SOUTH AFRICA MAINSTREAM RENEWABLE POWER LOERIESFONTEIN (PTY) LTD

Proposed Construction of Wind Farms near Loeriesfontein, Northern Cape Province, South Africa

Final Environmental Impact Report:

PROJECT 1	**DEA Ref No: 12/12/20/2321/1**
	NEAS Ref No: DEA/EIA/0000381/2011
PROJECT 2	**DEA Ref No: 12/12/20/2321/3**
	NEAS Ref No: DEA/EIA/0001086/2012

Issue Date: 4th May 2012
Revision No.: 3
Project No.: 10777

Date:	4th May 2012
Document Title:	Construction of a Wind Farm near Loeriesfontein, Northern Cape Province, South Africa: Final Environmental Impact Report
Author:	Faith Kalibbala
Revision Number:	3
Checked by:	Kelly Tucker
Approved:	Kelly Tucker
Signature:	
For:	South Africa Mainstream Renewable Power Loeriesfontein (Pty) Ltd

KEY PROJECT INFORMATION

FARM DESCRIPTION	21 DIGIT SURVEYOR GENERAL CODE
Remainder of the Farm No. 226, Calvinia Road, Northern Cape	C01500000000022600000
Portion 1 of the Farm No. 213, Calvinia Road, Northern Cape	C01500000000021300001
Portion 2 of the Farm No. 213, Calvinia Road, Northern Cape	C01500000000021300002

TITLE DEEDS: Attached as Appendix 7

PHOTOGRAPHS OF SITE:

General Characteristics of the study area


General Characteristics of the study area

SENSITIVE VISUAL RECEPTORS: Potentially sensitive areas with sensitive receptors have been identified but sensitive visual receptors will be assessed in detail during the EIA phase of the project.

TYPE OF TECHNOLOGY: Wind Energy - turbines

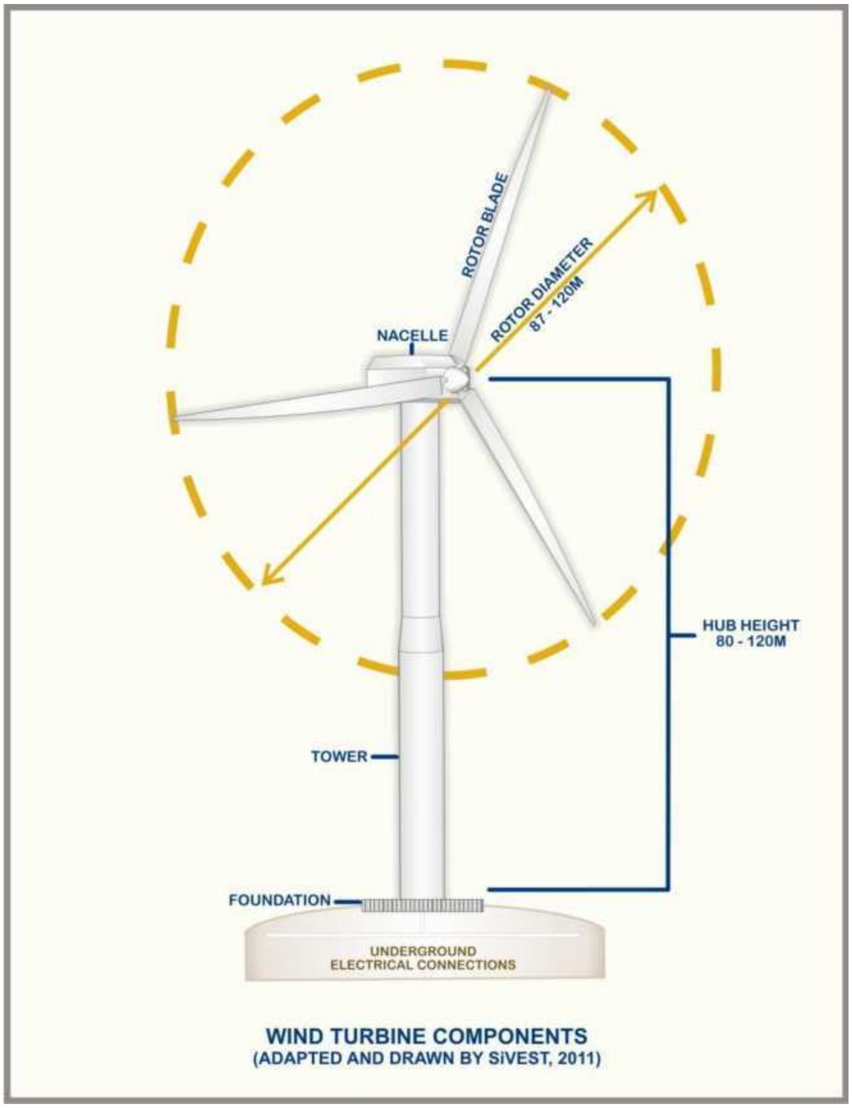
HUB HEIGHT: Wind Turbine - 80-120m

ROTOR DIAMETER: UP TO 120m

SURFACE AREA TO BE COVERED: 54.68 Hectares

STRUCTURE ORIENTATION: Wind Turbines - The structures will not be fixed and will be able to rotate in order to catch the prevailing winds. PV - Structure will be oriented in a north-east/north-west orientation.

TURBINE DESIGN: The final design is not available but average specifications are presented below:



FOUNDATION DIMENSIONS: Total footprint for each wind turbine and the associated hard standing area is approximately 2 800m².

BLADE ROTATION DIRECTION: The blade rotation direction may be clockwise or counter-clockwise. This will only be selected once the final turbine designs have been selected.

TEMPORARY LAYDOWN AREA DIMENSIONS: Wind Turbines - 100m X 100m (10 000m^2) during construction.

GENERATION CAPACITY: Wind energy - 50MW feeding into the 66kV line and 420MW feeding into the 400kV line.

ONSITE MEASURED WIND PARAMETERS: Data is confidential. Mainstream has measured wind at sufficient height since September 2010. The data gathered indicates that there is enough wind resource to construct a viable wind farm.

SOUTH AFRICA MAINSTREAM RENEWABLE POWER LOERIESFONTEIN (PTY) LTD

CONSTRUCTION OF WIND FARM FACILITIES NEAR LOERIESFONTEIN

FINAL ENVIRONMENTAL IMPACT REPORT

Executive Summary

SiVEST Environmental Division has been appointed by South Africa Mainstream Renewable Power Loeriesfontein (Pty) Ltd (hereafter referred to as Mainstream), as independent consultants to undertake an Environmental Impact Assessment process for the proposed construction of Wind Farm facilities near Loeriesfontein, Northern Cape Province. The proposed site is located on the farms Sous and Aan De Karree Doorn Pan approximately 60km north of Loeriesfontein. The objective of the project is to generate electricity to feed into the national grid by installing wind farm facilities of 50 MW and 420 MW capacity respectively. The project is also in line with the government's commitment to provide renewable energy as an alternative energy source to those currently utilized and in line with the IRP 2010.

The proposed development requires environmental authorisation from the National Department of Environmental Affairs (DEA), however provincial authorities have also been consulted with i.e. the Northern Cape Department of Tourism, Environment and Conservation (NCDTEC). The development will be carried out under the Environmental Regulations which were promulgated in June 2010 under the National Environmental Management Act - NEMA (Act No.107 of 1998) as amended. All relevant legislation (including Equator Principles) has been consulted during the EIA process and will be complied with at all times.

The proposed project is required to improve electricity supply to the Eskom Grid and to assist in achieving the Government's mandate for the establishment of renewable energy generation facilities.

The proposed project involves the construction a 50MW and 420MW Wind Farm facilities. Each project has a separate application submitted to the Department of Environmental Affairs in order to comply with the requirements of the Department of Energy. Layout alternatives have been investigated and these relate to the location of the associated infrastructure on the site. These are illustrated below:

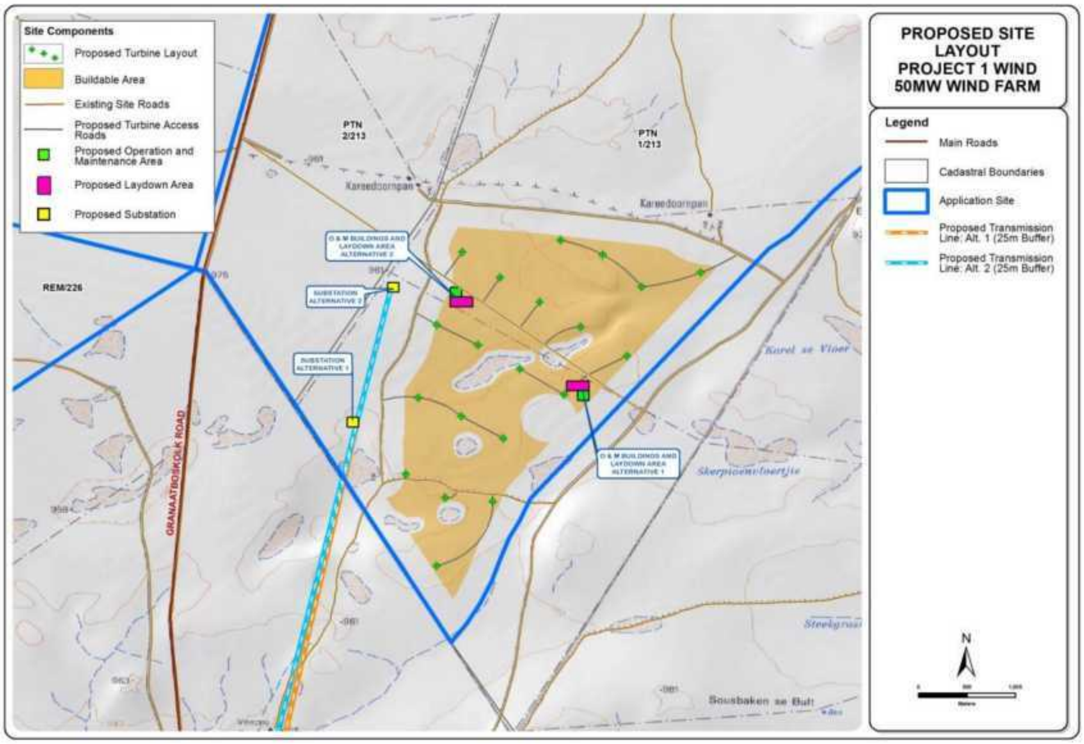


Figure i: Site layout alternatives 50MW Wind Farm

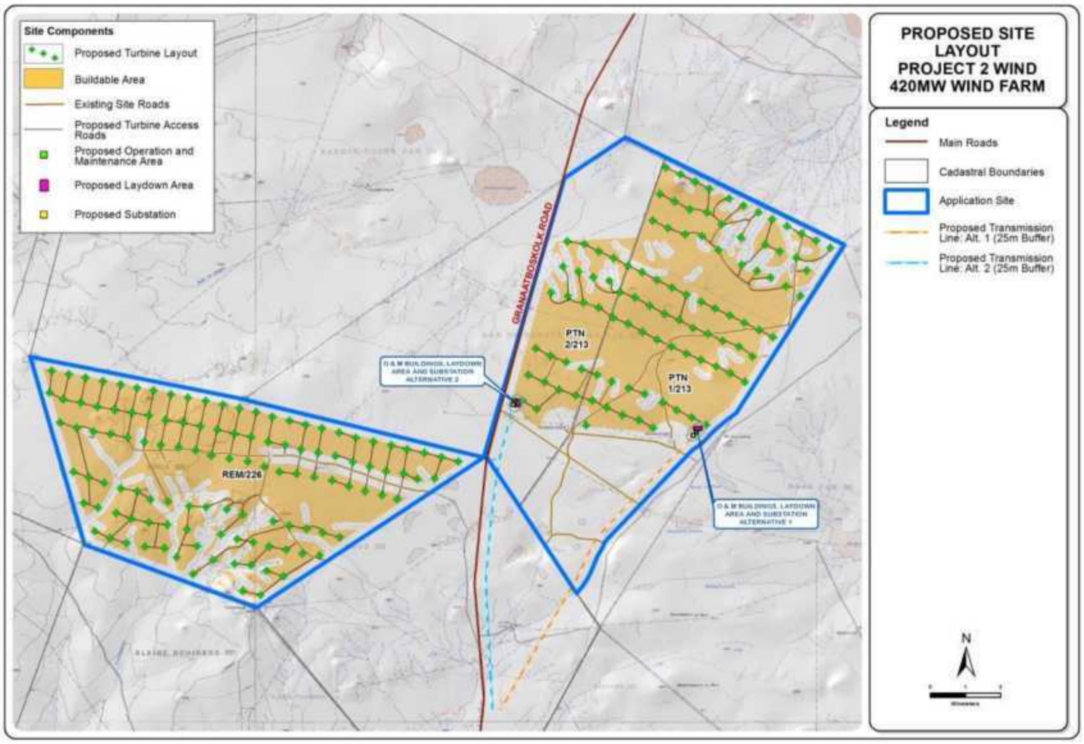


Figure ii: Site layout alternatives 420MW Wind Farm

The site is characterised by Bushmanland Basin Shrubland vegetation type of the Nama Karoo Biome and extensive sheep grazing dominates the land use and agricultural practices.

The following specialist studies were conducted as part of the EIR Phase as stipulated in the Plan of Study for EIA:

- Biodiversity (flora and fauna) Assessment
- Avifauna Assessment
- Bat Assessment
- Surface Water Impact Assessment
- Agricultural Potential
- Noise Impact Assessment
- Visual Impact Assessment
- Heritage Assessment
- Socio-economic Impact Assessment

Please note that a detailed engineering geotechnical assessment will be conducted by Mainstream prior to construction.

Table i: Summary of findings

Environmental Parameter	**Summary of major findings**	**Recommendations**
Biodiversity (flora and fauna) Assessment	The study area is very uniform in nature with characteristic Nama Karoo shrubland exhibiting sparse vegetation. No larger trees are present on the site. The study area currently operates as a functioning sheep farm and is not likely to be pristine in nature. Aan De Karree Doorn exhibits slightly more floral diversity than Sous due to different grazing regimes being practiced. The site can thus be considered to be in a fairly natural state. The site is very uniform in nature with very few distinct sensitive areas. Drainage lines on the site are not well defined due to the infrequent rains that occur. Those that have been clearly identified are considered to be sensitive as they provide rare habitat on the site when water is available. Areas of topographical change are also considered to be sensitive as they provide different microclimates on a site that is very uniform in nature. Various mammal, amphibian and reptile species are likely to occur within the study area. No Red Data species were noted during the field investigations.	Strict implementation of the suggested mitigation measures must be undertaken to ensure that the proposed development is not to the detriment of the biodiversity of the region. Although No Red Data species were noted during the field investigations, this does not however rule out their potential occurrence. Therefore, it is imperative that the mitigation measures are strictly implemented to ensure strict management should these species be encountered.

Environmental Parameter	Summary of major findings	Recommendations
	The potential impacts of the proposed development mainly related to loss of habitat for red data and general species; potential loss of species richness, edge effect and erosion. The impact of the proposed development will be limited to the turbine construction areas and the associated infrastructure such as roads. Surrounding vegetation will remain intact and will not be impacted upon. As such the impact is localised and if the mitigation measures are implemented, the overall impact can be reduced. No significant impacts on vegetation and habitat are expected during the operation phase of the proposed development, as long as rehabilitation of the impacted surrounding areas has taken place.	
Avifauna Assessment	The proposed site is characterised by intrinsic avian biodiversity value. It does not contain any unique habitats or landscape features, but it may affect locally important waterbird fly-ways, which may exists in the northern part of the proposed site. There are regionally and/or nationally important impact susceptible species present (or potentially present), and the proposed facility may have a significant detrimental effect on these birds, both during the construction and operational phases of the development.	If possible, northern part of the proposed site should be kept free of turbines until more information is available on actual bird traffic over the site. Although regionally and/or nationally important impact susceptible bird species likely to be affected by the proposed facility (both during the construction and operation) are potentially present, implementation of the required mitigation measures should reduce these impacts to Low

Environmental Parameter	Summary of major findings	Recommendations
Bat Assessment	The Loeriesfontein site does not have any of the three factors of possible roosting space, surface water and probability of insects strongly, with roosting space very limited and some foraging space in the stream beds. Overall the site is very dry and insect numbers as well as surface water would be limited during most of the year. A total of 9 bat species may occur on the site and 3 have a high probability of occurring on the site, with 2 of them having a chance of being impacted by wind turbines (*Nycteris thebaica* is not a high flying bat and therefore presumably less vulnerable to turbines). Two bat species namely Egyptian free-tailed bat (*Tadarida aegyptiaca*) and Cape serotine (*Neoromicia capensis*) were confirmed on site but none of them are of conservation concern Generally there was very low bat activity levels due to the lack of roosting and foraging opportunities.	The site needs to be visited by a bat specialist quarterly (4 times during the period) to assess and compare the bat activity on a seasonal basis.
Surface Water Impact Assessment	No wetlands were identified on the study site. However, two Priority Rivers and 233 drainage lines occur on the study namely the Leeuberg River and the Klein-rooiberg River.	Anticipated potential impacts in the pre-construction, construction, operation and decommissioning phases have been scoped and appropriate mitigation measures have been stipulated for the proposed development. A final walk-down by a suitably qualified

Environmental Parameter	Summary of major findings	Recommendations
		wetland specialist will not be required for the proposed development. Sufficient information is available to address identified potential impacts that may result from the proposed development of the wind farm
Agricultural Potential	The study area has an arid Mediterranean type climate with winter rainfall regime i.e. most of the rainfall is confined to early autumn and winter. Mean Annual Precipitation (MAP) is approximately 179 mm per year. The combination of low rainfall and severe moisture deficient means that sustainable arable agriculture cannot take place on the farm without some form of irrigation. The soils identified on the Proposed Development Area (PDA) are predominantly calcic and shallow with a low agricultural potential. Rocky and shallow calcic soils (Mispah and Coega Form) cover 97% of the surveyed area. Virtually all the soils encountered had a layer that was limiting to plant growth and the effective soil depth rarely extended below 50 cm. The site is not classified as high potential nor is it a unique dry land agricultural resource. The study area has been classified as having an extremely low potential for crop production due to an arid climate and highly restrictive soil characteristics but are considered to have a moderately low value as grazing land, its	Normal grazing (the dominant agricultural activity) will be permitted around the turbines. All three farms, which constitute the study area, are dominated grazing land and this activity is considered non-sensitive when assessed within the context of the proposed development. Consequently, the impact of the proposed development on the study area's agricultural potential will be extremely low, with the loss of agricultural land being attributed to the creation of the service roads and around the turbine and array foundations. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the proposed development. Therefore, from an agricultural perspective, there are no problematic or fatal flaw areas for the site

Environmental Parameter	Summary of major findings	Recommendations
	current use.	
Noise Impact Assessment	The proposed project will have a noise impact of a low significance on all Noise-Sensitive Development (NSDs) in the area during the construction phase, but a noise impact of medium significance on a noise sensitive development south of the study area during the operational phase. As the wind turbine to be selected is not confirmed, modelling made use of the Nordex H90 2500HS wind turbine that might present a worse-case scenario. Mitigation measures are proposed that will reduce the potential noise impact to a more acceptable low significance.	Where potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors. It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source – but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels
Visual Impact Assessment	Due to the limited human habitation in the surrounding area, very few potentially sensitive receptors are present in the study area and the proposed development will have a low or medium impact on most of these receptors. The proposed wind and solar energy facility will have a negative low visual impact during construction and a negative medium visual impact during operation, with very few mitigation measures available	Proposed mitigation measures should be implemented
Heritage Assessment	Several heritage resources have been identified on site which	Sensitive heritage resource areas are to be

<table>
<tr><th>Environmental Parameter</th><th>Summary of major findings</th><th>Recommendations</th></tr>
<tr><td></td><td>can be classed as having high significance.</td><td>excluded as no-go areas. Suggested buffer zones must be implemented.

All suggested mitigation measures must be implemented and included in the EMPr for the proposed development.</td></tr>
<tr><td>Socio-economic Impact Assessment</td><td>A summary of the construction impacts

<table>
<tr><th>Change Process</th><th>Issue</th><th>Pre-Mitigation</th><th>Post-Mitigation</th></tr>
<tr><td>Economic</td><td>Employment and output creation</td><td>+18</td><td>+30</td></tr>
<tr><td rowspan="2">Socio-Cultural</td><td>Social mobilisation</td><td>-20</td><td>-7</td></tr>
<tr><td>Health and safety</td><td>-60</td><td>-28</td></tr>
<tr><td>Average</td><td>Overall construction impacts</td><td>-20</td><td>-1.6</td></tr>
</table>

Apart from the possibility of temporary employment, overall the construction phase is characterised by negative low social impacts.

In certain instances the implementation of mitigation measures</td><td>Even though all of the identified social impacts can be mitigated or enhanced successfully, this can only be done if Mainstream, or its appointed contractor(s), commit to the responsibility of ensuring that the level of disturbance brought about to the social environment by the more negative aspects of the project, is minimised as far as possible.

It is therefore recommended that:

▪ Social issues identified during the EIA phase are addressed. This could be done by engaging social specialists where necessary or by ensuring that Environmental Control Officers (ECOs) used during construction have the necessary knowledge and skills to identify social problems and address these when necessary. Guidelines on</td></tr>
</table>

Environmental Parameter	Summary of major findings	Recommendations
	can bring about positive changes. One such case would be the implementation of an effective HIV/AIDS prevention programme that extends to the local communities where construction workers will spend their free time, as this can also serve to inform and empower local people to make better and more informed decisions regarding their future (sexual) behaviour. Where Mainstream has the opportunity to bring about positive change to local communities they should pursue such opportunities where possible. The in-migration of a construction team consisting of approximately 320 people in the case of the wind farm will create a housing need in Loeriesfontein as the nearest town. The more people are sourced from the local community, the less the demand for additional housing, as local community members are already resident in the area. Loeriesfontein has a small hospitality industry, consisting of one B&B and one hotel. It would therefore appear that accommodation options are fairly restricted in the area, given the fact that Mainstream have opted to not make use of a residential construction camp. The majority of impacts that would occur during the construction phase would affect people's sense of wellbeing and security within their social environment. A number of changes to the socio-economic environment would lead to economic impacts, but for the most part these impacts would be restricted to	managing possible social changes and impacts could be developed for this purpose. ▪ Alternative accommodation options are considered for the construction phase as it would appear that the hospitality industry in Loeriesfontein would not be able to cater for the quantity of people. ▪ Neighbouring landowners are informed beforehand of any construction activity that is going to take place in close proximity to their property. Prepare them on the number of people that will be on site and on the activities they will engage in. ▪ Employees are aware of their responsibility in terms of Mainstream's relationship with landowners and communities surrounding the site. Implement an awareness drive to relevant parts of the construction team to focus on respect, adequate communication and the 'good neighbour principle.' ▪ All mitigation measures in the Social Impact Assessment (SIA) are

<table>
<tr><th>Environmental Parameter</th><th>Summary of major findings</th><th>Recommendations</th></tr>
<tr><td></td><td>individuals or individual households and would not extend to the community at large.

A summary of the operations and maintenance impacts

<table>
<tr><th>Change Process</th><th>Issue</th><th>Pre-Mitigation</th><th>Post-Mitigation</th></tr>
<tr><td>Economic</td><td>Employment and output creation</td><td>+20</td><td>+36</td></tr>
<tr><td></td><td>Tax income</td><td>+14</td><td>+14</td></tr>
<tr><td></td><td>Corporate Social Investment</td><td>+27</td><td>+48</td></tr>
<tr><td></td><td>Agricultural output</td><td>-11</td><td>-11</td></tr>
<tr><td></td><td>Tourism</td><td>-10</td><td>-10</td></tr>
<tr><td></td><td>Property prices</td><td>-10</td><td>-10</td></tr>
<tr><td>Socio-cultural</td><td>Sense of place</td><td>-24</td><td>-20</td></tr>
<tr><td>Average</td><td>Overall operations and maintenance impacts</td><td>+0.9</td><td>+6.7</td></tr>
</table>

The presence of the wind farm during the operation and</td><td>incorporated in the Environmental Management Programme (EMPr) to ensure that Mainstream and the contractor adhere to these.</td></tr>
</table>

Environmental Parameter	Summary of major findings	Recommendations
	maintenance phase overall will have a low positive impact, although certain elements will yield medium positive impacts whereas other elements are expected to have a more negative connotation. Most positive impacts are of an economic nature, most significantly Mainstream's corporate social investment in the area, which in turn could lead to an array of other positive social upliftment projects (outside the scope of this study). Negative impacts are expected to be on the low side and would in all probability be over-shadowed by the more positive contributions that Mainstream will make to the area through their Corporate Social Investment (CSI).	

These specialist studies were conducted to address the potential impacts relating to the proposed development that were identified during the scoping phase. An impact assessment was conducted to ascertain the level of each identified impact, as well as mitigation measures which may be required. The potential positive and negative impacts associated within these studies have been evaluated and rated accordingly. The results of the specialist studies have indicated that no fatal flaws exist as a result of the proposed project.

Based on the findings of the specialist studies, the following layout was chosen as the preferred layout.

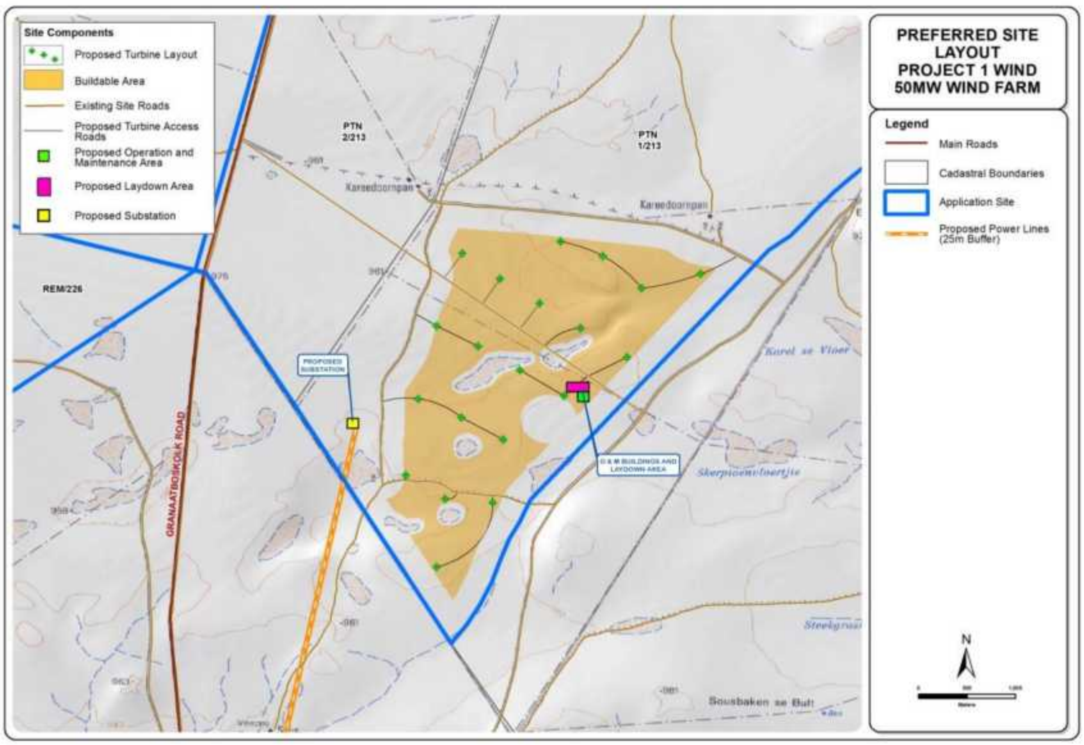


Figure iii: Preferred site layout 50MW

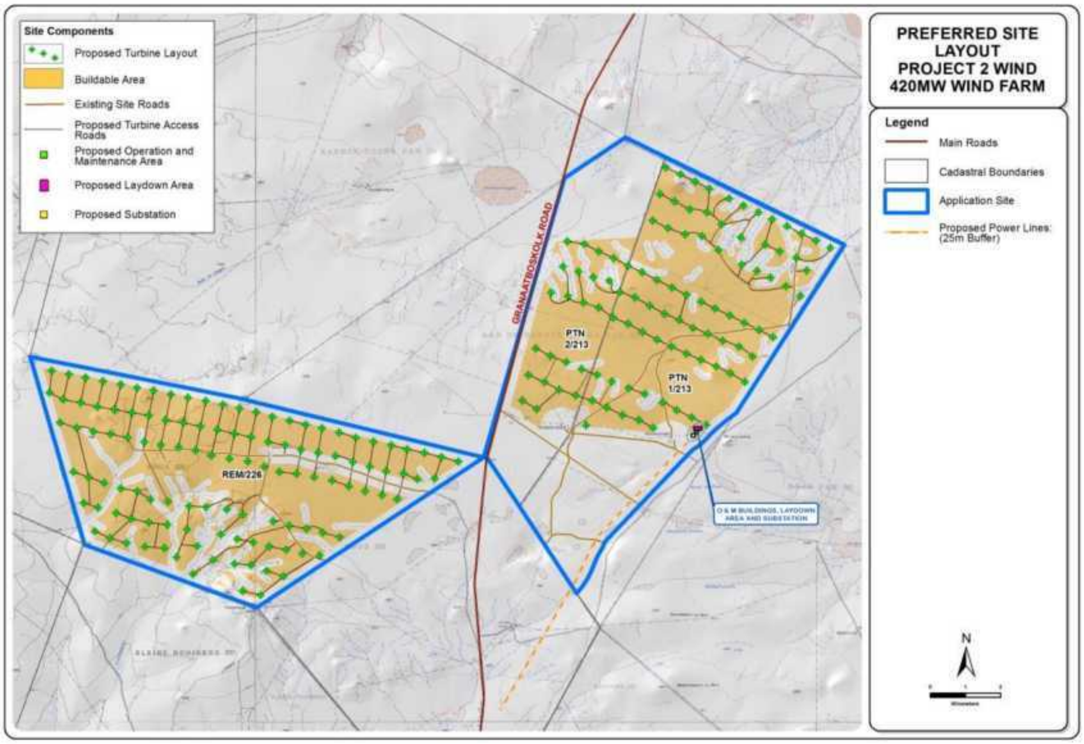


Figure iv: Preferred site layout 420MW

It is the opinion of the Environmental Assessment Practitioner (EAP) that the proposed project be allowed to proceed provided that the recommended mitigation measures are implemented.

Please refer to appendix 11 for the Afrikaans version of the executive summary.

SOUTH AFRICA MAINSTREAM RENEWABLE POWER LOERIESFONTEIN (PTY) LTD

CONSTRUCTION OF WIND FARM FACILITIES NEAR LOERIESFONTEIN

FINAL ENVIRONMENTAL IMPACT REPORT

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Glossary of terms

Alluvial: Resulting from the action of rivers, whereby sedimentary deposits are laid down in river channels, floodplains, lakes, depressions etc

Biodiversity: The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

Cultural significance: This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

Cumulative Impact: In relation to an activity, cumulative impact means 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.

"Equator Principles": A financial industry benchmark for determining, assessing and managing social & environmental risk in project financing

Environmental Impact Assessment: 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 the application.

Environmental Impact Report: In-depth assessment of impacts associated with a proposed development. This forms the second phase of an Environmental Impact Assessment and follows on from the Scoping Report.

Environmental Management Programme: A legally binding working document, which stipulates environmental and socio-economic mitigation measures which must be implemented by several responsible parties throughout the duration of the proposed project.

Heritage resources: This means any place or object of cultural significance. See also archaeological resources above

Heritage Significance Grades:
a) Grade I: Heritage resources with qualities so exceptional that they are of special national significance;
(b) Grade II: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
(c) Grade III: Other heritage resources worthy of conservation,

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

Hyrdomorphic / hydric soil: Soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring growth and regeneration of hydrophytic vegetation. These soils are found in and associated with wetlands.

Iron Age: Period covering the last 1800 years, when new people brought a new way of life to southern Africa. They established settled villages, cultivated domestic crops such as sorghum, millet and beans, and they herded cattle as well as sheep and goats. These people, according to archaeological evidence, spoke early variations of the Bantu Language. Because they produced their own iron tools, archaeologists call this the Iron Age.
Early Iron Age AD 200 - AD 900
Middle Iron Age AD 900 - AD 1300
Late Iron Age AD 1300 - AD 1830

Kilovolt (kV): a unit of electric potential equal to a thousand volts (a volt being the standard unit of electric potential. It is defined as the amount of electrical potential between two points on a conductor carrying a current of one ampere while one watt of power is dissipated between the two points).

Macro-geomorphological: Related to / on the scale of geomorphic provinces. A geomorphic province is a spatial entity with common geomorphic attributes.

Precipitation: Any form of water, such as rain, snow, sleet, or hail that falls to the earth's surface.

Red Data species: All those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for the Conservation of Nature and Natural Resources.

Riparian: The area of land adjacent to a stream or river that is influenced by stream induced or related processes.

Scoping Report: An “issues-based” report which forms the first phase of an Environmental Impact Assessment process

Stone Age: The first and longest part of human history is the Stone Age, which began with the appearance of early humans between 3-2 million years ago. Stone Age people were hunters, gatherers and scavengers who did not live in permanently settled communities. Their stone tools preserve well and are found in most places in South Africa and elsewhere.
Early Stone Age 2 000 000 - 150 000 Before Present
Middle Stone Age 150 000 - 30 000 BP

Late Stone Age 30 000 - until c. AD 200

List of Abbreviations

AP - Action Plan
BID - Background Information Document
CRM - Cost Recovery Mechanism
DEA - Department of Environmental Affairs
DoE - Department of Energy
DSR - Draft Scoping Report
DWA - Department of Water Affairs
EAPs - Environmental Assessment Practitioner
EHS - Environmental, Health, and Safety
EIA - Environmental Impact Assessment
EIR - Environmental Impact Report
EMPr - Environmental Management Programme
ENPAT - Environmental Potential Atlas
ECA - Environmental Conservation Act No 73 of 1989
EP - Equator Principles
EPFI - Equator Principles Financial Institutions
FGM - Focus Group Meeting
FSR - Final Scoping Report
FEIR - Final Environmental Impact Report
GDP - Gross Domestic Product
GIIP - Good International Industry Practice
GIS - Geographic Information System
GPS - Global Positioning System
GW - Gigawatts
HIA - Heritage Impact Assessment
HLM - Hantam Local Municipality
I&AP(s) - Interested and Affected Parties
IBA(s) - Important Bird Area(s)
IDP - Integrated Development Plan
IEP - Integrated Energy Plan
IPP(s) - Independent Power Producers
IUCN - International Union for the Conservation of Nature and Natural Resources
KSW - Key Stakeholder Workshop
kV - Kilo Volt
LED - Local Economic Development
LGMSA - Local Government: Municipal Systems Act No. 32 of 2000
MSA - Middle Stone Age
MYPD2 - Multi Year Price Determination 2

MW - Megawatt
MSBL - Multi-Site base load (MSBL)
NCDTEC - Northern Cape Department of Tourism, Environment and Conservation
NDM - Namakwa District Municipality
NEA - The National Energy Act No. 34 of 2008
NERSA - National Energy Regulator of South Africa
ERA - The Electricity Regulation Act No. 4 of 2006
IRP - Integrated Resource Plan
ISMO - Independent System and Market Operator
NEMA - National Environmental Management Act No. 107 of 1998
NEMBA - National Environmental Management: Biodiversity Act No. 10 of 2004
NFEPA - National Freshwater Ecological Priority Areas
NHRA - National Heritage Resources Act No. 25 of 1999
NSD - Noise Sensitive Development
NSBA - National Spatial Biodiversity Assessment
NWA - National Water Act No. 36 of 1998
NEMAA - National Environmental Management: Air Quality Act of 2004
OCGT - Open Cycle Gas Turbine
OHSA - Occupational Health and Safety Act No. 85 of 1993
PDA - Proposed Development Area
PFA - Project Facilitation Act No. 67 of 1995
PoS - Plan of Study
PM - Public Meeting
PPA - Power Purchase Agreement
PPP - Public Participation Process
PSR - Potentially Sensitive Receptor
REFIT - Renewable Feed-In Tariff Programme
RFP - Request for Proposals
RFQ - Request for Qualifications
SA - South Africa
SABAP 2 - Southern African Bird Atlas Project 2
SAHRA - South African Heritage Resources Agency
SANBI - South African National Biodiversity Institute
SAWS - South African Weather Service
SBO - Single Buyer Office
SDF - Spatial Development Framework
VAC - Visual Absorption Capacity

MAINSTREAM RENEWABLE POWER SOUTH AFRICA

CONSTRUCTION OF A WIND FARM FACILITY NEAR LOERIESFONTEIN

FINAL ENVIRONMENTAL IMPACT REPORT

1 INTRODUCTION

South Africa Mainstream Renewable Power Loeriesfontein (Pty) Ltd (hereafter referred to as Mainstream) has appointed SiVEST to undertake the EIA process for the proposed construction of a wind farm near Loeriesfontein, Northern Cape Province, South Africa. The site is approximately 60km to the north of Loeriesfontein. The objective of the project is to develop a wind farm in order to generate electricity to feed into the national grid. The project is also in line with the government's commitment to provide renewable energy as an alternative energy source to those currently utilized and in line with the IRP 2010.

The proposed project has been split into two in order to ensure that the licensing process with the Department of Energy is complied with. Project 1 involves the proposed construction of a 50MW wind farm whilst Project 2 involves the proposed construction of a 420MW wind farm project. The larger of the two is proposed to be constructed at a later stage when Eskom infrastructure allows.

In terms of the Environmental Impact Assessment Regulations (2010) published under the National Environmental Management Act, 1998 (Act No 107 of 1998) as amended, the proposed development is regarded as a listed activity under Government Notice R544 - R546 of 2010. The Scoping Phase of the project has been completed and has been accepted by the National Department of Environmental Affairs (DEA). We are now at the EIA phase.

This report has been compiled in accordance with World Bank standards and the Equator Principles. The Equator Principles ("EP") is a financial industry benchmark for determining, assessing and managing social & environmental risk in project financing (Equator Principles, 2006).

This wind farm is considered a Category B project. Category B Projects are those with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures (Equator Principles, 2006).

The project will also comply with the International Finance Corporation's Social and Environmental Performance Standards (2006).

1.1 Structure of this Report

This Final Environmental Impact Report (FEIR) is structured as follows:

- Chapter 1 introduces the project and discusses the experience of the Environmental Assessment Practitioners (EAP), including specialists, who have contributed to the report. It expands on the relevant legal ramifications applicable to the project and describes the Equator Principles, IFC Performance Standards and the relevant development strategies and guidelines.
- Chapter 2 details the approach used to undertake the study i.e. the scoping study, authority consultation and the EIR.
- Chapter 3 elaborates on the assumptions and limitations pertaining to the EIA process for the proposed development.
- Chapter 4 provides explanation to the need and desirability of the proposed project by highlighting issues such as security of power supply; local employment as well as regional and local income profile.
- Chapter 5 provides details pertaining to the project sustainability
- Chapter 6 gives detailed technical descriptions of the wind farm facility as well as the alternatives involved.
- Chapter 7 describes the alternatives of the proposed project
- Chapter 8 provides a description of the region in which the proposed development is intended to be located. Although the chapter provides a broad overview of the region, it is also specific to the application. It contains descriptions of the site and the specialist studies conducted.
- Chapter 9 describes the Public Participation Process (PPP) undertaken during the EIA Phase and tables issues and concerns raised by Interested and Affected Parties (I&APs).
- Chapter 10 documents the findings of the specialist studies and associated potential impacts of the proposed wind farm facility.
- Chapter 11 presents a rating of each environmental issue before and after mitigation measures.
- Chapter 12 identifies potential cumulative impacts per environmental issue (specialist study) as well as mitigation measures.
- Chapter 13 gives a comparative assessment of all identified alternatives based on the various environmental issues (specialist studies).
- Chapter 14 provides a description of the environmental monitoring and auditing process to be undertaken for the proposed wind farm facility.

- Chapter 15 presents a checklist that ensures that the report has been compiled according to the requirements of the World Bank Standards and Equator Principles.
- Chapter 14 summarises the findings and recommendations per specialist study and provides the overall conclusion.
- Chapter 17 lists references indicated in the EIR.

1.2 Expertise of Environmental Assessment Practitioner

SiVEST has considerable experience in the undertaking of EIAs. Staff and specialists who have worked on this project and contributed to the compilation of this Scoping Report are detailed in Table 1 below.

Table 1: Project Team

Name and Organisation	Role
Kelly Tucker SiVEST	Project Leader
Faith Kalibbala	Report compilation
Liesl Koch - SiVEST	Biodiversity (Flora and Fauna)
Paul da Cruz - SiVEST	Visual, Surface water
Chris van Rooyen	Avifauna
Shaun Taylor - SiVEST	Surface water
Andrea Gibb - SiVEST	Visual
Kurt Barichievy - SiVEST	Agricultural Potential
Kerry Schwartz - SiVEST	GIS and Mapping
Morne de Jager – M² Environmental Connections	Noise
Johnny Van Schalkwyk	Heritage
Bernard Casey, Mainstream	Geotechnical
Nonka Byker – MasterQ	Social
Werner Marais – Animalia	Bats
Nicolene Venter - SiVEST	Public participation
Mabel Qinisile - SiVEST	
Faith Kalibbala - SiVEST	

Please refer to attached CV's for more information (Appendix 1).

1.3 Key Legal and Administrative Requirements Relating to the Proposed Development

1.3.1 National Environmental Management Act (Act No 107 of 1998) – NEMA EIA Requirements

The National Environmental Management Act (Act No. 107 of 1998) was promulgated in 1998 but has since been amended on several occasions from this date. This Act replaces parts of the Environment Conservation Act (Act No 73 of 1989) with exception to certain parts pertaining to Integrated Environmental Management. The act intends to provide for:

- co-operative environmental governance by establishing principles for decision-making on matters affecting the environment;
- institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state;
- to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment;
- and to provide for matters connected therewith.

NEMA now governs the EIA process with the recent promulgation of the new EIA regulations in June 2010 (Government Gazette No. 33306 of 18th June 2010).

Activities that may significantly affect the environment must be considered, investigated and assessed prior to implementation.

In terms of the newly released EIA Regulations promulgated in terms of Chapter 5 NEMA (National Environmental Management Act), which came into effect on 2nd August 2010, a full EIA is required for the proposed project.

1.3.2 NEMA EIA Requirements

In terms of the new Regulations, which have been released on the 18th of June 2010 and placed into full effect on the 2nd of August 2010, a full Environmental Impact Assessment is required for the proposed development based on triggered activities. However, several activities which trigger a basic assessment were also identified and need also be specified. Ultimately, these activities will not form a separate assessment, but will fall into the greater EIA.

The following Schedules of the Government Notice No. R. 544 - 545 of the 18th June 2010 are of relevance to the project in question. All of the Listed Activities identified in terms of Sections 24(2) and 24D include:

Table 2: Listed activities in terms of the NEMA Regulations

Number and date of the relevant notice:	**Activity No (s)**	**Description of listed activity**
Government Notice R544 (18 June 2010)	Activity 1	The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of electricity where- i. The electricity output is more than 10 megawatts but less than 20 megawatts or ii. The output is 10 megawatts or less but the total extent of the facility covers an area in excess of one hectare.
	Activity 10	The construction of facilities or infrastructure for the transmission and distribution of electricity- **i. outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts.**
	Activity 22	The construction of a road outside urban areas i) with a reserve wider than 13.5 metres **ii) where no reserve exists where the road is wider than 8 metres**
	Activity 23	The transformation of undeveloped, vacant or derelict land to- i) residential, retail, commercial, recreational, industrial or institutional use, inside an urban area, and where the total area to be transformed is 5 hectares or more, but less than 20 hectares, or **ii) residential, retail, commercial, recreational, industrial or institutional use, outside an urban area, and where the total area to be transformed is bigger than 1 hectare but less than 20 hectares except where such transformation takes place for linear activities**
	Activity 24	The transformation of land bigger than 1000 square metres in size, to residential, retail, commercial, industrial or institutional use, where, at the time of the coming into effect of this schedule such lad was zoned open space, conservation or had an equivalent zoning.
Government Notice R545 (18 June 2010)	Activity 1	The construction of facilities or infrastructure, including associated structures or infrastructure, for the generation of

		electricity where the electricity output is 20 megawatts or more.
	Activity 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; or ii) Agriculture or afforestation where the activity 16 in this schedule will apply
Government Notice R546 (18 June 2010)	Activity 4	**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 and Northern Cape provinces:** ii) Outside urban areas, in: a) A protected area identified in terms of NEMPAA, excluding conservancies; b) National Protected Area Expansion Strategy Focus areas; c) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; d) Sites or areas identified in terms of an International Convention; e) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; f) Core areas in biosphere reserves; g) 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; h) 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.
	Activity 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 a) within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; **b) Within critical biodiversity areas identified in bioregional plans;**
	Activity 13	The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes indigenous vegetation, except where such removal of vegetation is required for: 1) the undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), in which case the activity is regarded to be excluded from this list; 2) The undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1. 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: i) In an estuary; ii) Outside urban areas, the following: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (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; (dd) Sites or areas identified in terms of an International Convention; (ee) Core areas in biosphere reserves;

		(ff) Areas within10 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; (gg) 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.

1.3.3 National Heritage Resources Act (Act No 25 of 1999)

This Act requires all developers to undertake archaeological impact studies whenever any type of development activity is undertaken. Preliminary archaeological impact studies will consequently become a common procedure for all development activities, even if such development may be exempted in terms of the National Environmental Management Act (Act No 107 of 1998).

The law ensures community participation in the protection of national heritage resources and will involve all three levels of government in the management of the country's national heritage. The South African Heritage Resources Agency (SAHRA) will establish and maintain a national policy, strategy plans and standards for heritage resources management and will monitor the system as a whole.

Heritage authorities will assist and co-operate with individuals and organisations concerned with the study, the conservation, promotion and utilisation of national heritage resources. A newly established National Heritage Resources Fund will provide financial assistance for heritage projects.

A heritage assessment has been conducted to explore how the proposed development may impact on heritage resources as protected by the Act.

1.3.4 National Water Act (Act No 36 of 1998)

The National Water Act, No 36 of 1998 (NWA) was promulgated on the 20th August 1998. This Act is important in that it provides a framework to protect water resources against over exploitation and to ensure that there is water for social and economic development, human needs and to meet the needs of the aquatic environment. The Act also recognises that water belongs to the whole nation for the benefit of all people.

It is important to note that water resources are protected under the Act. Under the act, water resources as defined include a watercourse, surface water, estuary or aquifer. A watercourse is defined as a river or spring, a natural channel in which water flows regularly or intermittently, or a wetland, lake or dam into which, or from which water flows.

One of the main aims of the Act is the protection of water resources. 'Protection' in relation to a water resource entails:

- Maintenance of the quality of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource
- The rehabilitation of the water resource

In the context of the proposed development and any potential impact on water resources, the definition of pollution and pollution prevention contained within the Act is relevant. 'Pollution', as described by the Act is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (inter alia)

- less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

This definition of pollution is quite wide ranging, and it applies to all types of water resource. Activities which cause alteration of the biological properties of a watercourse (i.e. the fauna and flora contained within that watercourse are also considered pollution).

In terms of section 19 of the Act owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include (inter alia):

- measures to cease, modify, or control any act or process causing the pollution
- comply with any prescribed waste standard or management practice
- contain or prevent the movement of pollutants
- remedy the effects of the pollution; and
- remedy the effects of any disturbance to the bed and banks of a watercourse

A surface water assessment has been conducted to explore how the proposed development may impact on water resources as protected by the Act.

1.3.5 Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009)

These are developed to protect both animal and plant species within the various provinces of the country which warrant protection. These may be species which are under threat or which are already considered to be endangered. The provincial environmental authorities are responsible for the issuing of permits in terms of this legislation. The Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009) and the Nature and Environmental Conservation Ordinance 19 of 1974 are of relevance to the Northern Cape Province.

A biodiversity assessment has been conducted to explore how the proposed development may impact on biodiversity as protected by the Act.

1.3.6 National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)

The overarching aim of the National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA), within the framework of NEMA, is to provide for:

- The management and conservation of biological diversity within South Africa, and of the components of such biological diversity;
- The use of indigenous biological resources in a sustainable manner; and
- The fair and equitable sharing among stakeholders of benefits arising from bio-prospecting involving indigenous biological resources.

The South African National Biodiversity Institute (SANBI) was established by the NEMBA, its purpose being (*inter alia*) to report on the status of the country's biodiversity and the conservation status of all listed threatened or protected species and ecosystems.

NEMBA provides for a range of measures to protect ecosystems and for the protection of species that are threatened or in need of protection to ensure their survival in the wild, including a prohibition on carrying out a "restricted activity" involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7. Lists of critically endangered, endangered, vulnerable and protected species have been published and a permit system for listed species has been established.

It is also appropriate to undertake a Faunal and Botanical Impact Assessment where proposed developments, in an area that is considered ecologically sensitive, require an environmental authorisation in terms of NEMA, with such Assessment taking place during the basic assessment or EIA. These two studies will be undertaken during the Mainstream project.

The NEMBA is relevant to the proposed project as the construction of the wind farms and other components (such as power lines and the substations) may impact negatively on biodiversity. The project proponent is therefore required to take appropriate reasonable measures to limit the impacts on biodiversity, to obtain permits if required and to also invite SANBI to provide commentary on any documentation resulting from the proposed development.

1.3.7 National Forests Act (Act No 84 of 1998)

The main purpose of the National Forests Act No 84 of 1998 as amended is to promote the sustainable management and development of forests for the benefit of all. Amongst the other functions of the Act, the purpose most relevant to a project such is this is the provision of special measures for the protection of certain forests and trees. The Act ensures that protected trees are preserved. A list of protected trees was published in GN 734 of the 16th September 2011. Any trees included on this list that are affected by any development require a permit to be removed or affected in any way.

Should any protected trees be affected on the site by the development they would require a permit in terms of this Act.

1.3.8 Conservation of Agricultural Resources Act No. 43 of 1983

The Conservation of Agricultural Resources Act (CARA) No. 43 of 1983 controls the utilization of natural agricultural resources in South Africa. The Act promotes the conservation of soil, water sources and vegetation as well as the combating weeds and invader plants. The Act has been amended in part by the Abolition of Racially Based Land Measures Act, No. 108 of 1991.

The primary objective of the Act is to conserve natural agricultural resources by:

- maintaining the production potential of land;
- combating and preventing erosion and weakening or destruction of the water resources;
- protecting vegetation; and
- combating weeds and invaders plants.

The CARA is relevant to the proposed project as the construction of wind and solar energy facility as well as other components (such as power lines and the substations) may impact on agricultural resources and vegetation on the site. The Act prohibits the spreading of weeds and prescribes control measures that need to be complied with in order to achieve this. As such, measures will need to be taken to protect agricultural resources and prevent weeds and exotic plants from invading the site as a result of the proposed development.

An agricultural potential assessment has been conducted to explore how the proposed development may impact on the agricultural production potential of the proposed site.

1.3.9 Subdivision of Agricultural Land Act No. 70 of 1970, as amended

The Subdivision of Agricultural Land Act No. 70 of 1970 controls the subdivision of all agricultural land in South Africa; prohibiting certain actions pertaining to agricultural land. Under the Act the owner of agricultural land is required to obtain consent from the Minister of Agriculture in order to subdivide agricultural land.

The purpose of the Act is to prevent uneconomic farming units from being created and degradation of prime agricultural land. To achieve this purpose the act also regulates leasing and selling of agricultural land as well as registration of servitudes.

The Act is of relevance to the proposed development as any land within the study area that is zoned for agricultural purposes will be regulated by this Act.

Although the whole of this Act has been repealed by section 1 of the Subdivision of Agricultural Land Act Repeal Act 64 of 1998, this Repeal Act has not been implemented and no date of coming into operation has been proclaimed.

