of major and high significance were identified which require mitigation. Mitigation to avoid impacts are primarily associated with the relocation of certain turbine positions of concern, as well as measures to be utilised during the construction phase to prevent negative impacts from occurring. These are discussed in more detail in the sections which follow. Where impacts cannot be avoided, appropriate environmental management measures are required to be implemented to mitigate the impact. Environmental specifications for the management of potential impacts are detailed within the draft Environmental **Management Programme (EMPr)** included within **Appendix M**.

The sections which follow provide a summary of the most significant environmental impacts associated with the proposed project, as identified through the EIA.

11.2 Summary of All Impacts

Table 11.1 and 11.2 indicates the significance ratings for the potential environmental and social impacts associated with the project.

The most significant impacts associated with the construction and operational phases of the development of Phase 1 of the Roggeveld wind energy facility (without the use of mitigation measure) are impacts on flora and fauna and visual impacts.

Table 11.1: Summary of pre-mitigation and residual impacts of the bio-physical and socio-economic environment during **construction phase** of the project

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
Flora and Fauna	Destruction & Loss of Vegetation	MAJOR (-)	MODERATE (-)
	Protected Plant Species	MODERATE (-)	MODERATE (-)
	Faunal impacts – Construction Disturbance	MODERATE (-)	MODERATE (-)
Birds	Habitat loss	MINOR (-)	MINOR (-)
	Disturbance	MINOR (-)	MINOR (-)
Bats	Habitat loss, destruction, disturbance and displacement	MINOR (-)	MINOR (-)
Soils, Surface and Groundwater	Loss of topsoil, compaction and erosion	MODERATE (-)	MINOR (-)
	Impact on surface and groundwater	MINOR (-)	MINOR (-)
Noise Impact	Construction noise	MODERATE (-)	MODERATE-MINOR (-)
Visual	Visual impact on fixed receptors	MODERATE(-)	MODERATE (-)
Cultural Heritage	Disturbance or damage to paleontological resources	MODERATE (-)	MODERATE-MAJOR (+)
	Disturbance or damage to archaeological resources	MINOR (-)	MINOR (-)
	Disturbance or damage to cultural heritage resources	MODERATE (-)	MINOR (-)
	Disturbance or damage to buried graves	MODERATE (-)	MINOR (-)
Socio-economic	Benefits to the local economy	MODERATE (+)	MODERATE (+)
	Increased social ills	MODERATE (-)	MINOR (-)
	Disruption to agricultural activities	MODERATE (-)	MINOR (-)
	Loss of agricultural land	MINOR (-)	MINOR (-)
	Tourism activities	MINOR (-)	NEGLIGIBLE
	Property prices and desirability of property	MINOR (-)	MINOR (-)
	Sense of place	MINOR (-)	NEGLIGIBLE
	Road infrastructure	MODERATE (-)	MINOR (-)
Other Impacts	Dust	MINOR (-)	MINOR (-)
	Traffic	MODERATE(-)	MINOR (-)
	Waste and effluent	MINOR (-)	MINOR (-)
	Health and safety	MINOR (-)	NEGLIGIBLE
	Handling and Storage of dangerous goods	MODERATE (-)	MINOR (-)

Table 11.2: Summary of residual bio-physical and social residual impacts during the **operational phase** of the project

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
Flora and Fauna	Erosion Risks	MODERATE-HIGH (-)	MINOR (-)
	Alien Plant Invasion	MODERATE (-)	MINOR (-)
	Impact on Fauna & Flora	MODERATE (-)	MINOR (-)
	Impact on Critical Biodiversity Areas	MODERATE-HIGH (-)	MODERATE (-)
Birds	Displacement	MODERATE (-)	MODERATE MINOR(-)
	Mortality	MODERATE (-)	MODERATE MINOR(-)
Bats	Habitat loss – Destruction, disturbance and displacement	MODERATE (-)	MINOR (-)
	Collision of bats with turbines	MODERATE (-)	MINOR (-)
	Barotrauma	MODERATE (-)	MINOR (-)
Soils, surface and groundwater	Loss of topsoil, compaction and erosion	MINOR (-)	MINOR (-)
	Impact on surface and groundwater	MINOR (-)	MINOR (-)
Noise Impact	Wind turbine noise during operation (at the boundary)	MINOR (-)	NEGLIGIBLE
Visual Impact	Visual impact on fixed receptors (wind turbines)	MAJOR (-)	MAJOR (-)
	Visual impact on fixed receptors (substation complex)	MODERATE (-)	MODERATE-MINOR (-)
	Visual impact on fixed receptors (at night)	MODERATE (-)	MODERATE-MINOR (-)
	Visual impact on temporary receptors (day time)	MODERATE (-)	MODERATE (-)
	Visual impact on temporary receptors (night time)	MODERATE (-)	MODERATE-MINOR (-)
Cultural Heritage	Cultural heritage visual or sense of place	MODERATE (-)	MODERATE (-)
Socio-economic	Benefits to the local economy	MODERATE (+)	MODERATE (+)
	Social Ills	MINOR (-)	MINOR (-
	Disruption to agricultural land	MINOR (-)	NEGLIGIBLE
	Loss of agricultural land	MINOR (-)	MINOR (-)
	Tourism activities for local traders	MINOR (+)	MODERATE (+)
	Impact on tourism activities of lifestyle farmers and reserves	MINOR (-)	NEGLIGIBLE
	Property prices and desirability of property	MINOR (-)	MINOR (-)
	Sense of place	MODERATE (-)	MINOR (-)
	Road infrastructure	MINOR (-)	MINOR (+)
Other Impacts	Dust and emissions	NEGLIGIBLE	NEGLIGIBLE
	Traffic	MINOR (-)	NEGLIGIBLE
	Waste and effluent	MINOR (-)	NEGLIGIBLE

Environmental Aspect	Impact	Pre-mitigation Significance	Residual Impact Significance
	Health and safety	**MINOR (-)**	**NEGLIGIBLE**
	Shadow flicker	**NEGLIGIBLE**	**NEGLIGIBLE**
	Handling and Storage of dangerous goods	**MODERATE (-)**	**MINOR (-)**

11.3 Impact of the Substations and Power Line

Two substations are proposed for Phase 1 of the Roggeveld Wind Farm. The proposed on-site substation is located within a previously cultivated area, is not sensitive. The second substation which is proposed to be located adjacent to the Eskom Komsberg substation is also located within an area of relatively low sensitivity and no species of conservation concern were observed in this area. The **impact of the two substations on ecology** will be of a **low significance**. The two substation positions are located in ecologically acceptable areas.

The **overhead power line** which is proposed to connect the facility to the Komsberg substation will also have a **low impact on ecology**. Although the power line traverses several drainage lines, the pylon foundations placement can be adjusted where necessary to avoid impact to drainage lines or any other sensitive features. No deviations to the power line route are recommended at this stage.

Power lines can also cause bird injury and/ mortality resulting from collisions with power lines and electrocution. The risk of collision where the power line cross upper valley slopes is considered greater for this group of birds than at the turbines on the ridges. This situation must be mitigated by installing markers at 3 m intervals on each wire to make the power line more visible. With the use of mitigation measures the **impact of the power line on avifauna** will be of **medium-low significance**.

An ecological and avifaunal pre-construction walk-through for the power line is recommended.

11.4 Cumulative Impacts

Cumulative impacts are detailed in Chapter 10. Significant cumulative impacts that could result from the development of Phase 1 of the Roggeveld Wind Farm and other wind energy facilities in the area include:

- visual intrusion;
- change in sense of place and character of the area;
- an increase in the significance of avifaunal impacts;
- an increase in the significance of the potential impact on bats;
- loss of vegetation; and
- temporary traffic impacts during construction.

Cumulative impacts will be of a **moderate significance** on a landscape level in this region of the Northern and Western Cape. The use of the EMPr and mitigation measures would assist in mitigating these negative impacts to an acceptable level.