It is important to note that the implementation of this act is problematic as the Act defines 'Agricultural Land' as being any land, except land situated in the area of jurisdiction of a municipality or town council, and subsequent to the promulgation of this Act uninterrupted Municipalities have been established throughout South Africa.

1.3.10 National Road Traffic Act No. 93 of 1996, as amended

The National Road Traffic Act (NRTA) No. 93 of 1996 provides for all road traffic matters and is applied uniformly throughout South Africa. The Act enforces the necessity of registering and licensing motor vehicles. It also stipulates requirements regarding fitness of drivers and vehicles as well as making provision for the transportation of dangerous goods.

All the requirements stipulated in the NRTA will need to be complied with during the construction and operational phases of the proposed wind farm and photovoltaic plant.

1.3.11 Civil Aviation Act No. 13 of 2009

The Civil Aviation Act No. 13 of 2009 controls and regulates aviation within South Africa. It provides for the establishment of a South African Civil Aviation Authority and independent Aviation Safety Investigation Board in compliance with Annexure 13 of the Chicago Convention. It gives effect to various conventions related to aircraft offences, civil aviation safety and security, and provides for additional measures directed at more effective control of the safety and security of aircrafts, airports and matters connected thereto.

Although the Act is not directly relevant to the proposed development, it should be considered as the establishment of a wind farm or photovoltaic plant may impact on aviation and air traffic safety if located directly within aircraft flight paths.

All relevant project information was submitted to ATNS (Air Traffic and Navigation Services Company Limited), who in turn evaluated the proposed development in respect of aviation. The Civil Aviation Authority have also been consulted about the project.

1.3.12 Astronomy Geographic Advantage Act No. 21 of 2007

The Astronomy Geographic Advantage Act No. 21 of 2007 provides for:

- The preservation and protection of areas that are uniquely suited for optical and radio astronomy;
- Intergovernmental cooperation and public consultation on matters concerning nationally significant astronomy advantage areas and matters connected therewith.

In terms of section 7(1) and 7(2) of this Act, the Minister declared core astronomy advantage areas on 20 August 2010 under Regulation No. 723 of Government Notice No. 33462. As such, all land within a 3 Kilometer radius of the center of the Southern African large Telescope (SALT) dome located in the Northern Cape Province, falls under the Sutherland Core Astronomy Advantage Area. The declaration also applies to the core astronomy advantage area containing the MeerKAT radio telescope and the core of the planned Square Kilometre Array (SKA) radio telescope.

Under Section 22(1) of the Act the Minister has the authority to protect the radio frequency spectrum for astronomy observations within a core or central astronomy advantage area. As such, the Minister may still under section 23(1) of the Act, declare that no person may undertake certain activities within a core or central astronomy advantage area. These activities include the construction, expansion or operation; of any fixed radio frequency interference source, facilities for the generation, transmission or distribution of electricity, or any activity capable of causing radio frequency interference or which may detrimentally influence the astronomy and scientific endeavours.

The South African SKA was notified of the proposed project, provided with the opportunity to comment on the project and a meeting was held with SiVEST, the project proponent and the South African SKA on Friday 14th October 2011.

The South African SKA was notified of the proposed project, provided with the opportunity to comment on the project and a meeting was held with SiVEST, the project proponent and the South African SKA on Friday 14th October 2011.

Comments received from SKA project office indicate that the facility poses a low to medium risk of detrimental impact on the SKA. Further comment will now be sought based on the final layout.

1.3.13 Additional Relevant Legislation

- Occupational Health and Safety Act No. 85 of 1993
- National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
- Development Facilitation Act No. 67 of 1995
- Northern Cape Planning and Development Act, 1998 (Act No. 7 of 1998)

1.4 Equator Principles (EPs)

The Equator Principles are a financial industry benchmark for determining, assessing and managing social & environmental risk in project financing. A number of banks, exchanges and organisations worldwide have adopted the Principles as a requirement to be undertaken for funding to be granted. However, certain funding institutions may not have formally adopted the Principles, although will require clients to be compliant with them in order to qualify for loans. The principles are summarised below:

Principle 1: Review and Categorisation

When a project is proposed for financing, the Equator Principles Funding Institution ("EPFI") will categorise the project based on the magnitude of its potential impacts and risks.

Principle 2: Social and Environmental Assessment

For each project assessed as being either Category A or Category B, the client / borrower must conduct a Social and Environmental Assessment ("Assessment") process to address the relevant impacts and risks of the proposed project. The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.

Principle 3: Applicable Social and Environmental Standards

The Assessment will refer to the applicable IFC Performance Standards and applicable Industry Specific EHS Guidelines.

Principle 4: Action Plan and Management System

The client / borrower must prepare an Action Plan ("AP") or management system that addresses the relevant findings, and draws on the conclusions of the Assessment. The AP will describe and prioritise the actions needed to implement mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in the Assessment. The management measures are required to comply with applicable host country, social and environmental laws and regulations, and requirements of the applicable Performance Standards and EHS Guidelines, as defined in the AP.

Principle 5: Consultation and Disclosure

The client / borrower or third party expert must consult with project affected communities in a structured and culturally appropriate manner. For projects with significant adverse impacts on affected communities, the process will ensure their free, prior and informed consultation and facilitate their informed participation as a means to establish, to the satisfaction of the EPFI, whether a project has adequately incorporated affected communities' concerns.

In order to accomplish this, the non-technical summaries must be made available to the public by the borrower for a reasonable minimum period in the relevant local language and in a culturally appropriate manner.

Principle 6: Grievance Mechanism

To ensure that consultation, disclosure and community engagement continues throughout construction and operation of the project, the borrower must, scaled to the risks and adverse impacts of the project; establish a grievance mechanism as part of the management system. This will allow the borrower to receive and facilitate resolutions of concerns and grievances about the project's social and environmental performance raised by individuals or groups from among project-affected communities.

Principle 7: Independent Review

For all Category A projects and, as appropriate, for Category B projects, an independent social or environmental expert not directly associated with the borrower must review the Assessment, AP and consultation process documentations in order to assist the EPFIs due diligence, and assess Equator Principles compliance.

Principle 8: Covenants

An important strength of the Principles is the incorporation of covenants linked to compliance. For Category A and B projects, the client / borrower will covenant in financing documentation:

- To comply with all relevant host country, social and environmental laws, regulations and permits in all material respects
- To comply with the AP (where applicable) during the construction and operation of the project in all material respects
- To provide periodic reports in a format agreed with EPFIs (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third party experts, that i) document compliance with the AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country social and environmental laws, regulations and permits
- To decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan

Principle 9: Independent Monitoring and Reporting

To ensure ongoing monitoring and reporting over the life of the loan, EPFIs will, for all Category A projects, and as appropriate, for Category B projects, require appointment of an independent environmental and/or social expert, or require that the borrower to retain qualified and experienced external experts to verify its monitoring information, which would be shared with EPFIs.

Principle 10: EPFI Reporting

Each EPFI adopting the Equator Principles commits to report publicly at least annually about its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations.

The following documentation will need to be taken into consideration:

- The “Equator Principles” 2006
- International Finance Corporations Performance Standards on Social and Environment, IFC, April, 2006 namely:
    - Performance Standard 1: Social and Environmental Assessment and Management Systems
    - Performance Standard 2: Labor and Working Conditions
    - Performance Standard 3: Pollution Prevention and Abatement
    - Performance Standard 4: Community Health, Safety and Security
    - Performance Standard 5: Land Acquisition and Involuntary Resettlement

- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

- International Finance Corporation – World Bank Guidelines, General EHS Guidelines 2007.

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). These EHS Guidelines are applied as required by the World Bank's respective policies and standards. These General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors.

- The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs.

1.5 Key Development Strategies and Guidelines

1.5.1 Integrated Development Plans

An Integrated Development Plan (IDP) is defined in the Local Government: Municipal Systems Act, 2000 (Act 32 of 2000), as an inclusive and strategic plan that:

- Links, integrates and co-ordinates plans and takes into account proposals for the development of the municipality;
- Aligns the resources and capacity of the municipality with the implementation of the plan
- Forms the policy framework on which annual budgets must be based; and,
- Is compatible with national and provincial development plans and planning requirements binding on the municipality in terms of legislation.

The main purpose of the IDP is considered the enhancement of service delivery and fighting poverty through an integrated and aligned approach between different role-players and stakeholders.

Each municipality is required to produce an IDP which would address pertinent issues relevant to their municipality. However, common concerns include municipal transformation and development, and service delivery and infrastructural development.

The site near Loeriesfontein falls within the Hantam Local Municipality, which is within the greater Namakwa District Municipality. Electricity, amongst other municipal services, is highlighted as a priority issue warranting attention, in particular the provision of access to electricity to affected communities and the improvement of the electricity infrastructure (mini-subs, cables). These objectives are anticipated to be achieved through the following strategies (Hantam Local Municipality 2009-2010):

- Upgrade the electricity networks
- Building of 150 houses which will therefore require the provision of electricity
- Electricity installations at SAPS offices
- Upgrading of Grootmaat electricity provision
- Developing a Master and Maintenance plan for electricity

In 2008, the Namakwa District Municipality planned to conduct viability studies on the possibility of creating green energy in the Namakwa District for exporting purposes. Studies were to be done on wind, solar and ocean energy.

It is therefore evident that the proposed development is aligned with the goals of the municipal IDPs and SDFs in the study area.

1.5.2 Integrated Energy Plan for the Republic of South Africa, 2003

The Integrated Energy Plan (IEP), developed by the former DME (now DMR), was formulated to address the energy demand of the country balanced with energy supply, transformation, economics and environmental considerations in concourse with available resources. One of the main objectives of the plan is to promote universal access to clean and affordable energy, with emphasis on household energy supply being co-ordinated with provincial and local integrated development programmes. Another objective is to ensure that environmental considerations in energy supply, transformation and end use are made. This project is thus a goal in order to implement this plan.

1.5.3 Independent Power Producer Process

(The following information was extracted from the Eskom website: Guide to Independent Power Producer (IPP) processes in South Africa and Eskom**,** June 2010 http://www.eskom.co.za/live/content.php?Item_ID=14324)

The objective of this section is to provide an overview of the processes in the country and within Eskom relating to Independent Power Producers (IPPs). It is important that certain enabling policies, rules and regulations are in place to provide certainty and transparency in the introduction of IPPs.

- Country Process

South Africa has two acts that direct the planning and development of the country's electricity sector:

i. The National Energy Act of 2008 (No. 34 of 2008)
ii. The Electricity Regulation Act (ERA) of 2006 (No. 4 of 2006).

In August 2009, the Department of Energy (DoE) gazetted the Electricity Regulations on New Generation Capacity under the ERA. The New Generation Regulations establish rules and guidelines that are applicable to the undertaking of an IPP Bid Programme and the procurement of an IPP for new generation capacity. They also facilitate the fair treatment and non-discrimination between IPPs and the buyer of the energy.

- Formal Programmes

In terms of the New Generation Regulations, the Integrated Resource Plan (IRP) developed by the DoE sets out the new generation capacity requirement per technology, taking energy efficiency and the demand-side management projects into account. This required, new generation capacity must be met through the technologies and projects listed in the IRP and all IPP procurement programmes will be executed in accordance with the specified capacities and technologies listed in the IRP. The table below highlights the enegy plan that has been proposed until 2030.

Table 3: Government Energy Plans up until 2030 in terms of the IRP

New Build Options								
	Coal	**Nuclear**	**Import Hydro**	**Gas - CCGT**	**Peak - OCGT**	**Wind**	**CSP**	**Solar PV**
2010	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0
2012	0	0	0	0	0	0	0	300
2013	0	0	0	0	0	0	0	300
2014	500	0	0	0	0	400	0	300
2015	500	0	0	0	0	400	0	300
2016	0	0	0	0	0	400	100	300
2017	0	0	0	0	0	400	100	300

2018	0	0	0	0	0	400	100	300
2019	250	0	0	237	0	400	100	300
2020	250	0	0	237	0	400	100	300
2021	250	0	0	237	0	400	100	300
2022	250	0	1143	0	805	400	100	300
2023	250	1600	1183	0	805	400	100	300
2024	250	1600	283	0	0	800	100	300
2025	250	1600	0	0	805	1600	100	1000
2026	1000	1600	0	0	0	400	0	500
2027	250	0	0	0	0	1600	0	500
2028	1000	1600	0	474	690	0	0	500
2029	250	1600	0	237	805	0	0	1000
2030	1000	0	0	948	0	0	0	1000
	6250	**9600**	**2609**	**2370**	**3910**	**8400**	**1000**	**8400**

A decision that additional capacity be provided by an IPP must be made with the concurrence of the Minister of Finance. Once such a decision is made, a procurement process needs to be embarked upon to procure that capacity in a fair, equitable and transparent process.
The New Generation Regulations set out the procurement process. The stages within a bid programme are prescribed as follows:

i. Request for Qualifications (RFQ)
ii. Request for Proposals (RFP)
iii. Negotiation with the preferred bidder(s).

A successful bidder will be awarded a Power Purchase Agreement (PPA) subject to approval by the Regulator.

To start renewable energy procurement in order to achieve targets as in the IRP the DOE has launched a call for renewable energy projects issued on the 3rd of August 2011. The request for qualification and proposals for new generation capacity under the IPP procurement programme, will have a continuous roll out and milestones till the end of 2013. DoE have allowed for 1850MW of wind energy capacity to be allocated in the next two years.

2 APPROACH TO UNDERTAKING THE STUDY

The Environmental Impact Assessment was undertaken in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, under Government Notices No R544, R545 and R546 promulgated on 18 June 2010, Section 24 (5); the World Bank Standards (IFC Guidelines) and the Equator Principles as well as with the relevant legislation and guidelines mentioned above.

2.1 Environmental Scoping Study

The Scoping Study identified the potential positive and negative impacts associated with the proposed development. The Scoping Study also identified the studies which were required to be undertaken as part of the EIA-stage of the project. The Draft Scoping Report was made available for public review from Tuesday 4th October 2011 to Monday 14th November 2011. Comments received on the Draft Scoping Report were included in the Final Scoping Report which was submitted to the DEA. The DEA accepted the Final Scoping Report on 29 February 2012. The following studies have been taken through into the EIA Phase:

- Biodiversity (including fauna and flora) Assessment
- Avifauna Assessment
- Bat Assessment
- Surface Water Impact Assessment
- Soils and Agricultural Potential Assessment
- Noise Impact Assessment
- Visual Impact Assessment
- Geotechnical Assessment
- Heritage Assessment
- Socio-economic Impact Assessment
- Compliance with the Equator Principles

2.2 Authority Consultation

The National Department of Environmental Affairs (DEA) is the competent authority for this project. As such initial application was submitted to DEA on the 4th of July 2011 and acknowledged on the 13th July 2011. Following amendments to this original application, the project application was acknowledged on the 6th of September 2011. Two reference numbers were allocated to the proposed development (one for PV and one for wind).

Authorisation was thus granted to undertake a Scoping study and submit a Scoping Report for the proposed project. A Landowner notification form formed part of the application form and was accordingly submitted on the same date.

The Final Scoping Report was submitted to the National Department of Environmental Affairs (NDEA) on 24th of November 2011.

Approval of the Final Scoping Report was received on the 29 of February 2012.

The application forms were further amended to comply with the Department of Energy requirements which stipulate that each phase of a project needs to have its own reference number. The wind components have been allocated the following reference numbers:

- Project 1 – 50MW Wind
  - DEA reference number 12/12/20/2321/1
  - NEAS reference number DEA/EIA/0000381/2011

- Project 2 – 420MW Wind
  - DEA reference number TBA
  - NEAS reference number TBA

The second projects numbers are still expected from DEA and will be advertised when they are received.

A record of all authority consultation is included within Appendix 3.

Consultation with other relevant authorities was and is also being undertaken via meetings and telephonic consultation in order to actively engage them and provide them with information and gain their feedback.

Authorities and key stakeholders consulted include the following:

- Department of Water Affairs (DWA)
- Northern Cape Department of Roads and Public Works
- Northern Cape Department of Economic Development and Tourism
- Northern Cape Provincial Government
- Department of Environment and Nature Conservation
- Department of Agriculture Forestry and Fisheries (DAFF)
- South African Heritage Resources Agency (SAHRA)
- Department of Heritage: Northern Cape Province;
- South African National Roads Agency Limited (SANRAL)
- Hantam Local Municipality
- Namakwa District Municipality
- Northern Cape Department of Heritage
- Eskom
- Square Kilometre Array
- South Africa Civil Aviation Authority

- Air Traffic and Navigation Services
- Transnet Freight Rail
- Endangered Wildlife Trust
- WESSA – Northern Cape
- Birdlife South Africa
- Telkom

2.3 Environmental Impact Report

The EIR Phase of the project has focused on consulting with Interested and / or Affected Parties as well as conducting specialist studies to address the potential impacts identified during the Scoping Phase.

The purpose of the EIR is to:

- address issues that have been raised during the scoping phase;
- assess alternatives to the proposed activity in a comparative manner;
- assess all identified impacts and determine the significance of each impact; and
- formulate mitigation measures.

3 ASSUMPTIONS AND LIMITATIONS

- All information provided by the Applicant to the Environmental Team was correct and valid at the time it was provided.
- It is not always possible to involve all Interested and / or Affected Parties individually. However, every effort has / is being made to involve as many interested parties as possible. It is also assumed that individuals representing various associations or parties convey the necessary information to these associations / parties.

4 PROJECT NEED AND DESIRABILITY

According to Eskom, the demand for electricity in South Africa has been growing at approximately 3% per annum. This growing demand, fueled by increasing economic growth and social development within Southern Africa, is placing increasing pressure on South Africa's existing power generation capacity. Coupled with this, is the growing awareness of environmental impact, climate change and the need for sustainable development. The use of renewable energy technologies, as one of a mix of technologies needed to meet future energy consumption requirements is being investigated as part of Eskom's long-term strategic planning and research process.

As the demand for electricity grows, there is need to establish new generation capacity in South Africa within the next several years. The technologies may differ in their generation costs, state of commercial development and most importantly, suitability to the South African Environment.

The Government of South Africa has also committed to supporting the development of renewable (both solar and wind) electricity generation in order to satisfy sustainable and short term solutions to the current energy crisis.

As one of its strategies to meet future energy consumption requirements, the country is opting for the use of renewable energy technologies. This technology is therefore fast becoming an important energy option. In addition to providing ideal locations for solar energy plants, the Northern Cape Province also provides good opportunities for wind generation projects hence the selection of the Loeriesfontein site.

According to the wind potential layer, developed by Environomics and MetroGIS (2011) for the Strategic Environmental Framework for the Optimal Location of Wind Farms in the Coastal Provinces of South Africa (Phase 1 for REFIT 1) (Figure 1), large parts of the Northern Cape region of South Africa have the highest suitability for the selection of wind farm sites. Hence, the Northern Cape can in general be seen as ideal for the establishment of wind farms. It must be remembered that wind energy is plentiful, renewable, widely distributed, clean and reduces greenhouse gas emissions when it displaces fossil-fuel derived from electricity. In this light, renewable wind energy can be seen as desirable.

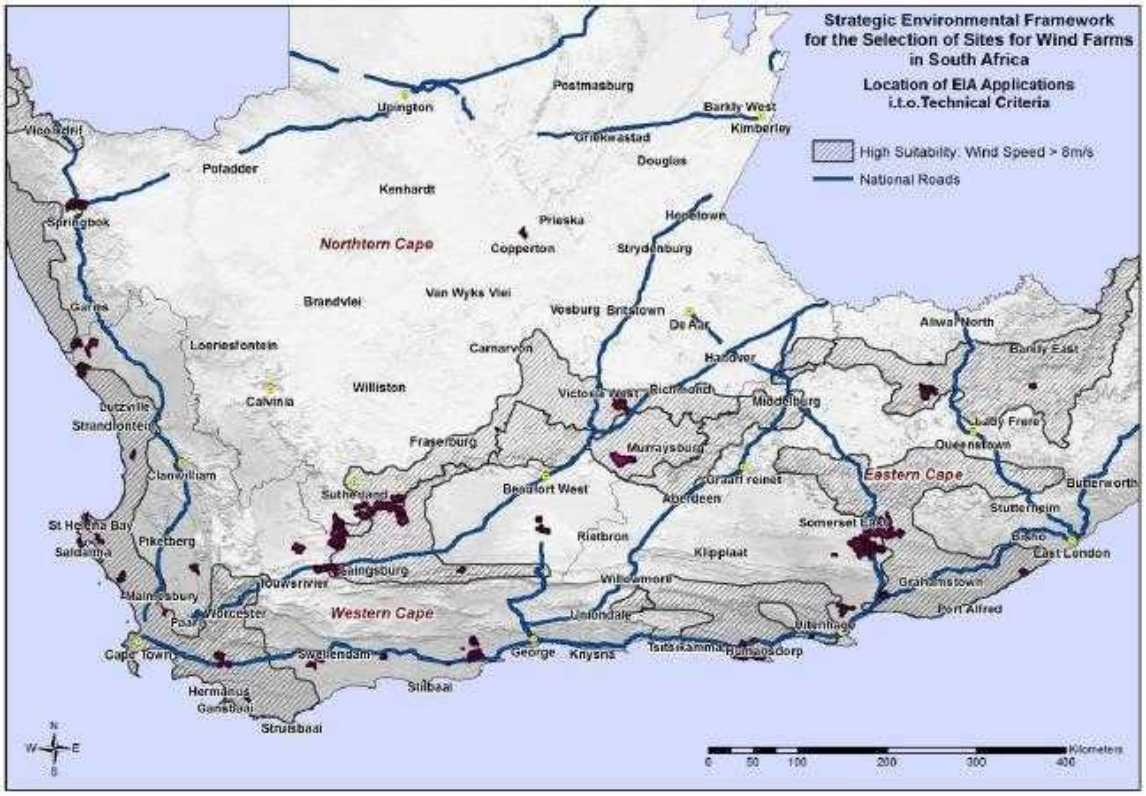


Figure 1: Wind Potential Map (Source: Environomics and MetroGIS, 2011).

4.1 Research Supporting Wind Energy

South Africa has abundant reserves of wind and solar energy resources. Electricity generated by means of wind power can provide the country with secure, reliable and clean sources of power while stimulating economic growth and job creation. A recent technical study carried out by Mainstream's Energy Analysis Group confirms SA has potential to generate over 70,000MWs of wind energy or 42% of the country's forecast total electricity demand for 2025. This research also showed that if 30GW of wind energy were installed, the industry would be able to provide 9GW of power (at a conservative 30% capacity factor) and of this 6GW would be base load, supplied at exactly the times when the country needed it most.

South Africa has a growing energy intensive economy, highly reliant on fossil fuels. 93% from coal fired power plants. SA currently has 44,157MWs of power generation capacity installed, with 248 Terawatt hours of electricity consumed annually. Current forecasts by 2025 indicate that SA will need almost twice today's electricity demand, doubling to approximately 80,000MWs. The generation of electricity from wind energy can contribute substantially to meeting this demand.

4.2 Security of Power Supply

In the period immediately after the supply shortage and 2007/2008 power blackouts, Eskom announced a number of new power generation facilities including new coal-fired power stations, refurbishment of mothballed stations and oil, diesel or gas powered turbines in order to ensure appropriate supply and the needed reserve margin. In the intervening period several of these projects have experienced delays as the economic recession has lead to reductions in demand pressure. However, with possible recovery looming, the situation may change in 2010/2011 and demand growth may resume. Short to medium term electricity supply security is instrumental in securing economic growth and investor confidence (HIS Global Insight, 2009

The project has the potential of “securing” economic activity by assisting in removing supply constraints if Eskom generation activities result in a supply shortfall. When supply is constrained it represents a limitation to economic growth. When a supply reserve is available, it represents an opportunity for economic growth.

The project will contribute to local economic progress by supporting industry development in line with provincial and regional goals and ensuring advanced skills are drawn to the Northern Cape. The project will likely encounter widespread support from government, civil society and businesses, all of whom see potential opportunities for revenues, employment and business opportunities locally.

4.3 Local Employment

Employment statistics, intrinsically considered to be related to skill levels, income levels and education levels are low in this district, but more alarming is the dependency ratios. The proportion of those who were formally employed increased between 2001 and 2007 by a small number while the number of those who were unemployed decreased during this period with the proportion of economically inactive persons increasing.

Overall, the municipality does compare well, with a higher average employment rate than the district or provincial averages. It has an unemployment rate which is slightly higher than the district but lower than the province but, importantly, it has a lower economically inactive population. Taking all variables into account it would appear than Hantam Local Municipality (HLM) is perhaps better off than both the province and the district in which it resides regarding employment statuses.

Local development in Loeriesfontein may help to raise employment rates especially during the construction phase providing income to the largely unemployed local community.

4.4 Regional and Local Income Profile

Overall, HLM does not appear badly in context as it has fewer non-earners than the District and Province. Other than this it closely follows the monthly income profile of the Namakwa District, while the HLM displays a relatively low income across the board. By 'low incomes' it is meant that, in relation to RDP standards, the LM does not present well with a full 76.4% of people being below the acceptable RDP income grade of R1 600 per month.

4.5 Further Facts Justifying Wind Energy

Wind is an internationally tried and tested highly reliable form of power generation. It is also the fastest growing form of power generation in the world with 150,000+ MWs installed globally and this is forecast to increase by more than 30,000 MWs each year over the next decade. In 2008, more wind energy capacity was installed in Europe and the US than any other form of power.

- Renewable energy reduces electricity generation costs

SA has some of the most highly subsidised electricity in the world. Diversifying a country's portfolio of generation plants leads to lower overall generation cost. Everywhere wind power has been introduced it has reduced the long term price of electricity and has helped stabilise the price volatility of fossil fuels. It is seen as the cornerstone of German, British, Danish, and Spanish generation.

- Renewable energy reduces fossil fuel prices

Increased levels of renewable energy generation on an electricity system lowers the demand for coal, oil & gas, reducing the price of these commodities and ultimately the cost of electricity.

- Renewable energy decreases greenhouse gas emissions

SA is currently the 12th largest polluter in the world and the largest in Africa. Renewable energy reduces carbon emissions, resulting in avoidable costs to the economy in terms of global obligations and the domestic social and economic impacts of such emissions.

- Renewable energy increases water availability

Agricultural & economic yield is increased due to an increased availability of water resources that would have alternatively been used for coal-fired power generation. Eskom currently uses 1400 Litres of water per 1000 kWh of energy produced.

- Renewable energy creates jobs

Large-scale renewable energy deployment creates significant employment in the development, construction and operation of the wind farms, significantly contributing to rural development, transferring skills and knowledge from abroad and enhancing a domestic manufacturing supply chain.

- Renewable energy aids grid stability

In certain areas, particularly in the south of the country renewable energy aids grid stability

5 PROJECT SUSTAINABILITY

Mainstream's objective is to develop the proposed wind farm near Loeriesfontein under the Clean Development Mechanism (CDM). As such, project information gathered during the EIA process will be submitted to the South African Designated National Authority (DNA) who sits within the Department of Energy (DME) to be assessed against the Sustainable Development Criteria for CDM projects as defined by the DME in South Africa.

5.1 CDM Background

The purpose of the Clean Development Mechanism (CDM) is to assist developing countries such as South Africa achieve sustainable development, and to assist industrialized countries achieve compliance with their emission targets under the Kyoto Protocol (KP) through the acquisition of certified emission reductions accruing from project activities. Specifically, the CDM can contribute to South Africa's sustainable development objectives through:

- Transfer of technology and financial resources;
- Sustainable ways of energy production;
- Increasing energy efficiency & conservation; and
- Poverty alleviation through income and employment generation

Currently, the project information is being compiled in a Project Design Document that will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) towards the end of this year.

The project will generate electricity from a renewable energy with an associated carbon dioxide emission of close to zero for every kWh that is generated into the grid. For every kWh generated, approximately 0.97 to 1.1 kg carbon dioxide emissions will be reduced from the national grid managed by Eskom. The estimated reduction of CO_2 over the 20 year period for this project will be presented once the energy analysis is completed.

6 TECHNICAL PROJECT DESCRIPTION

At this stage, it is estimated that the wind farm proposed project will encompass the installation of a number of wind turbine generators their associated components in order to generate electricity that is to be fed into the existing Eskom distribution and / or transmission lines that cross or are located near the proposed sites. The total power generation capacity limit and the number of wind turbines to be accommodated will ultimately depend on the size of the developable area which will be determined by the EIA. The project is proposed on the following farm portions:

- Remainder of the Farm No. 226, Calvinia Road, Northern Cape
- Portion 1 of the Farm No. 213, Calvinia Road, Northern Cape
- Portion 2 of the Farm No. 213, Calvinia Road, Northern Cape

A total of approximately 234 turbines might be required. The project will involve the construction of a wind farm with an ultimate capacity of 470MW across the three land portions. The project is likely to comprise of the following components:

- Phase 1 - 50MW to connect to the 66kV busbar of the Eskom 400kV Helios Substation;
- Phase 2 - 420MW connecting to Eskom's 400kV Helios Substation.

The key components of the project are follow in the sub-sections below.

6.1 Turbines

The size of the wind turbines will depend amongst others on the developable area wind resource and available technology when the wind farm is constructed, and the total generation capacity that can be produced as a result. The wind turbines will therefore have a hub height of between 80 to 120m and a rotor diameter of 87 to 120m (Figure 2). The blade rotation direction will depend on wind measurement information received later in the process. The rotation will range from 6 to 20 rpm. The foundation of each wind turbine will be approximately 20m x 20m. The footprint for each wind turbine will therefore be approximately 400m². A hard standing area of approximately 2 400m^2 for crane usage will accompany each wind turbine. Hence, the total footprint for each wind turbine and the associated hard standing area will be 2 800m². The foundation will be up to 2.5m deep. As already mentioned, it is anticipated at this stage that 180 wind turbines will be constructed. The total area for all the wind turbines for the Loeriesfontein study site will therefore be approximately 54.68 hectares (including the hard standing areas). The electrical generation capacity for each turbine will range from 1 – 3MW depending on the final wind turbine selected for the proposed development. The total generation capacity for the Loeriesfontein study site is envisaged to be a maximum of 470MW as stated earlier.

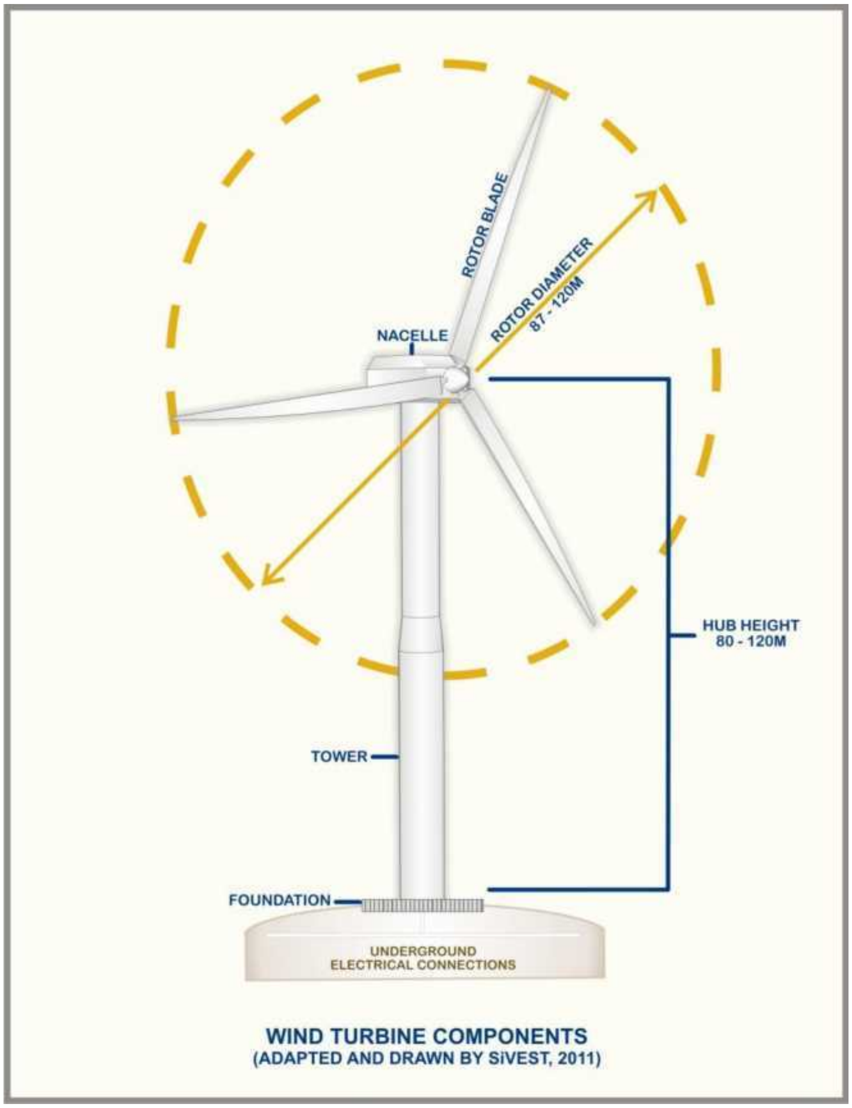


Figure 2: Typical Components of a wind turbine.

6.2 Electrical Connections

The wind turbines will be connected to each other and to the substation using buried (up to a 1m depth) medium voltage cables (Figure 3) except where a technical assessment of the proposed design suggests that overhead lines are appropriate such as over rivers and gullies. Where overhead power lines are to be constructed, monopole tower structures will be used. The dimensions of the monopole structures will depend on grid safety requirements and the grid operator. No servitudes will be associated with the wind farm infrastructure although servitudes for Eskom infrastructure may be required on site. As previously mentioned, the electrical connection to the grid will be dependent on the total generation capacity and the actual available connection as determined by Eskom. The power lines could therefore have a voltage of 66kV to 132kV.

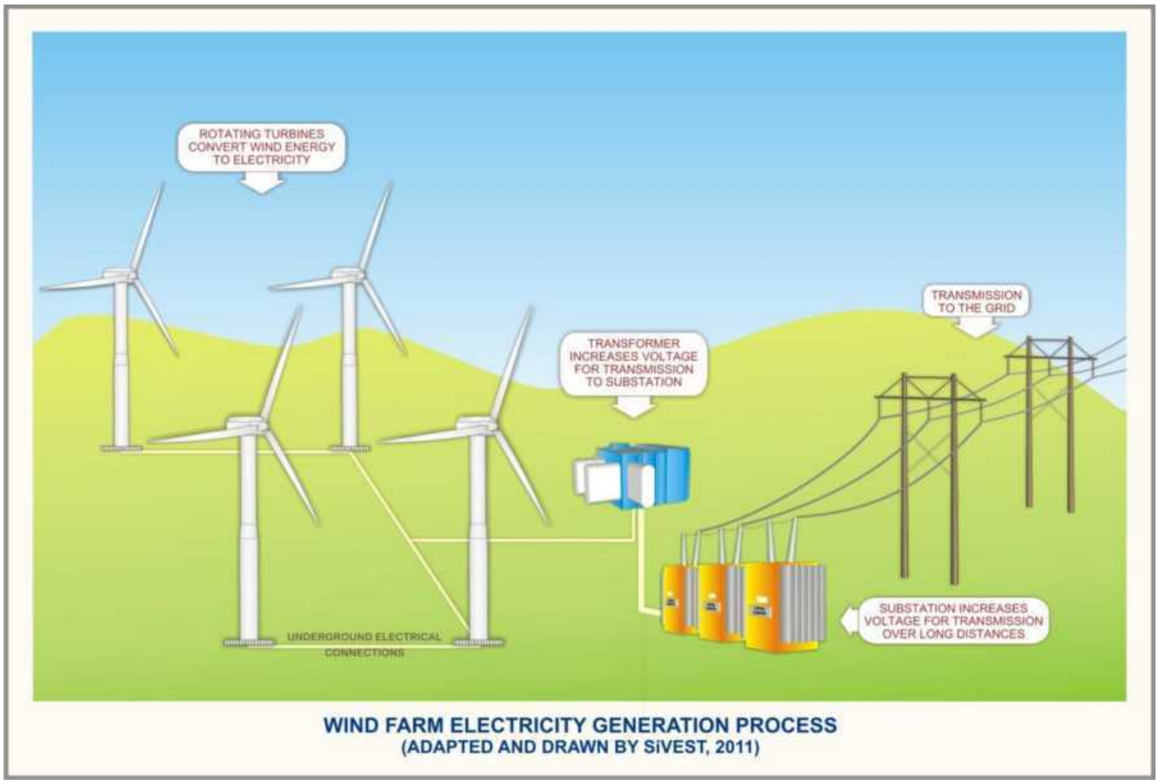


Figure 3: Conceptual wind farm electricity generation process showing electrical connections

6.3 Substations

A new substation (approx. 90 x 120m) and associated transformers will be developed which will supply the generated electricity to the Eskom grid. The transformers' operating voltage may range from 22 to 132kV. The footprint of the substation site will be approximately 10 800m². The Substation will be built preferably close to existing transmission line(s). The connection from the substation to the Eskom grid line will be an overhead line and pole. This will be dependent on the location of the substation relative to the existing line(s). Eskom grid line and access servitudes will be required, the sizes of which depend on the voltage connection.

6.4 Roads

The access roads are proposed to be 6-10m wide. The roads will be gravel roads from the site on to the public road. An internal road network to the turbines and other infrastructure will include;

- Turning circles for large trucks.
- Passing points and culverts over gullies and rivers if required
- Existing roads will be upgraded.

6.5 Temporary construction area

A maximum 10 000m^2 temporary lay down area will be constructed for the proposed development. Components that will comprise the temporary lay down area include an access route and a contractor's site office area of up to 5 000m^2.

6.6 Other infrastructure

Other infrastructure includes the following:

- Administration and warehouse buildings: A single storey building with a maximum area of up to 5 000 m^2 with a warehouse/workshop space and access, office, telecoms space, security and ablution facilities are to be developed. The buildings will most likely be situated preferably close to the substation. Security will be required.
- Borrow pits (if required).
- Fencing (if required).
- Panel Maintenance - The panels will require cleaning and dust will accumulate on them affecting their productivity. Cleaning will take place once every quarter (providing job creation). Municipal water will be utilised for this exercise.

7 ALTERNATIVES

In terms of the EIA regulations, feasible alternatives are required to be considered during the EIA process. Layout Alternatives and the No-go alternative were considered in this Final Environmental Impact Report.

From the outset of the proposed development, Mainstream advanced the following criteria when considering sites for a wind farm:

- Estimation of wind energy resource (which is derived from Mainstream's propriety information based on national available wind data and advanced theoretical modelling developed in-house and by consultants);
- Proximity to residential areas;
- Proximity to environmentally (social and biophysical environments) and heritage sensitive areas (in consultation with appropriate specialists);
- Potential impacts on fauna and flora (in consultation with appropriate specialists).
- Availability of national wind farm development sensitivity maps such as those currently being prepared by Birdlife SA and being finalised by the Western Cape Government for the west coast region. (**Note these maps were not yet developed during the selection process**);
- International best practice in the siting of wind farms.
- Potential visual impact;
- Potential impact on aviation;
- Presence of obstacles on the site such as rivers, dams, roads, existing gridlines and current land use;
- Need for grid stabilization in the area;
- Need for energy security in the area;
- Need for rural development through job creation in the area;
- Accessibility of the area as a result of the topography;
- Grid connection options – is connection affordable and in national interest?
- Willingness of land owners to participate;
- Possibility to support land reform objectives.

After the potentially appropriate sites were selected, the affected land owners were contacted and options to develop, including long term lease agreements, were negotiated.

7.1 Location alternatives

Once the specific land portions were identified, Mainstream developed a map of the potentially available area on the specific farm/farms that could be earmarked for possible development. This area is referred to as the 'buildable' area. The following applicable buffer zones were additionally applied to the sensitive areas identified in the table below so as to identify the undevelopable areas.

Table 4: Buffer zones applications to sensitive areas

SENSITIVE AREA	BUFFER

Airports and Military Facilities	15-30km
Privately owned and managed run ways	5km including consultation with the SACAA
Public Roads/railway	200m
Houses	800m
Residential Areas	800m
Rivers/Floodplains/Wetland/Lakes	100m - 200m
Forestry (away from the prevailing wind)	500m
Forestry (non-prevailing wind direction)	200m
Forestry (when turbine is keyholed[1])	500m
Protected and archaeological areas	100 – 200m
Communication corridors/radar/Microwave towers	200m
Existing Generation/Wind farms	> 1km
Existing Servitudes	As per servitude + (1.5 x Tip height)
Site Boundary	200m
Electrical grid distribution/transmission lines	200m – 300m
Substation	500m

With further consultation with the affected land owners, Mainstream was also able to preliminarily identify specific areas (areas where extensive farming is practised or future farming is expected to be practised) on their land which was excluded from the proposed development.

Specialist studies were then undertaken throughout the scoping phase and EIA phase to eliminate potentially sensitive areas from the buildable areas for the locations of the key components of the project. Once this had been undertaken, various layout alternatives were investigated. These include the location of:

- Substation locations
- Overhead power line routes (
- Laydown area locations
- Operations and Maintenance building locations
- Turbine locations (based on specialist feedback)

[1] Placing the turbine in a forest

The alternatives are presented Table 5, Figure 4 and

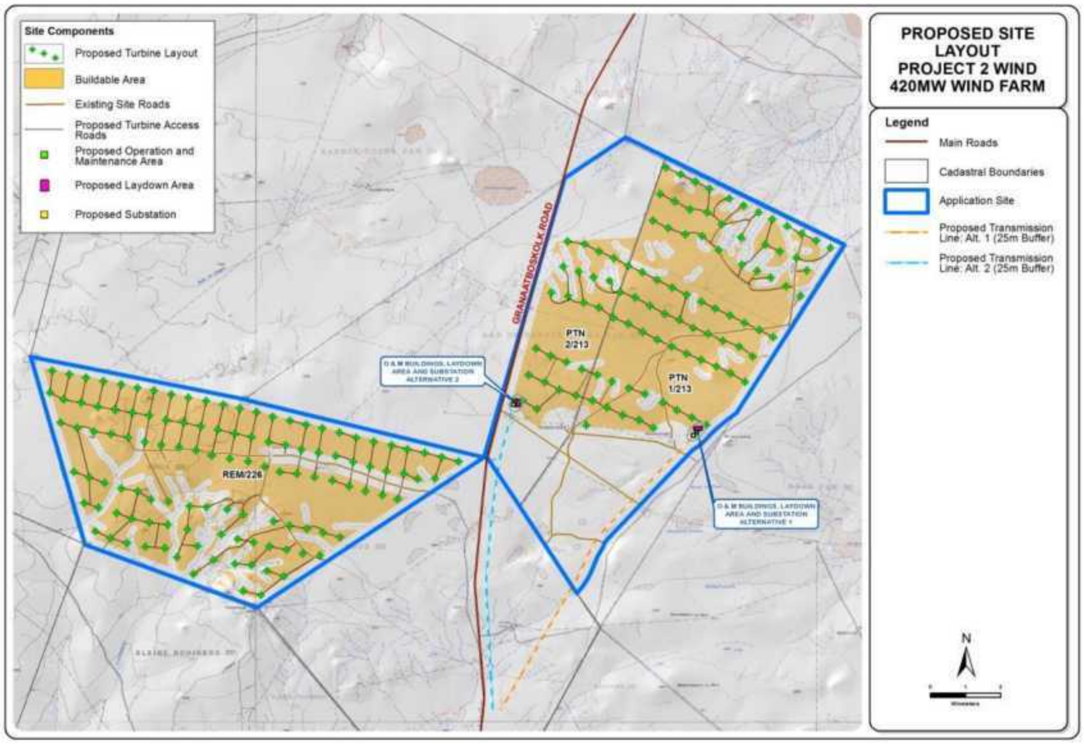


Figure 5 below

Layouts for the wind turbines were set and alternative layout locations and/or routes for each of the key components (listed above) were proposed (Figure 4 and

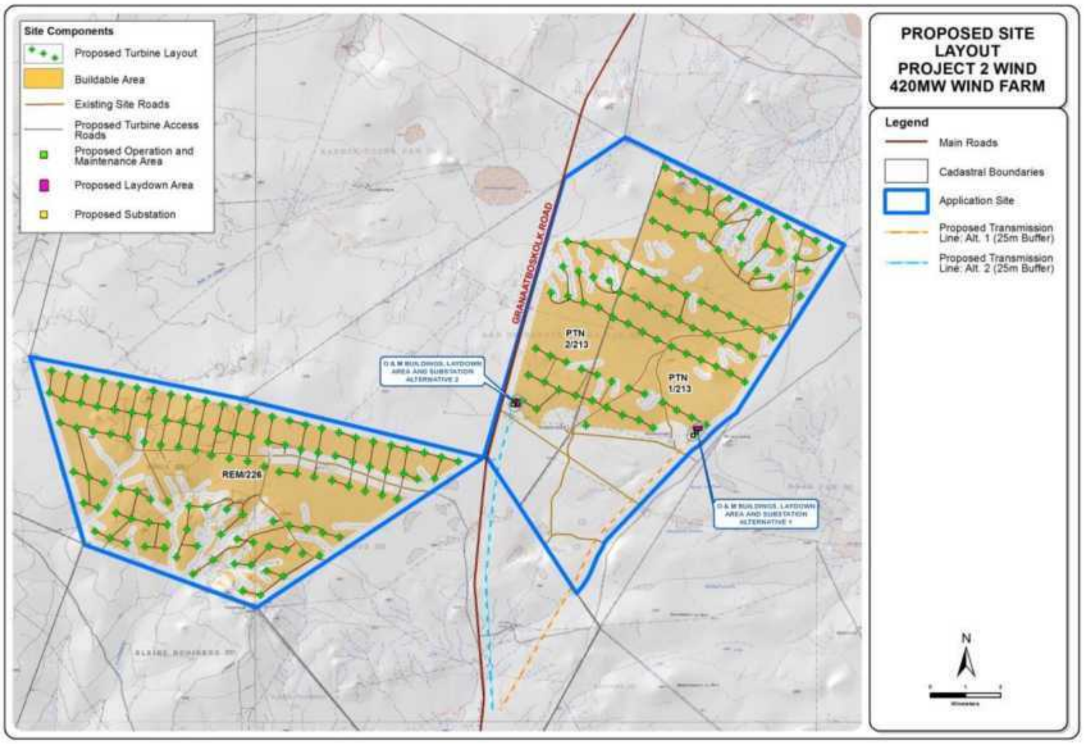


Figure 5). A comparative assessment and evaluation of each of the layout alternatives is provided in Chapter 12.

Table 5: Alternatives to be assessed

Project	Alternative
Project 1: 50MW Wind	Power line alt 1
	Power line alt 2
	Substation alt 1
	Substation alt 2
	O & M buildings and laydown area alt 1
	O & M buildings and laydown area alt 2
Project 2: 420MW Wind	Power line alt 1
	Power line alt 2
	Substation alt 1
	Substation alt 2
	O & M buildings and laydown area alt 1
	O & M buildings and laydown area alt 2

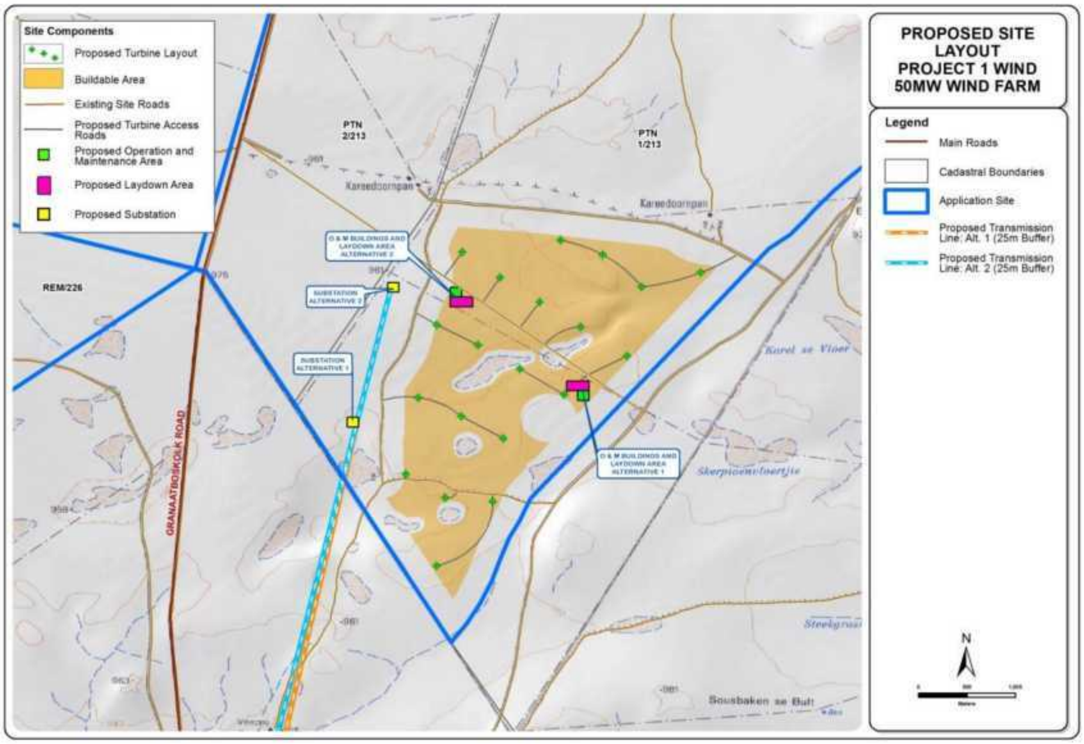


Figure 4: Project 1 50MW Wind - Alternatives and Proposed Layout

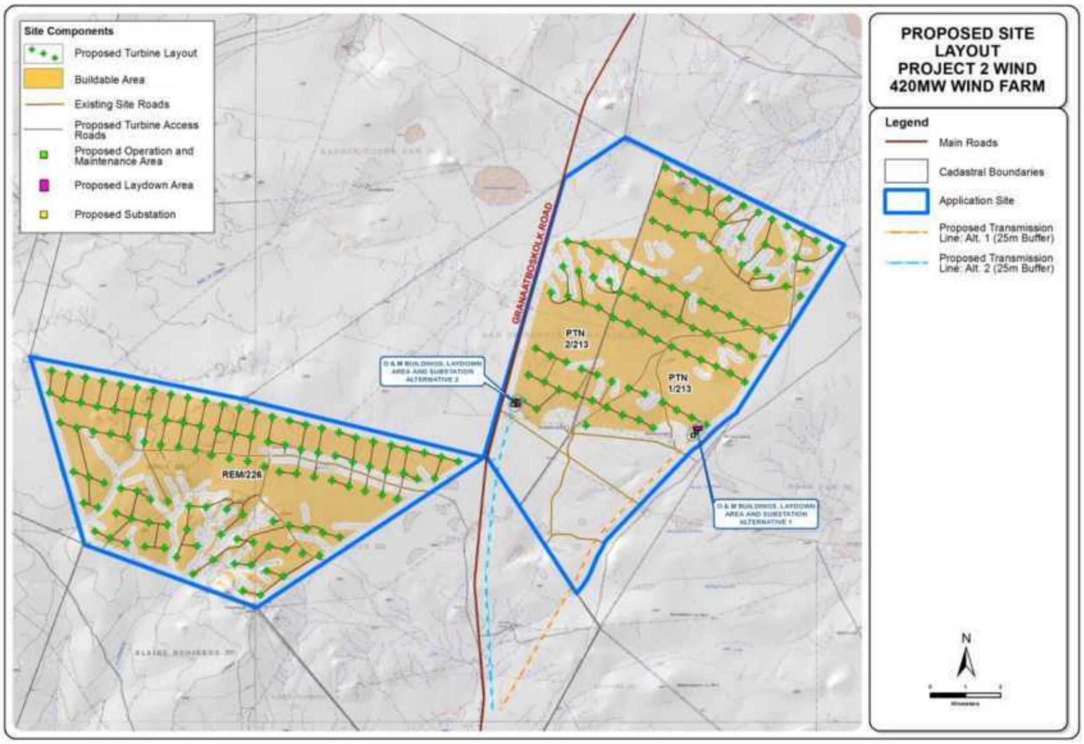


Figure 5: Project 2 420MW Wind- Alternatives and Proposed Layout

7.2 No-go Alternative

The ‘no-go’ alternative is the option of not establishing the proposed wind farm. South Africa is currently under immense pressure to provide electricity generating capacity to accommodate for the pressures which have been identified in this regard. With the current global focus on climate change, the government are under severe pressure to explore alternative energy sources in addition to coal fired power stations. Although wind power and solar power are not the only solution to solving the energy crisis in South Africa, not establishing the proposed wind farm would be detrimental to the mandate that the government has set to promote the implementation of renewable power. It is a suitable sustainable solution to the energy crisis and this project would contribute to this solution. This project will aid in achieving South Africa’s goals in terms of sustainability, energy security, mitigating energy cost risks, local economic development and national job creation.