11.5 Environmental Sensitivity Mapping

From the specialist investigations undertaken for the proposed Phase 1 of the Roggeveld Wind Farm, a number of sensitive areas were identified (refer to **Figure 11.1 and the A3 map in Appendix N**). The following sensitive areas/environmental features have been identified on the site:

» Prominent horizontal ridges/slopes.
» Drainage lines and associated riparian vegetation.
» Special habitats (rock fields – refer to Figure 10.2 for a zoomed in map of this area)
» Avifaunal sensitive areas:
  * Five saddles (the lowest areas along ridge sections). Many bird species, including the Ludwig's Bustard (vulnerable species), often use saddles when crossing ridges, especially when this requires them to fly into headwinds. The risk of collision mortalities can be mitigated by leaving a 100 m gap between successive turbines across the five saddles designated from monitoring observations.
  * Verreaux's Eagles nesting areas - to minimise the risk of disturbance to, and collision mortality risk of, no turbines should be located nearer than 1.3 km from the established nesting area.
» Areas of high bat sensitivity:
  * Drainage lines closest to proposed turbine positions, especially when exposed rock that can be used as roosting space is visible in the drainage line.

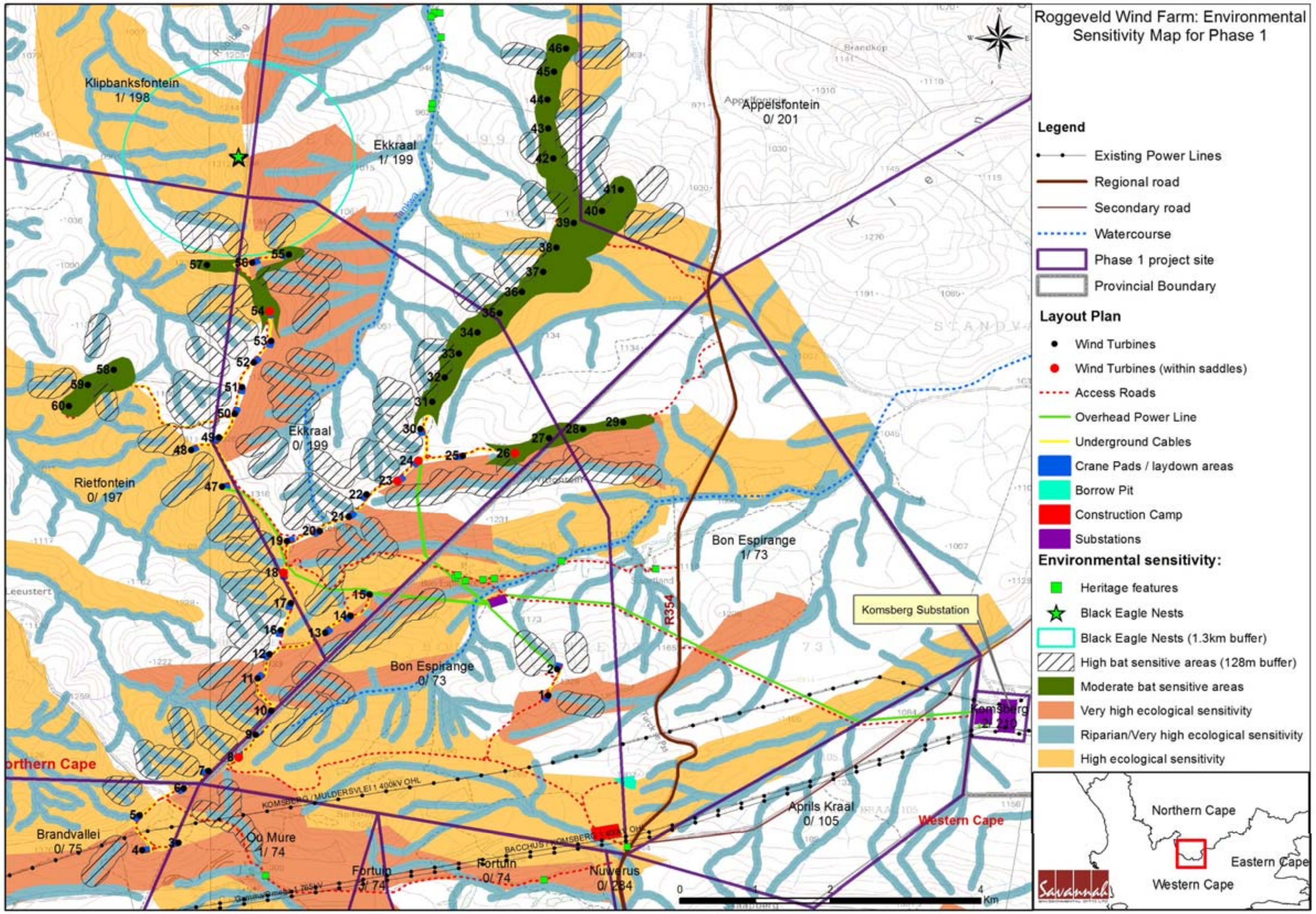

Figure 11.1: Environmental sensitivity map for the project study area illustrating sensitive areas in relation to the proposed development footprint for Phase 1 of the Roggeveld Wind Farm **(Appendix N contains an A3 map)**

  * Clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. Mostly in drainage lines.
  * Most prominent horizontal ridges of exposed rock on hill slopes can offer roosting space.
- Areas of moderate bat sensitivity: Valleys and lower altitudes are expected to offer more sheltered terrain for bat prey (insects) as well as foraging bats.
- Heritage sites (although outside the development footprint and of low heritage significance).

11.6 Recommendations for Micro-Siting of Turbines

The specialist studies assessed the Phase 1 layout and the following points regarding the wind turbine layout are made:

- Ecology (flora, fauna and drainage lines):
  * The ecological walk-through survey of the final layout of Phase 1 of the Roggeveld wind farm revealed that the majority of the turbines were located within physically and ecologically acceptable areas.
  * Turbine 52 was located within a rock field, which is an exceptional and unique habitat on the site and no other similar areas are present in the area.
- Birds:
  * The 100m gap between turbines occurring in saddles has been maintained in the revised layout. However, all turbines are spaced by a minimum of 3 x Rotor Diameter (i.e. up to 351m apart).
  * No turbines are located nearer than 1.3 km from the established Verreaux's Eagles nesting areas.
- Bats:
  * No proposed turbines are located within High bat sensitive areas and their respective buffer zones.
  * Turbines within Moderate Bat Sensitivity areas and buffer zones (turbines 26 - 29, 31 - 46, 54, 55, 57, 58 – 60) must be prioritised for potential mitigation; however other turbines must be observed during post construction monitoring.
- Heritage Site – archaeological sites of low heritage significance occur outside the development footprint.
- Noise – Based on the current layout - no noise mitigation procedures would need to be implemented at any of the dwellings located within Phase 1 the Roggeveld Wind Farm site boundaries.

The ecological walk-through survey of the final layout of Phase 1 of the Roggeveld wind farm revealed that a section within the central part of the site has several turbines within a sensitive environment, and the developer was encouraged to alter the final layout of the development in response to these findings. Figure 11.2 shows the turbines which are proposed to be relocated, which are described below:

» Turbine 52 was located within a rock field, which is an exceptional and unique habitat on the site and no other similar areas are present in the area. There a numerous geophytes, small succulents and forbs among the rocks in this area.
» As a result of relocating Turbine 52, both Turbines 53 and 54 also need to be relocated in order to maintain the required turbine spacing for wake effects.
» Turbine 57 was located along a narrow ridge that was not wide enough to accommodate the turbine and service area without considerable damage to the ridge, and the access road was also problematic as it traversed a steep slope. The turbine was relocated to the east and although the sensitive area cannot be entirely avoided, the primary sensitive portion of the ridge will no longer be impacted.