In light of the above, the no-go alternative has also been comparatively evaluated in Chapter 12.

8 DESCRIPTION OF THE RECEIVING ENVIRONMENT

The Northern Cape Province is considered to be one of the most suitable regions for the establishment of wind farms. Accordingly, land portions located outside of Loeriesfontein have been identified as a potential site. A general description of the study area is outlined in the sections below. The receiving environment in relation to each specialists study is also provided.

8.1 Regional Locality

Loeriesfontein is a small town in the Northern Cape of South Africa. It falls within the Hantam Local Municipality, which is within the greater Namakwa District Municipality, Northern Cape province. The town of Loeriesfontein is within a basin surrounded by mountains, and it is accessed from the N7 highway (north out of Cape Town), turning off on the R27 at Van Rhynsdorp to Nieuwoudtville, then following the R357 to Loeriesfontein (a further 65km north).

The proposed site is located on the farms Sous and Aan De Karree Doorn Pan approximately 60km north of Loeriesfontein. The site near Loeriesfontein, falls within the boundaries of the Hantam Local Municipality. The site is approximately 10 400Ha in size of which a smaller area will be required for the establishment of the proposed wind farm.

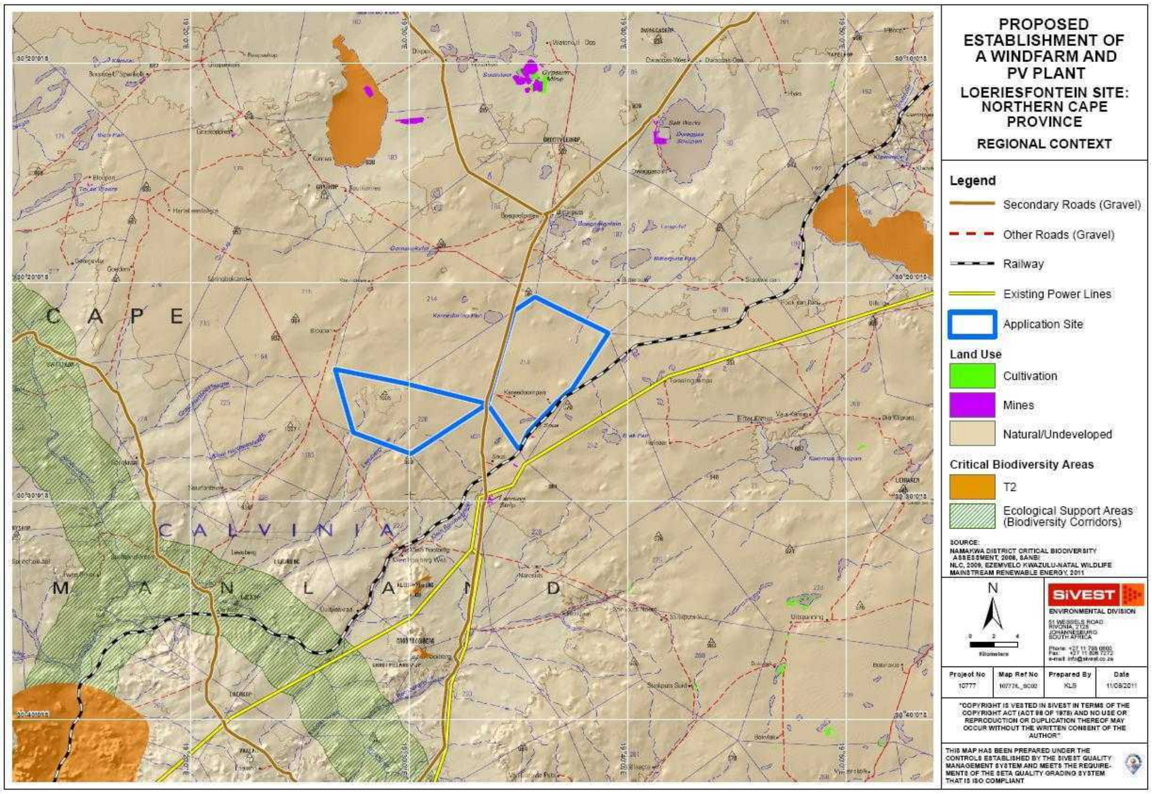


Figure 6: Loeriesfontein Regional Study Area.

8.2 Study Area Description

The sites that are proposed for the wind farm facility near Loeriesfontein are located on the following farms (Figure 7):

- Remainder of the Farm No. 226, Calvinia Road, Northern Cape
- Portion 1 of the Farm No. 213, Calvinia Road, Northern Cape
- Portion 2 of the Farm No. 213, Calvinia Road, Northern Cape

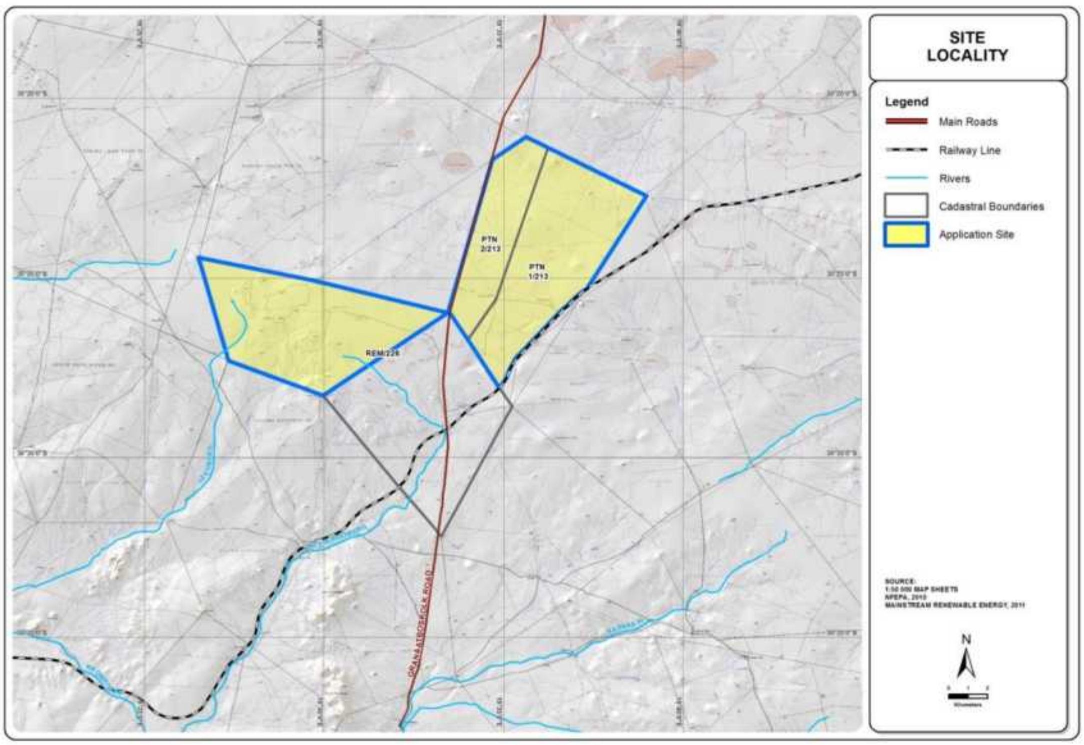


Figure 7: Loeriesfontein Site Locality Map

The study area is considered to be fairly natural karoo shrubland with low intensity sheep grazing on the site. The study area is classified as natural / vacant and is used as general grazing land for sheep and wildlife. As such the human footprint in most of the area is considered to be relatively low. Vast grazing land is interspersed with seasonal pans and non-perennial streams. The non-perennial streams are located to the southwest of the site.

The southern end of the study area contains an existing substation which will be the link between the proposed development and the national electricity grid. Stocking rate for the area is approximately at a low stocking rate of around 1 SSM (small stock unit) per 6 hectares.

The site is traversed by a railway line and a district road (Granaatboskolk Road).

It is characterised by flat and gently sloping topography. The flat topography makes this area ideal for the proposed development. The drainage systems situated in the southwest of the site are not anticipated to be impacted upon

8.3 Climate

The study area has an arid Mediterranean type climate with winter rainfall regime i.e. most of the rainfall is confined to early autumn and winter. Mean Annual Precipitation (MAP) is approximately 179 mm per year and without some form of supplementary irrigation natural rainfall is insufficient to produce sustainable harvests (Table 6 and Figure 8). This is reflected in the lack of dry land crop production within the study area. Average daily temperatures range from 30ºC in summer to 17 ºC in winter. Average night time temperatures drop to around 2.4 ºC during winter (Table 2).

Table 6: Mean monthly rainfall for Loeriesfontein (Source: South Africa's Rain Atlas)

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Avg**
Rainfall (mm)	8.7	11.3	17	20.8	23.3	21.1	18.3	14.3	11.1	9	7	7	14.1

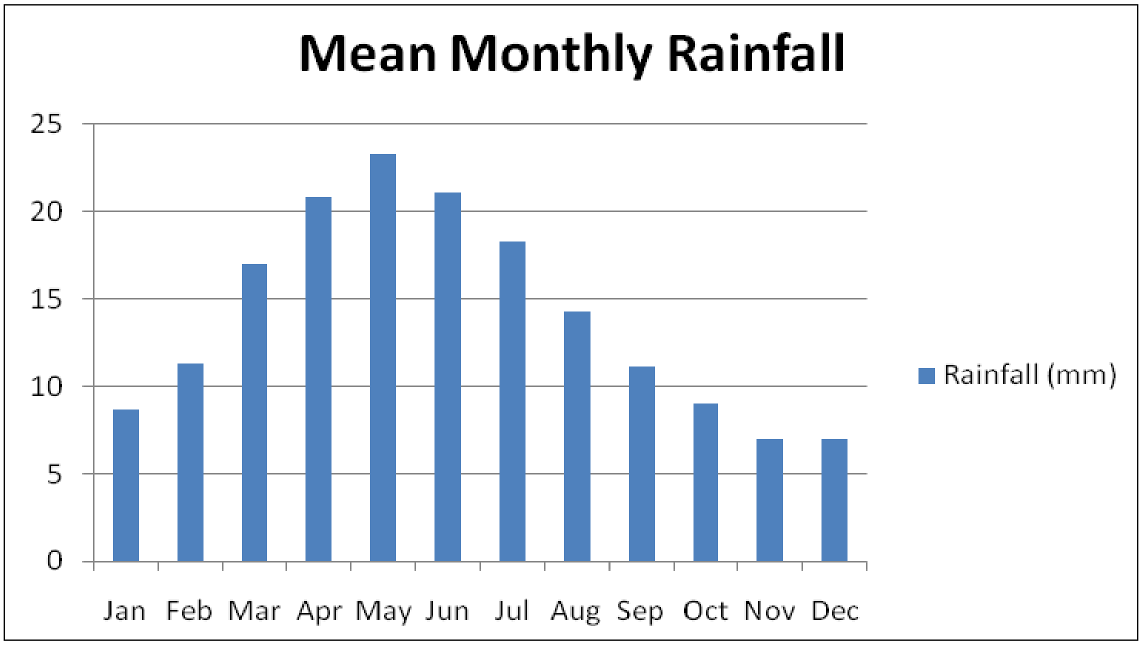


Figure 8: Mean Monthly Rainfall Graph for Loeriesfontein

Table 7: Mean monthly and annual temperature for Loeriesfontein (Source: http://www.saexplorer.co.za)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Avg
Midday Temp (°C)	21	32	29	25	21	17	17	19	22	25	28	30	24
Night Temp (°C)	31	14	13	9	6	4	2	3	5	8	10	12	8

8.4 Geology

Virtually the entire study area is underlain by a Shale parent material. Shale is a clastic sedimentary rock and is formed by the settling and accumulation of clay rich minerals and other sediments. Due to the settling process this parent material usually takes the form parallel rock layers which lithifies over time. Non-descript sedimentary geologic materials are located along the western border of the study area derived from pre-existing rock and sediments.

8.5 Biodiversity (Flora and Fauna)

The Biodiversity Assessment was conducted by SiVEST and the detailed report is included in (Appendix 6A). The environmental baseline from a biodiversity perspective is presented below.

8.5.1 Flora in the study area

A list of plant species including Red Data species are presented in Appendix 1.

According to the Namakwa Bioregional Plan, the Hantam Local Municipality has 59 threatened, 9 near threatened and 25 data deficient plant species. The majority of the Municipality is not conserved in any way, including the study area in question. The vegetation type in question has about 10 endemic species.

According to Mucina, *et al,* (2006), the proposed wind farm site in Loeriesfontein falls within the Bushmanland Basin Shrubland vegetation type (Figure 9) which is classified under the Bushmanland and West Griqualand bioregion of the Nama Karoo Biome (Mucina, *et al.,* 2006). In terms of the conservation status, the Bushmanland Basin Shrubland vegetation type is considered Least Threatened (Mucina, *et al,* (2006).

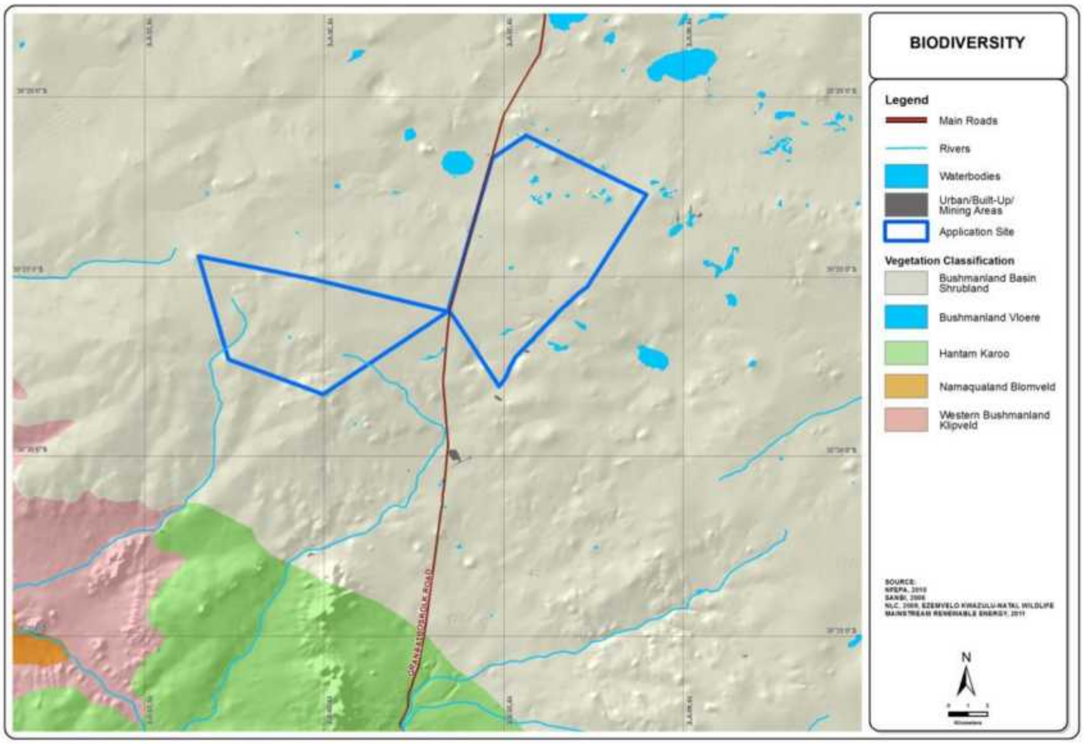


Figure 9: Vegetation of the study area

According to Esler, *et al.,* (2006), vegetation cover in the study area ranges from 15% to 20% which is the lowest compared to other parts of the country i.e. the central and eastern parts. Vegetation cover refers to the percentage of soil overshadowed by plants (Esler, *et al.,* 2006).

The vegetation type on the site is described as Bushmanland Basin Shrubland (Figure 10) located in the Nama Karoo Biome.

Figure 10: Sparse vegetation, typical of the Nama Karoo Biome

This vegetation type is characterised by low shrubs species which include: *Aptosimum spinescens*, *Hermannia spinosa*, *Pentzia spinescens, Zygophyllum microphyllum* and *Aptosimum elongatum*.

The vegetation type is considered to be Least Threatened and none of it is conserved in statutory conservation areas (Mucina, *et al,* (2006).

The study area is transformed after good winter rains into a large expanse of wild flowers however not as spectacularly as areas further south. This is however heavily dependent on the amount of rainfall.

The study area does not fall into a Critical Biodiversity Area as defined by the Namakwa Bioregional Plan.

Species diversity on the site is limited give the aridity of the region.

In terms of endemism, out of about 36 plant species in the study area (within three Quarter Degree Squares (QDS) - 3019AD, 3019BC and 3019DA), only 10 (28%) are endemic (SANBI, 2009). According to Gibbs Russel, (1987), of 2147 species in a central area about 198,000 km^2 of the Nama Karoo only 377 (16%) were endemic. The above figures imply that the Nama Karoo presents low levels of plant endemism. Endemism refers to an ecological state in which a species or other taxonomic group is restricted to a particular geographic region, owing to factor such as isolation or response to soil or climatic conditions (Allaby, 1994).

However, according to Desmet (2000), an archipelago of mountains within a part of the Nama Karoo ecoregion known as Bushmanland were found to harbor both Nama Karoo and Succulent Karoo type vegetation, as well as a diverse assemblage of succulents endemic to the archipelago (Desmet 2000). Therefore the wider Bushmanland area may not exhibit such a low level of endemism.

Table 8 below presents a list of endemic species in the study area.

Table 8: Endemic species documented within the study area

Family	**Species**	**Threat status**	**SA Endemic**
ASTERACEAE	*Amellus microglossus DC.*	LC	Yes
ASTERACEAE	*Eriocephalus spinescens Burch.*	LC	Yes
BRASSICACEAE	*Heliophila arenosa Schltr.*	LC	Yes
CHENOPODIACEAE	*Salsola henriciae I.Verd.*	LC	Yes
FABACEAE	*Lotononis leptoloba Bolus*	LC	Yes
IRIDACEAE	*Tritonia karooica M.P.de Vos*	LC	Yes
MESEMBRYANTHEMACEAE	*Psilocaulon junceum (Haw.) Schwantes*	LC	Yes
MESEMBRYANTHEMACEAE	*Aloinopsis luckhoffii (L.Bolus) L.Bolus*	DDT	Yes
SCROPHULARIACEAE	*Aptosimum indivisum Burch. ex Benth.*	LC	Yes
SCROPHULARIACEAE	*Nemesia calcarata E.Mey. ex Benth.*	LC	Yes

A species of concern in the study area is *Hoodia gordonii* (Boboejaanghaap), an important medicinal plant which is over harvested in the Northern Cape. No specimens were however noted during the site visit.

H. gordonii, as well as other *Hoodia* species, are listed as protected species under the Environmental Conservation Ordinance No.19 of 1974. No one is allowed to harvest, collect, damage, collect seeds, trade (import or export) or transport any *Hoodia* material without a valid permit from the Permit Section of the Directorate of Conservation Service in the Northern Cape .

Hoodia is listed on Appendix II of CITES (Convention on International Trade in Endangered Species). Trade in any parts and derivatives of Hoodia species is prohibited without a permit.

In terms of GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 none of the species documented within the study area are considered to be protected in terms of this legislation.

The study area does not fall into a Critical Biodiversity Area or Ecological Support Area as defined by the Namakwa Bioregional Plan.

8.5.2 Fauna in the study area

- Mammals

Various mammal species are likely to occur within the study area. Appendix 2 comprises a list of mammals that are likely to occur in study area with the assigned level of threat facing each particular species. A map was used to correlate the occurrence of the Red Data species with their approximate occurrence within the study area. According to Friedman and Daly, (2004), the majority of species within the study area are listed as species of least concern. As mentioned above, the Honey Badger (*Mellivora capensis*) and the Littledale's Whistling Rat (*Parotomys littledalei*) which are both listed as Near Threatened are likely to occur in the study area. On the other hand, the Black Rhinoceros (*Diceros bicornis bicornis*) which is listed as Critically Endangered (Friedman and Daly, 2004) along with several other recorded mammal species are not likely to occur in the study area due to the anthropogenic activities such as fencing etc that have taken place.

Table 9 below presents mammal species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 which potentially occur within the study area.

Table 9: Mammal species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007

Common name	Scientific name	Status under GN 1187
Black Rhinoceros	*Diceros bicornis bicornis*	Endangered
Leopard	*Panthera pardus*	Vulnerable
Black-footed Cat	*Felis nigripes*	Protected
Honey Badger	*Mellivora capensis*	Protected
Cape Fox	*Vulpes Chama*	Protected

Note that Friedman and Daly, (2004) list Black Rhinoceros as Critically Endangered while GN 1187 lists the species as Endangered.

The majority of these species are highly unlikely to occur within the study area, particularly the large mammals due to the anthropogenic activities such as fencing and lack of protected areas.

- Field assessment results

During field assessments, only two small mammal species were trapped over a three day survey period. These include the Striped Mouse (*Rhabdomys pumilio*) (Figure 11) and the Round-eared elephant-shrew (*Macroscelides proboscideus))*.

Figure 11: Striped Mouse (*Rhabdomys pumilio)*

Furthermore, several individuals of yellow mongoose (*Cynictis penicillata*) and scrub hares (*lepus saxatilis*) were spotted within the study area during site surveys. In addition, evidence of Porcupines (*Hysterix africaeaustralis*) (Figure 12) and Aardvark (*Orycteropus afer*) were prominent on the site.

Figure 12: Porcupine (*Hysterix africaeaustralis*) excavation and faeces on the site

Trapping success of small mammals was low generally perhaps due to the low cover which is typical of the Nama Karoo Biome where although vegetation grows on rich soils, plant growth is limited by climate. Cover is among the most important factors that influence small mammal abundance and richness. This is because unlike open habitats which increase predation risk (Kotler, 1997), habitats with cover provide protection against predators (Asher *et al.,* 2004; Keller & Schradin, 2008). According to Silva *et al.,* (2005), open habitats exhibit low mammal diversity due to reduced cover (which provides food and resources) hence leading to lower fecundity (Grant *et al.,* 1982). Therefore, greater species abundance and richness are expected in areas that exhibit dense cover.

Furthermore, sheep grazing observed within the study area influences the existence of small mammals in the area. Although in terms of grazing, the farm where the proposed site is situated is well managed in that rest periods are allowed between camps, it is predicated that grazing has an impact on small mammal richness and abundance to some degree. According to Bergstrom (2004), the presence of livestock has a negative effect on both small mammal species richness and abundance. Moreover small mammals can be seen as indicators of environmental conditions (Linzey & Kesner, 1997). This is because changes in the environment due to heavy grazing leads to changes in the habitats for small mammals therefore affecting their abundance, survival and breeding success (Dooley & Bowers, 1996). In the North American rangelands, trampling and grazing have been shown to reduce the lower vegetation cover for small animals hence increasing their exposure to predators (Grant *et al.,* 1982; Birney et al., 1976; Edge *et al.,* 1995). In addition trampling may affect the burrowing substrate for the rodents (Bergstrom, 2004).

The mammal species of concern is the bats which are present within the area due to the risks of barotrama. A separate assessment has however been undertaken of this faunal grouping. In addition, avifauna is also at risk from the turbines. This faunal grouping is also addressed in a separate study.

- Reptiles

According to the Namakwa Bioregional Plan, the Loeriesfontein has a high reptile species abundance. Several reptile species are present in the study area. A list of reptiles in the study is presented in appendix 2 (Branch 1998). According to the current Red Data, none of these species are currently Red Listed (McLachlan, 1978). The Red Data book is currently being updated.

Armadillo Girdled Lizard *(Cordylus cataphractus)* which potentially occurs in the study area (Branch 1998) is a protected species in terms of GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007. The species was not observed.

  - Field assessment results

Habitat for these species is currently available. A number of reptiles were trapped in pitfall traps during field assessments. These include the Namaqua sand lizard, Karoo (*Pedioplanis namaquensis*) and Spotted desert lizard (*Meroles suborbitalis*)

Figure 13: Namaqua sand lizard, Karoo (*Pedioplanis namaquensis*)

Namaqua sand lizards are small and slender with an SVL (snout-vent length) of about 53mm and a long tail (Branch, 1998). The species occur in sparsely vegetated sand and gravel flats in karroid veld, arid savannah and semi-desert (Branch, 1998). Their foraging range is wide and they feed on small insects (Branch, 1998).

Figure 14: Spotted desert lizard (*Meroles suborbitalis*)

Figure 15: Sandveld Lizard possibly Western Sandveld Lizard (Nucras tessellata) and Endemic species

Apart from *C. cataphractus*, no other species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 occurs within the study area.

- Amphibians

  - Field assessment results

No amphibian species were recorded in the study site during filed surveys. However Du Preez and Carruthers, (2009) list a number of amphibians that could potentially occur in the study area and are likely to be present near water courses. All amphibian species previously recorded in the study area are Not Threatened (Du Preez and Carruthers, 2009). The study area is extremely dry with very little rainfall and amphibian numbers are expected to be very low. The table below indicates the species that have been previously recorded.

Table 10: Amphibian species in the study area

Scientific	**Common**	**Category**
Vandijkophrynus gariepensis	Karoo Toad	Not threatened
Vandijkophrynus robinsoni	Paradise Toad	Not threatened
Cacosternum boettgeri	Boettger's Caco	Not threatened
Amietia fuscigula	Cape River Frog	Not threatened
Xenopus laevis	Common Platanna	Not threatened

There is no red data amphibian species recorded in the study area. No species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 occur within the study area.

- Invertebrates

The Namakwa Bioregional Plan indicates that there is a high diversity of invertebrate species associated with the pollination systems associated with all the flowers in the study area.

  - Field assessment results

Several invertebrates were trapped in pitfall traps which were randomly placed in the study area while others were trapped in sweep nets and others recorded around the study area (Table 11)

Table 11: List of invertebrates in the study area

Order: Family	**Common name**	**Scientific name**
Coleoptera: Carabidae	Velvet Ground Beetle	*Graphipterus limbatus*

Order: Family	Common name	Scientific name
Coleoptera: Scarabaeidae	Woolly Chafer	*Sparrmannia flava*
Coleoptera: Tenebrionidae	Long-legged Darkling Beetle	*Stenocara dentata*
Coleoptera: Tenebrionidae	Unspecified	*Stenocara longipes*
Coleoptera: Tenebrionidae	Unspecified	Unspecified
Coleoptera: Tenebrionidae	Unspecified	Unspecified
Coleoptera: Meloidae	CMR Bean Beetle	*Mylabris oculata*
Hymenoptera: Formicidae	Bal-byter	*Camponotus fulvopilosus*
Orthoptera: Acrididae	Yellow wings	*Oedaleus*
Orthoptera: Pyrgomorphidae	Unspecified	*Ochrophlebia*
Orthoptera: Acrididae	Unspecified	*Rhachitopis*
Orthoptera: Pamphagidae	Saw-backed locust	*Haplolopha*

The Velvet Ground Beetle (*Graphipterus limbatus*) which occurs in the study area is a protected species in terms of GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007.

Apart from the *G. limbatus*, no other species listed in GN 1187 published under the National Environmental Management: Biodiversity Act on the 23rd of February 2007 occurs within the study area.

It is important to note that invertebrate species are mobile in nature and are not likely to be affected by the construction of the wind farm and PV facility. In addition, no unique larval habitat is present on the site which could be affected by the proposed development. Mitigation measures to reduce habitat destruction will aid in the preservation of habitat for invertebrate species.

8.6 Avifauna

The Avifauna Assessment was conducted by Chris van Rooyen and the detailed report is included in (Appendix 6B).

8.6.1 Natural environment

According to Mucina *et al.* (2006), the vegetation at the proposed wind farm site in Loeriesfontein is classified as Bushmanland Basin Shrubland. However, vegetation structure is more critical in determining bird habitat than actual plant composition (Harrison *et.al.* 1997). Therefore, the description of the habitat presented in this study concentrates on factors relevant to birds, and does not give an exhaustive list of plant species which occur in the study area (for more detail on the vegetation composition and potential impacts, please consult the Biodiversity (Flora and Fauna) Assessment above). The vegetation classification system presented in the Atlas of southern African birds (SABAP1) (Harrison *et.al.* 1997) is used for purposes of this report. The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data.

The proposed wind farm site is situated in an ecological transitional zone between the Nama Karoo and Succulent Karoo biomes (Harrison *et.al*. 1997). Both Karoo biomes support a particularly high diversity of species endemic to southern Africa. The Karoo avifauna characteristically comprises ground-dwelling species of open habitats, but the many tree-lined watercourses allow penetration of several species characteristic of arid woodland (Harrison *et.al.* 1997), particularly in the Nama Karoo. In comparison with Succulent Karoo, the Nama Karoo has higher proportions of grass and tree cover. The ecotonal nature of the study area is apparent from the presence of typical species of both Succulent and Nama Karoo at the wind farm site e.g. Karoo Eremomela *Eremomela gregalis* and Red Lark *Calendulauda burra*.

An important feature of the arid landscape where the proposed site is located is the presence of pans. Pans are endorheic wetlands having closed drainage systems; water usually flows in from small catchments but with no outflow from the pan basins themselves. They are of poorly drained, relatively flat and dry regions. Water loss is mainly through evaporation, sometimes resulting in saline conditions, especially in the most arid regions. Water depth is shallow (<3m), and flooding characteristically ephemeral (Harrison et al. 1997). Although the site itself does not contain any significant pans, there are several large pans situated in a 20km radius around the site (see Figure 16 below). When these pans hold water, waterbird movement between them are likely, including Greater Flamingo *Phoenicopterus roseus* and Lesser Flamingo *Phoenicopterus minor*. Some of that movement might take place over the proposed wind farm site.

8.6.2 Modified environment

Whilst most of the distribution and abundance of the bird species at the wind farm site are associated with natural vegetation, as this comprises the vast majority of habitat, it is also necessary to examine the modified environment available to birds.

In addition to the natural vegetation, the following avifaunal relevant modifications to the habitat were recorded at the wind farm site:

- Transmission lines: There are two transmission lines located in close proximity to the site, with one running partially within the boundaries of the site. Transmission lines are important anthropogenic habitat modifications, especially in an arid environment, as they constitute important perching and nesting substrate for raptors and crows.
- Artificial water points: A water trough was recorded on the site. In this highly arid environment, water attracts birds like a magnet. A water trough is a source of surface water that could periodically attract several priority species of raptors and small birds, particularly sandgrouse, larks and seed-eaters (see Appendix 2 of the main Avifauna Report).

Figure 16 below for a map of the wind farm site, indicating important habitat features, and the location of monitoring transects and vantage points for flight observations.

Appendix 1 of the main Avifauna Report provides a photographic overview of the bird habitats at the site.

Figure 16: The bird habitat and the location of monitoring transects and vantage points for flight observations at the development area and control area.

8.6.3 Avifauna

It is estimated that at least 76 bird species could potentially occur at the site, of which 60 have been recorded at the turbine and control site to date. Of the birds potentially occurring at the site, 28 are classified as priority species for wind farm sites (Retief 2011). The priority species potentially occurring at the site can be broadly classified in four groupings namely large terrestrial species, soaring species, waterbirds and small birds:

- Large terrestrial species: Medium to large birds that spend most of the time foraging on the ground. They do not fly often and then generally short distances at low to medium altitude, usually powered flight. Some species undertake longer distance flights at higher altitudes, when commuting between foraging and roosting areas. At the wind farm site, cranes, bustards and korhaans are included in this category.
- Soaring species: Species that spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering and gliding at medium to high altitudes. At the wind farm site, these are mostly raptors.
- Waterbirds: These are species that are generally associated with aquatic habitats. At the wind farm site, these comprise ducks, waders and flamingos.
- Small birds: At the wind farms site these are mainly several species of passerines. These species generally spend most of the time on the ground or calling from perches, but display flights at medium height are also undertaken by some species, and swallows spend most of the time flying. Sandgrouse undertake long distance flights.

Appendix 2 of the detailed Avifauna report lists the species that may potentially occur on the site, based on the results of the pre-construction monitoring and various other sources (SABAP1, SABAP2, Young et al. 2003, Young 2008, Young 2009a, Young 2009b, Young 2010a, Young 2010b, Hockey et al. 2007, pre-construction monitoring).

8.7 Bats

The Bat Assessment was conducted by Werner Marais of Animalia and the detailed report is included in (Appendix 6C).

8.7.1 Bats and wind turbines

Since bats have highly sophisticated navigation by means of their echolocation, it is puzzling as to why they would get hit by rotating turbine blades. It may be theorized that under natural circumstances their echolocation is designed to track down and pursue smaller insect prey or avoid stationary objects, not primarily focused on unnatural objects moving sideways across the flight path. Apart from physical collisions, a major cause of bat mortality at wind turbines is barotrauma. This is a condition where the lungs of a bat collapse in the low air pressure around the moving blades, causing severe and fatal internal hemorrhage. One study done by Baerwald, et al. (2008) showed that 90% of bat fatalities around wind turbines involved internal hemorrhaging consistent with barotrauma.

Some studies propose that bats may be attracted to the large turbine structure as roosting space, or that swarms of insects get trapped in low air pockets around the turbine and subsequently attract bats.

Whatever the reason for bat mortalities around wind turbines, the facts indicate this to be a very serious and concerning problem. During a study by Arnett, et al. (2009), 10 turbines monitored over a period of 3 months showed 124 bat fatalities in South-central Pennsylvania (America), which can cumulatively have a catastrophic long term effect on bat populations, if such a rate is persistent. Most bat species only reproduce once a year, bearing one young per female, meaning their numbers are slow to recover. Mitigation measures are being researched and experimented with globally, but are still only effective on a small scale. An exception to this is a mitigation measure called curtailment, where the turbine cut-in speed is raised to a higher wind speed. This relies on the fact that bats will be less active in strong winds and therefore less likely to be impacted by a moving turbine blade, however this mitigation is not as effective yet to move this threat to a category of low concern.

8.7.2 Species probability of occurrence at the proposed site

Table 12: Table of species that may be roosting on the study area, the possible site specific roosts, and their probability of occurrence.LC = Least Concern; NT = Near Threatened; V = Vulnerable; DD = Data Deficient (Monadjemet al., 2010).

Species	**Common name**	**Probability of occurrence**	**Conservation status**	**Possible roosting habitat to be utilised on study area**
Rhinolophuscapensis	Cape horseshoe bat	Low	NT	Roosts gregariously in caves, no known caves close to the study site.
Rhinolophusclivosus	Geoffroy's horseshoe bat	Low	LC	Roosts gregariously in caves, no known

				caves close to the study site.
Nycteris thebaica	Egyptian slit-faced bat	High	LC	Cavities, aardvark burrows, and culverts under roads. Any suitable hollows
Tadarida aegyptiaca	Egyptian free-tailed bat	Confirmed	LC	Crevices, buildings, rock crevices. Very common and adaptable.
Cistugoseabrae	Angolan wing-gland bat	Medium - High	NT	Endemic to West Coast, restricted to arid climates (semi-desert), netted in dry river beds.
Miniopterus natalensis	Natal long-fingered bat	Low	NT	Roosts gregariously in caves, no known caves close to the study site.
Neoromiciacapensis	Cape serotine	Confirmed	LC	Under bark of trees and roofs of buildings. Common and adaptable

8.7.3 Bat detection and roost scouting

Very few bat calls (5 in total) were recorded during vehicle based monitoring within the site (Figure 17)). The site is mostly void of roosting opportunities (Figure 18) and we did not come across any open water sources during physical scouting of the site. No sources of open water were detected using Google Earth searches of the site. The lack of bat activity during monitoring can therefore probably be attributed to the lack of roosting space and open drinking water.
Bat activity is most likely centered around the dams north of the Loeriesfontein site, as insect availability will be much higher here. Roosting space created by trees, rocky outcrops and buildings are also more abundant in this area.

A bat call consists of a series of ultrasonic sound pulses, with each species calling at a characteristic sound frequency (Figure 19). It is used for navigational and hunting purposes, comparable to but more sophisticated than modern sonar. Pulses within a bat call may also vary by means of their sound frequency and characteristics, although this variation is within a certain range restricted to a specific bat species. Certain call parameters are used to identify a bat species from its echolocation call. These include pulse length, pulse bandwidth, pulse interval and pulse dominant frequency (loudest frequency), of which dominant frequency is the most commonly used parameter. The dominant frequencies of the three loudest pulses recorded were chosen since the loudest pulse is produced when the bat is in close proximity to the bat detector, limiting the ramifications the Doppler Effect has on the results of sound waves emitted by a moving bat. A feeding buzz is the common term used to describe the change in echolocation call when a bat is approaching its prey. A feeding buzz is a series of very short pulses that dramatically become more rapid as the bat is closing in on the insect prey, giving it a clear image of the prey. A feeding buzz is proof of bats actively foraging. Species identification with the use of echolocation is less accurate when compared to morphological identification, nevertheless it is a very certain and accurate indication of bat activity and their presence.

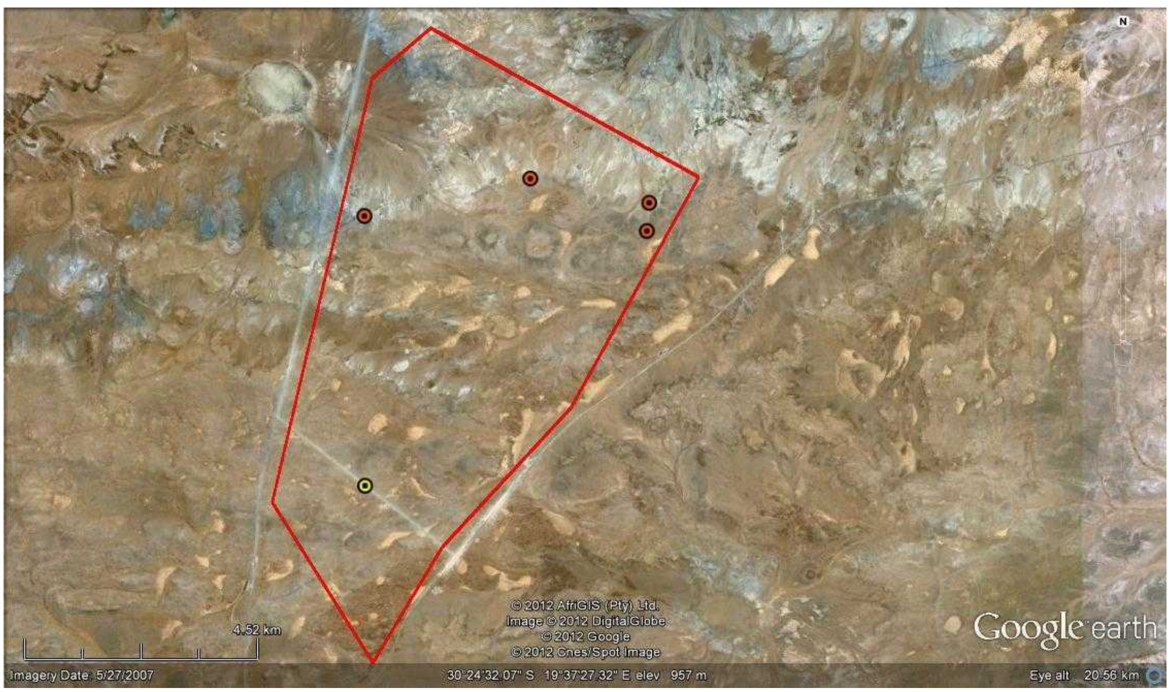


Figure 17: Bat species and activity detected during vehicle monitoring on site, showing very low levels of activity. Orange circles indicate where Egyptian free-tailed bats (*Tadarida aegyptiaca*) were detected and yellow circles indicate where Cape serotine bats (*Neoromicia capensis*) were detected.

Figure 18: Typical topography of site showing lack of roosting opportunities for bats.

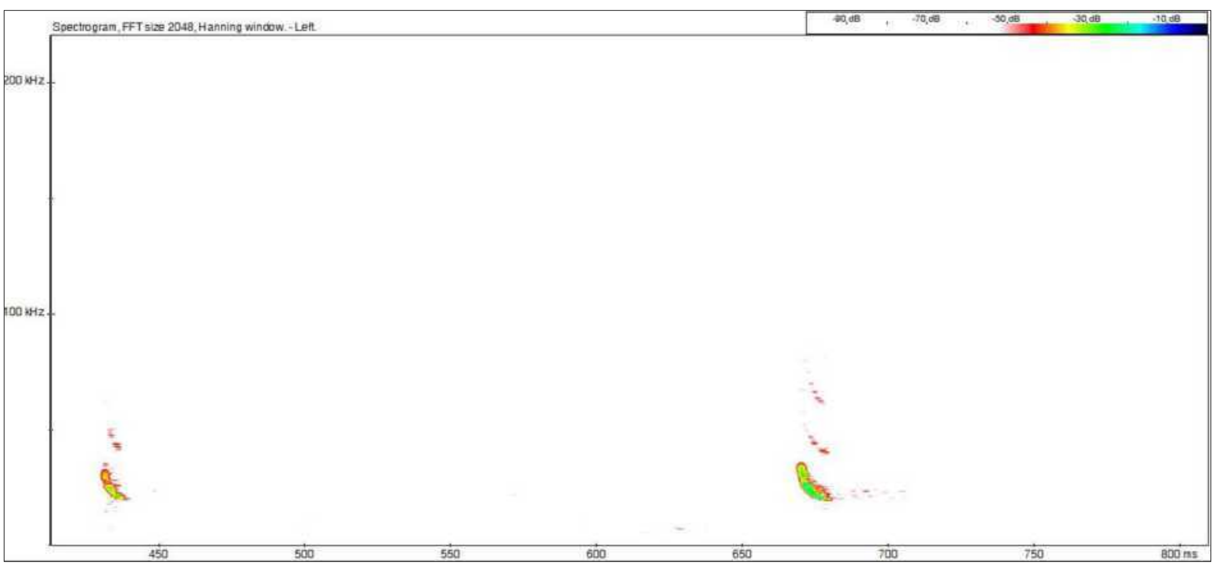


Figure 19: Spectrogram of pulses from *Tadarida aegyptiaca* (Egyptian Free-tailed bat)

8.8 Surface Water

The Surface Water Assessment was conducted by SiVEST and the detailed report is included in (Appendix 6D).

8.8.1 Study Area Drainage and Hydrology

In order to understand the drainage and hydrology of the study site, it is best to consult with available literature pertaining to surface water resources in the study area. However, academic or scientific literature is very limited and/or potentially inaccessible. Mucina and Rutherford (2006) however, reports on the general condition of the landscape with respect to the climate, vegetation and landscape features as well as the geology and soils for the bioregion in which the study site is located. Given this information, the drainage context can be elucidated. Accordingly, Mucina and Rutherford (2006) provide the main source of information for this section unless otherwise specified.

The climate of the bioregion depicts a rainfall pattern occurring in late summer and early autumn with the Mean Annual Precipitation (MAP) ranging from about 100-200mm. The Mean maximum and minimum monthly temperatures in Brandvlei are 39.5° C and -4.6° C respectively.

At a more local scale, the area of Loeriesfontein normally receives about 143mm of rain per year and because it receives most of its rainfall during winter it has a Mediterranean climate (www.saexplorer.co.za). The general rainfall pattern in Loeriesfontein indicates that the lowest rainfall is received in January whilst the highest is in June (www.saexplorer.co.za). The monthly distribution of average daily maximum temperatures indicates that the average midday temperatures for Loeriesfontein ranges from 17°C in July to 31.8°C in February (www.saexplorer.co.za).. The region is the coldest during July when the mercury drops to 2.4°C on average during the night (www.saexplorer.co.za). The average minimum daily temperatures range from a high in the region of 14° C in February to a low of about 2° C around June (www.saexplorer.co.za).

The landscape of the study site is characterized by slightly irregular plains covered with dwarf shrubland dominated by a mixture of low sturdy and spiny shrubs (*Rhigozum, Salsola, Pentzia, Eriocephalus*) white grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as *Gazania* and *Leysera*. Beneath the vegetation cover, the underlying geology of the study site is predominantly underlain by Mudstones and shales of Ecca Group (Prince Albert and Volkrust Formations) and Dwyka tillites both of early Karoo age. Approximately 20% of rocky outcrops is formed by Jurassic intrusive dolerite sheets and dykes. The overlying soils are made up of shallow Mispah and Glenrosa forms, with lime generally present in the entire landscape and to a lesser extent, red-yellow apedal, freely drained soils with high base status and usually <15% clay are also present. The soil content of the above-mentioned soils is very high.

From the above given information, it has been indicated that the area around Loeriesfontein receives low rainfall primarily during the winter months when it is reasonably cold. With relatively flat areas associated with irregular plains, water accumulation in low lying drainage areas can be anticipated. Due to a relatively shallow soil profile as a result of Mispah and Glenrosa soil forms, very little sub-surface drainage is expected except where deeper soil profiles prevail. However, where deeper soils prevail, the red-yellow apedal soil form is likely to be present which consist of a low percentage of clay and express a freely draining characteristic. Surface water resources (in the way of wetlands specifically) are therefore not expected to be a prominent environmental feature in the landscape of the study site. Instead any surface water resources are foreseen to be temporary to ephemeral in nature, if any occur in the study site.

8.8.2 Findings of Assessment

- Desktop Database Surface Water Features

According to the consulted databases, the study site falls on the divide of the Olifants and Orange primary catchments. At the quarternary catchment level, most of the southern area of Portion 2 of Farm No. 226 and a relatively smaller sub-section of Portions 1 and 2 of Farm No. 213 fall within the quarternary catchment E31C belonging to the Olifants primary catchment. Most of the northern areas of Portions 1 and 2 of Farm No. 213as well as a relatively smaller area to the north of Portion 2 of Farm No. 226 falls within the quarternary catchment D53F draining into the Orange primary catchment.

The occurrence of wetlands and other surface water resources for the greater study area, as per information drawn from the various databases, are displayed in Figure 6. The NFEPA (2011) database particularly is the most comprehensive and updated database as far as wetlands and rivers are concerned for the country and best reflects the occurrence of surface water resources. In terms of the database, a total of 29 wetlands occur on all the portions constituting the Loeriesfontein study site. More specifically, of the wetlands that occur on the study site in terms of the database, thirteen are depression wetlands, eight are flat wetlands and seven are seep wetlands.

Two priority river systems (NFEPA 2011) distanced approximately 5km apart from one another flow to the south of the Loeriesfontein study site. The river systems located to the western most area of the site is identified as the Leeuberg River (Reach number E81). This particular river is classed as a largely natural river system (Class B) according to the Present Ecological State assessment conducted in 1999 (NFEPA 2011). Equally, the river system located in the central southern region of the study site is classed as a largely natural river system (Class B) according to the Present Ecological State assessment conducted in 1999 (NFEPA 2011). This river is identified as the Klein-Rooiberg River (Reach number E61). Numerous associated drainage lines can be evidenced from satellite imagery in addition to these systems.

The results of desktop analysis of the 29 wetlands, 2 rivers and numerous drainage lines were taken into the field for verification and potential further assessment.

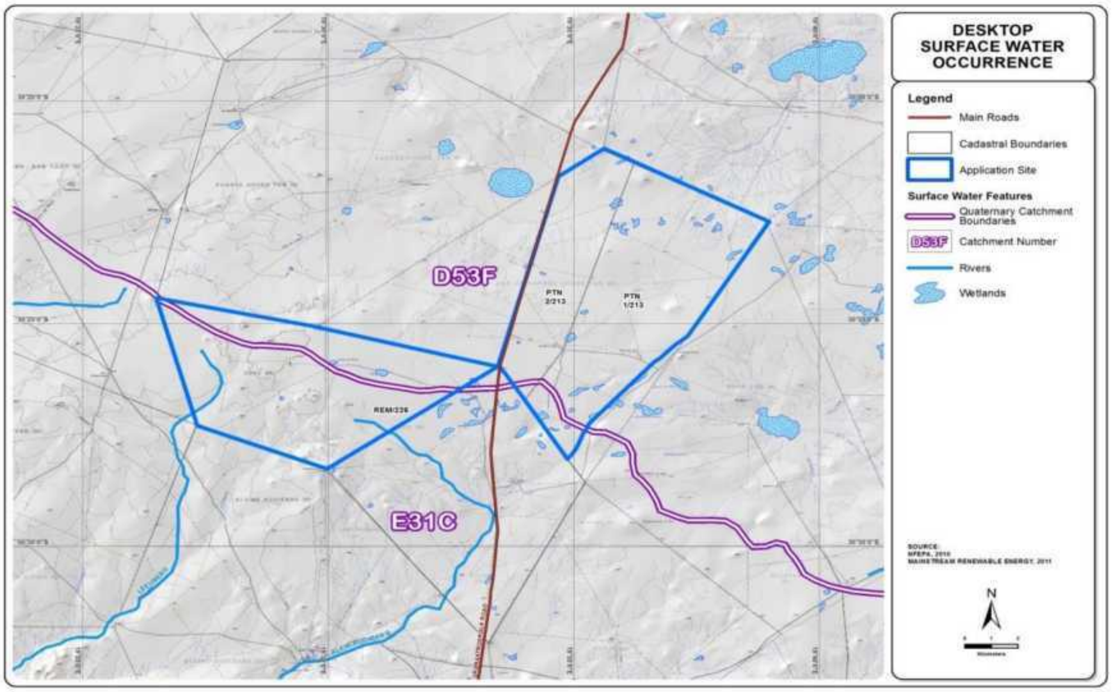


Figure 20: Desktop surface water occurrence within and around the study site.

- Field-assessed Wetlands

The field assessment identified no wetlands, but two priority river systems and 232 drainage lines on the entire study site. These hydrological features are displayed in Figure 7 below.

  - Wetlands

Photographic evidence taken in the field is provided in Plate 1 for the wetlands assessment. Upon site investigation of the various locations where it had been preliminarily identified at a desktop level that wetlands occurred, it was found that only one of the four indicators could be satisfied for the delineation process. This particularly concerns the terrain unit indicator. The areas where it had been identified at a desktop level that wetlands occurred were all located in a depression or valley bottom. These areas were predominantly devoid of vegetation, although some areas did contain sparse vegetation (Photos 1 and 2). Having located the potential areas where the wetlands had been identified at a desktop level to occur, soils samples were drawn from these sites. The soil samples revealed no signs of wetness. Hence, the soil wetness indicator could not be satisfied. The soil samples normally showed a uniform but unconsolidated profile in the top 50-100cm (where possible) bearing soil particles with a fine sandy texture and typically yellow colour. Small lime nodules were present (Photo 3) in addition to carbonate precipitations (Photo 4) in some of the soil samples usually at depths over 30cm. Given these characteristics, the diagnostic soil horizons could be associated with either yellow apedal or neocarbonate soils. The profile therefore could be attributed with the Clovelly and Augrabies Soil Form (McVicar *et al.* 2006). Importantly, these soils forms are not recognised as wetland soil forms.

In terms of vegetation, the areas where wetlands had been identified at a desktop level to occur did not contain any species that could be described as hydrophyllic. As previously mentioned, most wetlands areas were predominantly bare. Where vegetation was present (Photo 5), it comprised mostly of low sturdy (and sometimes succulent) as well as spiny shrubs (Photo 6).