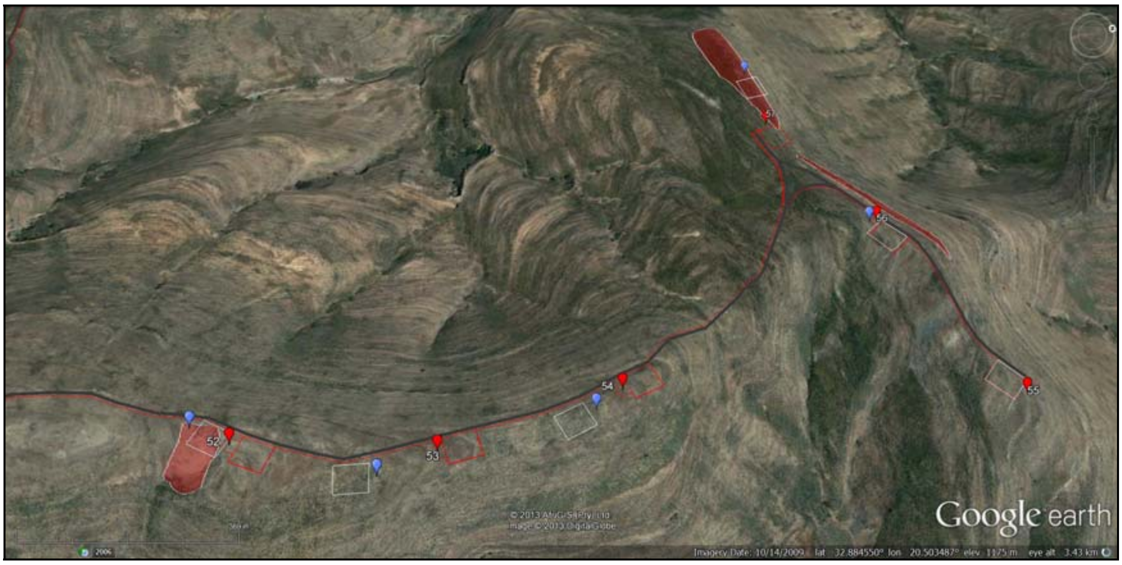

Figure 11.2 Satellite image illustrating the turbines that were relocated on the basis of the assessment of the final development layout. The blue markers illustrate the original location of the turbines, while the red markers show the revised locations. The red polygons illustrate the sensitive areas that were observed and mapped in the field.

As a result of the ecologically sensitive areas, the layout for Phase 1 was revised and is presented in Figure 11.3. The following changes to the layout of 8 wind turbines have been made to avoid impacts on the above-mentioned sensitive areas:

Turbine Name	Shift [metres]	Direction of Shift	Reason for Change
11	10	south-west	keeping minimum 3D distance to shifted turbine 12
12	11	south-south-west	keeping minimum 3D distance to turbine 16

Turbine Name	Shift [metres]	Direction of Shift	Reason for Change
45	13	south	keeping minimum 3D distance to turbine 46
52	80	north-east	removed from ecologically sensitive area
53	108	north	keeping minimum 3D distance to shifted turbine 52 (knock-on effect)
54	66	north-north-west	keeping minimum 3D distance to shifted turbine 53 (knock-on effect)
56	15	north	keeping minimum 3D distance to shifted turbine 57 (knock-on effect)
57	164	east	removed from ecologically sensitive area

Mitigation of impacts is the next option for the rest of the environmentally sensitive areas shown in Figure 11.1. Mitigation measures as detailed in the specialist studies, this final EIA report and the **Draft EMPr (Appendix M**) are to be applied during the development of the wind farm. The revised layout allows for avoidance of negative impacts on sensitive areas and is considered acceptable from an environmental and social perspective