In light of the above, there was not sufficient evidence to conclude that the supposed wetland areas identified at a desktop level were in fact wetlands. Instead, it is surmised that water may likely accumulate in these lower lying depression areas after rainfall events. However, the characteristics and nature of the soils presumably allow for good drainage thereby preventing surface and sub-surface water retention for periods long enough for hydromorphism to take place and for consequent soil wetness characteristics to develop. Evaporation may also contribute to the loss of surface and sub-surface water accumulation after rainfall events. However, the aforementioned the potential explanation provided here is not definitive and would need to be proven with further studies.

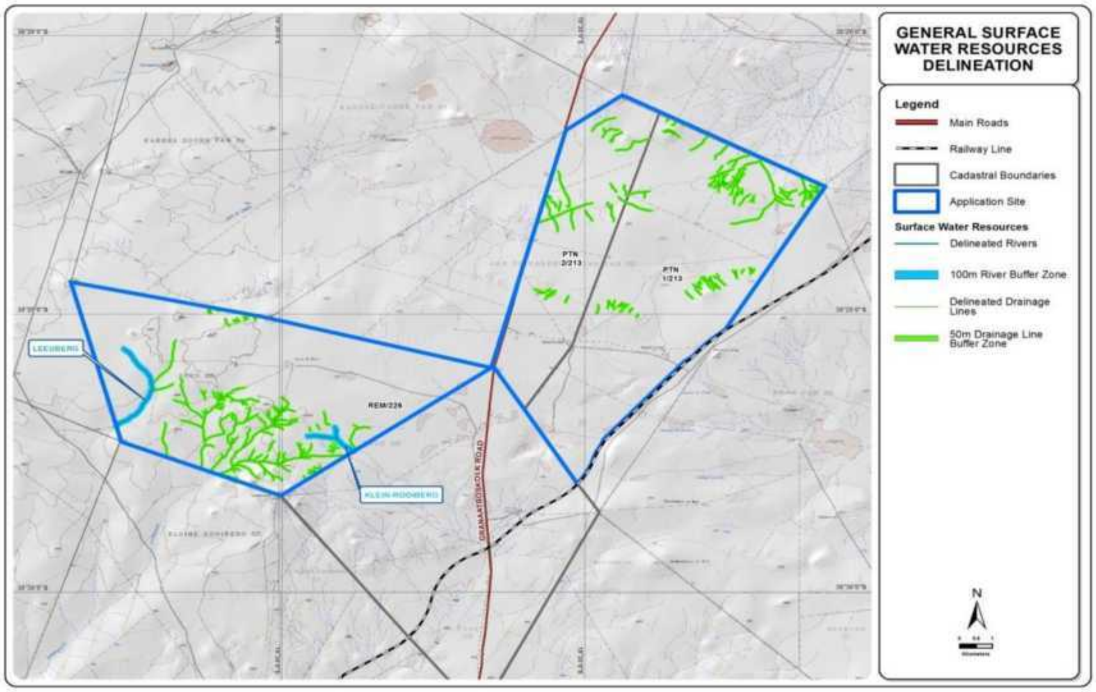


Figure 21: Identified and delineated Priority Rivers and drainage lines in the study site.

Plate 1: Photographic evidence of the field verification exercise for the potential wetland areas.

Photo 1. Example of one of the open bares areas assessed where potential wetlands had been identified at a desktop level.

Photo 2. Another example of an area where the potential wetlands identified at a desktop level was investigated for actual occurrence.

Photo 3. Soil sample drawn from a location where a wetland had been identified at a desktop level and was investigated.

Photo 4. Soil sample showing salt precipitation in the soil profile.

Photo 5. One of the bare open areas that had been investigated for the presence of a wetland that contained vegetation.

Photo 6. Example of the low sturdy and succulent shrubland vegetation identified in one of the areas investigated for the potential occurrence of a wetland.

- Priority Rivers

Photographic evidence taken in the field is provided in Plate 2 for the priority rivers assessment. The two Priority Rivers (Leeuberg and Klein-rooiberg rivers) that were identified at a desktop level were identified and verified in the field (Photo 7). These two priority rivers could be described as temporary or non-perennial hydrological systems. The in-stream character of these two systems contained vegetation species that could be associated with dry river courses. The main grass species identified within the channel of both river systems were *Stipagrostis namaquensis* (River Bushman Grass – Photo 8). Dense shrubland vegetation lined the channel banks. The actual channel width varied in locations along each of the river lengths. Alluvial deposits (Photo 9) were visibly evident within the respective channels as a consequence of the non-perennial nature of the hydrological systems and the dry climate thereby exposing river beds. Each river system was accordingly delineated. A 100 metre buffer was applied to the Priority Rivers due to their significance.

- Drainage Lines

Photographic evidence taken in the field is provided in Plate 2 for the priority rivers assessment. Overall, 233 drainage lines were identified and delineated. Most of the drainage lines were associated with areas of some relief (Photo 10). These areas were predominantly to the south west of Portion 2 of the Farm 223 as well as the central and northern regions of Portions 1 and 2 of the Farm 213. The drainage lines varied in size (width and length) but most were relatively small (1 to 2 metres in width – Photo 11). Some of the drainage lines also expressed a degree of bedrock influence (Photo 12). A buffer zone of 50 metres was applied to the drainage lines.

Plate 2: Photographic evidence of the wetland assessment of Large Wetland 1.

		
Photo 7. Picture taken from within the channel of the Leeuberg River.	Photo 8. *S. namaquensis* was prevalent in the in-stream part of the channels for both the Leeuberg and Klein-rooiberg Rivers.	Photo 9. Alluvial deposits in the exposed river beds of the Klein-rooiberg River.
		
Photo 10. Example of one of the drainage lines in an area with some relief.	Photo 11. One of the drainage lines where the width is variable but normally between 1 to 2m	Photo12. Exposed bedrock in one of the drainage lines assessed and

8.9 Agricultural Potential

The Agricultural Potential Assessment was conducted by SiVEST and the detailed report is included in (Appendix 6E).

8.9.1 Soil Characteristics and Soil Potential

According to the ENPAT database the site is dominated by mix of Glenrosa and Mispah soil forms (Figure 22). These soils develop where bands of weathering rock are found close to the soil surface. Glenrosa and Mispah soils generally have an inherently low agricultural potential due to a distinct lack of rooting depth (<0.45 m) (Figure 23) and also exhibit moderately high soil erosion hazard ratings; thus soil conservation practices such as minimum tillage and trash blankets should be employed.

A mix of red and yellow apedal soil forms are found near the western border of the site are also associated with a shallow effective soil depth of less than 0.45 m.

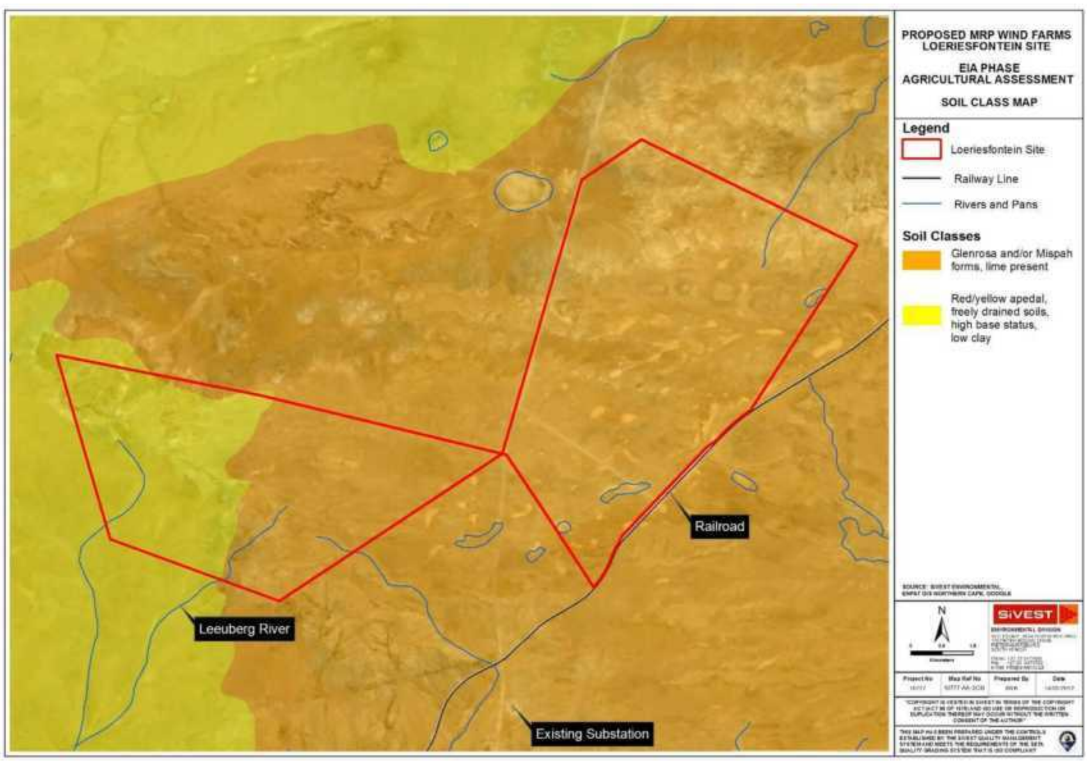


Figure 22: Broad soil type map

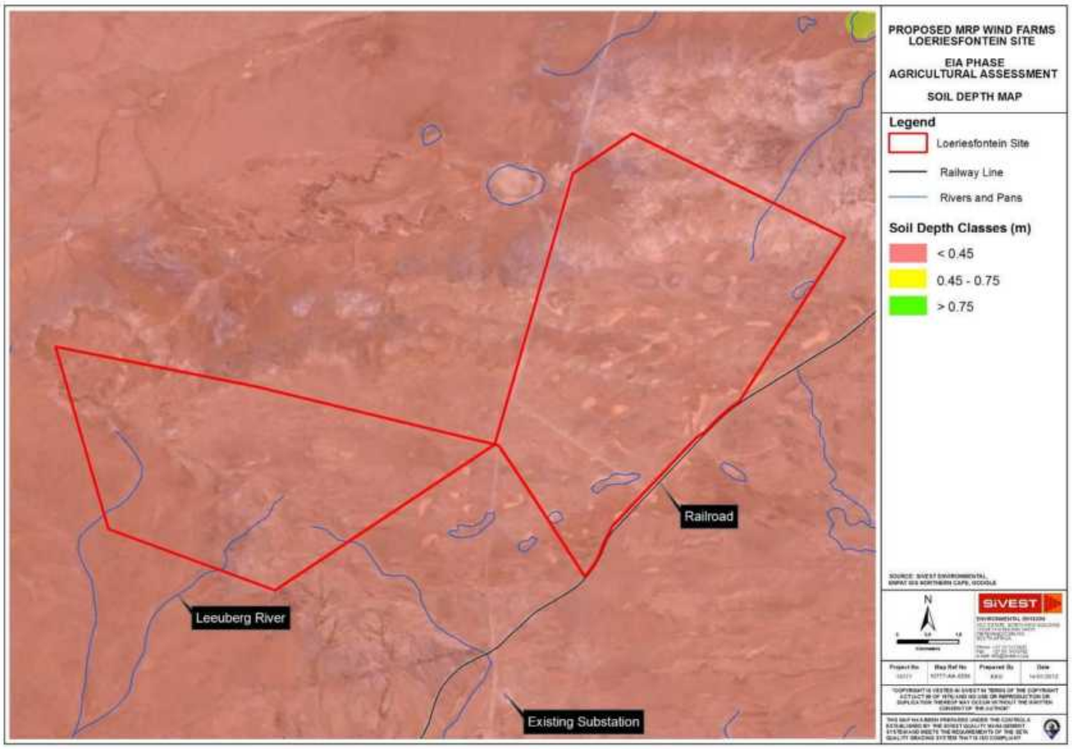


Figure 23: Soil depth map

The ENPAT Database also provides an overview of the study area’s agricultural potential based on its soil characteristics, it should be noted this spatial dataset does not take prevailing climate into account. Restrictive climate characteristics, due to heat and moisture stress will further reduce the agricultural potential of the area under assessment. The study area is dominated by soils which are not suited for arable agriculture (Figure 24) but which can still used as grazing land.

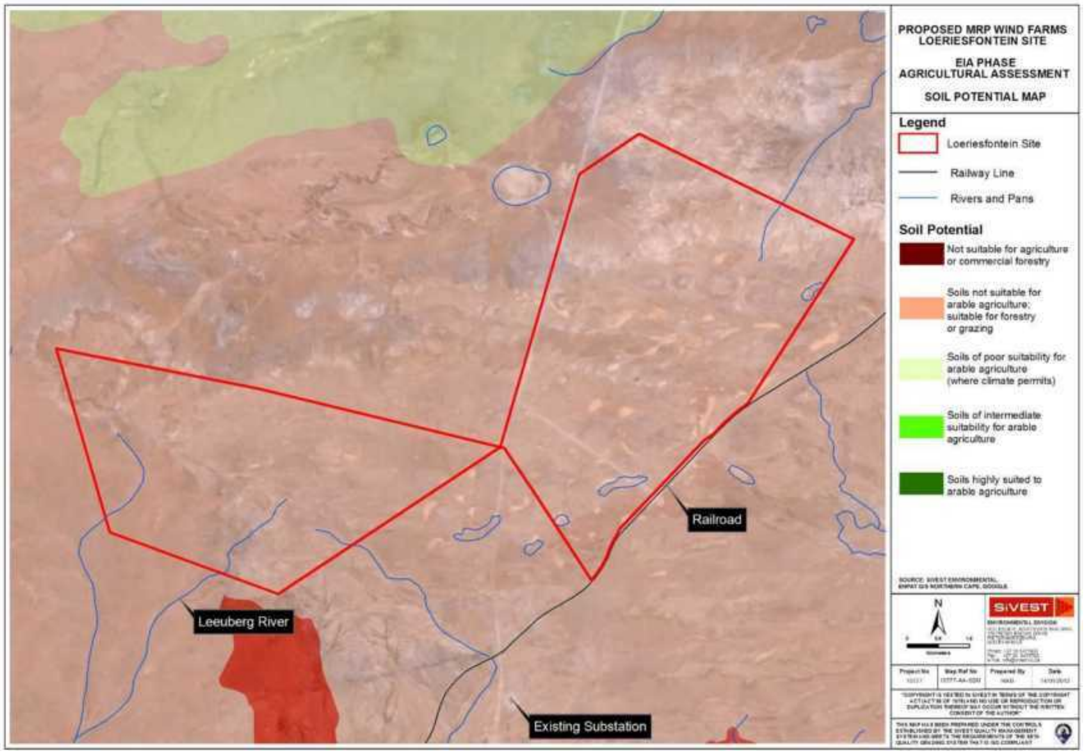


Figure 24: Soil Potential Map

8.9.2 Desktop Agricultural Assessment: Result Summary

By taking all the site characteristics (climate, geology, land use, slope and soils) into account the agricultural potential for the majority of the study area is classified as being extremely low for crop production while moderately low for grazing. This poor agricultural potential rating is primarily due to restrictive climatic characteristics and soil depth limitations. The site is not classified as high potential nor is it a unique dry land agricultural resource.

8.9.3 Soil Survey and Field Verification

Due to the size of the site (10 157 ha) local agricultural activities (unimproved grazing land) and the nature of the proposed activities, an exploratory soil survey was performed. At each survey point the soil was described to form and family level according to "Soil Classification - A Taxonomic System for South Africa" (Soil Classification Working Group, 1991) and the following properties were noted:

i. Estimation of 'A' horizon clay content,

ii. Permeability of upper B horizon,
iii. Effective rooting depth,
iv. Signs of wetness,
v. Surface rockiness,
vi. Surface crusting,
vii. Vegetation cover, and
viii. Detailed description of the particular area such as slope.

- Soil Descriptions

This Section lists the major soil forms encountered during the soil survey along with a site-specific description of each soil form. Other soils encountered during the field verification, which were recorded very sparsely across the site and therefore not fully described include:

i. Brandvlei
ii. Augrabies

- Mispah Form

Soil Family: Mostly 1200 (Non bleached, Calcareous), limited bleached and/or non-calcareous
Diagnostic Horizons and Materials:

i. A-Horizon: Orthic
ii. B-Horizon: Hard Rock

- Site Specific Description:

The Mispah soil form falls within the lithic soil group. Lithic soils are associated with shallow soils where parent rock is found close to the soil surface. The A-horizon varied from brown to ivory in colour and was generally 10-20 cm deep, directly overlying various hard rock materials (Figure 25). The Mispah soil form dominates large areas of the study area and surface rocks are common (Figure 26). Large portions of the site contain non-contiguous bands of shallow rock and Hardpan Carbonate which lead to areas being classified as a Mispah and Coega complex.

- Land Use Capability:

This soil has low agricultural potential due to the distinct lack of rooting depth and as such these soils are generally utilised for grazing land. If ripped and cultivated however precise irrigation scheduling is imperative. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

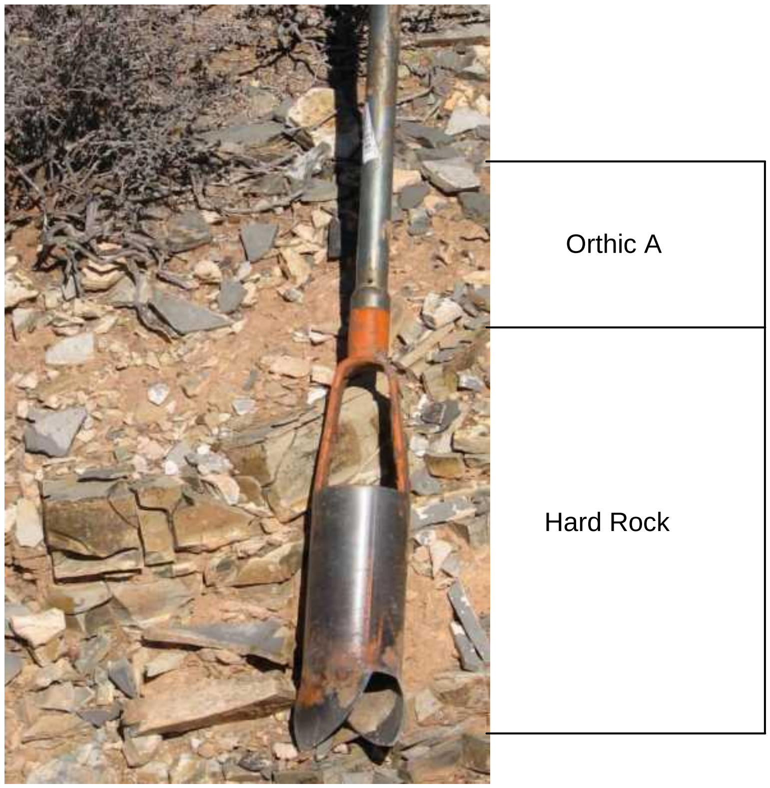


Figure 25: An example of a shallow Mispah Soil Form encountered on the Proposed Development Area (PDA)

Figure 26: Shallow, rocky soils dominate large portions the PDA

- Coega Form

Family: 1000 (Calcareous A Horizon)
Diagnostic Horizons and Materials:

i. A-Horizon: Orthic
ii. B-Horizon: Hardpan Carbonate

- Site Specific Description:

The Coega form is a type of calcic soil whose profile contains at least one carbonate-rich horizon. Carbonate retention in the soil profile is a result of an arid climate where evaporation far exceeds rainfall. When encountered on the PDA the A-horizon of this soil form was generally light brown, calcareous and lightly structured. This Orthic A-horizon overlies a hard pan carbonate which was limiting to plant growth. The effective soil depth was generally less than 0.2 m. Large portions of the site contain non-contiguous bands of shallow rock and Hardpan Carbonate which lead to areas being classified as a Mispah and Coega complex.

- Agricultural Potential:

Calcic soils are associated with arid regions and thus the use of these carbonate rich soils in South Africa is limited. Limitations in terms of sustainable agricultural use include shallow rooting depth, high pH, high salinity and low plant Phosphorus availability (Fey, 2010). The distinct lack of rooting depth also reduces the agricultural potential of these soils. Such limitations restrict calcic soils to extensive grazing unless irrigation is available. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

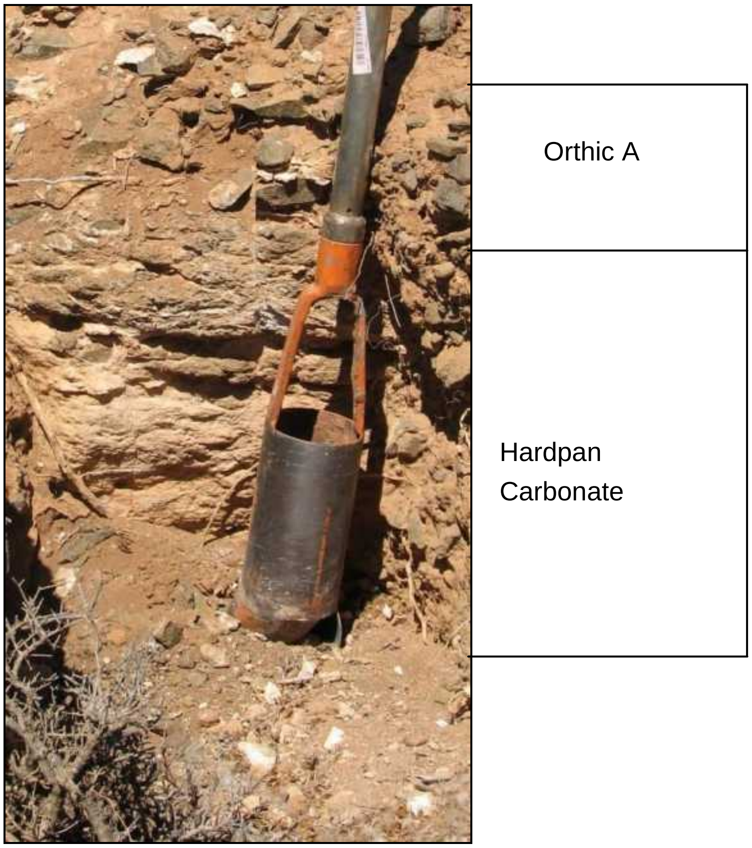


Figure 27: An example of a shallow Coega Soil Form encountered on the PDA

Figure 28: Shallow and surface Hardpan Carbonate is common throughout the PDA

- Prieska Form

Soil Family: Generally 1110 (Not bleached, Non-red B, Non Luvic)
Diagnostic Horizons and Materials:

i. A-Horizon: Orthic
ii. B-Horizon: Neocarbonate
iii. C-Horizon: Hardpan Carbonate

- Site Specific Description:

Like the Coega form the Augrabies soil form falls within the calcic soil group whose defining characteristic is the accumulation of calcium carbonate. Carbonate retention in the soil profile is a result of an arid climate where evaporation far exceeds rainfall. When encountered on the PDA the A-horizon of this soil form was light brown and thin. This Orthic A-horizon overlies a Neocarbonate B-horizon which lacked structure other than the porous micro-aggregates and had a uniform ivory colour (Figure 29). The Neocarbonate B overlies Hard Pan Carbonate which is limiting to plants. The soil form was generally non-luvic and the pedological depth seldom exceeded 0.5 m. The entire profile tested positive to the presence of carbonates when treated with cold 10% hydrochloric acid.

- Land Use Capability:

Calcic soils are associated with arid regions and thus the use of these carbonate rich soils in South Africa is limited. Limitations in terms of sustainable agricultural use include high pH, high salinity, low plant available Phosphorus and other trace elements as well as toxic levels of extractable of Boron (Fey, 2010). Such limitations restrict calcic soils to extensive grazing unless irrigation is available. These soils also exhibit high soil erosion hazard ratings thus soil conservation practices such as minimum tillage and trash blankets should be employed.

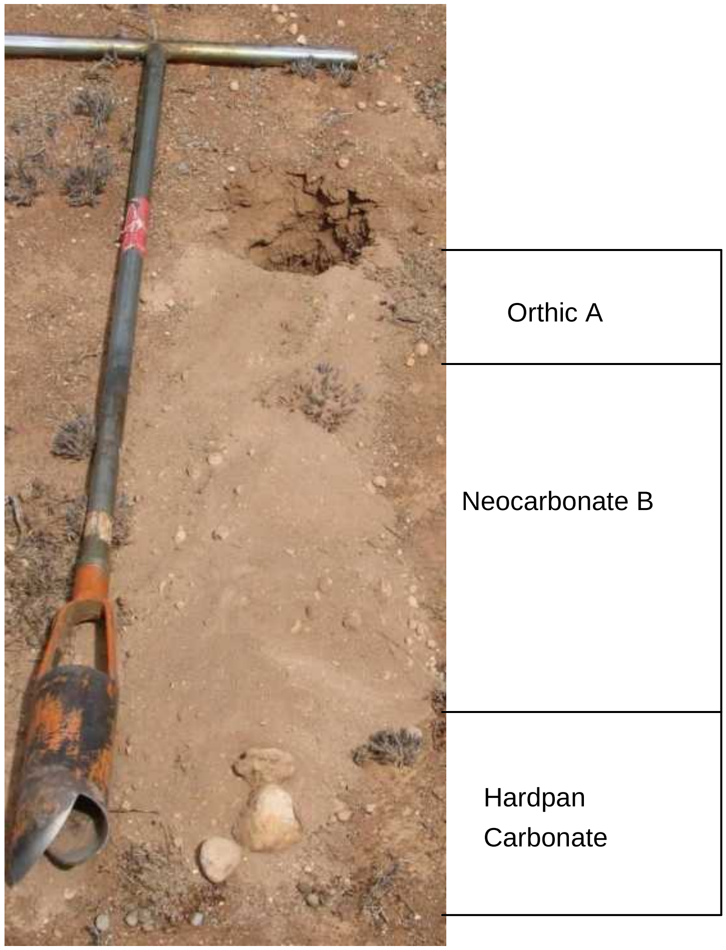


Figure 29: An example of a Prieska encountered the PDA

- Soil Summary

The soils identified on the PDA are predominantly calcic and shallow with a low agricultural potential. Rocky and shallow calcic soils (Mispah and Coega Form) cover 97% of the surveyed area (Figure 30). Virtually all the soils encountered on site contained at least one layer that was limiting to plant growth and these layers included rock and hard pan carbonate. The soils' properties identified during the field verification reflect the arid climate in which they were formed.

The location and description of the sample points are provided in Appendix A of the main Agricultural Potential Specialist Report: Soil Properties. This information was used to create a verified soil map showing homogeneous soil bodies (Figure 30). Combining the effective depth information (i.e. depth to root limiting layer) and Inverse Distance Weighting one is able to obtain a generalised soil depth for the PDA (Figure 32). Soils with an effective depth of greater than 50 cm were rarely observed during the soil survey with most soils exhibiting an effective soil depth of less than 30 cm.

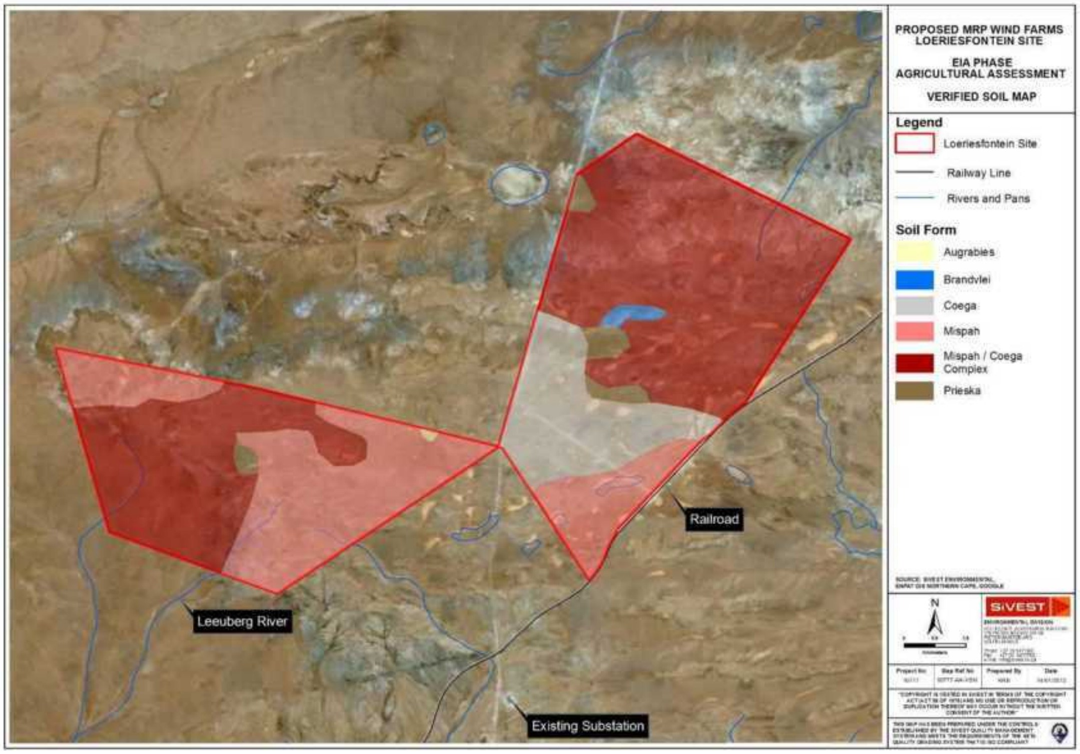


Figure 30: Verified Soil Map for the Plateau East North Site

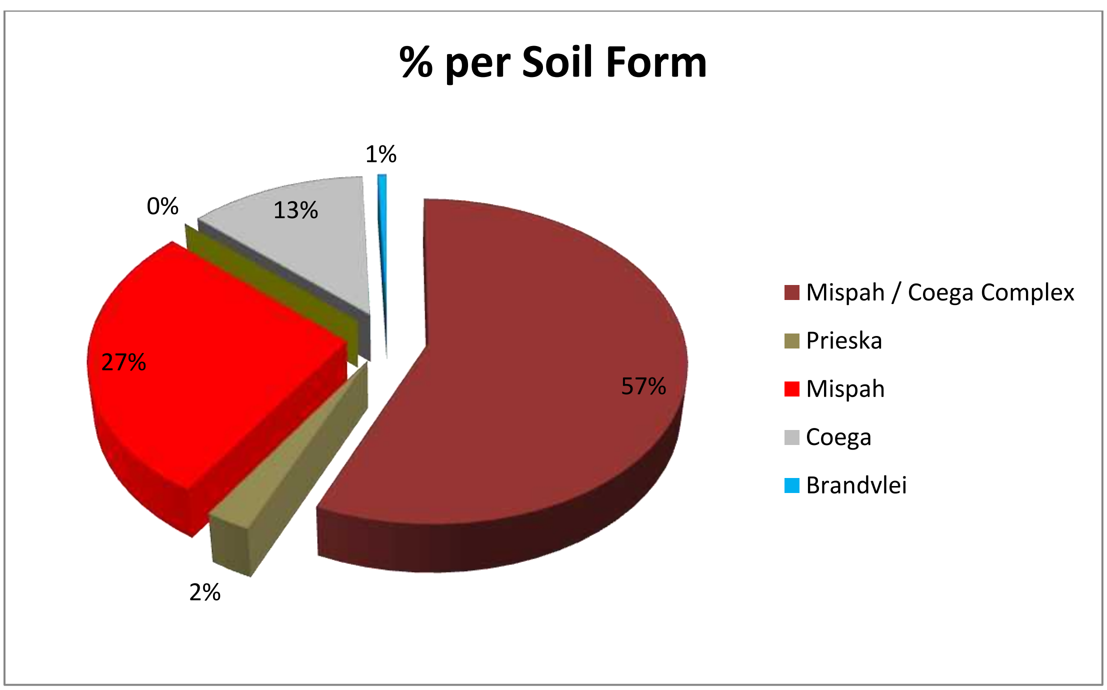


Figure 31: Graph showing the percentage area per soil form for the Plateau East North Site

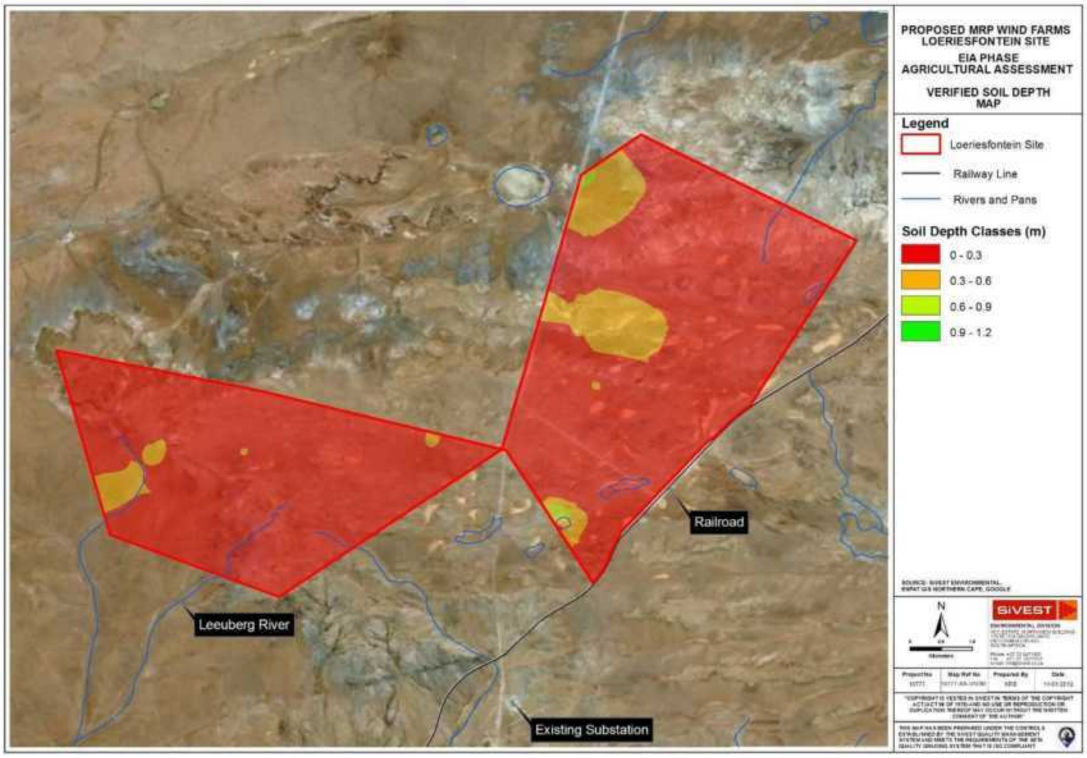


Figure 32: Verified Soil Depth Map

8.10 Noise

The Noise Assessment was conducted by Morne de Jager from M² Environmental Connections and the detailed report is included in (Appendix 6G).

8.10.1 Potential sensitive receptors (Noise Sensitive Developments)

Potentially Sensitive Receptors (PSRs), also known as Noise-Sensitive Developments (NSDs) were initially identified using Google Earth®, supported by a site visit to confirm the status of the identified dwellings.

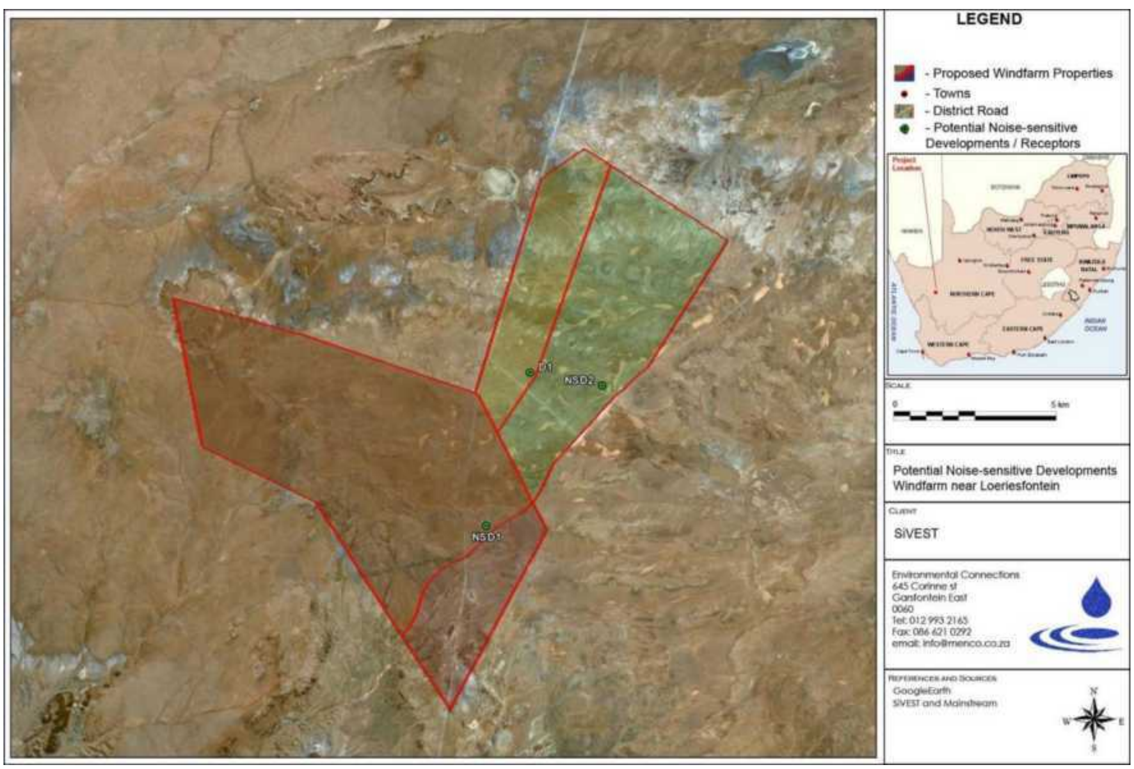
The reason for the site visit, apart from sampling ambient sound levels, is that there could be a number of derelict or abandoned dwellings that could be seen as a sensitive receptor, or small dwellings that could not be identified on the aerial image, or those that were built after the date of the aerial photograph.

Potential receptors in and around[2] the proposed WEF were identified and are presented in Figure 33. The distances between the PSRs and the closest proposed Wind Turbine Generator (WTG) (as per the proposed preliminary second layout) are also defined.

Table 13: Locations of the identified Noise-sensitive Developments (Datum type: WGS84 – Hartbeeshoek)

Noise-sensitive development	Description	Location Latitude	Location Longitude	Distance to closest Wind Turbine
NSD01	Residential	-30.475701°	19.564488°	770 m
NSD02	Residential	-30.427893°	19.605356°	2,205 m
D1	Derelict	-30.424920°	19.577818°	Not relevant, old shed that is unoccupied

The occupation of both NSD01 and NSD02 is based on the observation of livestock such as chickens around the dwellings. There is also a train station near NSD01, but it is not occupied.



[2] The area inside and up to 2,000 meters from the proposed WEF

Figure 33: Aerial image indicating potentially sensitive receptors and property boundaries in the proposed WEF

8.10.2 Current Environmental Sound Character

- Measurement Procedure

Ambient (background) noise levels were measured at appropriate times in accordance with the South African National Standard SANS 10103:2008 ***"The measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication"***. The standard specifies the acceptable techniques for sound measurements including:

- type of equipment;
- minimum duration of measurement;
- microphone positions;
- calibration procedures and instrument checks; and
- weather conditions.

It should be noted that wind-induced noises are usually seen as unwanted noises, and samples reflecting significant background interference due to wind-induced noises are normally discarded. However, for the purpose of this study, it was opted to include all measurements taken because the typical operating noise of the facility will only be emitted during times when wind-induced noise levels are relevant.

The equipment defined in Table 14 was used for gathering data:

Table 14: Equipment used to gather data

Equipment	Model	Serial no	Calibration
SLM	Rion NL-32	01182945	17 June 2010
Microphone*	Rion UC-53A	315479	17 June 2010
Preamplifier	Rion NH-21	28879	17 June 2010
Calibrator	Rion NC-74	34494286	27 January 2011
Anemometer	Kestrel 4000	587391	Calibrated[3]

* Microphone fitted with the appropriate windshield.

- On-site Measurements

[3] Certificate of Conformity issued by Nielsen-Kellerman Co.

A number of 10 minute measurements were taken during the day and night of 13 June 2011. The sound level meter was referenced at 1,000 Hz directly before and after the measurements were taken. In all cases drift was less than 0.2 dBA.

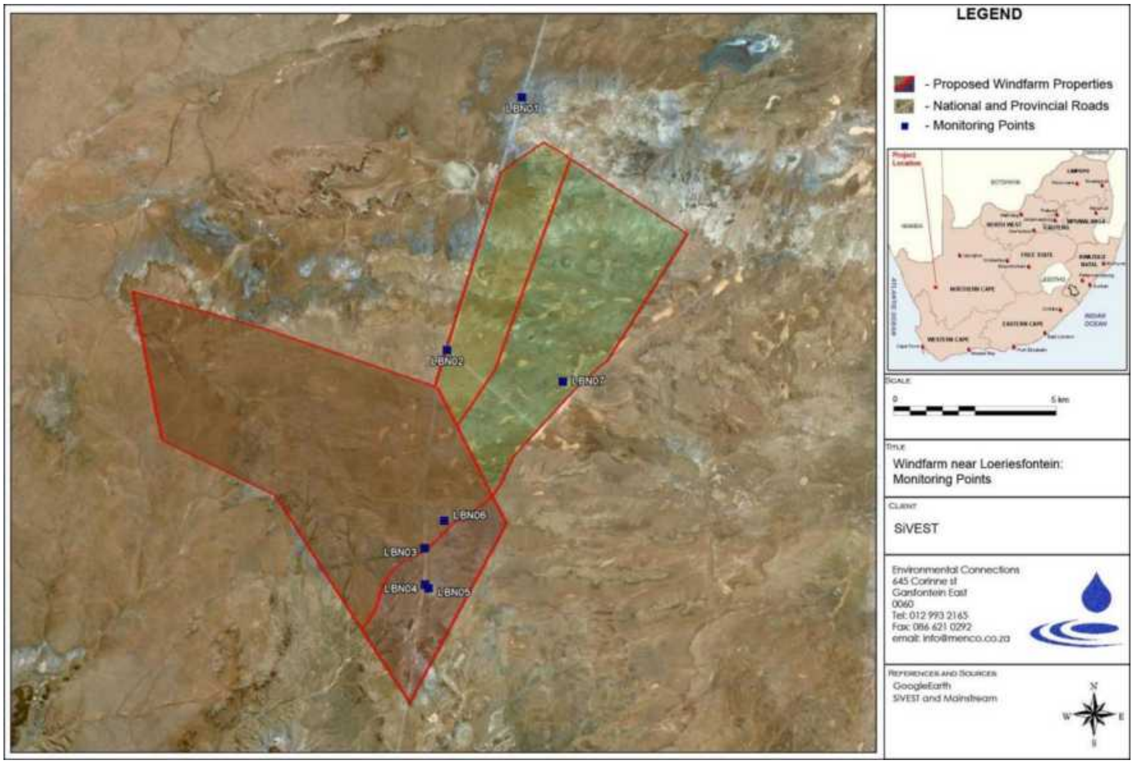


Figure 34: Monitoring points selected near the proposed facility (marked as blues squares)

The locations used to measure ambient (background) sound levels are presented in Figure 34. These points are considered sufficient to determine the ambient (background) sound levels in the area. The results are presented in Table 15 below.

Table 15: Results of ambient sound level monitoring (Datum type: WGS 84, Decimal Degrees)

Point name	Location, Latitude	Location, Longitude	$L_{Aeq,T}$ (dBA)	$L_{A, max}$ (dBA)	$L_{A, min}$ (dBA)	$L_{A, 90}$ (dBA)	Wind speed Ave. (m/s)
LBN01 (N)	-30.336740°	19.584582°	25.7	32.1	16.3	18.8	1.1
LBN02 (N)	-30.420516°	19.561455°	23.6	36.6	16.1	16.9	0.9
LBN03 (N)	-30.485515°	19.557087°	29.7	43.1	17	19.4	0.9
LBN04 (D)	-30.497410°	19.557970°	54.3	64.2	48.9	50.8	4.2
LBN05 (D)	-30.498541°	19.559391°	74.1	74.5	72.7	73.5	3.2
LBN06 (D)	-30.476170°	19.563890°	30.6	38.9	18.3	23.3	0.4

LBN07 (D)	-30.428747°	19.605808°	42.2	55.7	25.4	33.5	3.4
LBN07 (D)(T)	-30.428747°	19.605808°	51.3	61.2	28.4	33.1	3.2

Notes:

- The Sound Level Meter was fitted with the WS-03 all-weather windshield during times when the average wind speed exceeded 3 m/s
- (D) = Day, (N) = Night, (R) = Road, (T) = Train moving slowly through station
- The Rion Sound Level Meter NL 32 minimum limit is at 18 dBA.
- LBN05 taken approximately 1 meter from Transformer inside the substation perimeter.

During the period that measurements were collected sound levels in the area ranged from less than 18 dBA (L_{A90}) upwards, indicating that this area is very quiet (with no wind blowing and away from anthropogenic activities). All samples illustrate the rural character of the area during periods with light winds, with mainly natural sounds defining the acoustic character. The area is considered rural.

- Influence of wind on Ambient Sound Levels

Unfortunately, current local regulations and standards do not consider changing ambient (background) sound levels due to natural events, such as can be found near the coast or areas where wind-induced noises are prevalent. This is unfortunately unfeasible with wind energy facilities, as these facilities will only operate when the wind is blowing. It is therefore important that the impact of wind-induced noises be considered when determining the noise impact of such as a facility. However, care should be taken when taking this approach due to other factors that complicate noise propagation from wind turbines (see also section 10.6.2 of the main Noise report).

Figure 35 illustrates this situation where the sound pressure levels associated with wind action increase as wind speeds increase. The actual sound levels measured (mainly wind impacting on the background ambient sound levels) is also indicated in this figure (in Yellow and Light Blue).

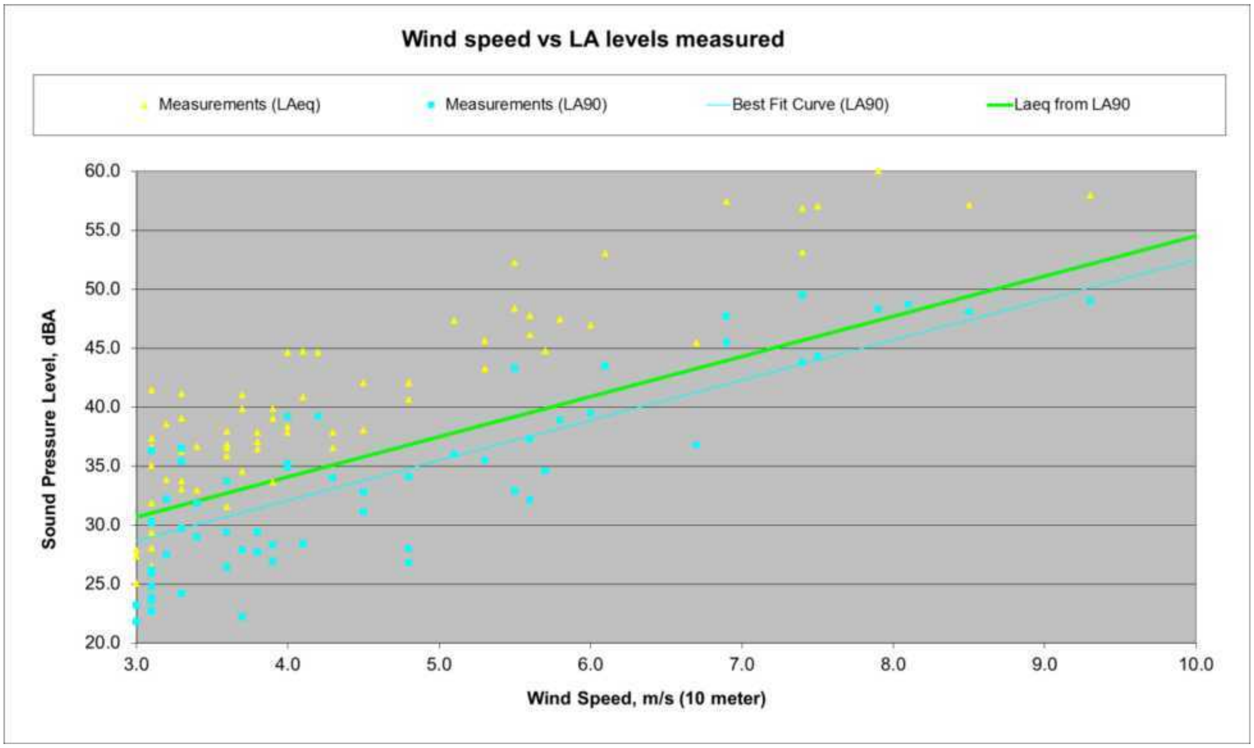


Figure 35: Ambient sound levels as wind speed increase

Due to the lack of an acceptable guideline in South Africa, the method proposed in the ETSU R97 (1996) will be adopted in this report. The curve developed is based on the noise measurements collected at a number of sites in South Africa. While these measurements are not site-specific, it relates to measurements collected in areas away from any anthropogenic noise sources, including measurements collected in areas considered semi-arid. It is presented to illustrate the concept that as wind speeds increase, ambient sound levels will also increase.

To develop appropriate ambient sound levels at various wind speeds, the best curve was fitted through the L_{A90} measurements (see also section 5.3.3 of the main Noise report).

It should be noted that most of these sound levels were measured at least 200 m away from any dwelling, and in most cases preferably more than 500 m[4]. In addition the points were selected to be away from structures (buildings, trees, etc.) that could significantly impact the ambient sound levels during periods when wind is blowing. During times when wind is blowing, ambient sound levels are generally higher near dwellings or other structures than at areas away from such structures. There is a number of factors that determine by how much ambient sound levels close to a dwelling might differ from the ambient sound level further away, including:

[4] It should be noted that this is different from the ETSU-R97 method, where the ambient sound measurements are conducted close to the dwelling of the potential noise-sensitive development. These measurement as such would be significantly (2 – 10 dBA) lower than if the measurements were to be collected next or close to a farm house.

- Whether there are any wind pumps close to the dwelling;
- Type of trees around dwelling (conifers vs. broad-leaved trees, habitat that it provides to birds/animals, food that it may provide to birds/animals);
- The number, type and distance between the dwelling (measuring point) and trees. This is especially relevant when the trees are directly against the house (where the branches can touch the roof);
- The material used in the construction of the dwelling;
- How well the dwelling was maintained; and
- What type and how many farm animals are in the vicinity of the dwelling.

8.11 Visual

The Visual Assessment was conducted by SiVEST and the detailed report is included in (Appendix 6F).

8.11.1 Visual characteristics of the study area

- Physical Landscape Characteristics

As part of the visual characterisation, the physical landscape characteristics are described in terms the prevailing topography, vegetation cover and land use in the study area.

  - Topography

The topography in the immediate vicinity of the site proposed for the wind farm is characterised by a flat to gently undulating landscape (typical of much of the Karoo). In the wider area, the Klein and Groot Rooiberg and Leeuberg koppies form an area of localised hilly topography to the south and south-west of the site. Immediately north of the site the presence of a number of large pans signals that the topography is very flat and thus very poorly drained (Figure 36).