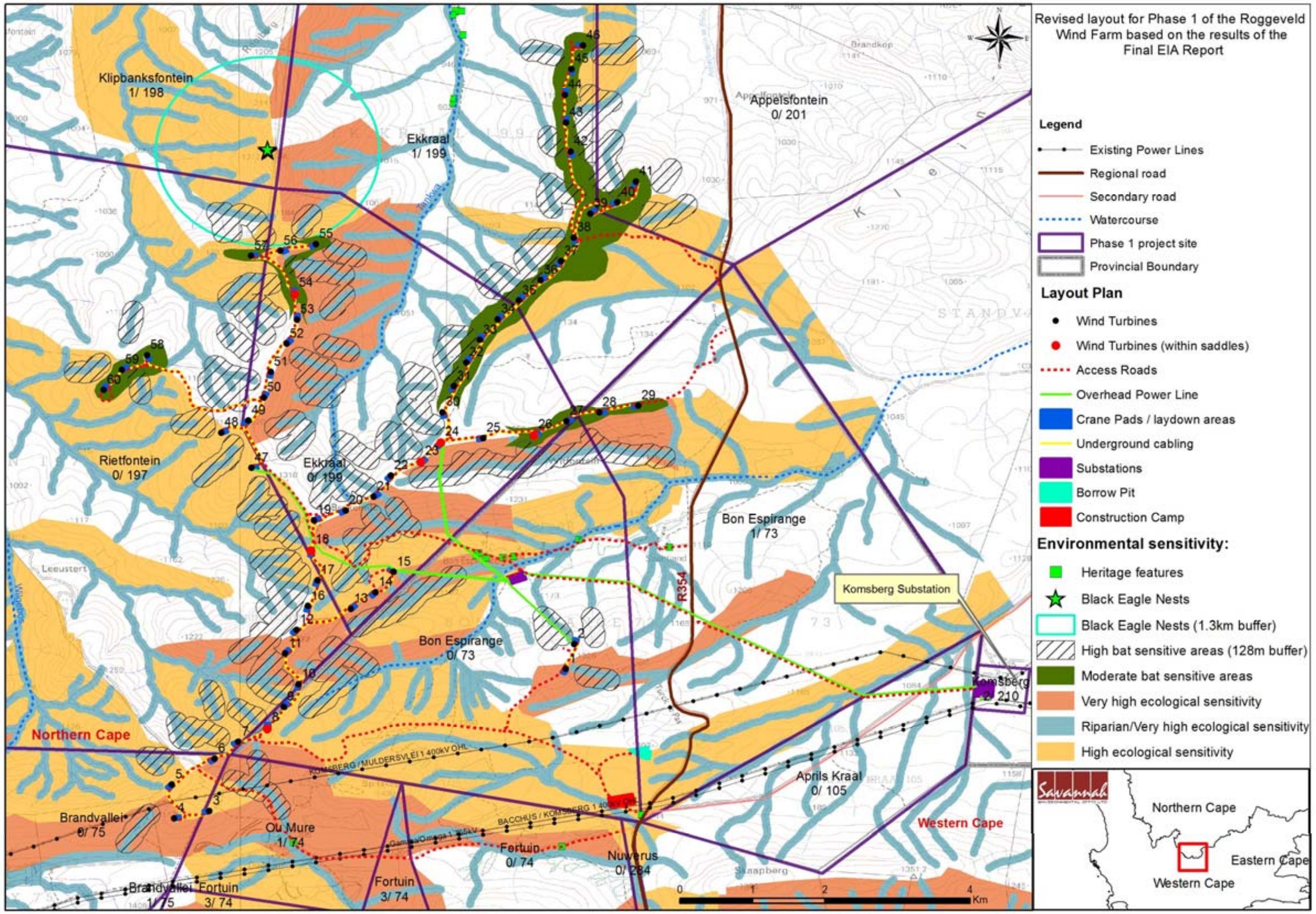

Figure 11.3: Revised layout for Phase 1 of the Roggeveld Wind Farm based on the findings of the final EIA report, for DEA approval

11.7 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. In order to meet the long-term goal of a sustainable renewable energy industry in South Africa, a goal of 17,8GW of renewables by 2030 has been set by the Department of Energy (DoE) within the Integrated Resource Plan (IRP) 2010. This energy will be produced mainly from wind, solar, biomass, and small-scale hydro (with wind and solar comprising the bulk of the power generation capacity). This amounts to ~42% of all new power generation capacity being derived from renewable energy forms by 2030.

Through pre-feasibility assessments and research, the viability of establishing the Phase 1 of the Roggeveld Wind Farm has been established by Roggeveld Wind Power (Pty) Ltd. The positive implications of establishing a wind energy facility on the demarcated site include:

» The project would assist the South African government in reaching their set targets for renewable energy.
» The potential to harness and utilise wind energy resources on this site would be realised.
» The National electricity grid in the Northern Cape and Western Cape would benefit from the additional generated power.
» Promotion of clean, renewable energy in South Africa.
» Creation of local employment and business opportunities for the area.

The findings of the specialist studies undertaken within this EIA for Phase 1 of the Roggeveld Wind Farm 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, monitoring and management measures are implemented.
» The most significant impacts associated with the construction and operational phases of the development of Phase 1 of the Roggeveld wind energy facility (without the use of mitigation measure) are impacts on flora and fauna and visual impacts.
» Majority of the environmental and social impacts associated with development of Phase 1 of the Roggeveld wind energy facility will be of moderate significance and of acceptable levels.
» 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.

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**.

11.8 Overall Recommendation

Based on the nature and extent of the proposed 140MW wind farm, 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 Phase 1 of the Roggeveld Wind Farm and associated infrastructure can be mitigated to an acceptable level, provided appropriate mitigation is implemented and adequate regard for the recommendations of this report and the associated specialist studies is taken during the detailed design of the project.