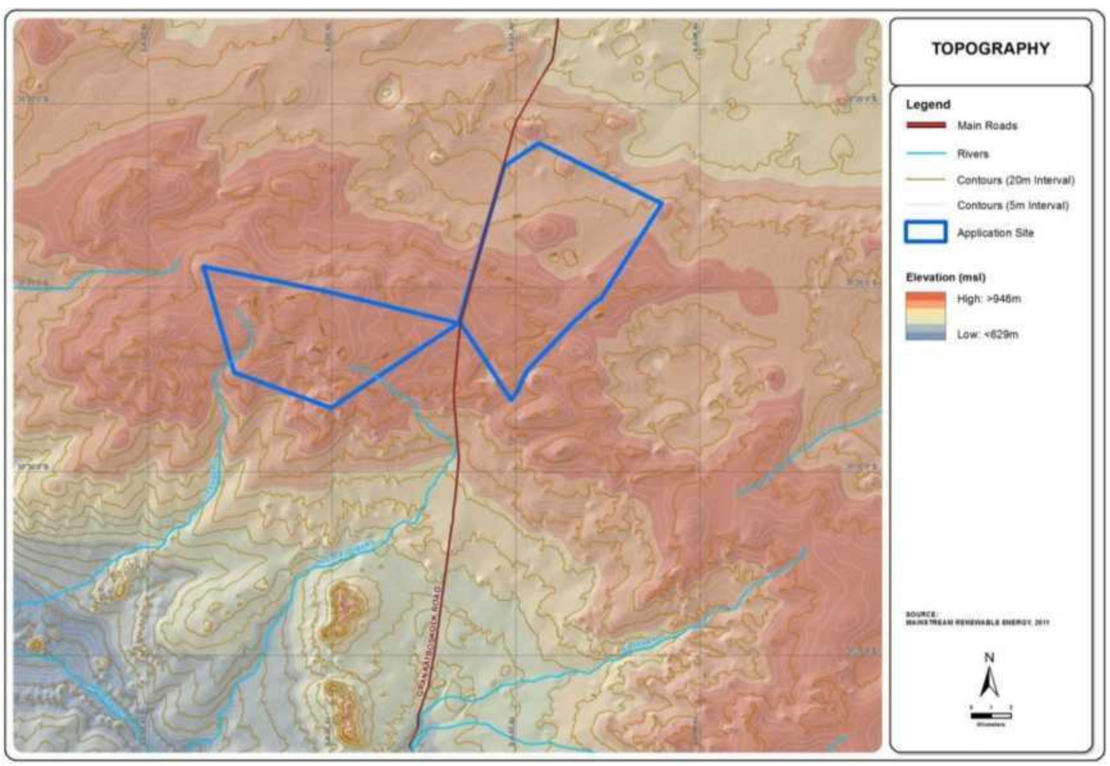


Figure 36: Topography within the study area

i. Visual Implications:

The flat terrain that occurs over most of the site results in generally wide-ranging vistas throughout the study area, and the horizon is usually visible across an entire 360^{o}arc of the viewer. The only exception to this flat topography is the range of hills located to the south and south-west of the site, which will constrain the viewshed. Bearing in mind that the wind turbines are very large structures (over 120m in height when the rotor blades are taken into account), these could be visible from a very wide radius around the site, except from areas to the south and south-west of the site where hills will shield the proposed development. Thus there would be very little shielding to lessen the impact of the wind turbines from any locally-occurring receptor locations.

- Vegetation

The site is covered by natural short Bushmanland Basin Shrubland. Due to the aridity of the area the vegetation consists of low shrubs around 30-40 cm in height, distributed uniformly across the landscape, except in areas of disturbance where patches of bare earth occur. In certain areas, man has had an impact on the natural vegetation, especially around farmsteads, where over many years tall exotic trees and other typical garden vegetation have been established.

i. Visual Implications:

The natural short vegetation cover will offer no visual screening. Tall exotic trees may effectively screen the proposed development from farmhouses, where these trees occur in close proximity to the farmhouse and are located directly in the way of views to the site (Figure 37).

Figure 37: View toward the proposed site from a farmhouse (Van der Westhuizen) in Klein Rooiberg. Exotic trees will block out views of the development site from the front porch.

- Land Use

The land use in the wider study area is classified natural or undeveloped as sheep farming dominates the area and the sheep graze on natural vegetation (Figure 38). Activities related to gypsum mining occur along the railway which makes up a part of the site. The nature of the arid climate entails that stocking densities for the sheep are low which has resulted in the properties being relatively large across the area. Therefore the area is very sparsely populated, and thus little human-related infrastructure exists. Some infrastructure exists in the vicinity of the site in the form of gravel access roads, a railway that runs along a part of the eastern boundary of the site (the railway linking Sishen with Saldanha Bay), and associated railway works warehousing and offices. An electricity transmission substation (Helios Substation) exists to the south of the site, as well as power lines that run to and from this. A very tall microwave tower (communication tower) is also located on the site of the proposed wind farm.

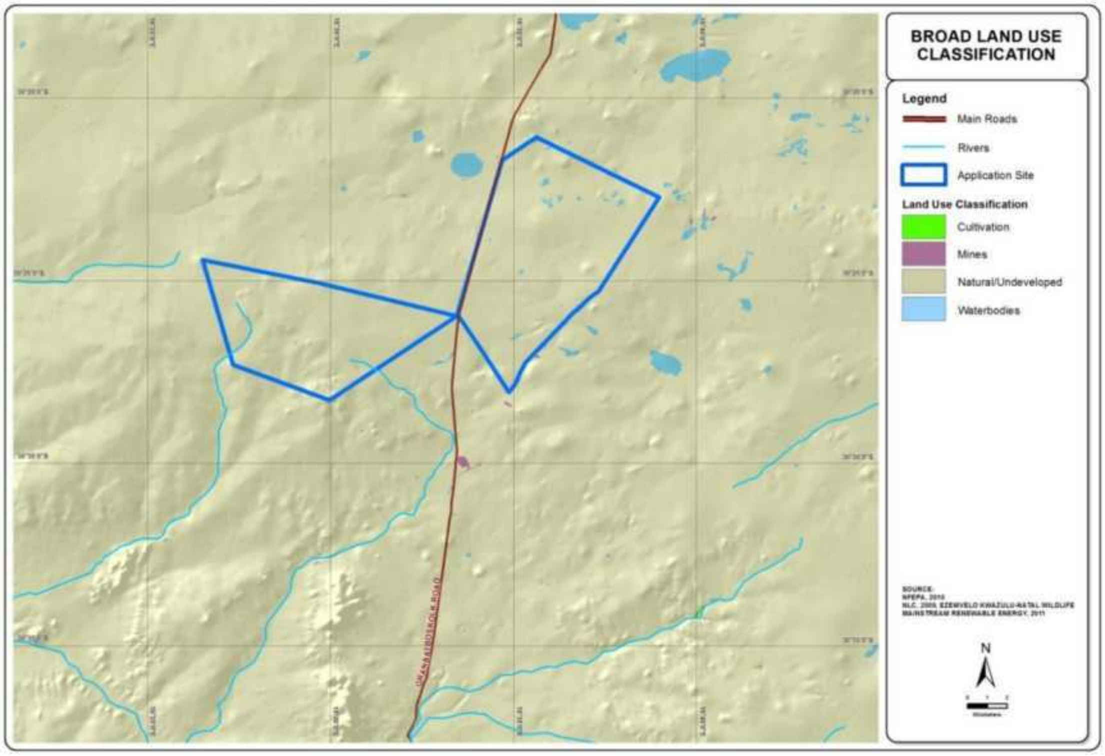


Figure 38: Map showing land use within the study area

Except for two farmhouses the site of the proposed development is mostly vacant. The surrounding area is largely uninhabited and the closest built up area is the small town of Loeriesfontein approximately 60km to the south of the site.

i. Visual Implications

The generally lack of human habitation and associated human infrastructure, has an obvious impact on the sense of place and thus giving the area a largely natural, rural feel.

- Visual Character

The above physical landscape characteristics as well as the presence of built infrastructure influences the visual character of the study area. Visual character is defined based on the level of transformation from a completely natural setting (little evidence of human transformation), with varying degrees of transformation engendering different visual characteristics.

Most of the study area is considered to have a natural (almost vacant) visual character as natural shrub land prevails throughout the site and there is minimal human habitation and associated infrastructural footprint (Figure 39). In addition the predominant land use (sheep farming) has not transformed the natural landscape and the area has thus largely retained its rural natural character. As mentioned above, built infrastructure within the proposed site is limited to isolated farmhouses, gravel farm roads, the railway line, some electrical infrastructure, farm boundary fences and a microwave (telecommunications) tower.

Figure 39: Typical natural visual character in the study area

The greater area surrounding the proposed development site is an important component when assessing visual character. The area can be considered to be typical of a Karoo or “platteland” landscape that would characteristically be encountered across the high-lying dry western and central interior of South Africa. Much of South Africa’s dry Karoo interior consists of wide open, uninhabited spaces sparsely punctuated by widely scattered farmsteads and small towns. Traditionally the Karoo has been seen by many as a dull, lifeless part of the country that was to be crossed as quickly as possible on route between the major inland centres and the Cape coast, or between the Cape and Namibia. However, in the last couple of decades this has been changing, with the launching of tourism routes within the Karoo, and the promotion of tourism in this little visited, but large part of South Africa. In a context of increasing urbanisation in South Africa’s major centres, the Karoo is being marketed as an undisturbed getaway, especially as a stop on a longer journey from the northern parts of South Africa to the Western and Eastern Cape coasts. Examples of this may be found in the relatively recently published “Getaway Guide to Karoo, Namaqualand and Kalahari” (Moseley and Naude-Moseley, 2008). The exposure of the Karoo in the national press during 2011, as part of the debate around the potential for fracking (hydraulic fracturing) mining activities, has brought the natural resources, land use and lifestyle of the Karoo into sharp focus. Many potential objectors stress the need to preserve the environment of the Karoo, as well as preserve the ‘Karoo Way of Life’, i.e. the stock farming practices which are highly dependent on the use of abstracted ground water (e.g. refer to the Treasure Karoo Action Group website http://treasurethekaroo.co.za/).

Typical Karoo landscape can be considered a valuable ‘cultural landscape’ in the South African context. Although the cultural landscape concept is relatively new, it is becoming an increasingly important concept in terms of the preservation and management of rural and urban settings across the world (Breedlove, 2002).

Cultural Landscapes can fall into three categories (according to the Committee's Operational Guidelines):

i. "a landscape designed and created intentionally by man";
ii. an "organically evolved landscape" which may be a "relict (or fossil) landscape" or a "continuing landscape";
iii. an "associative cultural landscape" which may be valued because of the "religious, artistic or cultural associations of the natural element"

The typical Karoo landscape consisting of wide open plains, and isolated relief, interspersed with isolated farmsteads, windmills and stock holding pens, is an important part of the cultural matrix of the South African environment. The Karoo farmstead is an important representation of how the harsh arid nature of the environment in this part of the country has shaped the predominant land use and economic activity practiced in the area, as well as the patterns of human habitation and interaction. The presence of small Karoo towns, such as Loeriesfontein, engulfed by an otherwise rural environment, form an integral part of the wider Karoo landscape. As such, the Karoo landscape as it exists today has value as a cultural landscape in the South African context. In the context of the types of cultural landscape listed above, the Karoo cultural landscape would fall into the second category, that of an organically evolved, “continuing” landscape.

The study area, as visible to the viewer, represents a typical Karoo cultural landscape. This is important in the context of potential visual impacts associated with the proposed development of a wind farm as introducing this type of development could be considered to be a degrading factor in the context of the natural Karoo character of the study area, as discussed further below.

- Visual Absorption Capacity

The visual absorption capacity (VAC) of an area / landscape refers to the ability of the area / landscape to absorb the development without any noticeable intrusion or change to the visual character of the area. It is measured on a scale from high (an area which has a high capacity to absorb the development) to low (an area in which a development would be highly visible). It is a function of topography, land use and land cover, with urban areas having a high VAC and natural areas having a low VAC.

As discussed above, the study area has a natural largely uninhabited visual character typical of a Karoo landscape. In addition the vegetation cover on the site is short in comparison to other types of natural vegetation (e.g. thornveld or savannah where trees and shrubs are present) and will not impede views toward the renewable energy facility. The visual environment will therefore be characterised by wide open views, due to the mostly flat topography and limited height of the natural vegetation cover. Based on these characteristics, majority of the study area could be assigned a low VAC value, as the wind turbines would be highly visible and incongruous within this setting.

- Visual Sensitivity of the Study Area

Visual Sensitivity is expressed as the sensitivity of an area to a proposed development and the degree to which it is perceived as a visual impact by receptors. It is based on the, VAC, presence of existing infrastructure and visual character in an area, but also relates to the spatial distribution of potential receptors and likely value judgement of these receptors based on the perceived aesthetic appeal of an area. It is categorised as **high** (visually intrusive, negatively perceived by receptors), **moderate** (receptors present, limited negative perception) or **low** (little opposition, not negatively perceived).

The table below explores in more detail the inputs into categories of visual sensitivity:

Table 16: Environmental factors used to define visual sensitivity classes

Visual Sensitivity Category	Visual Absorption Capacity	Presence and size of Existing Infrastructure	Presence of Sensitive Receptors	Visual Character	Other factors influencing visual sensitivity
High	Low	Absent or at very low densities	Present	-Natural / largely natural -Rural / pastoral	- Areas of natural vegetation (conserved) -Practice of economic activities (esp. tourism) which place value on the scenic / beauty character of the area
Moderate	Moderate	Present – not high densities	Present	-Rural / pastoral -Urban	
Low	High	Present – high	Mostly	-Urban	

		densities, often a very large or tall	absent	-Industrial	

As described above, the visual character of the study area is largely associated with the natural and rural characteristics of the area. Within this context, an important factor contributing to the visual sensitivity of the area is the presence, or absence of visual receptors that may value the aesthetic quality of the landscape. As described below, very few potentially sensitive receptors are present in the study area. Although no formal protected areas or leisure / nature-based tourism activities exist within the study area, the context of the study area as a rural area with a relatively low density of human change and influence in the landscape provides the landscape with a moderate level of visual sensitivity. The low density of human infrastructure and low VAC further contribute to the visual sensitivity of the landscape. As such, the potential visual impact of the proposed wind farm on the visual environment in this context should be examined.

- Visually Sensitive Areas on the Site

During the EIR phase, all specialist consultants were requested by the Environmental Assessment Practitioner (EAP) to indicate environmentally-sensitive areas within the development site related to their specific field of speciality. This exercise was undertaken to allow a GIS-based spatial analysis of sensitive parts of the site to be undertaken to assist with designing the layout for the turbines.

Only two potentially sensitive receptors are located within the development site. In order to reduce the direct visual impacts of the proposed turbines (especially those related to shadow flicker), a buffer of 500m was recommended around these two potentially sensitive receptors located on the development site. These buffers should be treated as exclusion zones in which no infrastructure, in particular turbines, should be allowed to be developed.

An assessment was also undertaken to determine those parts of the site where the locating of turbines or other infrastructure would be associated with the greatest visual impacts on surrounding area. This assessment revealed that, the relative uniform nature of the flat terrain and short vegetation throughout the site would result in the turbines imposing a typically similar visual impact on the surrounding area from all parts of the site. As such, other than the 500m buffer areas around the houses, no other areas within the development site are regarded as visually sensitive areas that should be avoided.

8.12 Heritage

The Heritage Assessment was conducted by Dr. Johnny Van Schalkwyk and the detailed report is included in (Appendix 6I).

8.12.1 Regional overview

This is a rural landscape where sheep farming dominates. For large sections of the region even this is not a permanent type of settlement, as many farmers move their live-stock to different regions (Loeriesfontein) for a couple of months (July to December) every year. It was only with the drilling of bore holes that the possibility of permanent settlement became a reality.

- Stone Age

Information on occupation of the larger region in general and the Stone Age specifically, is very limited. This is probably the result of the fact that no systematic survey or studies has been done in the region.

In open country it is suggested that the most likely places for sites would be close to water points that predate the colonial period. Another potential for archaeological site concentration would be outcrops of raw material used in stone tool production. In mountain areas, rock shelters and caves would be where rock art is found.

It seems as if finds of Early Stone Age material this far to the west is very limited and no report of any such finds in the region of the study area could be found.

Similarly, information on settlement during the Middle Stone Age time is very limited. With regards to the Middle Stone Age, a few such tools and flakes were found. These were mostly of hornfels, although some are of indurated shale. All were found at the foot of a number of hills/outcrops in the southern section of the study area.

Occupation of the region seems to have increased during the Later Stone Age (LSA). This is probably the result of an interface between a foraging presence and a pastoralist occupation of the region. However, the latter subsistence regime would only have been possible in a situation of increased open water available for live-stock, a fact that would need much more background research to be confirmed.

According to local land owners stone tools are most commonly found in the following places:

- On the rims of fresh water pans or stream beds where water might remain for some time during the rainy season.

- Amongst some of the red sand dunes, where small pans are likely to develop during the rainy season.
- At the base of some of the dolerite hills/outcrops in the southern region.

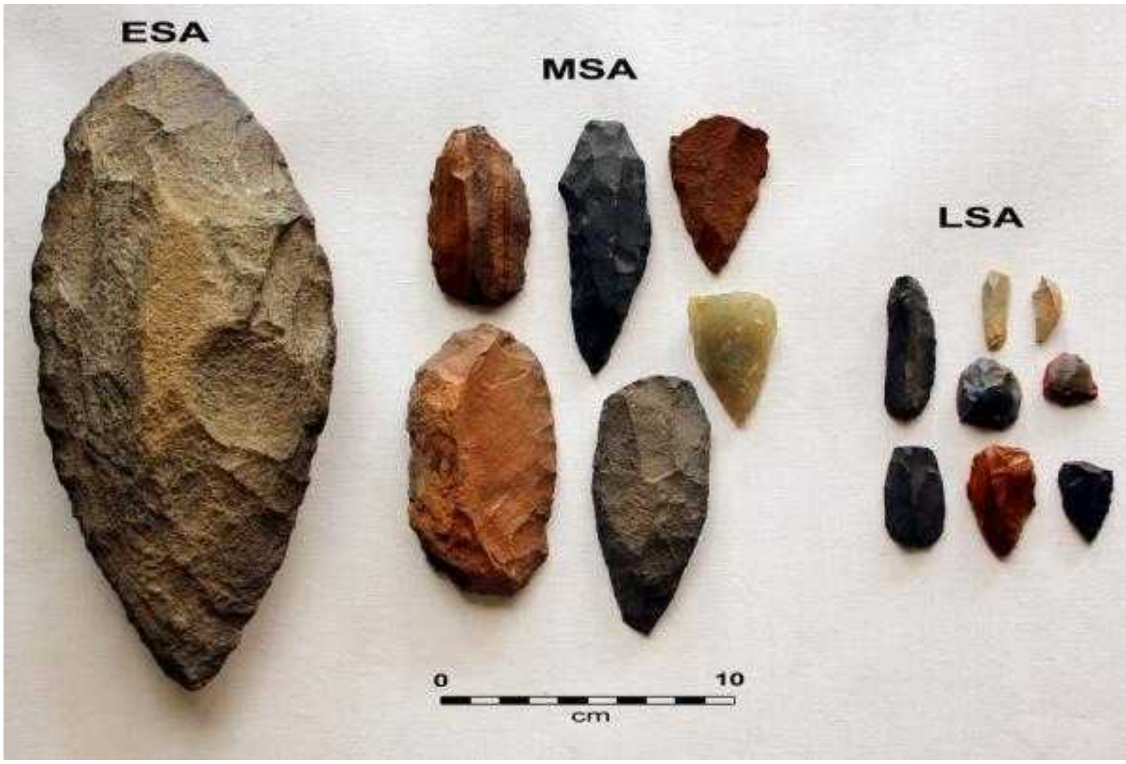


Figure 40: Typical stone tools (These stone tools are not from the region and are only used to illustrate the difference between Early (left), Middle (middle) and Later Stone Age (right) technology).

By the early 19th century some Dutch speaking trekboers moved into the region, grazing their stock. As they depended on water for their live-stock, these farmers would have stuck close to available water sources and it was only during the wetter parts of the rain season that they might have accessed other areas for short periods of time. Even today, people migrate with their stock on a seasonal basis, moving between winter and summer grazing. In the past this was done by following the sheep by means of wagons and donkey carts, but in recent times this is done by means of trucks.


Figure 41: Examples of farmsteads and farming related features (sheep dip) in the region.


Figure 42: An isolated grave and a monument on the southern section of the farm Sous

An investigation of the Title Deeds of most of the farms under consideration indicated that they were surveyed during the latter part of the nineteenth century, implying that they would have been occupied since then. Both the farms Sous and Aan de Karree Dorn Pan were first surveyed in 1898.

Due to the sparse population, infrastructural development in this part of the world has always been low. The roads are gravel and graded occasionally. As there are no major rivers, river crossings remained informal.

The one industrial activity that is practiced in the region on a commercial basis is the extraction of salt from the various pans in the region. The manner in which the salt is extracted requires a low level technology, with the result that even if it has taken place over a long period of time at any given place, few structures or features are associated with it.

It is probable that the salt pans were exploited in pre-colonial times for obtaining of salt, but this would have been on a very low level of activity. It was only with the more permanent settlement of farmers in the region since the early twentieth century that the salt was exploited on a commercial basis.

Figure 43: Typical salt works in the larger region.

8.13 Social Environment

The Socio economic Assessment was conducted by Nonka Byker of MasterQ and the detailed report is included in (Appendix 6J).

8.13.1 Geographical Processes

Geographical processes relate to the land use patterns and established and planned infrastructural developments in an area. Land use is defined as “the human modification of the natural environment or wilderness into a built environment such as fields, pastures, and settlements.” This subsection therefore describes the current and future land use in the project area (baseline profile).

The Hantam Local Municipality (HLM) is located in the Northern Cape Province and forms part of the Namakwa District Municipality (NDM), the only one in The Northern Cape to have access to a coastline. Other Local Municipalities (LMs) in the District are Nama Khoi; Khâi-Ma; Kamiesberg; Karoo Hoogland; Richtersveld; and Namaqualand.

The HLM is bordered in the South and South-West by The Western Cape Province, in the West by The Kamiesberg LM, in the North by the Khâi-Ma LM and Siyanda District, and in the East by both The Pixley ka Seme District and The Karoo Hoogland LM. The LM is large, taking up an area of approximately 27,968 km^2 (22% of the area of the district) and is comprised of 5 respective municipal wards.

According to the Hantam Municipality's Integrated Development Plan (IDP), none of the towns within the municipality's area of jurisdiction have official town planning schemes and therefore planning is mostly done on an ad-hoc basis.

At approximately 50km south, Loeriesfontein is the closest town to the proposed site. According to the IDP, the area in the south-western quadrant of the town has been earmarked for housing development. However, much of the area is characterised by rocky outcrops with steep slopes, which makes it unsuitable for further development.

Businesses are found in the eastern quadrant of the town. To the west of town there are also businesses, but these are less ordered and more widely dispersed throughout the area. Land is quite readily available for agricultural purposes, but should be substituted with "summer land" to ensure that the land is suitable for grazing throughout the year. The possibility of mining lime in the area is currently being investigated.

The District itself compiled a State of the District Profile Report that identified several issues and challenges. These included:

- The effective maintenance of existing infrastructure;
- Minimising existing infrastructural backlogs;
- Developing additional water sources;
- Increased investment for the maintenance of roads in order to capitalise on the economic benefits that tourism and agriculture offered;
- Increased investment in development projects that were in line with the IDP, the NCPGDS and the NSDP;
- The effective use of resources to assist in development;
- Improving intergovernmental cooperation to ensure that common goals and targets were achieved; and
- Developing human potential within the district in an effort to retain the economically active population within the district.

The sites that are proposed for the wind farm near Loeriesfontein are located on the following farms:

- Remainder of the Farm No. 226, Calvinia Road, Northern Cape;

- Portion 1 of the Farm No. 213, Calvinia Road, Northern Cape;
- Portion 2 of the Farm No. 213, Calvinia Road, Northern Cape.

On-site there are 5 structures (located in the vicinity of the red circles), a train station (for industrial goods), two borrow pits and an existing power line. All the structures are located on Portions 1 and 2 of the Farm 213. The Remainder of Farm 226 is void of any structures. The on-site sensitivity is reflected in Figure 44 below. However, it should be noted that although these structures have been marked as sensitive, the land will be leased from the landowner(s) and therefore they will be either in agreement with the wind turbines in close proximity to their houses or to vacate their houses. The existing power line is required to tap into the Eskom network.

Figure 44: On-site Sensitivity

A contentious point is the gravel road that passes between the two sites that also leads to the gypsum mine further north of the site. The road will serve as a very good access road to the site, but is already used by heavy vehicles travelling up and down to the mine. During a focus group meeting with the Loeriesfontein Agricultural Union held on 21 October 2011, local farmers complained about the state of the road, especially in terms of the amount of dust created by heavy vehicles travelling up and down the road and litter that is thrown out the truck windows. It is therefore important that the state of the road would have to be upgraded and maintained to minimise dust population – this might be done in cooperation with the gypsum mine.

8.13.2 Demographical Processes

Demographical processes relate to the number of people and the composition of a community. This includes an overview of the population size, the race, age, gender and educational profile of a population as well as household compositions.

Unless otherwise stated, the baseline social profile was compiled based on data obtained from Census 2001 and the more recent Community Survey (CS) 2007. It is important for readers to note that CS data does not replace Census data, but that the CS merely attempted to adjust measurements to a best estimate. In this regard, Statistics South Africa stated the following: *"Any adjustment done (*in CS 2007) *has maintained the profiling of the community in terms of the people and households while compensating and correcting the undercounted bias by different projections on national, provincial and municipalities level* (Statistics SA, 2007)*."* Therefore, please bear in mind that the following data should only be viewed as indicative of the broad demographical trends within the area and not as a rigid representation of the area.

- Population size and growth

The Statistics South Africa Census of 2001 (Census 2001) estimated the population of the Hantam Local Municipality (HLM) at 19 813 persons. The Community Survey of 2007 (CS 2007) estimated that population to be a total of 21 235 persons 6 years later, making up about 18% of the district population. This represents an average annual population increase of around 237 persons per year or 1.12% annually. Table 17 below provides a summary of the population size and also provides a 2011 estimate based on continued growth of 1.12% annually.

Table 17: Population growth in HLM at 1.12% annually

Year/Study	**Population Size**
Census 2001	19 813
CS 2007	21 235
Estimate – 2011	22 183

Regarding the respective centres with the HLM, only 28% of its population is rural, with 42% of the population residing in Calvinia and the remainder in Loeriesfontein, Brandvlei, and Niewoudtville according to a local government skills audit (Kitchin & Ovens; 2005). The HLM has a population density of 1.32 persons per km^2.

- Race and Gender

The proportion of males to females shows little difference in the HLM with marginally more females in 2001 (48.1% male; 51.9% female), and a slight magnification of this by 2007 with

47.9% of the population being male and 52.1% of the population being female. Overall, gender distributions have remained relatively stable.

With regards to the age of the population, Figure 45 and Figure 46 show distributions for males and females, juxtaposing 2001 graphical data with that from 2007:

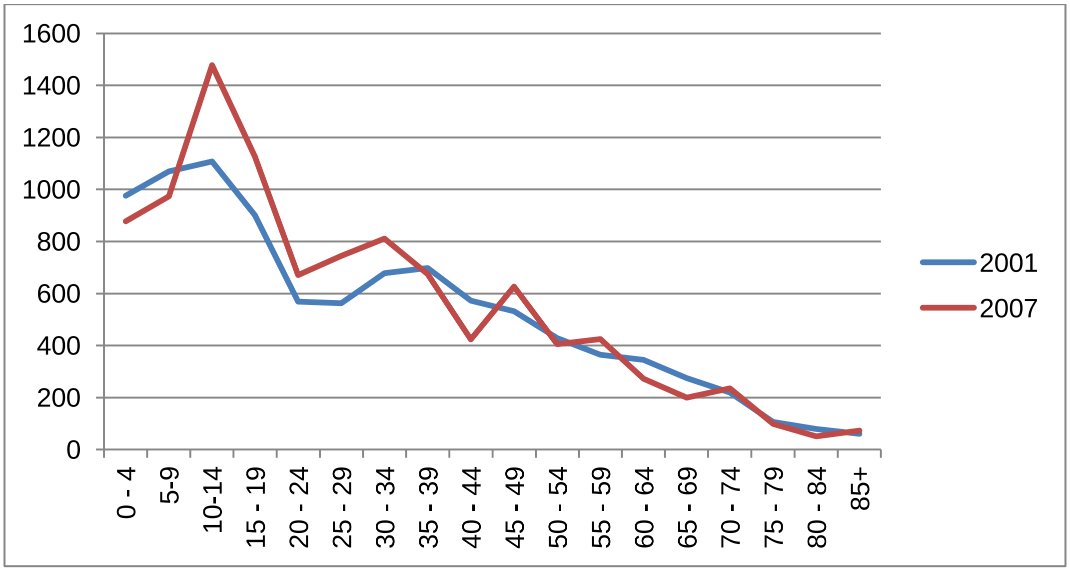


Figure 45: Age distribution for males in HLM by numbers (Source: Stats SA 2001 & CS 2007)

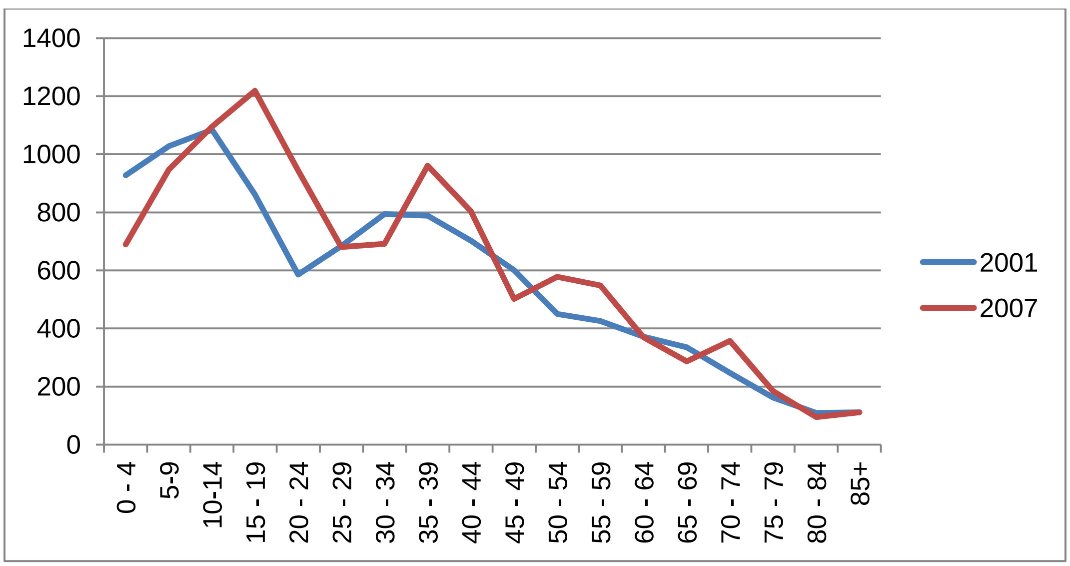


Figure 46: Age distribution for females in HLM by numbers (Source: Stats SA 2001 & CS 2007)

In both of the graphs above it is evident that there is a spike in individuals aged approximately 10 to 19 (particularly in the 2007 sample), indicating a rise in births between the years 2001 to 2007 for this population and a decline thereafter. Statistics South Africa considers those aged 15 to 65 to be of working age; in this instance it is shown that there are more working age females than males in the HLM.

Overall, it is shown that a good 64% of the population is of working age. On the other hand, this can also be a burden in many developing nations (and provinces and municipalities) as it indicates the need to provide employment for almost two thirds of the entire population of the LM.

The racial composition of the HLM, according to the CS 2007, is predominantly made up by the Coloured racial group, comprising around 87.3% of the entire population, followed by Whites at 11%, and then Black Africans and Indian/Asians at 0.8% respectively.

Table 18: Racial breakdown in the HLM according to CS 2007

Race	**Proportion of Population**
Black/African n=181	0.8%
Coloured n=18 533	87.3%
Indian/Asian n=173	0.8%
White n=2 348	11%

Racial compositional changes have altered considering the number of persons represented by a percentage point and the short space of time in question. From 2001 to 2007, the following changes can be observed:

- The Black African population decreased by 0.5%;
- The Coloured population increased by 4.3%;
- The Indian/Asian population increased by 0.7%; and
- The White population decreased by 5%.

This would indicate that the Coloured population is not only dominant, but that it is continuing to grow while other racial groups (Black & White) are declining in number in the region. Only the Indian/Asian population showed increases in their number, but these were very small.

8.13.3 Economic Processes

Information below on the regional and local economic sectors was sourced from the Namakwa District Municipality (NDM), Hantam Local Municipality (HLM) and Statistics South Africa (Stats SA).

The Northern Cape is comparatively sparsely populated as a province, which usually translates into low economic output when compared to population centres. Gross Domestic Product figures support this notion and the Northern Cape contributed only 2.3% of national GDP in 2008 (StatsSA, 2009). This contribution is in turn dominated by the mining industry which contributes 27% of the total Gross Geographic Product (GGP) of the province of R52 billion. The contribution of mining to GGP in the province fluctuated in the period 1995-2008 with a low of 19% in 1996 and a high of 28.9% in 2002. Trade/hospitality, financial/business services and government are other sectors of importance, contributing between 11% and 13% each. These contributions have remained fairly stable throughout the period 1995 to 2008.

Historically economic growth in the province has usually been lower than national growth figures and this occurred again in 2008 when the provincial GGP growth was 2.1% compared to the South African GDP growth of 3.7%. The industry contributions to the regional economy of the Namakwa DM area are reflected below:

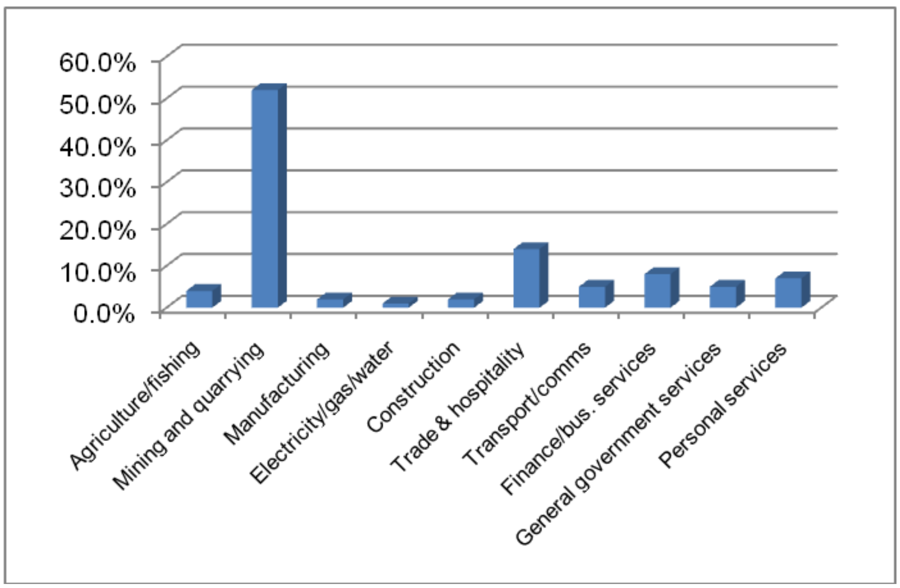


Figure 47: Contributions of different industries to the Namakwa DM GGP (Namakwa DM, 2009)

The Namakwa DM area contains a historically important mining node in the province, namely the area surrounding the town of Springbok, and the mining industry has been one of the main productive forces in the NDM area. The NDM LED plan (Urban Econ, 2009) indicates that mining continues to dominate the economic landscape in that area with a contribution of 52%. In general it appears that the NDM area is not economically diversified and therefore more prone to economic shocks in its key industries, especially the mining industry. This happened in 2008 during the global economic crisis, when the economy was adversely affected to a significant degree due to a number of mining operations closing down temporarily in the Springbok area (Urban Econ, 2009).

The Local Economic Development (LED) documentation for the NDM area indicates that distance from markets and a lack of infrastructure represent the biggest challenges to development as these factors limit the ability of businesses to access major markets in a cost effective manner. Furthermore, the NDM area and the Northern Cape Province is currently experiencing a population decline, putting a severe constraint on available local skills for growth and development.

According to the above documentation the economic development strategies and future target areas of the NDM area focuses on the development, diversification and stabilization of the regional economy by:

- Developing and supporting agriculture that will increase autonomy of local communities and better food security in each region, especially in the case of land obtained by previously disadvantaged communities or individuals.
- Developing the tourism industry and maximising tourism resources, especially in light of their non-expendable nature if well managed. Three areas of strong potential that have been identified are mining or history-related tourism, eco-tourism and adventure tourism.
- Encouraging local skills development initiatives to support the above economic interventions, including the development of new local institutions of learning that can supply the skills needed specifically in that region.
- Encouraging entrepreneurial endeavours in line with the opportunities above and providing support, advice and funding where possible.
- Maintaining and expanding infrastructure to ensure better access to the respective regions.
- Promoting projects for which a sparsely populated area with an arid climate would be an advantage. Examples would be the square-kilometre telescope array, solar energy and wilderness tourism.

This is in line with development plans in other regions in the province as the strengths and opportunities across the Northern Cape are similar.

The project will contribute to local economic progress by supporting industry development in line with provincial and regional goals and ensuring advanced skills are drawn to the Northern Cape. The project will likely encounter widespread support from government, civil society and businesses, all of whom see potential opportunities for revenues, employment and business opportunities locally.

- Local Employment

Employment levels in the district were substantially better than the province, probably due to exported unemployment and conversely imported labour for the mining industry. These workers would then return to their home areas if employment levels declined in the district. High local level employment is probably due to a small population largely employed in the agricultural sector.

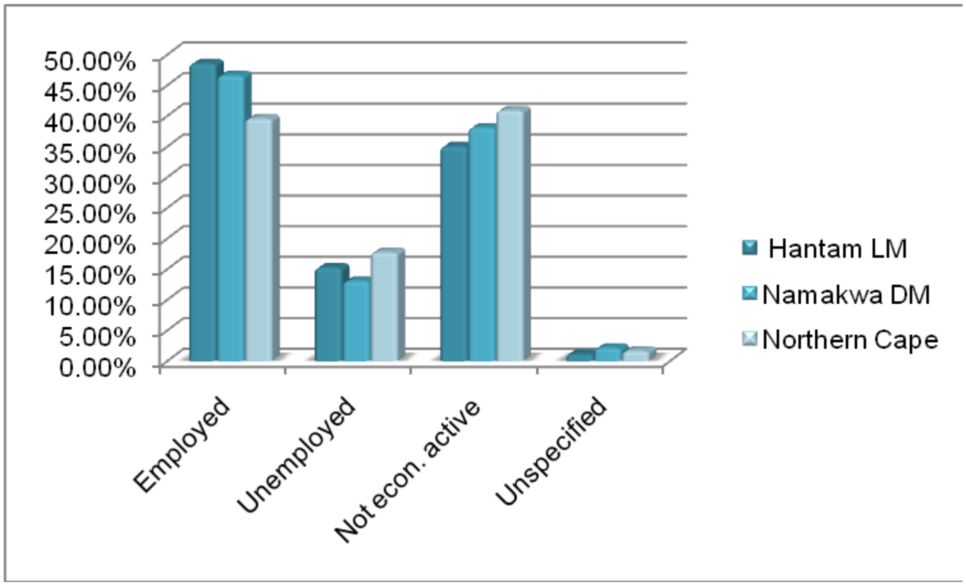


Figure 48: Regional and local employment amongst those aged 15 to 65

High labour import from other areas is likely due to a small population with good local employment prospects. The project will provide some employment relief, depending on the hiring practices used during the project and the extent to which local employment is prioritised. Training and development measures may be needed to increase labour participation.

- Regional and Local Income Profile

The local income figures are noticeably better when compared to those of the province, possibly due to better employment levels. There is a notable difference in the percentage of individuals locally receiving a small income (R1-R800 per month) which may be attributed to seasonal work in the agricultural industry.

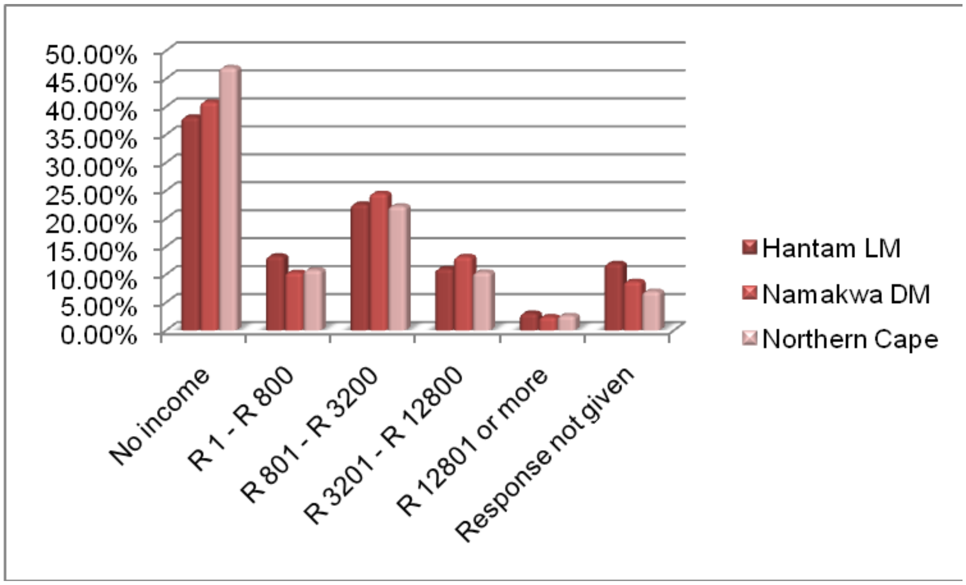


Figure 49: Regional and local monthly income amongst those aged 15 to 65

There may be wide local interest in the project as many will see it as an opportunity to secure better sources of income. The project will probably increase the number of local residents in all income categories during construction, and the number of residents in higher income categories (R3200 and above), during the operations phase.

8.13.4 Institutional and Legal Processes

Institutional and Legal processes refer to the role and efficiency of the local authority and other service providers in the area in terms of their capacity to deliver a quality and uninterrupted service to local communities.

The following section engages in disseminating information pertaining to housing and the status of households within HLM, as well as other municipal infrastructure such as services, crime rates, etc.

The specific focus is on Hantam Local Municipality with occasional contextual reference to the district and the province. The Namakwa District in its IDP (2007-2011) identified, as one of its 'over-arching' challenges, the improvement of service delivery in terms of water, housing, sanitation and electricity. The IDP listed certain 'critical actions' in this regard which included the following:

- To plan and improve the bulk water supply to certain municipalities (one being Hantam);

- To unblock housing projects and address existing housing backlogs;
- To eradicate the bucket system by the end of 2007; and
- Upgrading and maintenance of existing municipal infrastructure

- Housing & Household Status

In 2001 there were a total of 5 490 households in the HLM, while in 2007 this figure had increased by 330 households (or approximately 55 households a year) to 5 820. If this increase is to remain stable then one could expect the number of households in 2011 to be around 6 040. Table 19 below indicates the number of households in 2001 and 2007, the annual average increase in household numbers and an approximate 2011 projection for The Northern Cape Province, Namakwa District Municipality, and Hantam Local Municipality respectively.

Table 19: Regional Household Numbers – Province, District and Municipality

NUMBER OF HOUSEHOLDS				
Area	**Stats SA 2001**	**CS 2007**	**Average annual change**	**2011 projection**
Northern Cape	259 632	264 658	+838 Households	268 010
Namakwa District	30 601	36 438	+973 Households	40 330
Hantam LM	5 490	5 820	+55 households	6 040

The nature of these households, that is whether they are formal or informal dwellings, is shown by Figure 50 below, which shows data from 2001 and 2007:

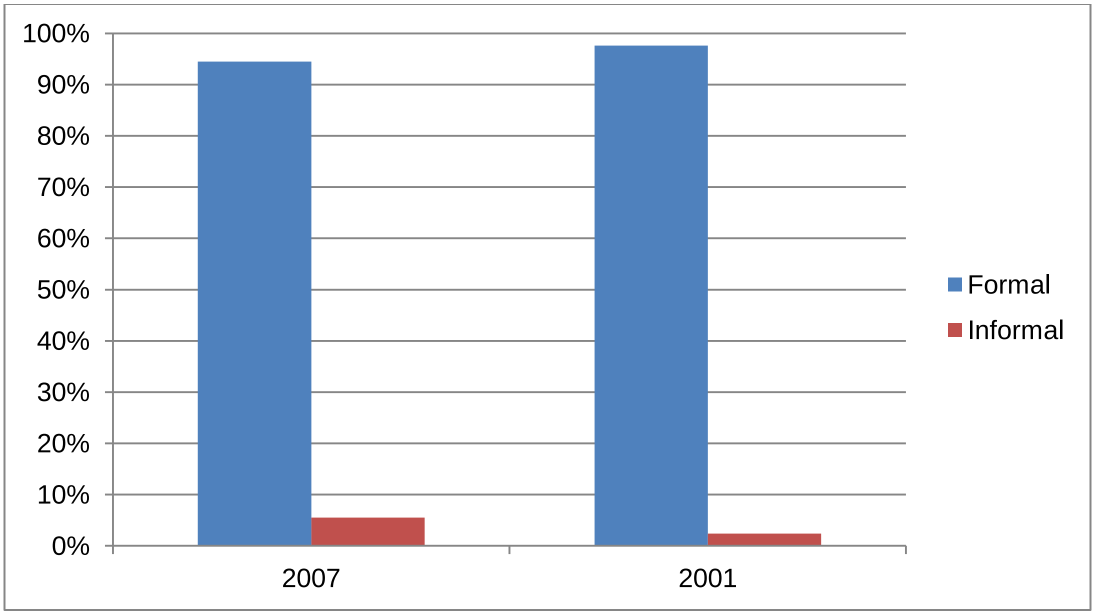


Figure 50: Proportion of formal to informal dwellings in HLM in 2001 and 2007 (Source: CS 2007)

There were a very low proportion of households living in informal dwellings in the municipality in 2007. In addition, there were more informal households, proportionally, in 2007 than 2001. The increase in informal dwellings can point to an existing influx of people to the area.

- Water and Sanitation

While this section will focus almost exclusively on access to water and sanitation facilities, it must be mentioned upfront that the HLM is situated in an arid region in which water supply is a constant source of concern. Currently the Department of Water Affairs (DWA) backs the 'Blue Drop Project' in which an analysis of the drinking water quality of various regions of the country is assessed according to several criteria. Such a system is of great value for monitoring and evaluation purposes. The latest scorecard available is from 2010 and assessed criteria involved the following: water safety plan; process control and maintenance quality; efficiency of monitoring programme; credibility of sample analyses; data submission to the DWA; compliance with national standards; failure response management; responsible publication of performance; and efficacy of asset management. HLM received a total score of 68.5% which was far above the district average of 38.1%.

Overall, and according to RDP standard (that all citizens should have access to piped water no further than 200m from the dwelling), only 5.9% of the population had access services below RDP standard in 2001 (Figure 51)

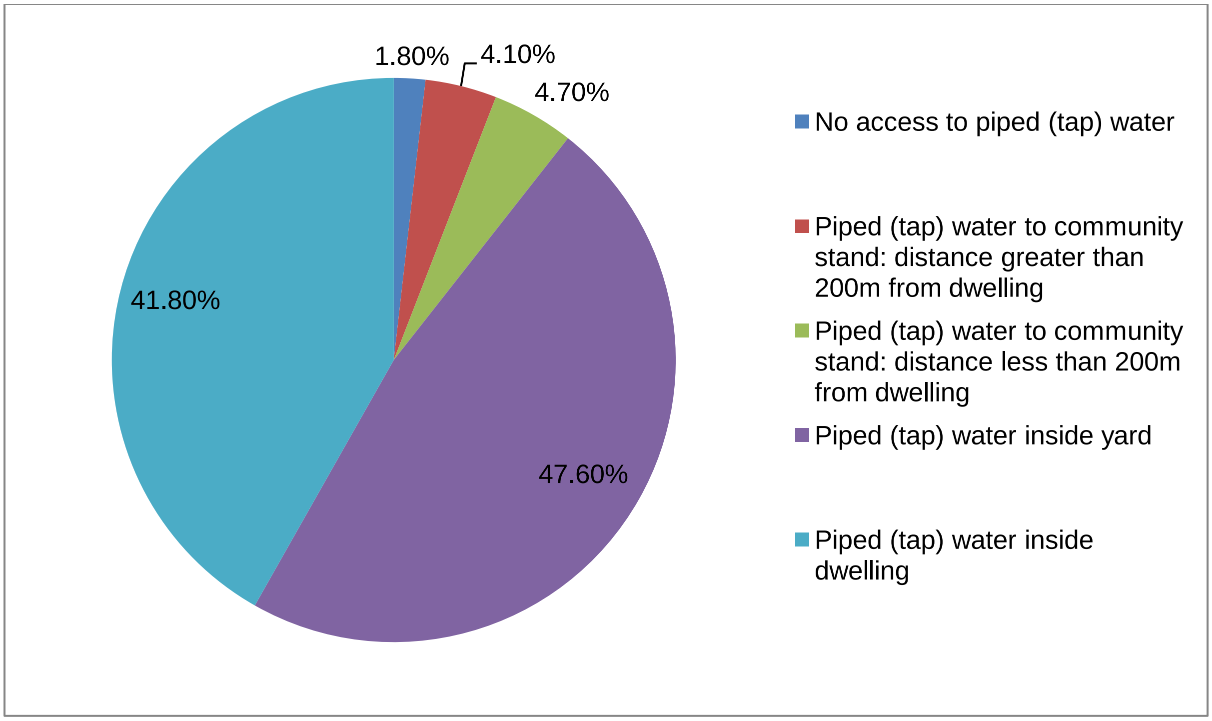


Figure 51: Water access in 2001 in HLM (Source: Census 2001)

According to Census 2001 and CS 2007, and taking into account RDP standards, the following information is available regarding HLM, NDM, and The Northern Cape:

Table 20: Water supply according to RDP standard in HLM, NDM, and The Northern Cape (Sources: Census 2001 & CS 2007)

Water Access in HLM, NDM, & Northern Cape (2001 & 2007)						
RDP Standard	**2001 HLM**	**2007 HLM**	**2001 NDM**	**2007 NDM**	**2001 N. Cape**	**2007 N. Cape**
Above RDP	94.1%	93.7%	92.7%	91.2%	83.5%	80.8%
Below RDP	5.9%	6.3%	7.3%	8.8%	16.5%	19.2%

With a focus on sanitation, the Census 2001 and CS 2007 recorded those who make use of a pit latrine, bucket toilet, or who do not have access to a toilet facility. The RDP plan, which states that a VIP toilet with ventilation is the minimum acceptable requirement, has been used as the yardstick by which sanitation standards are measured

Table 21: Sanitation standards in HLM, NDM and The Northern Cape (Sources: Census 2001 & CS 2007)

Sanitation in HLM, NDM, & Northern Cape (2001 & 2007)						
RDP Standard	**2001 HLM**	**2007 HLM**	**2001 NDM**	**2007 NDM**	**2001 N. Cape**	**2007 N. Cape**
Above RDP	77.2%	84.7%	78.3%	95.8%	76.7%	87.7%
Below RDP	22.8%	15.3%	21.7%	4.2%	23.3%	12.3%

- Refuse Removal

Refuse removal is a very important facet of any functioning society as human beings will always create waste products which must be disposed of in order to ensure that the spread of disease and introduction of vermin and parasites are prevented, and to maintain a healthy and aesthetically pleasing environment free of pollution. The most recent 2007 data showed that nearly 90% of all refuse was removed weekly by the authorities in the HLM. Only a mere 1.2% of the population did not have access to refuse removal which is a low figure by national standards.