The EAP recommends DEA needs to consider that the visual impact and impact on heritage sense of place as well as the impact on vegetation remain of moderate-major significance. This should then be weighed up against the benefits to the local economy as well as the government's commitments in terms of renewable energy targets. If promoting renewable/ alternative energy is an important consideration for the SA Government (also because of the associated benefits in terms of reduction in CO_2 emissions) it may become important that some **trade-offs and choices** would need to be made between promoting renewable energy versus the local and regional environmental and social impacts and benefits of the proposed wind farm.

The following infrastructure would be included within an authorisation issued for Phase 1 of the Roggeveld wind farm project:

» Up to 60 2MW - 3.3MW wind turbines with a foundation of 20m in diameter and 3m in depth.
» Permanent compacted hardstand areas / crane pads for each wind turbine (60x50m).
» Electrical turbine transformers (690kV/33kV) at each turbine (2m x 2m typical but up to 10 x 10m at certain locations).
» Internal access roads up to 12 m wide.
» Approximately 11km of 33kV overhead power lines; and approximately 6km of 400kV overhead power line to Eskom's Komsberg Substation.

» Electrical substations (an on-site 132/400 kV substation (100m x 200m) and a 400 kV substation (200m x 200m) adjacent to the existing Eskom Komsberg Substation.
» An operations and maintenance building (O&M building) next to the smaller substation.
» Up to 4 x 100m tall wind measuring masts.
» Temporary infrastructure required during the construction phase includes construction lay down areas and a construction camp up to 4.5ha (150m x 300m).
» A borrow pit for locally sourcing aggregates required for construction (~2.2ha).

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

» Adherence to the final layout as indicated in Figure 11.3.
» Mitigation measures detailed within this report should be considered to minimise environmental impact. These are either already taken into account in the design of the final layout or are incorporated into the EMPr.
» The draft Environmental Management Programme (EMPr) as contained within Appendix M of this report should be approved and 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 EMPr 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.
» The detailed engineering design of the facility must be submitted to DEA for prior to the commencement of construction.
» Should there be any changes to the location of the wind turbines and associated infrastructure (including power lines) that fall within identified sensitive areas (if any), walk - through surveys must be undertaken by ecological and avifaunal specialists. The findings of these surveys must be included in the site-specific EMPr to be compiled for the project.
» An ecological and avifaunal pre-construction walk-through for the power line to be undertaken.
» Feasible curtailment measures (feathering of blades) as recommended by the pre-construction bat monitoring programme to be implemented.
» Feasible mitigation measures as recommended by the pre-construction bird monitoring programme to be implemented.
» Disturbed areas should be kept to a minimum and rehabilitated as quickly as possible and an on-going monitoring programme should be established to

detect, quantify and remove any alien plant species that may become established.

» Implement site specific erosion and stormwater control measures to prevent excessive surface runoff from the site (turbines and roads).
» Should any heritage site, human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to Heritage Western Cape. The developers, site managers, and any operators of excavation equipment, need to be alerted to this possibility. If fossil material is encountered, the palaeontologist must be given sufficient time and access to resources to recover at least a scientifically representative sample for further study. If it cannot be studied immediately, the costs of housing the material should be borne by the developers. In the event of human bones being found on site, SAHRA must be informed immediately and the remains removed by an archaeologist under an emergency permit. This process will incur some expense as removal of human remains is at the cost of the developer. Time delays may result while application is made to the authorities and an archaeologist is appointed to do the work.
» Applications for all other relevant and required permits if required to be obtained by the developer must be submitted to the relevant regulating authorities. This includes, where necessary, permits for the transporting of all components (abnormal loads) to site, water use licence for disturbance to any water courses/ drainage lines, permits for disturbance of protected vegetation and borrow pit/s.
» Where feasible, training and skills development programmes for locals should be initiated prior to the initiation of the construction phase.

REFERENCES CHAPTER 12

» ACO Associates (2013) Heritage Impact Assessment for Phase 1 of the Roggeveld Wind Farm
» African Insights (2013) Avifaunal Specialist Report and Preconstruction Bird Monitoring Report for the Roggeveld Wind Energy Facility (Phase 1)
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