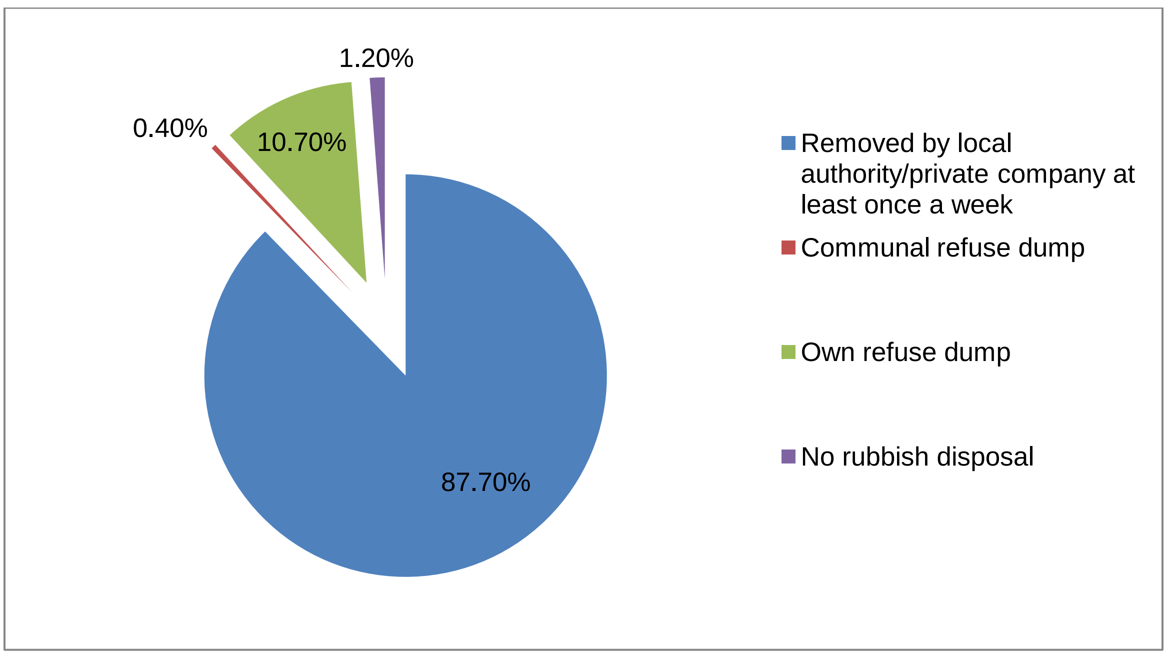


Figure 52: Refuse removal in HLM (Source: CS 2007)

- Energy Usage and Sources

The major source of energy in HLM is electricity.

The CS 2007 studies indicate municipal electrical supply in terms of the percentage of households using electricity as an energy source for cooking, lighting and heating.

Table 22: Percentage of HLM, NDM & Northern Cape residents using electricity for cooking, lighting and heating (Source: Census 2001 & CS 2007)

Region	Lighting		Cooking		Heating	
	2001	**2007**	**2001**	**2007**	**2001**	**2007**
HLM	74.2%	91.9%	60.7%	88.5%	49.8%	74.2%
NDM	77%	92.7%	65.2%	89.2%	59%	86.6%
N. Cape	73.3%	86.8%	55.4%	77.4%	50.8%	66.4%

The period between 2001 and 2007 saw major improvements in the use of electricity as an energy source in all three areas. The residents of HLM had a higher usage (and thereby accessibility) of electricity in their homes, than the provincial average.

- Crime Statistics in HLM

While a section on crime rates and statistics should not strictly form a part of the social infrastructure analysis, it was reasoned that such a section would not only provide insight into the occurrence of crime and criminal activity from within the HLM, it would also be intrinsically related to the details regarding emergency services and health services as well as policing and correctional facilities. The crime statistics provided below have been sourced from the SAPS official statistics over a 3 year period with the number of crimes per category per year as well as the total number of crimes occurring within this period being presented.

Table 23: Crime statistics in Loeriesfontein over a 3 year period

Crime in Loeriesfontein	Crimes during 2007/2008	Crimes during 2008/2009	Crimes during 2009/2010	Total no. of Crimes between 2007/2008 and 2009/10
Contact Crimes				
Murder	3	0	2	5
Sexual Crimes	0	10	4	14
Attempted Murder	0	0	6	6
Assault-attempt to do grievous bodily harm	17	9	15	41
Common Assault	23	32	32	87
Common Robbery	2	2	1	5
Robbery with Aggravating Circumstances	0	0	0	0
Contact-related Crime				

Crime in Loeriesfontein	Crimes during 2007/2008	Crimes during 2008/2009	Crimes during 2009/2010	Total no. of Crimes between 2007/2008 and 2009/10
Arson	0	0	0	0
Malicious damage to property	2	2	8	12
Property-related Crime				
Burglary	7	15	16	38
Theft of Motor Vehicle	2	1	4	7
Stock Theft	0	2	3	5

In Loeriesfontein 4 types of crimes are on the increase: sex crimes, common assault, drug-related crimes, and crimen injuria. It appears that burglary and assault are the most common crimes, while drug-related issues also persist and may be fuelling the two former crimes.

- Emergency, Safety and Security Infrastructure

The emergency, safety and security infrastructure within the HLM are summarised as per Table 24 below.

Table 24: Emergency, safety and security infrastructure in HLM

Emergency, Safety & Security Infrastructure		
Type	**Number**	**Location**
Fire Brigade	1 station with no resource numbers clearly defined by the municipality.	Calvinia
Police Stations & Prisons	4 Police Stations; 1 medium security prison.	Police Stations are located in Calvinia, Nieuwoudtville, Brandvlei and Loeriesfontein. Prison is located in Calvinia.
Traffic Police	1 x Hantam Traffic department with smaller subsidiaries nearby settlements.	Calvinia.

- Health Infrastructure

The health infrastructure found in the HLM are summarised as per Table 25 below.

Table 25: Health facilities in HLM

Health in HLM	
Facility	**Numbers**
Hospitals – Calvinia, Abraham Esau State Hospital; Loeriesfontein Hospital.	2
Healthcare Clinics - *Hantam Community Education Trust – provides primary health care and pharmacy services, as well as HIV education and oral health services; Nieuwoudtville clinic; Wilma Fortuin Clinic; Brandvlei Clinic; Loeriesfontein Medical Centre.	4

8.13.5 Socio-Cultural Processes

Socio-cultural processes relate to the way in which humans behave, interact and relate to each other and their environment, as well as the belief and value systems which guide these interactions.

The closest towns around the wind farm site include Loeriesfontein (approximately 47km south of the site), Calvinia (approximately 106km south-southeast of the site) and Nieuwoudtville (approximately 102km southwest of the site).

- Loeriesfontein

Loeriesfontein became an independent municipality in 1958, but has since been incorporated into the Hantam Local Municipality. The town grew around a general store that was established in 1894 by a travelling salesman named Frederick Turner, a nephew of Charles Spurgeon. The shop still exists to this day and is now called the Turner and Haupt SPAR, under the ownership of a grandson of Frederick Turner.

The south-western part of the town forms part of the wider region known as Namaqualand, which is well known for its spring flowers during August and September. The flowers attract many visitors to the area, but mostly the economy of the area centres on sheep farming and salt mining. The town is also home to an annual agricultural show that takes place during October. The show has status at national and provincial level and focuses on sheep and saddle horses.

Loeriesfontein is also home to the Windmill Museum that was established in the 1970s, which gave the town the reputation of the windmill capital of South Africa. The museum features some thirty windmills in the old school playground alongside the old school building that houses the Fred Turner Folk and Cultural Museum. This museum displays the culture and historical way of life of the “Trek Boers” of Namaqualand, people of Afrikaans heritage that travelled to the area in the 1700s in search of land.

Much of the historic character of the town is still evident, with the original Loeriesfontein Hotel still in operation, and offers a wide array of attractions, including the legendary Quiver Tree Forest where Bushmen used to make quivers for their arrows.

- Cultural Background

As reflected in the demographical profile, almost 90% of the area is occupied by Coloured people. The term coloured (also known as *Bruinmense, Kleurlinge* or *Bruin Afrikaners*) refers to the ethnic group of mixed race people who possess some sub-Saharan African ancestry, but not enough to be considered Black African under the laws of South Africa. Apart from their ancestry in sub-Saharan Africa, they also have substantial ancestry from Europe, Indonesia, Madagascar, Malaya, Mozambique, Mauritius, St Helena and Southern Africa. In fact, genetic history studies suggest that this group has the highest levels of mixed ancestry in the world.

The coloured people of KwaZulu-Natal mostly come from British and Zulu heritage, while coloured people in neighbouring Zimbabwe mostly have a Shona or Ndebele mixing with British and Afrikaner settlers. Due to the fact that they have such a wide array of ancestry from 'naturalised' racial groups, they are referred to as 'coloured' in the southern African context. This does not mean that this racial group self-identify this way, as some prefer to call themselves 'black' or 'Khoisan' or just plainly 'South African'. Due to the historical practices of racial segregation in South Africa and neighbouring countries, governments grouped all 'mixed race' people together, which means that the apartheid government categorised this group of people under 'Coloureds'. Other ethnic groups have traditionally viewed the coloured people as a separate group. During apartheid, to maintain divisions and a race-focused society, the then government divided the main racial groups as Blacks, Whites, Coloureds and Indians.

During the apartheid era, many of the Griqua people began to self-identify as 'Coloureds' as there were certain advantages being classified as 'Coloured', e.g. Coloureds were not required to carry a *dompas*, while the Griqua, who was seen as an indigenous African group, were required to do so.

Coloured people constitute the majority of the populations of the Western and Northern Cape and mostly speak Afrikaans in the form of 'Kaapse Taal' (a creolised dialect of Afrikaans) and 'Pure Afrikaans' (formal Afrikaans).

The political rights of Coloured people varied by location and over time. During the 19th century they had similar rights to the White population, although income and property qualifications affected Coloureds disproportionately. However, in areas such as the Transvaal Republic and the Orange Free State the Coloured had few rights. The establishment of the Union of South Africa afforded Coloured people the right to vote, but by 1930 they were restricted to elect only White representatives. In protest, they conducted various voting boycotts, which might have aided the election of the National Party in 1948 as their apartheid programme was aimed at stripping Coloured people of their already limited voting powers.

As with their Black African counterparts, Coloured people were also subject to forced removals, which lead to people being forcibly removed from traditional areas like District Six to the Cape Flats. When people were forced to move into townships and suburbs defined by the race, social problems such as alcoholism, poor health care, and a rising crime rate resulted. Not all of these negative factors have been eliminated under the new democratic system. Although Coloured people received better education than Black South Africans, their education was still inferior to that of Whites.

JG Strijdom, who was known as 'The Lion of the North' worked endlessly to further restrict the rights of Coloured people. He removed their right to vote by amending the entrenchment clause regarding the Coloured vote, known as the South African Act. Coloured people were subsequently placed on a separate voters' roll and could only elect four Whites to represent them in the House of Assembly. This decision was met with lots of resistance, amongst them the Torch Commando and the Black Sash. Many Coloured people refused to register on the new voters' roll, leading to a dramatic drop in the number of Coloured voters. During the subsequent election, only 50.2% of eligible Coloured voters voted as they had no interest in voting for white representatives, which they regarded as pointless.

In 1958 the then government established the Department of Coloured Affairs, followed by the Union for Coloured Affairs in 1959. The Union had 27 members and served as the advisory link between the government and the Coloured people. The Constitution was reformed in 1983 to allow the Coloured and Asian minorities limited participation in separate and subordinate Houses in Parliament. This allowed the Coloured people limited rights, while their Black African counterparts were to be removed to independent homelands.

During the first democratic elections in 1994, many Coloured voters still voted for the National Party in opposition to affirmative action programmes that would give preference to non-Coloured Black people or old privileges people feared giving up under the leadership of the African National Congress. Since then the Coloured politics has continued to be important in areas such as the Western Cape as political parties view the area as a place where they might gain ground against the dominant ANC.
Today, the large number of Coloured people living in informal settlements and low-cost housing schemes still reflects the then government policies of racial segregation, and not one of choice or the product of culture. In the Namaqualand District, traditional Khoi mat houses can still be found where many White inhabitants chose to build in similar architectural designs.

The heterogeneous nature of the Coloured culture is reflected in the patterns of family life, kinship and marriage. For example, on the Namaqualand reserves, many families follow practices regarding descent, generation, age and sex that are recognisably Nama Khoi. The lifestyle of most middle class families in the major urban areas hardly differs from their Western middle-class family counterparts. An importance aspect of the Coloured kinship and marriage lies in people's preoccupation with class, status and colour, which is evident in the reserve communities of the Namaqualand District where marriages are guided by preferential rules of status based on criteria such as skin colour, hair form, ethnic origin, etc. Similar patterns can be found in the urban areas, which are further complicated by indexes of association, educational achievement, political and religious affiliation, occupation and the like. Some Coloured people managed to change their racial classification to White, but this could only be undertaken successfully by higher-status people with established social networks within the White community.

Coloured people observe two main religions, namely Christianity and Islam, both of which play an influential role in the population. Religious beliefs are seen as a factor in the emergence of a strong conservative element among the Coloured people.

9 PUBLIC PARTICIPATION PROCESS

Public participation is the cornerstone of any EIA. The principles of NEMA as well as the EIA Regulations govern the EIA process, including public participation. The Public Participation Process (PPP) for the proposed development has been conducted according to Guideline 4 of the EIA Regulations. These guidelines include the provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment. The guidelines also ensure the participation of previously disadvantaged people, women and the youth.

The public participation process is primarily based on two factors. Firstly, ongoing interaction with the environmental specialists and the technical teams are required in order to achieve integration of technical assessment and public participation throughout. Secondly, public participation is conducted to obtain the bulk of the issues to be addressed early on in the process, with the latter half of the process designed to provide environmental and technical evaluation of these issues. These findings are presented to stakeholders for verification. Any issues raised in relation to the findings are then captured and made available for further comment.

Input into the public participation process by members of the public and stakeholders can be given at various stages of the EIA process. Registration on the project can take place at any time during the EIA process up until the final EIA report is submitted to DEA. There are however set periods in which comments are required from Interested and / or Affected Parties (I&APs) in order to ensure that these are captured in time for the submission of the various reports. The comment periods during the EIA phase will be implemented according to Guideline 4 of the NEMA (107/1998), Environmental Impact Assessment Regulations in terms of section 24(5).

The EIA regulations emphasise the importance of public participation. In terms of the EIA regulations, registered interested and/or affected parties –

- may participate in the application process;
- may comment on any written communication submitted to the competent authority by the applicant or environmental consultant;
- must comment within the timeframes as stipulated by the EIA Regulations;
- must send a copy of any comments to the applicant or Environmental Assessment Practitioner (EAP) if the comments were submitted directly to the competent authority; and
- Must disclose any direct business, financial, personal or other interests that the person has in the application being granted or refused.

The following actions were taken upon receiving comments/ queries/ issues:

- The contact details provided were entered into the project database for use in future notifications.
- Confirmation of receipt of comments.
- Addressed comments in the Issues & Response Report.

9.1 Overview of the Public Participation Process to date

The public participation process for the EIA phase was initiated in March 2012. The EIA Newsletter was distributed via email to all stakeholders as well as distributed in hard copy (by postal service) in the town of Loeriesfontein. The purpose of the EIA newsletter was to reacquaint I&APs and Stakeholders with the proposed project and the EIA process.

The public participation process that was followed during the Scoping Phase of the project was initiated on the 12th August 2011. The stages that formed part of the public participation process to date (Scoping Phase) for the project is reflected in the Figure 53 below.

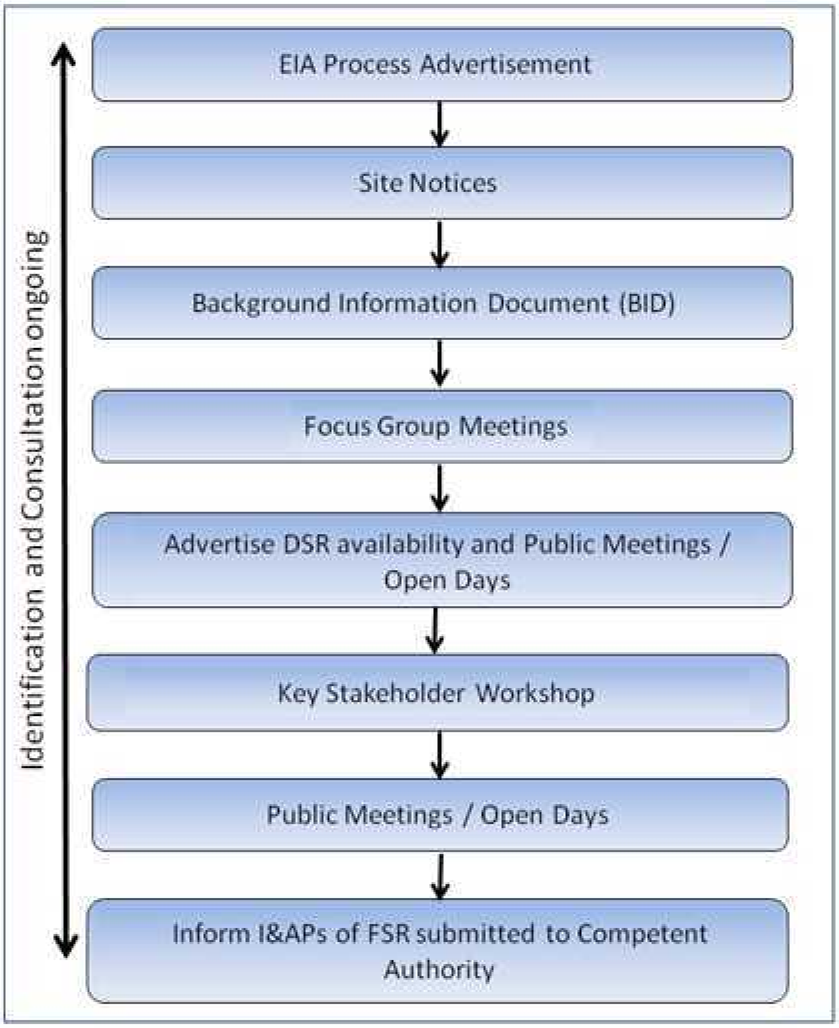


Figure 53: Public Participation Process during the scoping phase

Members of the public who wished to be registered on the database as I&APs were able to do so via telephone, fax, email, mail or SiVEST's website (www.sivest.co.za).

On-going consultation with key stakeholders (e.g. provincial, district and local authorities, relevant government departments, local business etc.) and identified I&APs ensured that I&APs were kept informed regarding the EIA process. Networking with I&APs effectively continued throughout the scoping phase of the project until the Final Scoping Report and EIA Plan of Study was submitted to DEA. Where required, stakeholders and I&APs were engaged on an individual basis.

During the environmental studies, consultations were held with individuals, businesses, institutions and organisations, and the following sectors of society have been identified and were afforded the opportunity to comment (the full stakeholder database list is included in Appendix 5):

- National Authorities
- Provincial Authorities
- Namakwa District Municipality
- Hantam Local Municipality
- Government Structures such as SAHRA, SANRAL, Telkom, etc
- Agriculture Associations
- Regional and local media (advertisements and public documents e.g. BID)
- Business and commerce
- Environmental bodies / NGOs
- Community representatives, CBOs, development bodies
- Landowners

After the specialist studies were completed, comments from all I&APs were integrated into the Final Scoping Report which was submitted to the DEA. Approval of the Final Scoping Report and Plan of Study was received on 29 February 2012.

The same process will essentially be followed during the EIA phase.

The initiation of the EIA phase was therefore undertaken after receipt of the approval of the Final Scoping Report and Plan of Study. The same round of public meetings / open days, key stakeholder workshops and focus group meetings are to be held during the EIA phase. These are yet to take place.

9.2 Consultation and Public Involvement

As in the scoping phase, telephonic discussions and focus group meetings were held with key stakeholders and other relevant I&APs in order to identify key issues, needs and priorities for input into the proposed project. Special attention was given to the consultation with possibly affected landowners and communities within the study area to try and address their main concerns.

An advertisement was placed in the Noordwester (in English and Afrikaans) to advertise the public meeting and availability of the Final Environmental Impact Report. Site notices were also placed within the town of Loeriesfontein notifying the public of the public meeting and availability of the report. An Afrikaans executive summary has also been provided (Appendix 11).

9.3 Proof of Notification

Appendix 5 includes all the proofs of notification and correspondence with Interested and Affected Parties:

- Public Meeting and Draft Environmental Impact Report (DEIR) poster text (Appendix 5B);
- EIA Newsletter (Appendix 5B);
- Proof of advertisements in the newspapers (Appendix 5C); and
- Correspondence to and from registered I&APs and key stakeholders (Appendix 5D).

9.4 Focus Group Meetings

Focus Group Meetings took place in March 2012, during the review period of the DEIR. FGMs are smaller meetings with specific groups or organisations who have similar interests in or concerns about the project. The details pertaining to the focus group meeting are listed in Table 26 below.

Table 26: Focus Group meetings

Venue	Interested Parties	Date	Time
Board Room, Hantam Local Municipality, Calvinia	Municipal officials (Local and District)	Monday, 26 March 2012	10h00 – 12h00
Cape Agri Building	Loeriesfontein Agricultural Union	Tuesday, 27 March 2012	10h00 – 12h00

Minutes of this meeting were compiled and forwarded to all attendees (Appendix 5E). The primary aim of these meetings is to:

- disseminate information regarding the proposed development to I&APs;
- provide I&APs with an opportunity to interact with the EIA team and the Mainstream Renewable Energy representatives present;
- supply more information regarding the EIA process;
- answer questions regarding the project and the EIA process; and
- receive input regarding the public participation process and the proposed development.

9.5 Key Stakeholder Workshop

A Key Stakeholder Workshop was undertaken in April 2012 during the review period of the DEIR. The Key Stakeholder Workshop is to be held in order to provide commenting authorities and key stakeholders with additional information regarding the proposed development, to present the environmental findings of the impact-phase studies and to invite stakeholders to submit their comments on the EIR as well as to raise any further comments and/or concerns that they may have. Details pertaining to the Key Stakeholder Workshop are provided in Table 27 below.

Table 27: Key Stakeholder Workshop

Venue	Date	Time
La Casa Mia 27A Carters Road, Hadison Park Kimberley	Monday, 2nd April 2012	10h00

The key stakeholders that were invited to the Key Stakeholder Workshop are contained in Table 28.

Table 28: List of Key Stakeholders invited to the Key Stakeholder Workshop

Name	Organisation
Mr Abrahams	Dept of Water Affairs: Northern Cape
Ms. Ah Shene-Verdoorn	Birdlife South Africa
Ms. Anderson	WESSA: Northern Cape
Mr. Auret	Namakwa District Municipality
Ms. Bester	Telkom
Mr. Botes	Dept of Environment & Nature Conservation
Mr. Bruiners	Telkom SA (Ltd)
Mr. Cloete	Transnet Freight Rail
Mrs. Collett	Dept of Agriculture, Forestry & Fisheries
Mr. Crous	Namakwa District Municipality
Ms. De Kock	SANRAL: Western Region
Mr. Diokpala	Pixley Ka Seme District Municipality
Mr. Fiff	Transnet
Mr. Fortuin	Namakwa Distrik Munisipaliteit
Ms. Galimberi	SAHRA: Head Office
Mr. Gibbons	EWT: African Crane Conservation Programme
Mr. Gopichund	ATNS
Mr. Gresse	Transnet Rail Freight (Iron Ore Line)
Mr. Herrmann	Dept of Environment & Nature Conservation

Mr. Isherwood	SA Civil Aviation Authority
Mrs. Kibi	Pixley Ka Seme District Municipality
Mr. Koen	Dept of Environment & Nature Conservation
Mr. Leask	Eskom
Mr. Loubser	Namakwa District Municipality
Mr. Maccollan	Pixley Ka Seme District Municipality
Mr. Molefe	Pixley Ka Seme District Municipality
Mr. Mutyorauta	Dept of Environment & Nature Conservation
Mr. Schoeman	Transnet Freight Rail
Mr. Shaw	Telkom
Mr. Sinthumule	Dept of Heritage: Northern Cape Province
Mr. Snyders	Dept of Water Affairs: Northern Cape Province
Ms. Stroh	SA Civil Aviation Authority
Dr. Tiplady	Square Kilometre Array
Mr. Van Schalkwyk	ATNS

The draft minutes from the Key Stakeholder Workshop were compiled and forwarded to all attendees. The final minutes have been included in the FEIR for submission to the Competent Authority (Appendix 5G).

9.6 Public Meeting

A Public Meeting is to be held during the review period of the DEIR. The meeting is to take place on 27 March 2012. Details pertaining to the Public Meeting are provided in Table 29 below.

Table 29: Public Meeting / Open Day

Venue	Date	Time
Loeriesfontein Sports Hall, No 13 Long Street, Loeriesfontein	27 March 2011	18h00-20h00 **Registration from:** 17h00 – 18h00

This meeting was advertised in the Noordwester and invitation letters were also sent via postal service and e-mail to all registered I&APs on the project's database.

Furthermore, posters advertising the Public Meeting were displayed at the public venues (as advertised) as well as various public places frequented by the public i.e. hotel, cafés etc. Proof of the poster are included in Appendix 5B.

The Public Meeting was held in order to provide I&APs with information regarding the proposed development, present the impact phase environmental findings and invite I&APs to raise any further comments and/or concerns that they may have.

Draft minutes of this meeting are to be compiled and forwarded to all attendees. Ultimately, the final minutes are to be included in the FEIR for submission to the Decision making Authority (Appendix 5G).

9.7 Public review of Draft Environmental Impact Report

The Draft EIR was made available for review at the following venues from the 9th of March 2012 to the 17 of April 2012.

- Loeriesfontein Public Library

Table 30: Venues where the Draft Environmental Impact Report was publically available

Venue	Street Address	Hours	Contact No.
Loeriesfontein Library	Main Street, Loeriesfontein	Mondays: 14h00 – 17h00 Tuesdays: 14h00 – 17h00 Wednesdays: 15h00 -17h30 Thursdays: 15h30-17h00 Fridays: 10h00-12h30 and 14h30 – 17h00	027 662 8607

All comments received on this report have been incorporated into the Comment and Response Report which has been attached as an Appendix in the FEIR.

The following stakeholders identified in Table 31 were sent copies of the report and a round of telephone calls was undertaken in March 2012 to determine if comments would be received.

Table 31: Authorities follow up consultation

Representative	Department	Response
Mr Riaan van Wyk	Hantam Local Municipality	Attended FGM on 26/03/2012 – comments captured in draft minutes. Refer to Appendix 5G of the FEIR.
Mr Jannie Loubser	Namkwa District Municipality	Comments forthcoming but no timeframe provided. E-mail

Representative	Department	Response
		sent on 26/04/2012 to confirm telephone discussion - NV
Mr Ernest Kubayi	Dept of Water Affairs	Telephonic discussion held on 4/5/2012 and email sent on 4/5/2012 confirming discussion. Comments to be sent directly to DEA
Ms Jacoline Mans	Dept of Agriculture, Forestry and Fisheries – National	Comments submitted on DSR regarding the removal of protected trees. Concern addressed in FSR. No need for further comments.
Mrs Anneliza Collett	Dept of Agriculture, Forestry and Fisheries - Provincial	Not responsible for EIA comments. Contact details of staff member responsible for comments forwarded to project team. Sent e-mail on 26/04/2012 to newly appointed employees enquiring whether the will submit written comments.
Mr Julius Koen	Dept of Environment and Nature Conservation	Confirmed will not be commenting. E-mail send on 26/04/2012 confirming tele-phone discussion.
Ms Rene De Kock	SANRAL: Western Region	Site far from National road, will therefore not submit any written comment. E-mail sent on 26/04/2012 confirming telephone discussion.
Mr Nico Fourie	NC Dept of Roads and Public Works	Attended KSW during scoping phase and submitted comments. Will not be submitting any written comments on DEIR.
Ms Mariagrazia Galimberi	SAHRA – Head office	Written comments will be submitted directly to DEA. DEA details provided.
Mr Jason Sinthumule	NC Dept of Heritage	No comments received.

Representative	Department	Response
Mr Kevin Leask	Eskom	Could not be reached to enquire whether written comments will be submitted.
Dr Adriaan Tiplady	Square Kilometre Array	Submitted extensive comments during Scoping Phase. Could not be reached to confirm whether written comments on DEIR will be submitted.
Mr Chris Isherwood	SA Civil Aviation Authority	Written comments received. Requested final turbine layout, which was forwarded to the CAA once available. No further comments received.
Ms Stoh Lizell	SA Civil Aviation Authority	
Mr Uvesh Gopichund	Air traffic and Navigation Services	Sent e-mail on 26/4/2012 confirming telephone discussion that ATNS has not objections
Mr Cobus Cloete	Transnet Freight Rail	No comments received. Unavailable and could not be reached during follow-up activity.
Mr Hennie Schoeman	Transnet Freight Rail	
Mr Sam Fiff	Transnet Freight Rail	
Mr Leonard Shaw	Telkom	Submitted written comments and is attached in Appendix 5D
Mr Bradley Gibbons	Endangered Wildlife Trust	In agreement with content of Report and will not be submitting written comments. Send e-mail on 26/4/2012 confirming telephone discussion.
Ms Tania Anderson	WESSA - NC	Will not be submitting written comments on DEIR and forwarded DEIR to Chairperson of conservancy. Send e-mail on 26/4/2012 confirming telephone discussion

Representative	Department	Response
Ms Carolyn Ah Shene-Verdoorn	Birdlife South Africa	Could not be reached to enquire whether written comments will be submitted.

9.8 Comment and response report

Issues, comments and concerns raised during the public participation process are captured in the Comment and Response Report (C&RR) – Appendix 5E. The C&RR provides a summary of the issues raised, as well as responses which were provided to I&APs. The information was used to feed into the evaluation of all the specialist studies.

10 SPECIALIST STUDIES

The following specialist studies were undertaken as per the Plan of Study for EIA:

- Biodiversity (flora and fauna) Assessment (Liesl Koch - SiVEST)
- Avifauna Assessment (Chris van Rooyen)
- Bat Assessment (Werner Marais - Animalia)
- Surface Water Impact Assessment (Paul da Cruz / Shaun Taylor– SiVEST)
- Agricultural Potential (Kurt Barichievy – SiVEST)
- Noise Impact Assessment (Morne de Jager – M^2)
- Visual Impact Assessment (Paul da Cruz – SiVEST)
- Heritage Assessment (Johnny van Schalkwyk)
- Socio-economic Impact Assessment (Nonka Byker – MasterQ)

The findings of these studies are presented below.

10.1 Biodiversity (flora and fauna) Assessment

10.1.1 Sensitive areas

A negative mapping exercise was undertaken to determine where the turbines could be located without affecting the biodiversity of the site.

The site is very uniform in nature with very few distinct sensitive areas. Drainage lines on the site are not well defined to the infrequent rains that occur. Those that have been clearly identified are considered to be sensitive as they provide rare habitat on the site when water is available.

Areas of topographical change are also considered to be sensitive as they provide difference microclimates on a site that is very uniform in nature.

No “no-go” areas have been identified from a biodiversity perspective on the site. Strict mitigation measures have however been identified to ensure that habitat on the site is not unnecessarily destroyed. This sensitivity map should be viewed in conjunction with the surface water specialist study which details surface water features in more detail.

10.1.2 Potential Impacts of the Proposed Development During Construction

The potential impacts of the proposed development mainly related to loss of habitat for red data and general species; potential loss of species richness, edge effect and erosion. The impact of the proposed development will be limited to the turbine / PV construction areas and the associated infrastructure such as roads. Surrounding vegetation will remain intact and will not be impacted upon. As such the impact is localised and if the mitigation measures are implemented, the overall impact can be reduced.

During the construction phase the following impacts are predicted in terms of each of the biodiversity groupings.

- Flora

A number of potential impacts could be associated with the proposed wind farm. The clearing for the wind farm and associated infrastructure is likely to result in loss of vegetation and more importantly natural vegetation. This can also result in habitat fragmentation due to loss of ecological linkages which may be present across the site. The clearing of vegetation could also result in the introduction of exotic species into the study area.

The impacts associated with the floral environment relate to the removal of vegetation and associated loss of habitat for endemic and Red Data species. This could result in loss of species richness and increase the edge effect. The edge effect implies an increase of alien species into the area thus affecting the local species.

The construction of the Wind turbines and PV plant does not result in clearing of all vegetation i.e. a large amount of vegetation will remain between the turbines and PV panels.

- Mammals

The proposed wind farm and PV plant could potentially result in the destruction of the habitat available for these species. The impact of the turbines and PV plant is likely to be higher during construction as displacement will occur as a result of foundations and road construction.

The impact associated with the mammal population on site relates to the loss of habitat and disturbance during construction. The area does not have a large mammal population due to the arid nature of the climate and as mentioned above the surrounding area contains the same habitat into which mammal species can move during construction.

- Reptiles

The proposed wind farm and PV plant could potentially result in habitat destruction for these reptile species.

The area has been determined to be rich in reptile species as these species adapt well to the arid environment. The impacts associated with reptiles relate, as with other faunal groupings, to habitat loss. Cumulatively however, a large amount of habitat surrounding the site is present into which these species can move during construction. These species will also be able to re-colonise the vegetation under the Wind turbines and the PV panels during operation.

- Amphibians

The construction of the proposed wind farm could result in habitat destruction for amphibian species.

Due to the extreme weather which characterises the study area, amphibians are scarce. Some specimens are however present, particularly near the drainage lines. It is unlikely that these species would be affected by the proposed development.

- Invertebrates

The study area has a remarkable invertebrate diversity. Invertebrates are fairly mobile and will be able to move away during construction to the surrounding habitat.

10.1.3 Potential Impacts of the Proposed Development During Operation

No significant impacts on vegetation and habitat are expected during the operation phase of the proposed development, as long as rehabilitation of the impacted surrounding areas has taken place.

10.2 Avifauna Assessment

10.2.1 Identification of Issues and Impacts

The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss causes a reduction in birds using an area which might then reduce the risk of collision). The principal areas of concern are:

- Mortality due to collision with the wind turbines;
- Displacement due to disturbance; and
- Habitat loss due to the footprint of the wind farm.
- Mortalities due to collision with associated power line infrastructure

- Mortalities from collisions with wind turbines

Internationally, it is widely accepted that bird mortalities from collisions with wind turbines contribute a relatively small proportion of the total mortality from all causes. The US National Wind Coordinating Committee (NWCC) conducted a comparison of wind farm bird mortality with that caused by other man-made structures in the USA (Anon. (b) 2000). It reports that "data collected outside California indicate an average of 1.83 avian fatalities per turbine (for all species combined), and 0.006 raptor fatalities per turbine per year. It further reports that: "Based on current estimates, windplant related avian collision fatalities probably represent from 0.01% to 0.02% (i.e. 1 out of every 5,000 to 10,000) of the annual avian collision fatalities in the United States". That is, commercial wind turbines cause the direct deaths of only 0.01% to 0.02% of all of the birds killed by collisions with man-made structures and activities in the USA.

The majority of studies on collisions caused by wind turbines have recorded relatively low mortality levels (Madders & Whitfield 2006). This is perhaps largely a reflection of the fact that many of the studied wind farms are located away from large concentrations of birds. It is also important to note that many records are based only on finding corpses, with no correction for corpses that are overlooked or removed by scavengers (Drewitt & Langston, 2006). Relatively high collision mortality rates have been recorded at several large, poorly-sited wind farms in areas where large concentrations of birds are present (including Important Bird Areas (IBAs)), especially among migrating birds, large raptors or other large soaring species, e.g. in the Altamont Pass in California, USA (Thelander & Smallwood 2007), and in Tarifa and Navarra in Spain (Barrios & Rodrigues 2004). In these cases actual deaths resulting from collision are high, notably of Golden Eagle *Aquila chrysaetos* and Eurasian Griffon *Gyps fulvus*, respectively.

Accepting that many wind farms may only cause low levels of mortality, even these levels of additional mortality may be significant for long-lived species with low productivity and slow maturation rates, especially when rarer species of conservation concern are affected (see for example almost all the Red Data species in Appendix 2). In such cases there could be significant effects at the population level (locally, regionally or, in the case of rare and restricted species, nationally), particularly in situations where cumulative mortality takes place as a result of multiple installations (Carette *et al.* 2009).

Large birds with poor manoeuvrability (such as cranes, korhaans, bustards and Secretarybirds) are generally at greater risk of collision with structures (Jenkins *et al.* 2010), and species that habitually fly at dawn and dusk or at night are perhaps less likely to detect and avoid turbines (e.g. cranes arriving at a roost site after sunset, or flamingos flying at night). Collision risk may also vary for a particular species, depending on age, behaviour and stage of annual cycle (Drewitt & Langston 2006). While the flight characteristics of cranes, flamingos and bustards make them obvious candidates for collisions with power lines (Jenkins *et al.* 2010), it is noted that these classes of birds (unlike raptors) do not feature prominently in literature as wind turbine collision victims. It may be that they avoid wind farms entirely, resulting in lower collision risks. However, this can only be verified through on-site post-construction monitoring.

The precise location of a wind farm site can be critical. Soaring species may use particular topographic features for lift (Barrios & Rodriguez 2004; De Lucas *et al.* 2008) or such features can result in large numbers of birds being funnelled through an area of turbines (Drewitt & Langston 2006). For example, absence of thermals on cold, overcast days may force larger, soaring species (e.g. Martial Eagle and Secretarybird) to use slopes for lift, which may increase their exposure to turbines. Gentle slopes may also pose a bigger risk than steep slopes for large soaring species, as updrafts from gentle slopes are weaker than those from steeper slopes, so turbines situated on the top of gentle slopes should pose a bigger risk to these birds than those situated atop steep slopes (De Lucas *et al.* 2008). Birds also lower their flight height in some locations, for example when following the coastline or crossing a ridge (Smallwood pers.comm), which might place them at greater risk of collision with rotors.

The size and alignment of turbines and rotor speed are likely to influence collision risk; however, physical structure is probably only significant in combination with other factors, especially wind speed, with moderate winds resulting in the highest risk (Barrios & Rodriguez 2004; Stewart *et. al.* 2007) as there is less lift for birds to clear the turbines. Lattice towers are generally regarded as more dangerous than tubular towers because many raptors use them for perching and occasionally for nesting; however Barrios & Rodriguez (2004) found tower structure to have no effect on mortality, and that mortality may be directly related to abundance for certain species (e.g. Common Kestrel *Falco tinnunculus*). De Lucas *et. al.* (2008) found that turbine height and higher elevations may heighten the risk (taller/higher = higher risk), but that abundance was not directly related to collision risk, at least for Eurasian Griffon Vulture *Gyps fulvus*.

A review of the available literature indicates that, where collisions have been recorded, the rates per turbine are highly variable with averages ranging from 0.01 to 23 bird collisions annually (the highest figure is the value, following correction for scavenger removal, for a coastal site in Belgium and relates to gulls, terns and ducks among other species) (Drewitt & Langston 2006).

Although providing a helpful and standardised indication of collision rates, average rates per turbine must be viewed with some caution as they are often cited without variance and can mask significantly higher (or lower) rates for individual turbines or groups of turbines (Everaert *et. al.* 2001 as cited by Drewitt & Langston 2006).

The effects of night-time illumination in increasing the risk of collisions with the turbines has not been adequately tested, and the results of studies are contradictory (Johnson *et al.* 2007).

Ultimately due to the lack of similar data for South Africa, long term monitoring of wind farm sites will quantify the potential impacts that have been identified above.

- Displacement due to disturbance

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance effectively can amount to habitat loss. Displacement may occur during both the construction and operational phases of wind farms, and may be caused by the presence of the turbines themselves through visual, noise and vibration impacts, or as a result of vehicle and personnel movements related to site maintenance. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

- Habitat change and loss

The scale of direct habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, generally speaking, is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development area (Fox *et al.* 2006 as cited by Drewitt & Langston 2006), though effects could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). Some changes could also be beneficial. For example, habitat changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor (for example through greater availability of burrows for Pocket Gophers *Thomomys bottae* around turbine bases), though this may also have increased collision risk (Thelander *et al.* 2003 as cited by Drewitt & Langston 2006).

- Collision mortality with associate power lines

The proposed power lines that will link the wind facility to the existing Eskom grid could potentially pose a collision risk. The turbines will be linked through underground reticulation cables.

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; Ledger et.al. 1992; Kruger & Van Rooyen

1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000). Electrocutions are not envisaged to be a problem on the proposed electricity line. Collisions, on the other hand, could be a major potential problem for some species.

10.2.2 Assessment of Impacts

- Mortalities from collisions with wind turbines

Terrestrial priority species that may be at risk include Blue Cranes, but their occurrence at the site would be very sporadic and linked to exceptional rainfall and high water levels in the pans. Ludwig's Bustard will also be at risk, based on the species flight characteristics and tendency to fly long distances between foraging and roosting areas. Movements by this species are triggered by rainfall (Allan 1994), and so are inherently erratic and unpredictable in this arid environment, where the quantity and timing of rains are highly variable between years. Hence, it is difficult to anticipate the extent to which Ludwig's Bustard may be exposed to collision risk, but the site contains ideal habitat and high densities can be expected in high rainfall years. It remains to be seen if Ludwig's Bustard will avoid the wind farm site entirely, as the species is very sensitive to disturbance, in which case the collision risk should be significantly reduced. Karoo Korhaan *Eupodotis vigorsii* has been recorded but the species is highly terrestrial and flies very seldom (Hockey *et al*. 2007) and should therefore not be regularly at risk of collision.

Soaring species that could be exposed to collision risk are mostly raptors that use the area for foraging (see Appendix 2). The site is flat with no specific topographical features that will increase the risk to soaring species. The biggest risk would most likely be to fledglings of species currently breeding on or close to the site (see Figure 2.1). The transmission lines running through and close to the site contain a Greater Kestrel *Falco rupicoloides* nest (30°26'47.83"S 19°35'25.01"E), and a Martial Eagle *Polemaetus bellicosus* nest (30°30'57.24"S 19°33'20.31"E).

The potential impact of collisions on small priority species is unclear. Species such as Namaqua Sandgrouse could potentially suffer multiple mortalities when travelling in flocks through the site area. The site contains populations of several endemic larks, which could also be exposed to collisions, particularly when performing display flights. Unfortunately very little is known on collision mortality of passerines at wind farms, as the focus of most research has been large species, particularly raptors. This is likely to remain so for some time, partially due to the difficulty of assessing collision mortality for small species because carcasses are difficult to find. The potential for collisions with the wind turbines due to presence of lights is not envisaged to be significant, primarily because the phenomenon of mass nocturnal passerine migrations is not a feature of the study area.

Whereas waterbirds are unlikely to occur regularly, due to the extreme aridity, stochastic rainfall events which fill up the ephemeral pans will trigger waterbird movement to and from these pans (see Figure 54). This may include both species of flamingo, and several species of ducks and waders (see Appendix 2 of the main Avifauna Report). These birds could be at risk when commuting over the turbine areas, particularly if these movements take place at night.

Figure 54: Potential waterbird flight paths between pans over the proposed turbine area

Ultimately, the only reliable way of establishing the potential extent of any collision risk to priority species is through the implementation of a pre-construction monitoring programme. This has commenced, and to date flight behaviour of priority species over the proposed turbine area (starting with the area where first 30 turbines are planned) was recorded for 48 hours in October (spring season) and January (summer season) at two vantage points, in three bands namely Low/below rotor height, Medium/within rotor height and High/above rotor height. Flight height was visually judged by an observer with the aid of binoculars. In the 48 hours of observation to date priority species were observed for approximately 1 hour and 4 minutes (2.2%) of the total 48 hour observation time, and for 34 minutes and 15 seconds (1.2%) of the total observation time, priority species were observed within the rotor height band (see Figure 55 below).

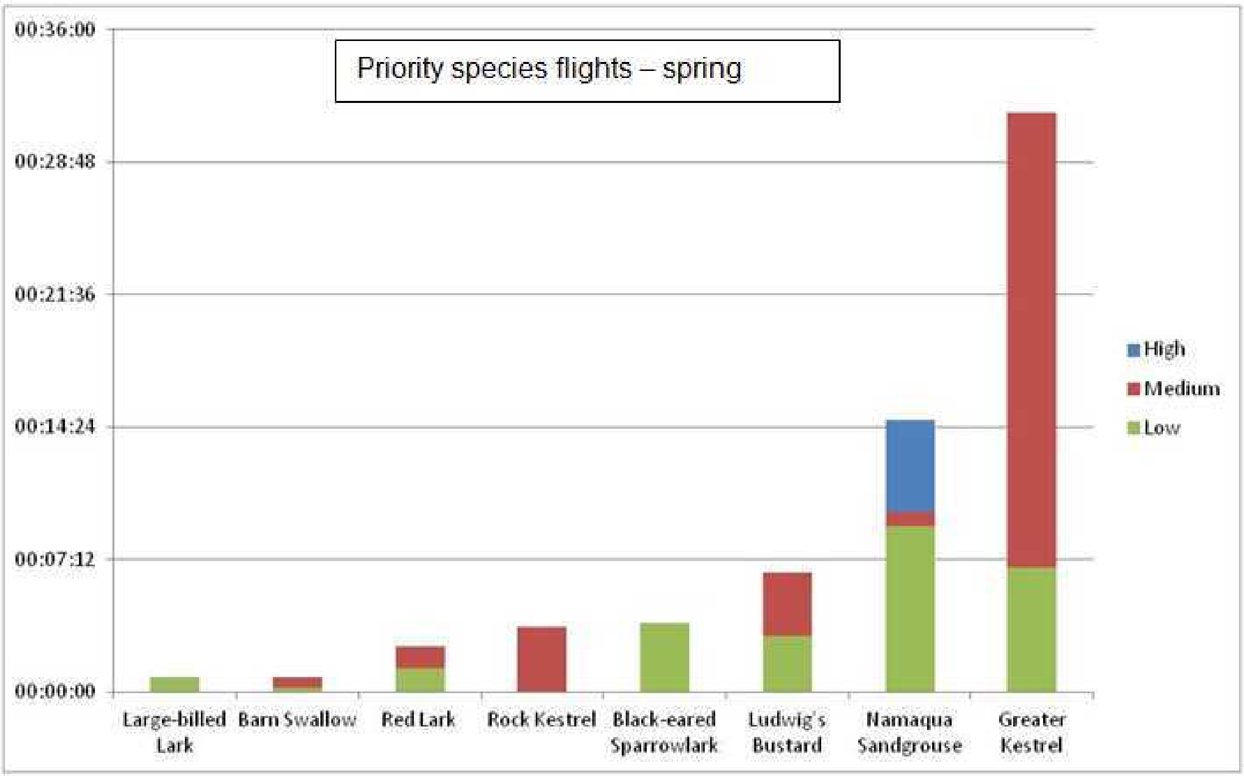


Figure 55: Total flight times (hours: minutes: seconds) and heights (low: medium: high) recorded for priority species

Data so far indicate very little flight activity over the proposed turbine area for priority species. However, it is important to note that only 50% of the proposed pre-construction flight behaviour monitoring has been completed, therefore final conclusions cannot be drawn at this stage. Furthermore, monitoring took place when the pans around the site were dry. As expected, Greater Kestrel contributed the majority of flight activity recorded, due to the breeding pair on the site.

- Displacement due to disturbance

The only reliable way of establishing whether the wind farm will lead to the displacement of priority species is through the implementation of the monitoring programme currently taking place at the site, by comparing pre- and post construction densities of priority species in the wind farm area. To date, a total of 31 species were recorded at the portion of the turbine site which is monitored (i.e. the area where the first 30 turbines are planned) and 21 at the control site using transect counts as a method of data collection. An additional 8 species were recorded within the boundaries of the site during incidental sightings. A total of 541 birds have been recorded at the turbine site, and 212 birds at the control site. Of the species recorded via transect counts at the turbine site, 10 species (32.2%) were priority species and 10 (47.6%) were priority species at the control site. In order to establish a baseline for abundance, an index of kilometre abundance

(IKA) was compiled for the turbine site and the control site for the combined transect counts in the spring and summer monitoring periods. Transects were counted six times in total.
Of the large terrestrial priority species that occur or is likely to occur on the site, Ludwig's Bustard are most likely to be affected by this impact. Bustards are very sensitive to disturbance, and will readily vacate an area due to the presence of human activity (pers. obs.). It is difficult to assess whether the other large priority terrestrial species which are likely to occur at the site will be displaced, but if so, it is likely to be a temporary impact during the construction phase.

As far as foraging raptors are concerned, the chances of displacement are probably low, based on research results elsewhere (Madders and Whitfield 2008). This trend also seems to be supported by the results of the limited post-construction monitoring conducted at the existing four turbines at the Darling Wind Farm (Van Rooyen 2011). The current breeding pair of Martial Eagles is breeding outside the borders of the site, approximately 6.3km away from the closest planned turbine area. The pair should therefore not be at risk of displacement by normal construction activities. The pair of Greater Kestrels breeding on the site would be potentially more at risk, but based on personal observation, it is unlikely that they will be as sensitive to disturbance as Martial Eagles. Provided a modest buffer zone is implemented, they should be able to tolerate the construction activities.

While the site does fall in a Succulent/Nama Karoo ecotone, and supports endemic species from both biomes/bioregions, given its small size (relative to the available habitat), it probably does not pose a significant threat in terms of displacement for endemic passerines. This is on the assumption that displacement of passerines and other small species will take place, which may not happen. Of the priority passerines occurring at the site, the Red Lark *Calendulauda burra* has the most restricted range, followed by Sclater's Lark *Spizocorys sclateri.* These two species would therefore be most impacted should displacement occurs.

- Habitat change and loss

The scale of direct habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, generally speaking, is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development area (Fox *et al.* 2006 as cited by Drewitt & Langston 2006). Direct habitat loss is not regarded as a major impact on avifauna relative to other direct impacts such as collisions with the turbines and potential displacement due to disturbance.

- Mortality due to collisions with associate power lines

Ludwig's Bustard could be negatively impacted by the proposed power line – its vulnerability to power line collisions is well known (Jenkins & Smallie 2009), but its occurrence at the site is likely to be sporadic. The steel monopole design which will be used should not pose an electrocution risk to priority raptors, but that would have to be verified.

10.3 Bat Assessment

There are no obvious roosting opportunities for bats on this site. For the purpose of this study a buffer of 100 meter around inland water bodies and 200 meter around rivers (for foraging purposes) is appropriate.

Since bat activity can vary greatly on a seasonal basis due to insect availability, the lack of bat activity at this site should not be considered a permanent trend. Long term monitoring is imperative to determine seasonal patterns of bat activity at this site. Even if bats do not use this site for regular foraging, possible seasonal migrations of bats may cause bats to fly through the site and this needs to be established through long term monitoring as well.

Although there are no South African guidelines for the consideration of bats in relation to wind farm developments, however, international guidelines such as the Eurobats Guidance and the Natural England Technical Note (Mitchell-Jones and Carlin 2009) give some indication of buffer zones which may be applicable. The Eurobats Guidance (Rodrigues *et al.* 2008) proposes a minimum distance of 200m to forest edges where tree felling is necessary to establish a wind farm. The Natural England Interim Guidance suggests a 50m buffer from blade tip to the nearest feature important to bats.

Impacts of the proposed development on bats include the following:

- Destruction of foraging habitat
- Bat mortalities due to blade collisions and barotrauma during foraging
- Bat mortalities due to blade collisions and barotrauma during migration

10.4 Surface Water Impact Assessment

10.4.1 Nature of the Potential and Anticipated Impacts Associated with the Proposed Development

Several impacts can be anticipated to potentially take place as a result of the proposed development. This section will identify and contextualise each of the anticipated potential impacts in relation to the delineated watercourses and rate these impacts according to an impact rating system (see Appendix B for a full methodology and description of the impact rating system) based on a worst case scenario approach, determine the effect of the environmental impact and provide recommendations towards mitigating the impact.

- Wind Farm Impacts

    - Destruction and Degradation of a Watercourse and Loss of Riparian Habitat along Rivers

Should wind farm, wind turbines and associated buildings and infrastructure need to be placed in a watercourse (encompassing both drainage lines and priority rivers), damage and destruction is highly likely to be caused to the structural component of the concerned hydrological system during the construction phase. Moreover, the consequent functioning of the system will be altered to various degrees depending on the severity of the impact. Loss of habitat will most likely take place where vegetation needs to be removed along the banks of a watercourse or where vegetation needs to be removed from the associated buffer zone. However, none of the wind farm buildings are to be placed within any of the identified watercourses. Potential impacts are therefore not expected but will be assessed and mitigation measures proposed.

Anthropogenic impacts that could affect watercourses may be caused as a result of construction workers or operation personnel entering into any watercourses for various reasons either during the construction or operation phase. The impact and effects can include depositing human feacal and urine waste resulting in pollution of the watercourse, removal of vegetation resulting in physical degradation or establishment of settlings along a watercourse also resulting in degradation of a watercourse, and lastly physical degradation of a watercourse as a consequence of being used as a thoroughfare. Construction is likely to take place in, near or through watercourses should option 1 of the powerlines for be selected, where internal access roads will need to cross watercourses, and where the placement of the wind turbines are within or nearby any of the watercourses, or within the buffer zones of the watercourses.

Construction vehicle activity and operation of machinery nearby or in watercourses can potentially result in the physical destruction and degradation of the channel, bed and banks of a watercourse. This is a particular concern where heavy vehicles enter watercourses. This is likely to take place where internal access roads will need to cross watercourses, and where the placement of the wind turbines are within or nearby any of the watercourses, or within the buffer zones of the watercourses.

Similarly, vehicle activity during the operation phase may potentially result in the destruction and degradation of a watercourse should movement need to take place within or through a watercourse. This is likely to take place where access roads cross watercourses or enter the associated buffer zones (particularly for phase 2 of the wind farm).

    - Excavation and Trenching through Watercourses

Excavations and trenching through watercourses could potentially take place should underground cabling need to course under and / or through the identified watercourses. Excavation will most likely result in the removal and subsequent loss of soils and overlying vegetation associated with a watercourse. This impact may potentially take place in the construction phase. Given the layout of the wind turbines it can be anticipated that trenching and excavation in or through watercourses will be required.

- Establishment of access roads through Watercourses

Internal access roads will be required. Where internal access roads are to course through watercourses (particularly for phase 2 of the wind farm), physical destruction and degradation could result in the construction phase as well as the operation phase. During the construction phase, access roads will need to be established for the duration of the proposed development. This will most likely either involve the infill of materials (sand, grit, tar, concrete etc.) through the channel or along the banks of a watercourse or potentially constructing structures (such as culvert bridges etc.) to cross a watercourse. This probably will have an effect on the hydrological functioning of the affected watercourse altering its hydrological regime.

During the operation phase, access roads that course through a watercourse (particularly for phase 2 of the wind farm) could potentially impact on a watercourse by means of erosion of the implemented structure or materials or through diverting storm water flows into or away from a watercourse. This could result in altering the hydrology of the system and may also act as a contributing factor to erosion impacts to the structural component of a watercourse.

- Pollution risks to Watercourses

Construction activities normally make use of fuels and oils which are necessary for the operation vehicles. In addition, other soluble substances (such as cement) are used for construction purposes. The above mentioned substances present a pollution risk where spillage and leakages take place either in or nearby to watercourses which can impact on the water and sediment quality of these hydrological systems. These impacts can be anticipated with the construction of the wind turbines in phase 2

- Pre-construction Phase Anticipated Potential Impacts

  - Impact – Pre-construction vegetation clearing along the banks of watercourses and in the associated buffer zones of the watercourses

Where vegetation clearing along the banks of a watercourse or in the associated buffer zones are required, the vegetation will therefore be replaced for the duration of the proposed development.

- Construction Phase Anticipated Potential Impacts

    - Impact – Construction phase stormwater run-off impacts

Open and exposed, bare construction areas will be required for the wind turbine laydown areas and for the access roads. As a result the possibility of stormwater run-off could impact on watercourse areas and the associated buffer zone areas by means of water erosion should adequate rainfall take place resulting in accelerated run-off quantities.

- Operation Phase Anticipated Potential Impacts

    - Impact – Vehicle damage to watercourses and associated buffer zones during wind turbine and powerline maintenance

Maintenance activities will need to be carried out on the powerlines as well as the wind turbines that have been authorised to be placed within or nearby to watercourses. Regular access will therefore be required in order for personnel to conduct maintenance activities. Access will most likely be required by means of vehicles. Regular vehicular activity into watercourses can cause damage not only to the vegetation, but also to the soils, bed and banks. These components are critical functional components of watercourses and depend on the unique properties or characteristics of each other. Once the properties and characteristics of the watercourse components are compromised or changed (for example, compaction caused by vehicle movement), change to the natural dynamics and functioning of a watercourse can be expected. Mitigation measures are provided below to minimise anticipated damage and degradation during operational phase maintenance.

    - Impact – Stormwater run-off impacts to watercourses and associated buffer zone areas

Due to the probable construction of internal access roads and laydown areas associated with the wind turbines that will need to be place within of nearby to watercourses and the associated buffer zones, stormwater run-off impacts can be expected. This potential impact is evaluated in Table 6 below and appropriate mitigation are proposed.

- Decommissioning Phase Anticipated Potential Impacts

- Impact – Removing wind turbines and power line structures from within or nearby watercourses and the associated buffer zone areas

Wind turbines are relatively large structures. Power lines and the associated towers will be much smaller structures than the wind turbines. Each however, will require foundations in order to stand. The process of allowing vehicles into watercourse areas to remove the abovementioned structures as well as for the purposes of excavating the foundations would disturb the substrate and entail the removal of soil and any prevalent vegetation in the wind turbine and power line tower footprint. The potential damage to vegetation and soils in the nearby area due to the movement of construction machinery in and out of the vicinity can also take place. Similarly, an area will be required to stockpile soil and equipment during de-construction. Sedimentation as a result run-off from excavation stockpiled soils and consequent erosion and deposition into nearby wetlands and watercourses is likely to occur and affect the functioning of a watercourse by causing pollution in terms of the NWA if not mitigated properly. Exposed excavations are furthermore susceptible to erosion especially after rainfall events which can extend to the nearby wetlands and watercourses if left open for long periods.

Further construction related impacts that are associated with the placing of monopole towers in wetlands and riparian zones include the presence and movement of vehicles as well as the operation of machinery in a watercourse and the associated buffer zone areas. Firstly, damage by means of compaction and consequent erosion may ensue with vehicles coming into and going out of the watercourses and buffer zone areas. Secondly, accidental leakages (fuel, oils and cement) and the consequent introduction of pollutants into these hydrological systems can occur. Additionally, the movement of heavy construction machinery into the buffer zones of the watercourses could likely result in the compaction of soils and degradation of sensitive vegetation in the adjacent areas. Finally, workers entering and using the watercourse and buffer zone areas for inappropriate activities (dumping materials, depositing human faecal and urine waste etc.) may impact on the surface water resources. It is important that these anticipated potential impacts are mitigated.

- Impact – Decommissioning phase stormwater run-off impacts

Open and exposed, bare construction areas can be anticipated for the wind turbine laydown areas and for de-construction of the access roads. As a result the possibility of stormwater run-off could impact on watercourse areas and the associated buffer zone areas by means of water erosion should adequate rainfall take place resulting in accelerated run-off quantities. This potential impact is evaluated in Table 8 below and appropriate mitigation are proposed.

10.5 Agricultural Potential

10.5.1 Agricultural potential assessment

In terms of this study, agricultural potential is described as an area's suitability and capacity to sustainably accommodate an agricultural land use with this potential being benchmarked against crop production.

- Current Situation

The farms which constitute the assessment area for this project are currently used as extensive grazing land for free range sheep production (Figure 56). After discussions with the various land owners the stocking rates are estimated at around 1 SSM (small stock unit) per 10 hectares. Water is the major limiting factor to local agricultural enterprises and PDA does not contain nor do they border a perennial river / freshwater impoundment which could be used as a source of irrigation water. The site does not currently accommodate any centre pivots, irrigation schemes or active agricultural fields. Seasonal pans tend to have the highest grazing potential due to the increased plant available water. Drinking water for the animals is sourced from the groundwater resources.

Figure 56: A typical flock of sheep grazing on the Loeriesfontein Site

- Verified Agricultural Potential

Overall agricultural potential is based on assessing a number of inter-related factors including climate, topography, soil type, soil limitations and current land use. In this area climate is the overriding and foremost limiting factor to sustainable agricultural production. The combination of low rainfall and an extreme moisture deficit means that sustainable arable agriculture cannot take place without some form of irrigation. The site does not contain nor is it bounded by a reliable surface water irrigation resource and the use of groundwater for this purpose does not seem agriculturally and economically feasible. This is due to the high cost of borehole installation, the sheer volume of water required for irrigation purposes and the quality of the local groundwater.

Shallow lithic and calcic soils (Mispah and Coega Form) cover approximately 97% of the total survey area. Virtually all the soils encountered had a layer that was limiting to plant growth and are very susceptible to erosion. Effective soil depth rarely exceeded 50 cm. A map indicating agricultural potential in terms of crop production for site is provided in Figure 57. The majority of the site has been classified as having low potential for crop production due to an arid climate and highly restrictive soil characteristics. The site is not classified in terms of registering a high agricultural potential and they are not a unique dry land agricultural resource. The PDA is considered to have a moderately low value when utilised as grazing land, its current use.

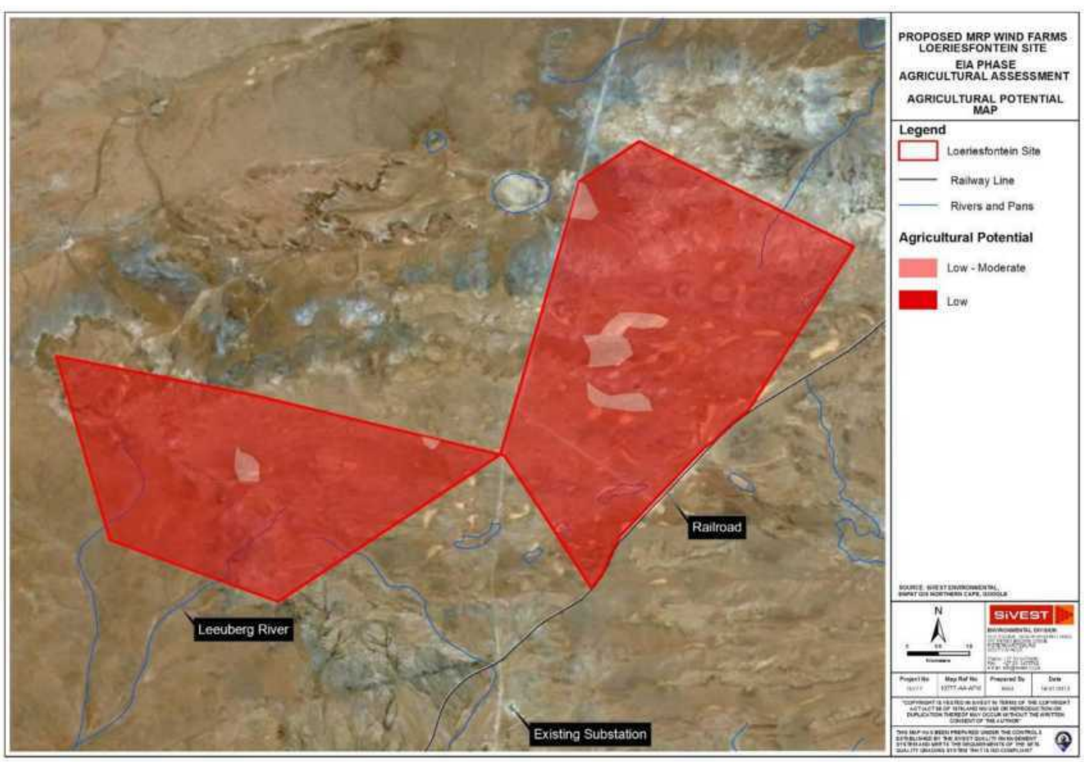


Figure 57: Agricultural Potential Map for the PDA

10.5.2 Impacts

The proposed development's primary impact on agricultural activities will involve the construction of the wind turbines and associated infrastructure. The construction entails the clearing of vegetation around the footprint of the turbines as well as creating service roads.

Normal grazing (the dominant agricultural activity) will be permitted around the turbines. All three farms, which constitute the study area, are dominated grazing land and this activity is considered non-sensitive when assessed within the context of the proposed development. Consequently, the impact of the proposed development on the study area's agricultural potential will be extremely low, with the loss of agricultural land being attributed to the creation of the service roads and around the turbine foundations. We re-iterate that this loss is considered inconsequential within the context of this assessment. The construction of these facilities will only influence a portion of assessed area. The remaining land will continue to function as they did prior to the development.

There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the proposed development. Therefore, from an agricultural perspective, there are no problematic or fatal flaw areas for the site (Figure 58).

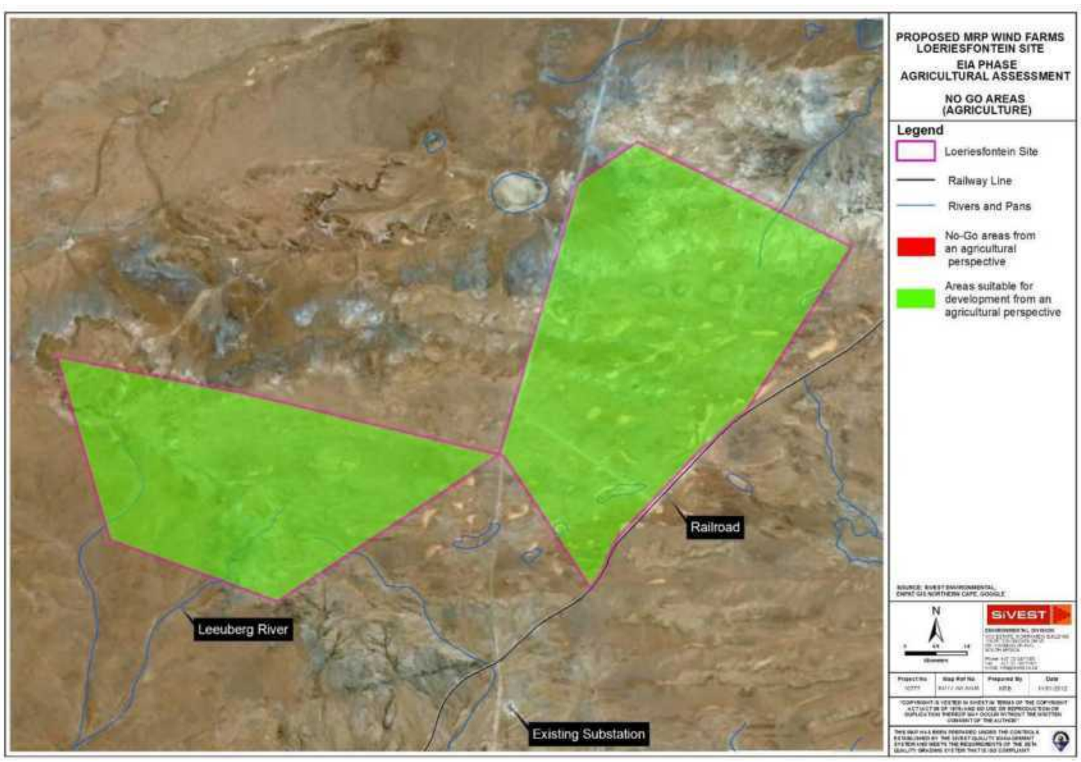


Figure 58: No Go Area Map from an Agricultural Perspective

10.6 Noise Impact Assessment

10.6.1 Potential Noise Sources: Construction Phase

- Construction equipment

Construction activities include:

- Establish internal access roads - the internal road alignment is governed by the positioning of the wind turbines. The potential risk would depend whether any access roads are constructed near to any potential noise-sensitive developments;
- Site preparation activities will include clearance of vegetation at the footprint of each turbine. These activities will require the stripping of topsoil which will need to be stockpiled, backfilled and/or spread on site;
- Construct foundations – it is expected that the volume of concrete required for each turbine foundation will be in the order 300 - 400 m^3. Due to the volume of concrete that will be required, an on-site batching plant could be required to ensure a continuous concreting operation. The source of aggregate is yet undefined;
- Transport of components and equipment to site – all components will be brought to site in sections by means of flatbed trucks. Additionally, components of various specialized construction and lifting equipment are required on site to erect the wind turbines and will need to be transported to site. The typical civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement trucks, etc.). The components required for the establishment of the overhead power line (including towers and cabling) will be transported to site as required;
- Establishment of laydown and hard standing areas - laydown areas will need to be established at each turbine position for the placement of wind turbine components. Laydown and storage areas will also be required to be established for the civil engineering construction equipment which will be required on site. Hard standing areas will need to be established for operation of the crane. Cranes of the size required to erect turbines are sensitive to differential movement during lifting operations and require a hard standing area;
- Erect turbines - a crane will be used to lift the tower sections into place and then the nacelle will be placed onto the top of the assembled tower. The next step will be to assemble or partially assemble the rotor on the ground; it will then be lifted

to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while the large crane will be needed to put it in place;

- Construct substation - the underground cables carrying the generated power from the individual turbines will join at the substation. The construction of the substation would require a site survey; site clearing and leveling and construction of access road/s (where required); construction of a substation terrace and foundation; assembly, erection and installation of equipment (including transformers); connection of conductors to equipment; and rehabilitation of any disturbed areas and protection of erosion sensitive areas;
- Establishment of ancillary infrastructure - A workshop as well as a contractor's equipment camp may be required. The establishment of these facilities/buildings will require the clearing of vegetation and leveling of the development site and the excavation of foundations prior to construction. A laydown area for building materials and equipment associated with these buildings will also be required;
- Connection of wind turbines to the substation - each wind turbine will be connected to the on-site substation via electrical cables, to be lain underground where possible. The installation of these cables will require the excavation of trenches of approximately 1 m deep within which they can then be laid. The underground cables will be planned to follow the internal access roads, where possible;
- A number of overhead power lines to connect to Eskom's existing Substation in the area;
- Site rehabilitation - once construction is completed and once all construction equipment is removed, the site will be rehabilitated where practical and reasonable.

The equipment likely to be required to complete the above tasks will typically include:

- excavator/graders, bulldozer(s), dump trucks(s), vibratory roller, bucket loader, rock breaker(s), drill rig, flatbed truck(s), pile drivers, concrete truck(s), crane(s), fork lift(s) and various 4WD and service vehicles.

Octave sound power levels typical for this equipment are presented in Appendix A of the main Noise Report.

- Material supply: Concrete batching plants and use of Borrow Pits

There exist three options for the supply of the concrete to the development site. These options are:

- The transport of "ready-mix" concrete from the closest centre to the development

- The transport of aggregate and cement from the closest centre to the development, with the establishment of a small concrete batching plant close to the activities. This would most likely be a movable plant.
- The establishment of a small quarrying activity, where aggregate will be mined, crushed and screened and used onsite. Cement will still be transported to the site, where there will be a small movable concrete batching plant.

While some stone are removed during foundation development, this stone may not be sufficient, or of an acceptable quality for the use as concrete aggregate material. Additional aggregate are generally required.

For the purpose of the EIA, Option 2 was assumed as being the preferred option. Any required aggregate will be sourced from existing commercial borrow pits in the area.

- Blasting

Blasting may be required as part of the civil works to clear obstacles or to prepare foundations. However, blasting will not be considered during the EIA phase for the following reasons:

- Blasting is highly regulated, and control of blasting to protect human health, equipment and infrastructure will ensure that any blasts will use the minimum explosives and will occur in a controlled manner. The breaking of obstacles with explosives is also a specialized field and when correct techniques are used, causes significantly less noise than using a rock-breaker.
- People are generally more concerned over ground vibration and air blast levels that might cause building damage than the impact of the noise from the blast. However, these are normally associated with close proximity mining/quarrying.
- Blasts are an infrequent occurrence, with a loud but a relative instantaneous character. Potentially affected parties generally receive sufficient notice (siren) and the knowledge that the duration of the siren noise as well as the blast will be over relative fast results in a higher acceptance of the noise. Note that with the selection of explosives and blasting methods, noise levels from blasting is relatively easy to control.

- Traffic

A significant source of noise during the construction phase is additional traffic to and from the site, as well as traffic on the site. This will include trucks transporting equipment, aggregate and cement as well as various components used to develop the wind turbine.

Construction traffic is expected to be generated throughout the entire construction period, however, the volume and type of traffic generated will be dependent upon the construction activities being conducted, which will vary during the construction period. Noise levels due to additional traffic will be estimated using the methods stipulated in SANS 10210:2004 (Calculating and predicting road traffic noise).

10.6.2 Potential Noise Sources: Operational Phase

Noise emitted by wind turbines can be associated with two types of noise sources. These are aerodynamic sources due to the passage of air over the wind turbine blades and mechanical sources that are associated with components of the power train within the turbine, such as the gearbox and generator and control equipment for yaw, blade pitch, etc. These sources generally have different characteristics and can be considered separately. In addition there are other lesser noise sources, such as the substations themselves, traffic (maintenance) as well as power line noise.

- Wind Turbine Noise: Aerodynamic sources[5]

Aerodynamic noise is emitted by a wind turbine blade through a number of sources such as:

- Self noise due to the interaction of the turbulent boundary layer with the blade trailing edge
- Noise due to inflow turbulence (turbulence in the wind interacting with the blades)
- Discrete frequency noise due to trailing edge thickness
- Discrete frequency noise due to laminar boundary layer instabilities (unstable flow close to the surface of the blade)
- Noise generated by the rotor tips

Noise due to aerodynamic instabilities (mechanisms 3 and 4) can be reduced to insignificant levels by careful design. The other mechanisms are an inescapable consequence of the aerodynamics of the turbine that produces the power and between them they will make up most, if not all, of the aerodynamic noise radiated by the wind turbine. The relative contribution of each source will depend upon the detailed design of the turbine and the wind speed and turbulence at the time.

The mechanisms responsible for tip noise (mechanism 5) are currently under investigation, but it appears that methods for its control through design of the tip shape might be available. Self-noise (mechanism 1) is most significant at low wind speeds, whereas noise due to inflow turbulence (mechanism 2) becomes the dominant source at the higher wind speeds. Both mechanisms increase in strength as the wind speed increases, particularly inflow turbulence. The overall result is that at low to moderate wind speeds, the noise from a fixed speed wind turbine increases at a

[5] *Renewable Energy Research Laboratory, 2006; ETSU R97: 1996*

rate of 0.5-1.5 dBA /m/s up to a maximum at wind speeds of 7 -12 m/s (noise generated by the WTG does not increase significantly at wind speeds above 12 m/s).

Therefore, as the wind speed increases, noises created by the wind turbine also increases. At a low wind speed the noise created by the wind turbine is generally (relatively) low, and increases to a maximum at a certain wind speed when it either remains constant as illustrated in Figure 59, increase very slightly or even drops, all depending on the design of the specific wind turbine generator.

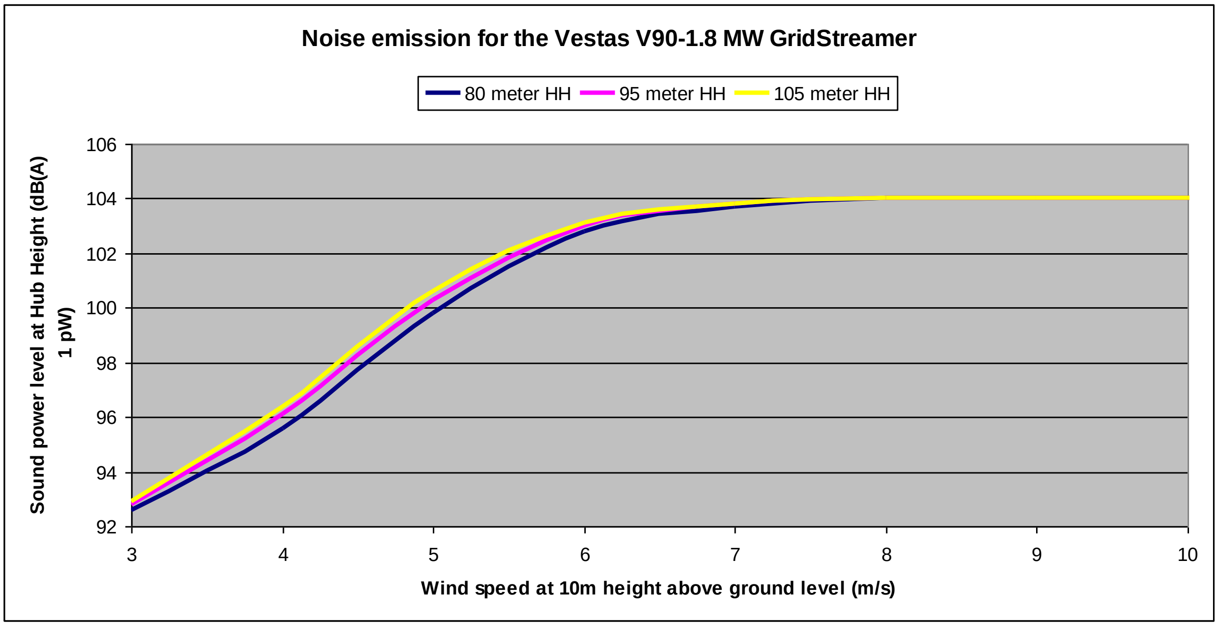


Figure 59: Noise Curve Vestas V90 – 1.8 MW GridStreamer (figure for illustration purposes only)

Typical noise characteristics can be measured for each type of wind turbine, and minimum/average/maximum curves can be compiled. The more accurate the data, the more accurate the modelling would be.

The developer highlighted that the exact make and model of wind turbine considered are yet unknown, and that the final choice would only be taken once more wind data is available as well as the economic conditions at that point. The Nordex H90 2500 wind turbine generator was selected for the purpose of this Environmental Noise Impact Assessment. The noise characteristics of this wind turbine were sourced from the internet.

Sound power emissions (in octave sound power levels) for this wind turbine are presented in Table 34. The propagation model makes use of various frequencies, because these frequencies are affected in different ways as it propagates through air, over barriers and over different ground conditions.

- Wind Turbine: Mechanical sources[6]

Mechanical noise is generally perceived within the emitted noise from wind turbines as an audible tone(s) that is subjectively more intrusive than a broad band noise of the same sound pressure level. Sources for this noise are generally associated with: the gearbox and the tooth mesh frequencies of the step up stages; generator noise caused by coil flexure of the generator windings that is associated with power regulation and control; generator noise caused by cooling fans; and control equipment noise caused by hydraulic compressors for pitch regulation and yaw control.

Tones are noises with a narrow sound frequency composition (e.g. the whine of an electrical motor). Annoying tones can be created in numerous ways: machinery with rotating parts such as motors, gearboxes, fans and pumps often create tones. An imbalance or repeated impacts may cause vibration that, when transmitted through surfaces into the air, can be heard as tones. Pulsating flows of liquids or gases can also create tones, which may be caused by combustion processes or flow restrictions. The best and most well-known example of a tonal noise is the buzz created by a flying mosquito.

Where complaints have been received due to the operation of wind farms, tonal noise from the installed wind turbines appears to have increased the annoyance perceived by the complainants and indeed has been the primary cause for complaint.

However, tones were normally associated with the older models of turbines. All turbine manufacturers have started to ensure that sufficient forethought is given to the design of quieter gearboxes and the means by which these vibration transmission paths may be broken. Through the use of careful gearbox design and/or the use of anti-vibration techniques, it is possible to minimise the transmission of vibration energy into the turbine supporting structure.

The benefits of these design improvements have started to filter through into wind farm developments which are using these modified wind turbines. ***New generation wind turbine generators should not emit any clearly distinguishable tones***.

- Transformer noises (Substations)

Also known as magnetostriction, this is when the sheet steel used in the core of the transformer tries to change shape when being magnetised. When the magnetism is taken away, the shape returns, only to try and deform in a different manner when the polarity is changed.

[6] *Renewable Energy Research Laboratory, 2006; ETSU R97: 1996; Audiology Today, 2010; HGC Engineering, 2007*

This deformation is not uniform; consequently it varies all over a sheet. With a transformer core being composed of many sheets of steel, these deformations are taking place erratically all over each sheet, and each sheet is behaving erratically with respect to its neighbour. The resultant is the “hum” frequently associated with transformers. While this may be a soothing sound in small home appliances, various complaints are logged in areas where people stay close to these transformers. At a voltage frequency of 50 Hz, these “vibrations” takes place 100 times a second, resulting in a tonal noise at 100Hz. This is normally not an issue if the substation is further than 200 meters from a potentially sensitive receptor.

This is a relatively easy noise to mitigate with the use of acoustic shielding and/or placement of the transformer equipment and will not be considered further in the EIA study.

- Power Line Noise (Corona noise)

Corona noise is caused by the partial breakdown of the insulation properties of air surrounding the conducting wires. It can generate an audible and radio-frequency noise, but generally only occurs in humid conditions as provided by fog or rain. A minimum line potential of 70 kV or higher is generally required to generate corona noise depending on the electrical design. Corona noise does not occur on domestic distribution lines.

Corona noise has two major components: a low frequency tone associated with the frequency of the AC supply (100 Hz for 50 Hz source) and broadband noise. The tonal component of the noise is related to the point along the electric waveform at which the air begins to conduct. This varies with each cycle and consequently the frequency of the emitted tone is subject to great fluctuations. Corona noise can be characterised as broadband ‘crackling’ or ‘buzzing’, but fortunately it is generally only a feature during fog or rain.

It will not be further investigated, as corona discharges results in:

- Power losses
- Audible noises
- Electromagnetic interference
- A purple glow
- Ozone production
- Insulation damage

As such, Electrical Service Providers (such as Eskom) goes to great lengths to design power transmission equipment to minimise the formation of corona discharges. In addition, it is an infrequent occurrence with a relative short duration compared to other operational noises. At the relative low voltages proposed for this project Corona noises would not be an issue.

- Low Frequency Noise[7]
    - Background

Low frequency sound is the term used to describe sound energy in the region below ~200Hz. The rumble of thunder and the throb of a diesel engine are both examples of sounds with most of their energy in this low frequency range. Infrasound is often used to describe sound energy in the region below 20Hz.

Almost all noise in the environment has components in this region although they are of such a low level that they are not significant (wind, ocean, thunder).

- The generation of Low Frequency Sounds

Due to the low rotational rates of the blades of a WTG as well as the size of these blades, significant acoustic energy is radiated by large wind turbines in the infrasonic range. It should be noted that a number of studies highlighted that these sounds are below the threshold of perception (BWEA, 2005).

- Detection of Low Frequency Sounds

The levels of infrasound radiated by the largest wind turbines are very low in comparison to other sources of acoustic energy in this frequency range such as sonic booms, shock waves from explosions, etc. The danger of hearing damage from wind turbine low-frequency emissions is remote to non-existent. However, sounds in a frequency range less than 100Hz can, under the right circumstances, be responsible for annoying nearby residents. However, except very near the source, most people outside cannot detect the presence of low-frequency noise from a wind turbine. It should be noted that there are people who are more sensitive to low frequency sounds.

- Measurement, Isolation and Assessment of Low Frequency Sounds

There remains significant debate regarding the noise from WTGs, public response to that noise, as well as the presence or not of low frequency sound and how it affects people. While low frequency sounds can be measured, it is far more difficult to isolate low frequency sounds due to the numerous sources that generate these sounds.

Unfortunately, there isn't a standardised test, nor an assessment procedure available for the assessment of low frequency sounds, neither is there an accepted methodology on how low frequency sounds can be modelled or predicted. This is because low frequency sound can travel large distances, and are present all around us, with a significant component generated by nature itself (ocean, wind, etc.).

[7] Renewable Energy Research Laboratory, 2006; DELTA, 2008; DEFRA, 2003; HGC Engineering, 2006; Whitford, Jacques, 2008; Noise-con, 2008; Minnesota DoH, 2009; Kamperman, 2008, Van den Berg, 2004

SANS 10103 proposes a method to identify whether low frequency noise could be an issue. It proposes that if the difference between the A-frequency weighted and the C-frequency weighted equivalent continuous (L_{Aeq} >> L_{Ceq}) sound pressure levels is greater than 10 dB, a predominant low frequency component **may** be present. However, at all cases existing acoustic energy in low frequencies associated with wind must be considered.

- Summary: Low Frequency Noise[8]

Low frequency noise is always present around us as it is produced by both man and nature. While problems have been associated with older downwind wind turbines in the 1980s, this has been considered by the wind industry and modern upwind turbines do not suffer from the same problems.

- Amplitude modulation[9]

Although very rare, there is one other characteristic of wind turbine sound that increases the sleep disturbance potential above that of other long-term noise sources. The amplitude modulation of the sound emissions from the wind turbines creates a repetitive rise and fall in sound levels synchronised to the blade rotation speed, sometimes referred to as a “swish” or “thump”.

Pederson (2003) highlighted a weak correlation between sound pressure level and noise annoyance caused by wind turbines. Residents complaining about wind turbines noise perceived more sound characteristics than noise levels. People were able to distinguish between background ambient sounds and the sounds that the blades made. The noise produced by the blades lead to most complaints. Most of the annoyance was experienced between 16:00 and midnight. This could be an issue as noise propagation modelling would be reporting an equivalent, or “average” sound pressure level, a parameter that ignores the “character” of the sound.

Unfortunately, the mechanism of amplitude modulated noises is not known although various possible reasons have been put forward. Although the prevalence of complaints about amplitude modulation is relatively small, it is not clear whether this is because it does not occur often enough or whether it is because housing is not in the right place to observe it. Furthermore, the fact that the mechanism is unknown means that it is not possible to predict when or whether it will occur.

8 BWEA, 2005

9 Renewable Energy Research Laboratory, 2006; Audiology Today, 2010; HGC Engineering, 2007; Whitford, 2008; Noise-con, 2008; DEFRA, 2007; Bowdler, 2008

Even though there are thousands of wind turbine generators in the world, amplitude modulation is one subject receiving the least complaints and due to this very few complaints, little research went into this subject. It is included in this report to highlight all potential risks, albeit extremely low risks such as this (low significance due to very low probability).

10.6.3 Results and Impact Assessment: Construction Phase Impact

Construction activities are highly dependent on the final operational layout. A number of different activities might take place close to a potentially sensitive receptor, each with a specific potential impact.

- Description of Construction Activities Modelled

The following construction activities are assumed to take place simultaneously:

- General work at the workshop area. This would be activities such as equipment maintenance, off-loading and material handling. All vehicles will travel to this site where most equipment and material will be off-loaded (general noise, crane). Material, such as aggregate and building sand, will be taken directly to the construction area (foundation establishment). Activities will be taking place for 16 hours during the 16 hour day time period.
- Surface preparation prior to civil work. This could be the removal of topsoil and levelling with compaction, or the preparation of an access road (bulldozer/grader). Activities will be taking place for 8 hours during the 16 hour day time period.
- Preparation of foundation area (sub-surface removal until secure base is reached – excavator, compaction, and general noise). Activities will be taking place for 10 hours during the 16 hour day time period.
- Pouring and compaction of foundation concrete (general noise, electric generator/compressor, concrete vibration, mobile concrete plant, TLB). As foundations must be poured in one go, the activity is projected to take place over the full 16 hour day time period.
- Erecting of the wind turbine generator (general noise, electric generator/compressor and a crane). Activities will be taking place for 16 hours during the 16 hour day time period.
- Traffic on the site (trucks transporting material, aggregate/concrete, work crews) moving from the workshop/store area to the various activity sites. All vehicles to travel at less than 60 km/h, with a maximum of five (5) trucks and vehicles per hour to be modelled travelling to the areas where work is taking place (red line).

There will be a number of smaller equipment, but the addition of the general noise source (at each point) covers most of these noise sources. It has been modelled that all equipment would be operating under full load (generate the most noise) and that atmospheric conditions would be ideal for sound propagation.

Even though construction activities are projected to take place only during day time, it might be required at times that construction activities take place during the night (particularly for a large project). Below is a list (and reasons) of construction activities that might occur during night time:

- Concrete pouring: Large portions of concrete do require pouring and vibrating to be completed once started, and work is sometimes required until the early hours of the morning to ensure a well-established concrete foundation. However the work force working at night for this work will be considerably smaller than during the day.
- Working late due to time constraints: Weather plays an important role in time management in construction. A spell of bad weather can cause a construction project to fall behind its completion date. Therefore it is hard to judge beforehand if a construction team would be required to work late at night.

Due to the dependence on the operational layout, it was selected to model the impact of the noisiest activity (laying of foundation totalling 113.6 dBA cumulative noise impact) at all noise-sensitive developments (Table 32) as well as mapping this modelled construction activity over distance. Noise created due to linear activities (roads) were also evaluated and plotted against distance as illustrated in Figure 61.

The various sound power levels of the equipment used (in the octave bands) can be found in Appendix A of the main Noise Report.

- Results: Construction Phase

The scenario as defined above was modelled with the output presented in Figure 60 and Figure 61. Modelled noise levels are defined for the layout in Table 32 with the impact tables presented in Table 33.

Only the calculated day time ambient noise levels are presented, as construction activities that might impact on sensitive receptors should be limited to the 06:00 – 22:00 time period. The worst case scenario is presented with all the activities taking place simultaneously during wind-still conditions, in good sound propagation conditions (20^{o}C and 80% humidity).

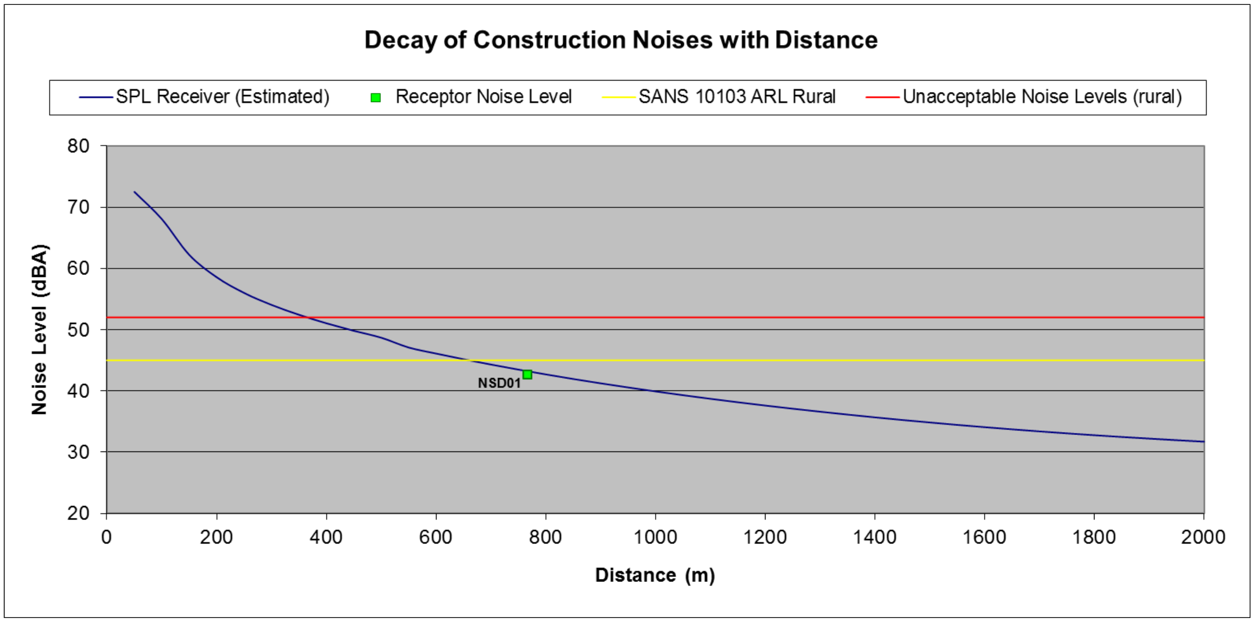


Figure 60: Construction noise: Projected Construction Noise Levels as distances increase between NSDs and locations where construction can take place

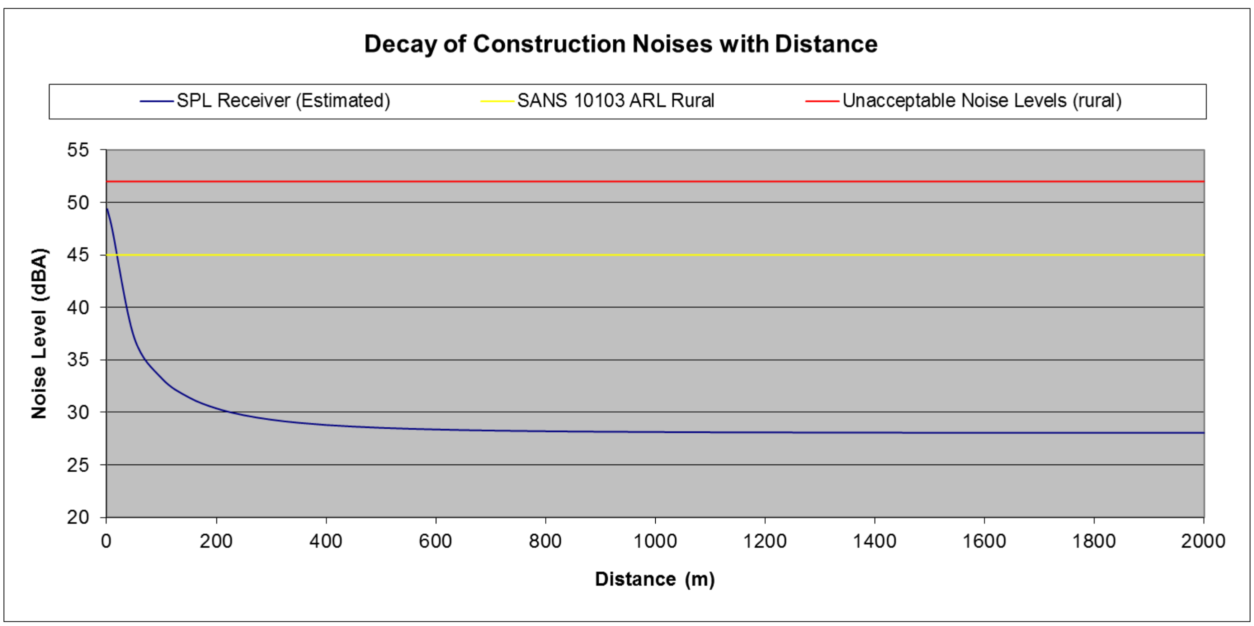


Figure 61: Construction noise: Projected Road Traffic Noise Levels as distances increase between a conceptual NSD and access roads (5 LDV and 5x Trucks per hour travelling at 50 km/hr on a gravel road)

From the preceding figures it can be observed the noise levels due to construction activities as well as increased traffic due to construction activities would be insignificant (access roads further than 20 meters from dwellings). While the increases in noise levels at NSD01 might be high, it is still far less than the proposed rating level and taking place during a time (during the day) when significant other ambient sounds exist.

Table 32: Construction: Defining noise impact on Receptors (dBA)

Receptor	Estimated Daytime Ambient Sound Level	Day Ambient Noise Level[10]	Above daytime rating level	Change From ambient sound level	Defining Significance of Noise Impact				
					Magnitude	Duration	Extent	Probability	Significance
NSD01	28	42.6	0.0	14.6	10	1	2	1	13
NSD02	28	31.1	0.0	3.1	4	1	2	1	7

- Impact Assessment: Construction Phase

The impact assessment for the various construction activities that may impact on the surrounding environment is presented in the Table 33.

Table 33: Impact Assessment: Construction Activities without Mitigation

Nature:	Numerous simultaneous construction activities that could impact on NSDs.
Acceptable Rating Level	Rural district with little road traffic: 45 dBA outside during day (refer section 5 of the main Noise report) Use of $L_{Req,d}$ of 45 dBA for rural areas.
Extent ($L_{Aeq} > L_{Req,d}$)	Local – Noise impact does not extend further than 1,000 meters from activity (2).
Duration	Temporary – Noisy activities in the vicinity of the receptors would last only a fraction of the construction period (few months) (1).
Magnitude	See Table 32 Ambient noise levels > Zone Sound Level Change in ambient sound levels > 7dBA (NSD01) High (10)
Probability	The construction noises will significantly change the existing ambient sound levels in the area, especially at NSD01, yet the projected noise levels are still less than the rating level. It is highly likely that the noise levels will be less than typical ambient sound levels associated with a farm dwelling. This is

10 Ambient sound level was calculated using the SANS methods discussed in this report.

	because the noises created by normal daily activities would mask all construction related noises. Improbable (1).
Significance	Low (7 - 13).
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Comments	-
Can impacts be mitigated?	Yes, though mitigation not required.
Mitigation:	Presented in the mitigation section below
Cumulative impacts:	This impact is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area.
Residual Impacts:	This impact will only disappear once construction activities cease.

10.6.4 Results and Impact Assessment: Operational Phase Impact

The Mitigation Options, Environmental Management Plan, Conclusions and Recommendations consider the output from this section.

- Description of Operational Activities Modelled

The developer indicated that the make and model for the wind turbine was not yet finalised, and the Nordex H90 2500HS wind turbine was selected to illustrate, identify and model potential noise impacts. The octave sound power levels of this wind turbine are presented in Table 34.

Table 34: Octave Sound Power Emission Levels used for modelling

Wind Speed at 10 m (m/s)	63 (dBA)	125 (dBA)	250 (dBA)	500 (dBA)	1000 (dBA)	2000 (dBA)	4000 (dBA)	LWA (dBA)
3*	80.2	84.3	88.7	89.1	87.6	86.5	82.5	95.0
4*	84.2	88.3	92.7	93.1	91.6	90.5	86.5	99.0
5*	87.7	91.8	96.2	96.6	95.1	94.0	90.0	102.5
6*	90.7	94.8	99.2	99.6	98.1	97.0	93.0	105.5
7*	91.7	95.8	100.2	100.6	99.1	98.0	94.0	106.5
8*	92.2	96.3	100.7	101.1	99.6	98.5	94.5	107.0

9*	92.2	96.3	100.7	101.1	99.6	98.5	94.5	107.0

* Source: NX_TR_0888_EN, 2007-09-11

Potential impacts due to low frequency sounds will also be considered. For this purpose the sound power level at both the 16 and 31.5 Hz frequency band will also be estimated and used to calculate the C-Weighted Noise Levels. However, as previously highlighted, as wind speeds increase, wind induced noise levels also increases, and the associated ambient sound levels due to wind will be considered at all times.

It should be noted that SANS 10357:2004 does not provide methods to estimate sound propagation below 63 Hz. While this assessment does calculate the sound power levels at lower frequency bands (to allow the calculation of the C-weighted Sound Power Levels to estimate the potential/probability for low frequency noises), the reader should realise that this is for information purposes only. In terms of accuracy, the sound power level at these frequency bands is estimated at ±5-15 dBA (due to the unknown adjustment factor for meteorological effects at the 16 and 31.5Hz octave band frequencies), as well as the lack of 16 and 31.5 Hz octave sound power levels of the selected wind turbine.

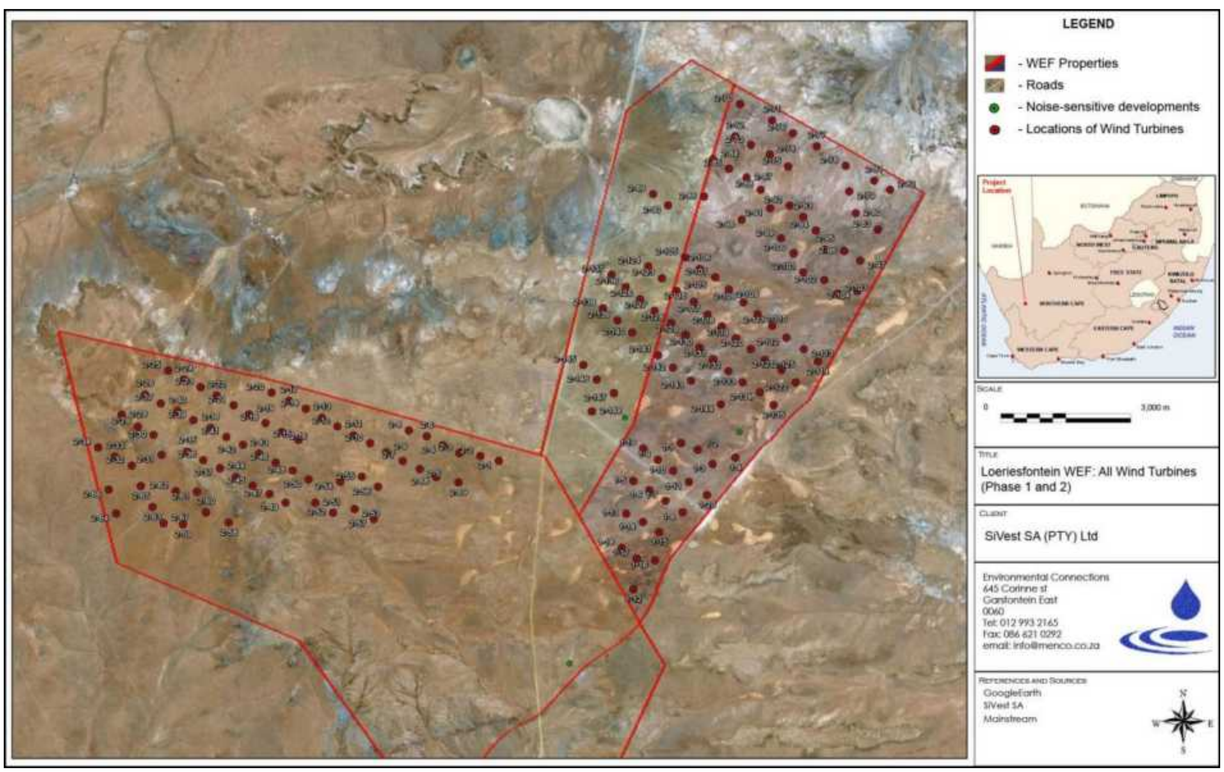


Figure 62: Loeriesfontein illustrating the revised Layout as modelled with turbines numbered

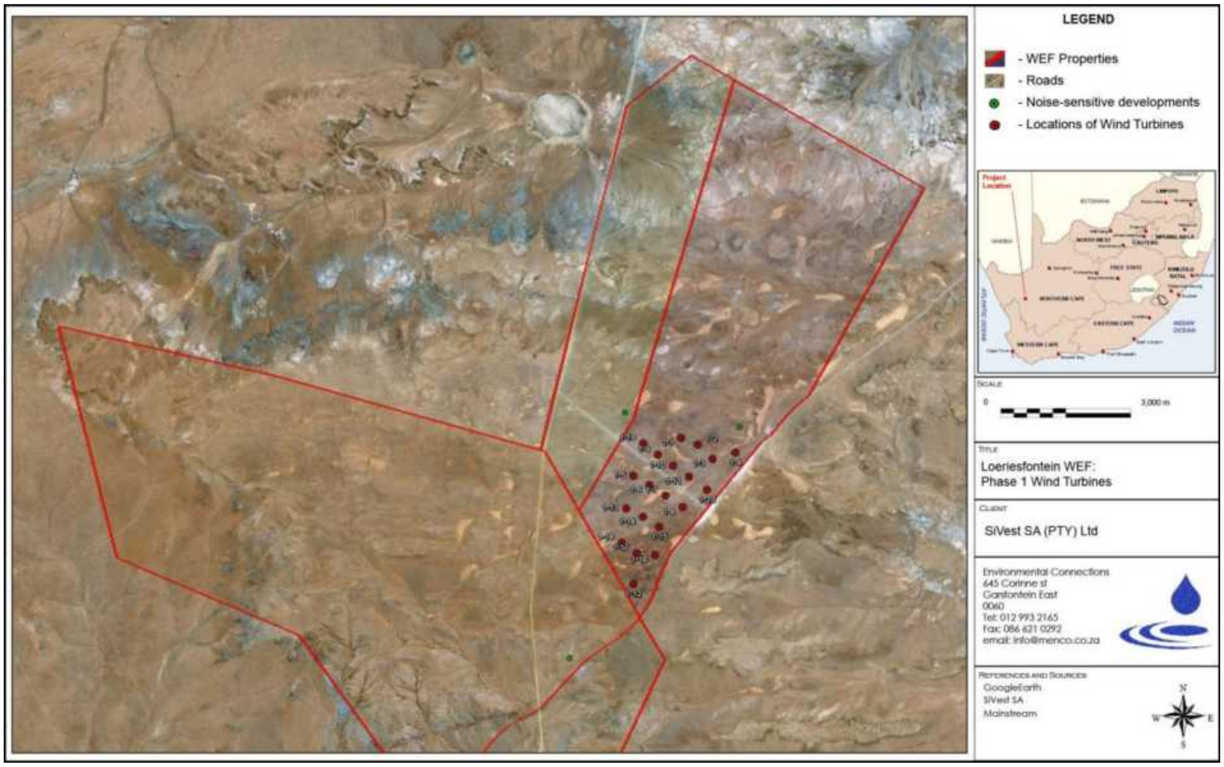


Figure 63: Loeriesfontein illustrating the Layout of Phase 1

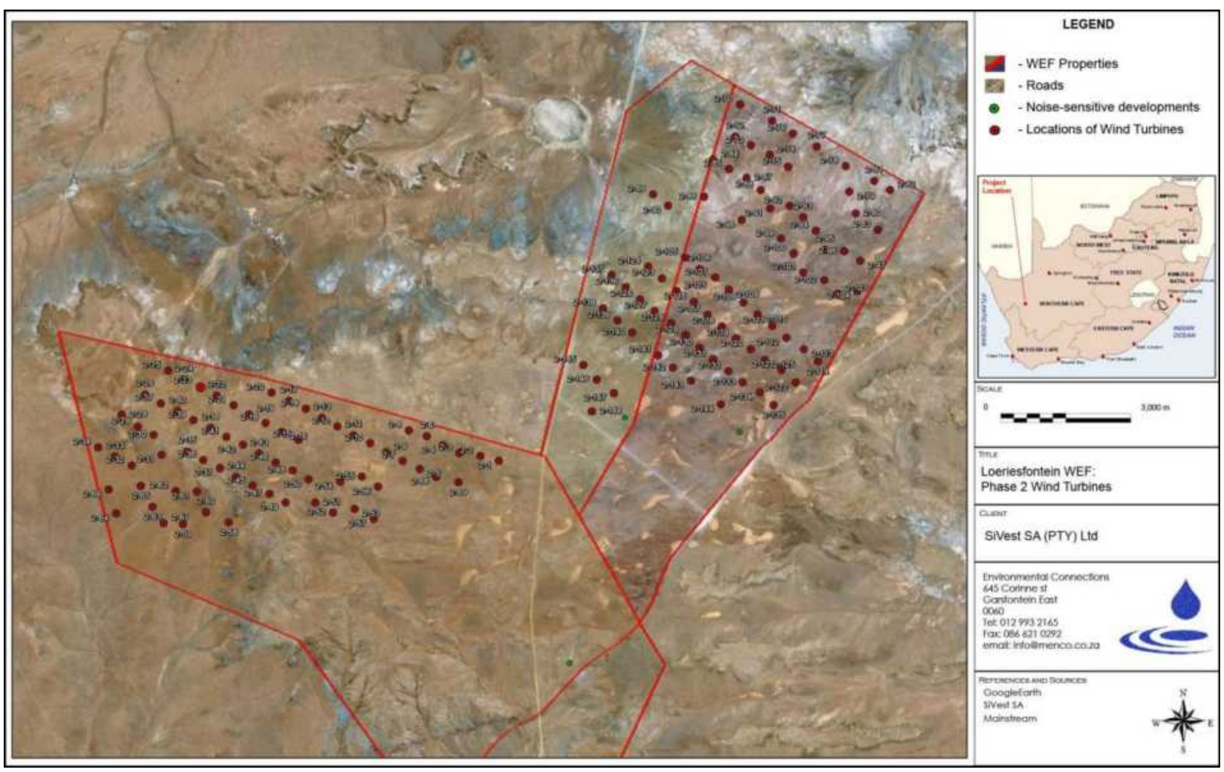


Figure 64:Loeriesfontein illustrating the Layout of Phase 2

- Results: Operational Phase

Projected Noise Levels in the area due to the operation of the Wind Energy Facility at a 5 m/s wind is defined in Table 35.

Table 35: Sound Pressure Levels and change in ambient sound levels at relevant NSDs for a 5 m/s wind with the Nordex H90 2500HS WTG

NSD	Estimated ambient sound levels, LAeq (dBA)	Modelled Noise Levels due Wind Turbines, Concave Model (dBA)	Modelled Noise Levels due Wind Turbines, ISO Model (dBA)	Estimated Change in Ambient Sound Levels, ISO Model (dB)	Magnitude	Duration	Extent	Probability	Significance of noise Impact (see section 5 of the main Noise report)
NSD01	37.3	39.1	43.3	7.1	8	4	2	4	56
NSD02	37.3	30.8	32.3	1.2	2	4	2	1	8

10.6.5 Impact Assessment: Operational Phase without mitigation

This Environmental Noise Impact Assessment focuses on the impacts on the surrounding sound environment during times when a quiet environment is highly desirable. Noise limits are therefore appropriate for the most noise-sensitive activity, such as sleeping, or areas used for relaxation or other activities (places of worship, school, etc).

Appropriate Zone Sound Levels are therefore important, yet it has been shown that the SANS recommended (fixed) Night Rating Level ($L_{Req,N}$ = 35dBA) might be inappropriate due to the increased ambient sounds relating to wind action, especially when the wind speeds increase to above 5 m/s.

A more appropriate method to determine the potential impact would be to make use of the projected noise levels due to the operation of the WEF, available international standards as well as the likely ambient sound levels due to wind induced noises. In all cases the output of both the Concawe and ISO model will be considered.

illustrate the projected noise impact at different wind speeds as reported by the ISO model.

Because there are a number of wind turbines around NSD01 the ISO model might be overestimating the potential noise impact due to the circular propagation of this model.

Being a downwind model, the ISO model considers that the wind is blowing from the noise source (the wind turbine) to the potential noise sensitive receptor at all instances. As can be seen from Table 36 the noise impact from the various wind turbines individually is far less than even the SANS rating level, yet, the total cumulative effect results in a noise level exceeding the proposed rating level.

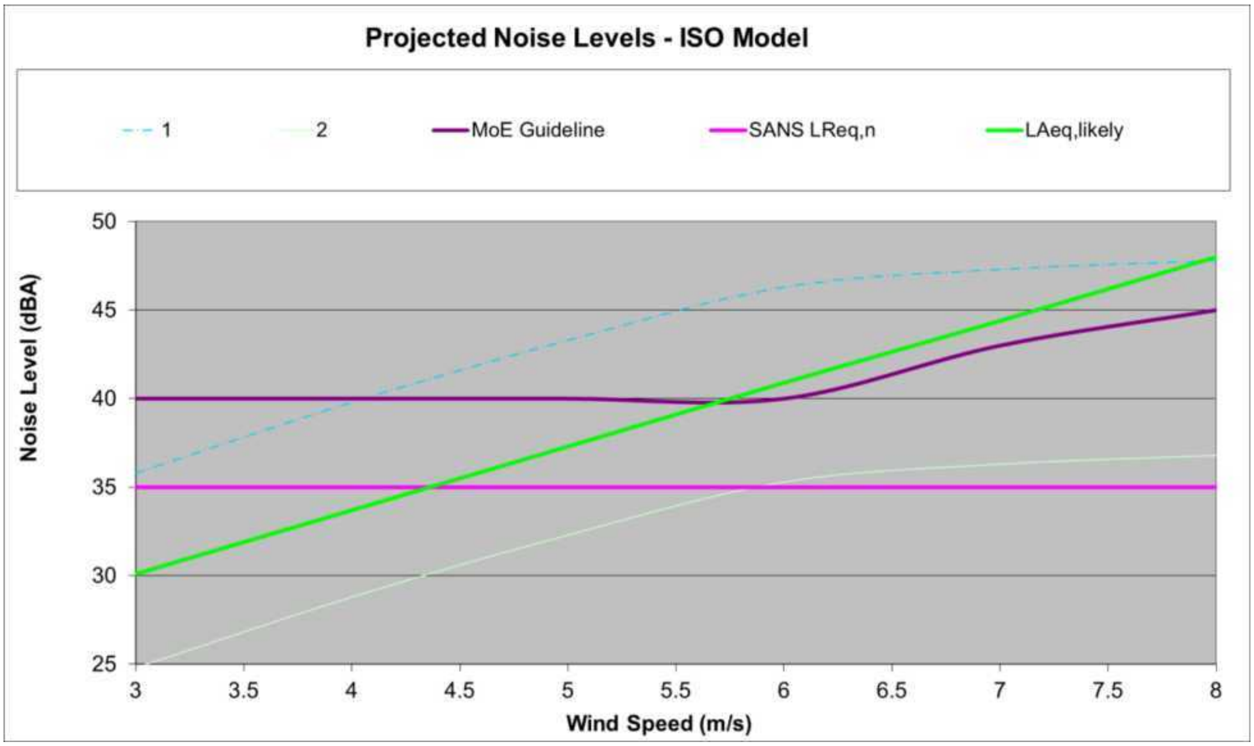


Figure 65: Projected noise levels at NSDs due to the operation of the at different wind speeds – ISO model output

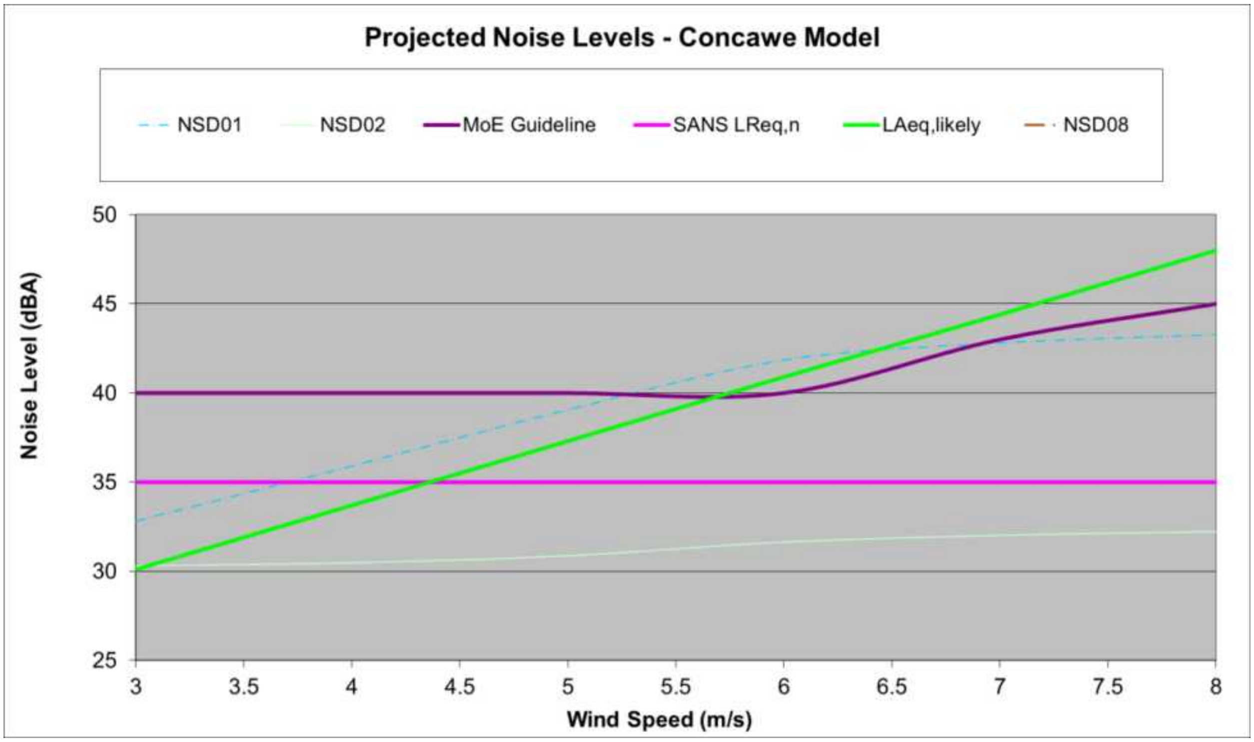


Figure 66: Projected noise levels at NSDs due to the operation of the at different wind speeds – Concawe model output (northern wind)

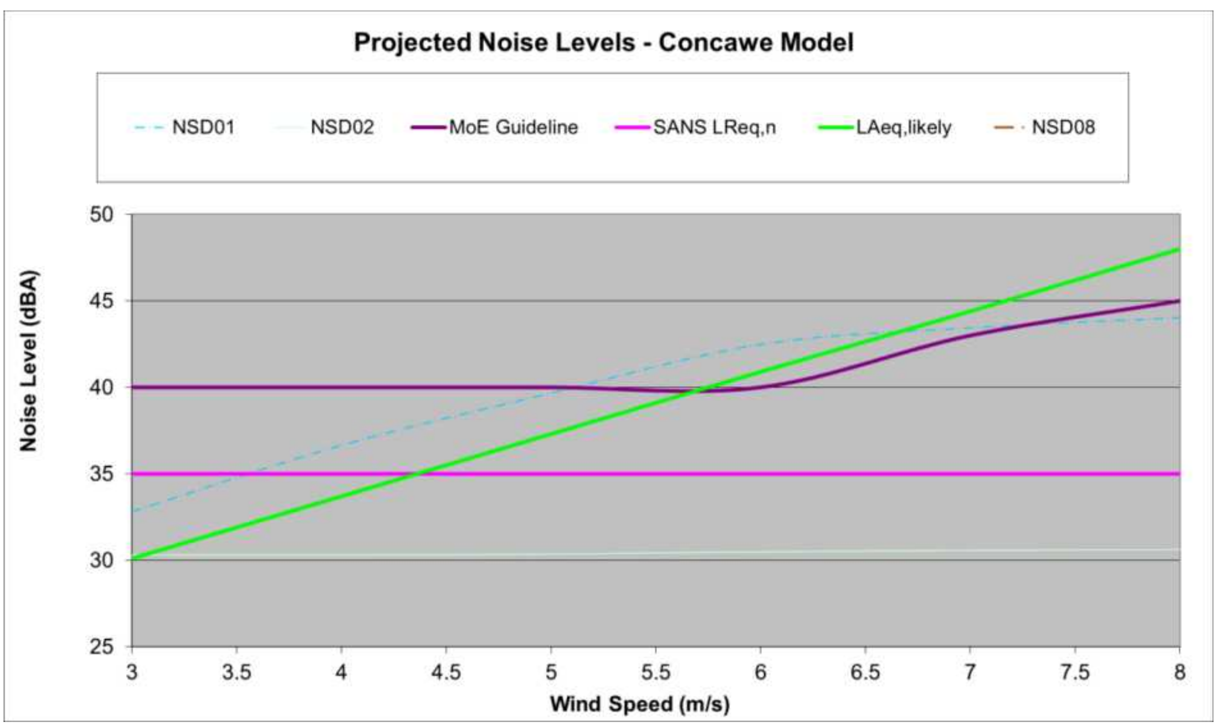


Figure 67: Projected noise levels at NSDs due to the operation of the at different wind speeds – Concawe model output (southern wind)

Table 36: Noise contribution of selected wind turbines around NSD01

WTG No (Phase – Turbine No)	Distance from NSD (meter)	Individual Noise Level (dBA)
1 - 2	1044	30.5
1 - 3	958	31.4
1 - 4	589	36.4
2 - 133	1150	29.4
2 - 134	1027	30.6
2 - 135	1005	30.9
2 - 144	768	33.7

With the current layout using the Nordex H90 2500HS wind turbine and model parameters as outlined, the following can be concluded:

- Excluding NSD01, the operation of the WEF will not have any noise impact on any other identified potential noise-sensitive development
- Output from the ISO model indicates that noise levels from the WEF could exceed the estimated ambient sound levels at wind speeds exceeding 3 m/s (as well as the SANS Guideline) as well as noise limits as used in Canada (MoE) at wind speeds higher than 4 m/s at NSD01
- Output from the Concawe model indicates that noise levels from the WEF could exceed the estimated ambient sound levels at wind speeds between 4 and 6.5 m/s, as well as the noise limits as used in Canada (MoE) at wind speeds higher than 5.5 and 7 m/s at NSD01 (for a northern wind)
- Considering L_{Aeq} measurements in similar surroundings away from any anthropogenic activities, ambient sound levels of between 40 – 45 dBA could be expected with a 5 m/s wind. Noise levels as predicted by the ISO model exceed the lower, but not the higher ambient sound levels
- Confidence levels in the calculation procedure and projected noise levels is high, and considering the output of both the Concave and ISO models the probability can be estimated as defined in Table 35
- Due to the lack of a specific wind turbine make and model, the use of a large wind turbine such as the Nordex H90 2500HS might project noise levels higher than it may be. However, as the make and model is unknown a worst case scenario is assumed.
- Output from the ISO model indicates that the operation of the WEF could change the ambient sound levels with more than 7 dB. This is a significant change in

ambient sound levels, and defined as a disturbing sound level in terms of the National Noise Control Regulations if it happens.

Table 35 defines $L_{Aeq(Concawe)}$, $L_{Aeq(ISO)}$ and estimated $\Delta L_{Aeq,n}$ at the various potentially sensitive receptors for the 5m/s wind as calculated using both the ISO and Concave models with Table 37 summarising the findings and impact assessment.

Table 37: Impact Assessment: Operational phase without mitigation

Nature:	Numerous turbines operating simultaneously during a period when a quiet environment is desirable.
Acceptable Rating Level	Rural district with little road traffic. Refer to refer to section 5 of the main Noise report for the proposed Night Rating Level that varies with wind speed.
Extent ($\Delta L_{Aeq,n}$>7dBA) $L_{Aeq,n} > L_{Req,n}$	Local – Noise Impact will not extend further than 1,000 meters from the activity (2).
Duration	Long – Facility will operate for a number of years (4)
Magnitude	Refer Table 35 Low (2 – NSD02) to Medium-high (8 – NSD01)
Probability	Improbable (1 – NSD02) – Highly-likely (4 – NSD01)
Significance	8 (Low) for NSD02 using the Nordex H90 2500HS WTG.
Significance	56 (Medium) for NSD01 using the Nordex H90 2500HS WTG.
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Comments	-
Can impacts be mitigated?	Yes.
Mitigation:	Presented in mitigation section below
Cumulative impacts:	This impact is cumulative with existing ambient background sounds and other noise in the area.
Residual Impacts:	This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.

10.7 Visual Impact Assessment

10.7.1 Visual Receptors

A sensitive receptor is defined as a receptor which would potentially be adversely impacted by the proposed development. This takes into account a subjective factor on behalf of the viewer – i.e. whether the viewer would consider the impact as a negative impact. An adverse impact is often associated with the alteration of the visual character of the area in terms of the intrusion of a new development into a 'view', which may affect the 'sense of place'. Thus receptors of visual impacts in areas / landscapes where the current visual character of the environment is part of the appeal of an area, and thus has a socio-economic importance, are likely to be considered sensitive receptors.

A distinction must be made between receptor locations and sensitive receptor locations – receptor locations are typically locations from where the proposed wind may be in view, but from where the receptor may not necessarily be adversely affected by any visual intrusion associated with the facility. Receptor locations include locations of commercial activities and certain movement corridors, such as roads that are not tourism routes. Sensitive receptor locations typically include locations of human habitation and tourism activities which are likely to be adversely impacted by a proposed project.

During the EIA Phase, it was confirmed that relatively few potentially sensitive visual receptors are present within the study area. This is mainly due to the limited human settlement within the immediate vicinity of the site (Figure 68).

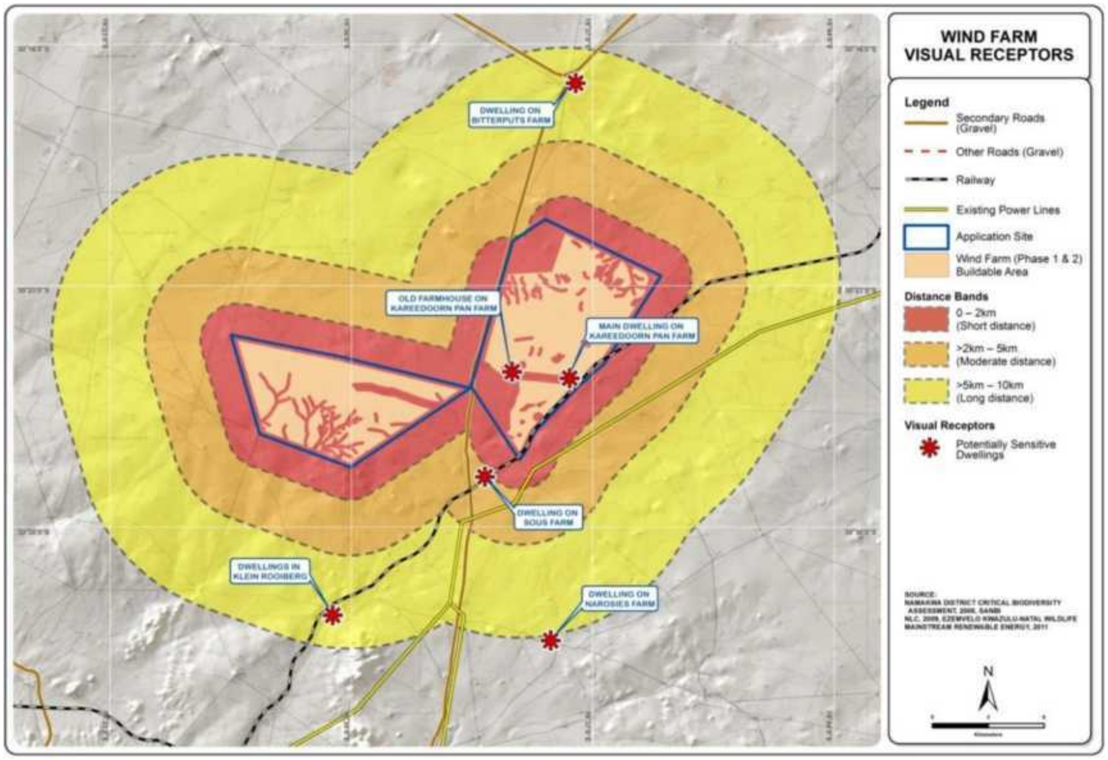


Figure 68: Visual receptors potentially sensitive to the wind farm

Wind Farm facilities will diminish exponentially over distance. As such, the development will be more visible to receptors located within a short distance and these receptors will experience a higher adverse visual impact than those located at a moderate or long distance from the proposed development. The distance of the potentially sensitive receptors from the development area will need to be considered when rating the visual impact of the development on these receptors.

Based on the extensive height and scale of the wind turbines and the fact that visual exposure diminishes exponentially over distance, the radii chosen to assign the distance bands for the wind farm are as follows:

0 – 2km (Short distance)

>2km – 5km (Moderate distance)

>5km – 10km (Long distance)

- Sensitive Receptor Locations

Very few scattered farmsteads / homesteads were identified within the study area (both in the surrounding area and on the proposed development site), which are used to house the local farmers as well as their farm workers. These dwellings are the only receptors, which may be potentially visually sensitive to the proposed development. They are regarded as receptor locations, as the proposed development will be visible to people residing in these dwellings. Although the visual impact of the development will be permanent, these receptors are not expected to be highly sensitive to this visual impact as the farms are mostly used for sheep farming activities and therefore the people residing on them do not rely on the scenic quality of the area to produce revenue. The degree of visual impact experienced will vary from one inhabitant to another, as it is largely based on the viewer's perception. Factors influencing the degree of visual impact experienced by the viewer include the following:

- Value placed by the viewer on the natural scenic characteristics of the area.
- The viewer's sentiments toward the proposed structures. These may be positive (a symbol of progression toward a less polluted future) or negative (foreign objects degrading the natural landscape).
- Degree to which the viewer will accept a change in the typical Karoo character of the surrounding area.

Table 38 below provide details of the potentially sensitive visual receptors that were identified for the wind farm during the field investigation.

Table 38: Visual receptors potentially sensitive to the proposed wind farm

Name	**Current Use**	**Distance from the proposed site**
Dwelling on Bitterputs Farm	Holiday / weekend home	Long distance
Main dwelling on Kareedoorn Pan Farm	Residential dwelling	Within proposed site
Old farmhouse on Kareedoorn Pan Farm	Storeroom (will house farm worker in the near future)	Within proposed site
Dwelling on Sous Farm	Farm workers dwelling	Moderate distance
Dwelling on Narosies Farm	Residential dwelling	Long distance
Dwellings in Klein Rooiberg	Residential and farm workers dwellings	Long distance

During the fieldwork, each potentially sensitive receptor location was visited in order to capture photos to be used for the visual modelling and investigate the visual environment immediately surrounding each receptor location. The survey involved, assessing the views towards the development site from each receptor location, in order to identify any screening factors which may conceal the development, as well as any anthropogenic features which may alter the natural character of views towards the development site.

The results of the field investigation at each receptor location are outlined in Table 39 below.

Table 39: Field survey undertaken at each potentially sensitive receptor location

Receptor	Screening factors	Visual character of views toward the development site
Dwelling on Bitterputs Farm (Figure 69)	No screening factors present. The location of the house on higher ground will prevent the exotic trees from screening the study area.	Views toward the site from the main veranda overlook a dry saltpan and have a natural scenic quality. Anthropogenic influences are limited to exotic trees and the farm boundary fence.
Main dwelling on Kareedoorn Pan Farm (Figure 70)	Small exotic trees provide limited visual screening.	Several anthropogenic features will impact views from the main farm house in an easterly direction. These include; power lines, the railway line, windmills, a tall communication tower, exotic trees, a Transnet substation and hostel buildings. Views toward the development site in a northerly direction remain natural - only small exotic trees and the boundary fence are in view.

Figure 69: Photomontage showing the view toward the development site from the main veranda of the dwelling on Bitterputs Farm

Figure 70: Photomontage showing views toward the development site from just outside the main dwelling on Kareedoorn Pan Farm

Table 4: Field survey undertaken at each potentially sensitive receptor location (continued)

Receptor	Screening factors	Visual character of views toward the development site
Old farmhouse on Kareedoorn Pan Farm (Figure 71)	No screening factors present.	Views toward the site are largely undisturbed and natural. The only unnatural features in view include; the old kraal, a monopole line, farm boundary fences and the communication tower in the distance. The visual character is typical of the Karoo farmland.
Dwelling on Sous Farm (Figure 72)	Screening factors are limited the slightly undulating ground.	Several power lines, the railway line and Helios Substation will impact views in a southern and north-eastern direction. The visual character of views toward the site are largely vacant and natural as only one power line is in view.
Dwelling on Narosies Farm (Figure 73)	Isolated hills to the south of the proposed site may provide partial screening. Some tall trees and shrubs in the vicinity of the dwelling may block out parts of the site from the farmhouse.	Views toward the site retain a natural visual character as the farm boundary fence is the only unnatural feature in view.

Figure 71: Photomontage showing views toward the development site from near the old farmhouse on Kareedoorn Pan Farm

Figure 72: Photomontage showing views toward the development site from near the dwelling on Sous Farm

Figure 73: Photomontage showing views toward the development site from near the dwelling on Narosies Farm

Table 4: Field survey undertaken at each potentially sensitive receptor location (continued)

Receptor	**Screening factors**	**Visual character of views toward the development site**
Dwellings in	The undulating topography and	Several farmsteads are located at

Receptor	Screening factors	Visual character of views toward the development site
Klein Rooiberg (Figure 74)	numerous exotic trees will partially / completely shield the development site from the dwellings (Figure 75). Only dwellings located on the higher ground to the north may have partial views of the development site.	Klein Rooiberg. Infrastructure associated with these dwellings may alter the natural views toward the site. Androgenic features include; extensive exotic trees and shrubs, boundary fences, dwellings and storerooms, water tanks and reservoirs, distant power lines and wind mills. Views to the south-east (opposite direction of the site) are typically scenic due to the mountainous terrain (Figure 76).

Figure 74: Photomontage showing views toward the development site from a dwelling located on higher ground in the northern parts of Klein Rooiberg

Figure 75: Numerous exotic trees and shrubs will screen views toward the proposed development site from several dwellings in Klein Rooiberg (particularly in the lower lying areas)

Figure 76: Typically scenic south-eastern views from dwellings in Klein Rooiberg

- Receptor Roads

There are no main or arterial roads in close enough proximity to the proposed development to be visually impacted by it, although a district road, that connects the town of Loeriesfontein with Granaatboskolk to the north, bisects the site. This road is used mainly as an access road for local farmers, as well as for people working on the gypsum mine to the north and on the railway. The road is thus, expected to carry a fair amount of traffic, but this traffic is mainly for local access and business purposes, rather than for tourism purposes. This factor is potentially important in a visual impact context as tourist routes are typically the most sensitive roads from a visual impact perspective. As such, there are no visually sensitive roads within the study area.

10.7.2 Impact Assessment

- Generic Visual Impacts of a Wind Farm

In this section, the generic visual issues / impacts related to the establishment of a wind farm as proposed are discussed. It is important to note that, no wind farms have been developed in South Africa, although within a few years wind facilities approved recently in the late part of 2011 should be constructed in this country. The development and associated environmental assessment of wind farms in South Africa is relatively new, and thus it is valuable to draw on international experience. Thus this section of the report draws on international literature and web material (of which there is significant material available) to describe the generic impacts associated with wind farms.

  - Wind Farm

A single wind turbine is a massive object and as such is highly visible. The standard turbine height is extremely large, with the hub height (from ground level to the base of the rotors) being between 80 and 120m (equivalent to a building of between 27 and 40 storeys). The rotor blades would extend even higher, these being between 45 and 60m in length (equivalent to an extra 15 to 20 storeys when the rotor is in a vertical orientation). The height of the turbine would result in it being typically visible for a large radius. A wind farm consists of a series of turbines spaced apart in groups around the site, making the facility highly visible. The visual prominence of the facility will be exacerbated within natural settings, in areas of flat terrain or if located on a ridge top. Even dense stands of wooded vegetation is likely to only offer partial visual screening, as the wind turbines are of such a height that they will rise above even mature large trees.

  - Associated infrastructure

The infrastructure associated with the proposed wind farm will include the following:

i. A substation and associated transformers to supply electricity the Eskom grid;

ii. 132kV overhead power lines to connect the substation to the Eskom grid;
iii. Underground (where possible) cabling to connect the wind turbines to each other;
iv. Gravel access roads;
v. A temporary lay down area during construction;
vi. Single storey administration and warehouse buildings;
vii. Borrow pits;
viii. Fencing; and
ix. A temporary wind measuring mast (70m high).

The new substation (approximately 90m x 120m) and overhead power lines by their nature are large objects and will typically be visible for great distances. Power lines consist of a series of tall towers thus making them highly visible. Like wind turbines, power lines and substations are not features of the natural environment, but are representative of human (anthropogenic) alteration. Thus when placed in largely natural landscapes, they will be perceived to be highly incongruous in this setting. Conversely, the presence of other anthropogenic objects associated with the built environment, especially other power lines or substations, may result in the visual environment being considered to be 'degraded' and thus the introduction of a new power line into this setting may be less of a visual impact than if there was no existing built infrastructure visible.

Other associated infrastructure may also be associated with visual impacts. The turbines are inter-connected with a series of cables, which are likely to be buried, but which also may take the form of above-ground power lines. These cables may become a visual intrusion if placed in areas of the site that are visible to the surrounding areas, especially those areas that are located on the low ridges and associated sloping ground. A trench dug for the cable (both during construction and post-construction once the trench has become back-filled) may become prominent if it creates a linear feature that contrasts with the surrounding vegetation that is typically low shrubs and small trees on the ridges. A similar principle exists with respect to any access roads constructed in these parts of the site. Roads are likely to be wider than cable trenches and thus could be even more greatly visible than the cable servitude. The site is however relatively flat and significant earthworks are unlikely to be required for constructing the roads, such as cutting of a 'terrace' into a steep side slope that would increase the visibility and contrast of the road against the surrounding vegetation.

Lastly buildings placed in prominent positions such as on ridge tops may also break the natural skyline, drawing the attention of the viewer.

The visual impact of the other associated infrastructure is not regarded to be a significant factor when compared to the visual impact associated with wind turbines; however it will magnify the visual prominence of the development within flat sites in natural settings where there is limited tall wooded vegetation present to conceal the impact.

- Shadow flicker

Shadow flicker is an effect which is caused when shadows repeatedly pass over the same point. It can be caused by wind turbines when the sun passes behind the hub of a wind turbine and casts a shadow that continually passes over the same point as the blade of the wind turbine rotates (http://www.ecotricity.co.uk).

The effect of shadow flicker is only likely to be experienced by people situated directly within the shadow cast by the blade of the wind turbine. As such, shadow flicker is only expected to have an impact on and cause health risks to people residing within houses that are located at a specific orientation and within close proximity to a wind turbine (less than 500m), particularly in areas where there is little screening present. Shadow flicker may also be experienced by and impact on motorist if a wind turbine is located in close proximity to an existing road. The impact of shadow flicker can be effectively mitigated by choosing the correct site and layout for the wind turbines, taking the orientation of the turbines relative to the nearby houses and the latitude of the site into consideration. Tall structures and trees will also obstruct shadows and prevent the effect of shadow flicker from impacting on surrounding residents (http://www.ecotricity.co.uk).

- Motion-based visual intrusion

An important component of the visual impact associated with wind turbines is the *movement* of the rotors. Labelled as motion-based visual intrusion, this refers to the inclination of the viewer to focus on discordant, moving features when scanning the landscape. Evidence from surveys of public attitudes towards wind farms suggest that the viewing of moving blades is not necessarily viewed more negatively than views / visualisations of static blades (Bishop and Miller, 2006). The authors of the study suggest two possible reasons for this; firstly when the turbines are moving they are seen as being ‘at work’, doing good, producing energy, conversely when they are stationary they are an intrusion with no evident purpose. More interestingly, the second theory that explains this perception is related to the intrinsic value of wind in a certain area and how turbines may be an expression or extension of an otherwise ‘invisible’ presence.

Famous winds across the world include the Mistral of the Camargue in France, the Föhn in the Alps, or the Bise in the Lavaux region of Switzerland. The wind, in these cases, is an intrinsic component of the landscapes, being expressed in the shape of trees or drifts of sands, but being otherwise invisible. The authors of the study argue that wind turbines in these environments give expression, when moving, to this quintessential landscape element. In a South African context, this phenomenon may well come to be experienced if wind farms are developed in areas where typical winds, like berg winds, or the south-easter in the Cape are an intrinsic part of the environment. In this way, it may even be possible that wind farms will, through time form part of the cultural landscape of an area, and become a representation of the opportunities presented by the natural environment

- Experiencing visual impacts

The perception of the viewer/receptor toward an impact is highly subjective and involves 'value judgements' on behalf of the receptor. It should be considered as certain receptors may not consider the development of a wind farm to be a negative visual impact. A study of perceived visual impacts of wind farms in rural areas in the USA has demonstrated this phenomenon; they have argued that visual perceptions in the study area were based upon judgements of symbolic as well as rational aspects of a specific wind farm (e.g. its size, colour, shape, etc.). The assessment concluded that a person's evaluation of visual impact was based upon a combination of perceptions or judgements, which related to the abstract sculptural nature of turbines, their perceived intrusiveness in that specific context and, finally, the degree to which turbines symbolised 'higher' concepts. These could be both positive and negative, such as the degree to which turbines are associated with wider environmental concerns such as climate change (Thayer and Hansen, 1988, as referenced in Devine-Wright,2005). Some views have expressed the graceful nature of wind farms or the beauty associated with the turbines (Devine-Wright, 2005).

If a development is associated with employment creation, social upliftment and the general growth and progression of an area, it may not be associated with any negative visual impacts and even have positive connotations. It should be noted that the proposed renewable energy facility may be considered to be an environmentally sustainable option of generating electricity, and this may positively alter the viewer's perceived experience of the visual impact, as the facility may be viewed as a symbol of progress toward a 'greener' future.

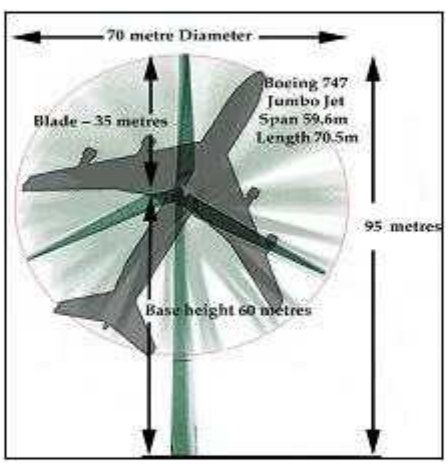
The wind developments are likely to be perceived as a visual impact in areas that have a natural scenic quality and where tourism activities based upon the enjoyment of, or exposure to, the scenic or aesthetic character of the area are practiced. Residents and visitors to these areas may regard the wind turbines to be unwelcome intrusions, which degrades the natural character and scenic beauty of the area, and which would potentially even compromise the practising of tourism activities in the area.

Wind turbines are not a feature of the natural environment, but are rather a representation of human (anthropogenic) alteration. Thus when placed in a largely natural landscape, a wind farm could be perceived to be highly incongruous in the context of the setting. The height and grouping together of turbines would exacerbate this incongruity with the natural landscape, as the turbines would tend to impinge on views within the landscape. Internationally, studies have demonstrated that there is a direct correlation between the number of turbines and the degree of objection to a wind farm, with potential opposition to a wind farm being lower when fewer turbines are proposed, with a preference for smaller, clustered groups of turbines over larger-scale installations. (Devine-Wright, 2005).

The presence / existence of other anthropogenic objects associated with the built environment may not only obstruct views but also influence the perception of whether a development is a visual impact. In industrial areas where structures, buildings and other infrastructure exist, the visual environment could be considered to be 'degraded' and thus the introduction of a wind farm into this setting may be considered to be less of a visual impact than if there was no existing built infrastructure visible. In this case value may not be placed in the aesthetic quality of the landscape, and the renewable energy facility may not necessarily be considered to be visually intrusive.

Much literature has explored public perceptions of wind farms and objection to them. In parts of the world where wind farms have been developed, they have been subject to opposition based around concerns about the transformation of natural landscapes into 'landscapes of power' (Warren, *et al,* 2005). This relates to the alteration of the visual character of an area. Internationally, wind farms are often perceived to be a source of visual impact if they affect or change the visual quality of a landscape, particularly in a natural or rural landscape within which the turbines would be considered to be highly incongruous. In the British Isles much of the opposition to wind farms has centred upon this factor. Landscape-based impacts of the wind farms have been exacerbated by the proposed development of wind farms in exposed upland areas which are valued for their scenic qualities and which are often ecologically sensitive (Warren, *et al,* 2005).

Certain objectors to wind farms mention the "sky space" occupied by the rotors of a turbine. As well as height, "sky space" is an important issue. "Sky space" refers to the area in which the rotors would rotate. The diagram below indicates that the "sky space" occupied by rotors would be similar to that occupied by a jumbo jet (http://www.stopbickertonwindturbines.co.uk/ - page on visual impact).



- Visual receptors

Visual impacts can be experienced by different types of receptors, such as people driving along roads, or people living / working in the area in which the wind turbines would be visible. The receptor type in turn affects the nature of the typical ‘view’ of a potential source of visual impact, with views being permanent in the case of a residence or other place of human habitation, or transient in the case of vehicles moving along a road. The nature of the view experienced affects the intensity of the visual impact experienced.

It is important to note that visual impacts are only experienced when there are receptors present to experience this impact; thus in a context where there are no human receptors or viewers present there are not likely to be any visual impacts experienced.

- Viewing distance

Viewing distance is a critical factor in the experiencing of visual impacts, as beyond a certain distance, even large developments such as a wind farm tend to be much less visible, and difficult to differentiate from the surrounding landscape. The visibility of an object is likely to decrease exponentially as one moves away from the source of impact, with the impact at 1000m being a quarter of the impact at 500m away (Figure 77).

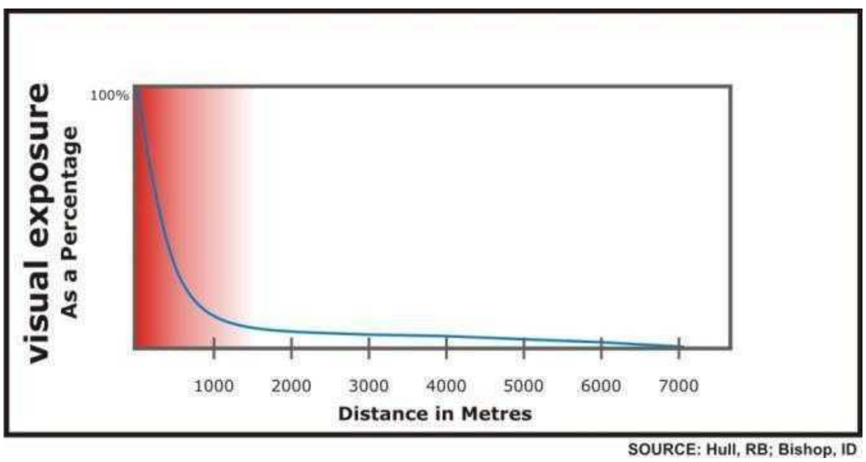


Figure 77: Diagram illustrating diminishing visual exposure over distance

Interestingly, literature does not reveal a direct correlation between those receptors located closest to existing turbines, and the level of objection to the wind farm, even though one may expect those most visually exposed to harbour the most negative perceptions towards it. However, some case studies contradict this (Devine-Wright, 2005).

- Visual Receptor Impact Rating

In order to assess the impact of the proposed wind farm on the potentially sensitive receptor locations listed above, a matrix that takes into account a number of factors has been developed, and is applied to each receptor location.

The matrix has been based on a number of factors as listed below:

- Distance of receptor away from the proposed development area (distance banding)
- Primary focus / orientation of the receptor
- Presence of screening factors (topography, vegetation etc.)

These factors are considered to be the most important factors when assessing the visual impact of a proposed development on a sensitive receptor in this context. It must be remembered that the experiencing of visual impacts is a complex and qualitative phenomenon, and thus difficult to accurately quantify; thus the matrix should be seen as a representation of the likely visual impact at a receptor location.

An explanation of the matrix follows.

Table 40: Visual Matrix – Impact of the development on sensitive receptors

Factor	**Classes and Scores**			
Distance of Receptor away from proposed development area (distance banding)	Within 0.5km (from either Wind Farm) Score: 4	>0.5-2km from Wind Farm Score:3	>2-5km from Wind Farm Score:2	>5-10km from Wind Farm Score:1
Primary Focus / orientation of receptor	'Arc of view' directly towards wind farm Score:4		'Arc of view' partially towards wind farm Score:2	'Arc of view' in opposite direction of the wind farm Score:1
Presence of Screening Factors	No screening factors – wind farm highly visible Score:4		Screening factors partially obscure wind farm Score:2	Screening factors completely block any views towards wind farm Score:1

Categories of impact:

High Visual Impact = >3-4

Medium Visual Impact = >2-3

Low Visual Impact = 1-2

The distance of the viewer / receptor location away from the wind farm is the most important factor in the context of the experiencing of visual impacts. Beyond a certain distance, even large structures such as wind turbine tend to be much less visible, and are difficult to differentiate from the surrounding landscape.

The highest rating has been assigned to receptor locations that are located within 500m (0.5km) of the development site. Beyond 5km, the visual impact associated with a wind turbine is likely to be relatively insignificant (although still visible), and any receptor location beyond 5km from the proposed development area has been allocated into the lowest class.
The orientation of a receptor becomes important in many cases, as the receptor location is typically oriented in a certain direction, e.g. with views towards a certain area / part of the landscape from a highly frequented area like a porch or garden. The visual impact of a wind farm could potentially be much greater if the facility intruded into such a view, and thus the highest rating has been given to a situation where the development would cross directly across an ‘arc of view / orientation’ – i.e. the 180^{o} panorama in a certain direction.

The presence of screening factors is equally important in this context to the distance away from the wind farm. Screening factors can be vegetation, buildings, as well as topography. For example a grove of trees located between a receptor location and the renewable energy facility could effectively completely shield the structures from the receptor. Topography (relative elevation and aspect) plays a similar role as a receptor location in a deep or incised valley will have a very limited viewshed and may not be able to view an object that is close by, but not in its viewshed. The opposite applies, as tall objects such as a wind turbine on a ridge would be highly visible.

Through the matrix a ‘Visual Impact Score average’ for each receptor location is calculated. This average score is derived by tallying the scores for each of the three classes to determine the average score. The range in which this average score falls, as listed above, determines the visual impact rating for each receptor location.

It should again be noted that this rating matrix is a relatively simplified way to assign a representative visual impact, which allows a number of factors to be considered. Part of its limitation lies in the quantitative assessment of what is largely a qualitative or subjective impact. The simplified matrix also has certain limitations as in certain cases the complete screening of the source of the impact from the receptor may not be taken into account. An example of this would be where tall exotic trees may completely hide the proposed wind farm from view at a receptor location.

Table 41, below presents the results of the visual impact matrix. The ratings provide an indication of the impact that the proposed wind farm will have on each receptor location. Table 41 assigns an impact rating for the wind farm development on each potentially sensitive visual receptor.

Table 41: Visual Matrix Results– Impact of the wind farm on sensitive receptors

Receptor Location	**Distance**	**Primary Focus**	**Screening**	**Total Score**	**Visual Impact Score Average**	**Visual Impact Rating**
Dwelling on Bitterputs Farm	1	4	4	9	**3**	**Medium**
Main dwelling on Kareedoorn Pan Farm	4	2	2	8	**2.7**	**Medium**
Old farmhouse on Kareedoorn Pan Farm	4	4	4	12	**4**	**High**
Dwelling on Sous Farm	3	1	2	6	**2**	**Low**
Dwelling on Narosies Farm	1	2	2	5	**1.7**	**Low**
Dwellings in Klein Rooiberg	1	2	2	5	**1.7**	**Low**

As can be seen in the table above, the proposed wind farm development will mostly have a low or medium impact on the receptor locations. The visual impact of the development on the old farmhouse on Kareedoorn Pan Farm is the only receptor assigned a high rating. This is due to the fact that, the dwelling is oriented toward the development area, there are no screening factors present and the dwelling is within the proposed site (i.e. in very close proximity). It should however be noted that although the main farm worker and his family intend to move into the farmhouse, there is currently no one residing within the dwelling to experience the visual impact. In addition, the farm owner has signed a lease agreement with Mainstream Renewable Power, indicating his willingness to lease his property to them should the project receive an Environmental Authorisation and License. The farm owner therefore will benefit from the development, as he will receive revenue from this lease agreement. This is likely to offset the visual impact experienced by the landowner by reducing any negative sentiments he may have towards the development. This high visual impact rating is therefore not regarded as a realistic representation of the actual impact likely to be experienced at the receptor location.

- Visual Modelling

Visualisation modelling has been undertaken for the proposed wind farm facility from key potentially sensitive receptor locations to provide a realistic picture of how the visual environment may be affected and to strengthen the findings of this visual impact assessment.

In order to give an indication of what the proposed wind farm would look like from various distances away from the development visual models were created from several vantage points located within the short, moderate and long distance band. The models illustrate how views from the each vantage point will be transformed by the proposed development if the turbines are erected on the site as proposed. The vantage points selected for the visual modeling are depicted in Figure 78 below.

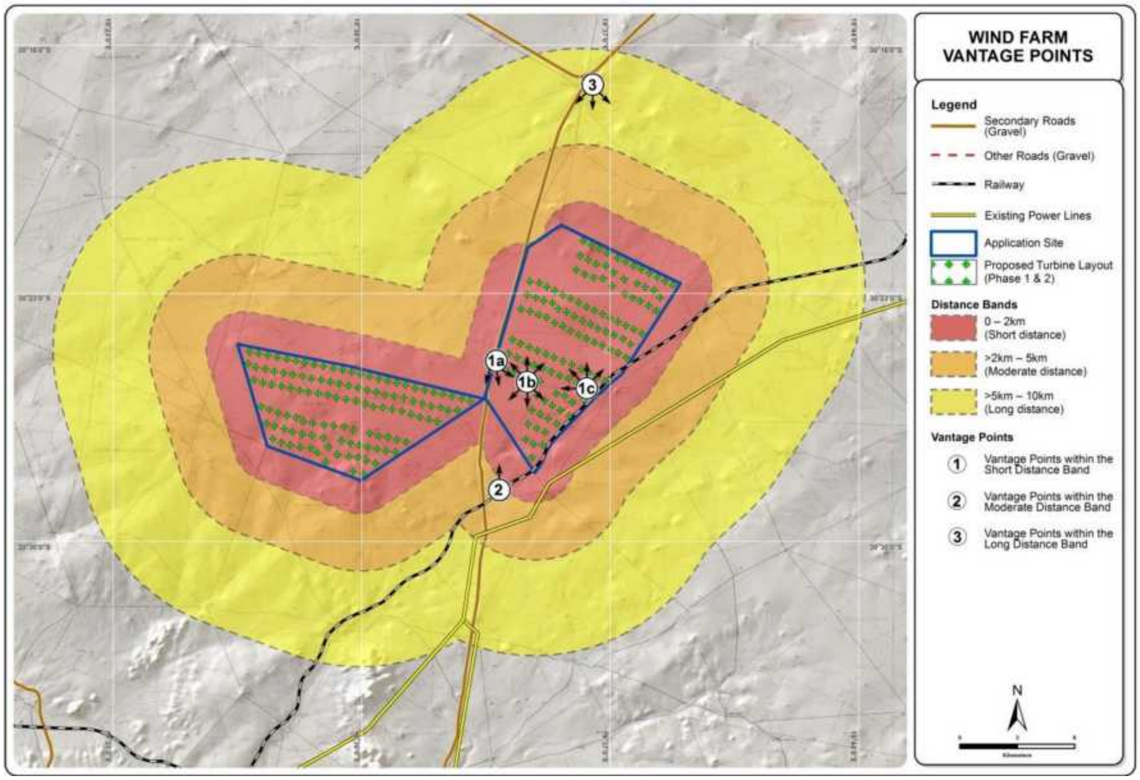


Figure 78: Vantage points used for visual modelling

The following assumptions and limitations are of relevance for the visual models:

- The visual models represent a visual environment that assumes all vegetative clearing will be restored to its current state after the construction phase. This is however, an improbable scenario as some trees and shrubs may be removed which may reduce the accuracy of the models generated.

- At the time of this study the proposed project was still in its early planning stages. Therefore, the layout plans of the turbines, as provided by Mainstream Renewable Power may change and certain infrastructure associated with the facility may not be included in the models.

- The visual models represent the worst case scenario which assumes that all the turbines proposed for both phase 1 and phase 2 would be constructed.

10.7.3 Vantage Point 1a – Within the short distance band on the Granaatboskolk road

This vantage point is situated on the Granaatboskolk road approximately 10km north of Helios Substation. The view is indicative of what motorists would see when travelling on the gravel road towards the town of Loeriesfontein (Figure 79 and Figure 80). The turbines will create a strong contrast with the flat terrain.

Figure 79: Existing view south-east to south south-west toward the proposed development area from the Granaatboskolk road

Figure 80: Visually modelled post-construction view south-east to south south-west toward the proposed development area from the Granaatboskolk road

10.7.4 *Vantage Point 1b – Within the short distance band at the old farm dwelling on Kareedoorn Pan Farm*

Vantage Point 1b is located at the old farmhouse on Kareedorn Pan Farm. Two visual models were created to indicate how the proposed development would transform views from the old farmhouse in both a northern and southern direction. As depicted in Figure 82, the terrain gradually slopes down from the old farmhouse in a northerly direction, thus making most of the turbines visible from this point. The low-lying ridge in the distance exacerbates the visual contrast, as the white turbines contrast strongly with the earthen tones (significantly more than they would against the horizon). The wind turbines are also highly visible in views to the south, however the they will contrast less with the blue sky in the background.

Figure 81: Existing view north-west to north-east toward the proposed development area from the old farm dwelling on Kareedoorn Pan Farm

Figure 82: Visually modelled post-construction view north-west to north-east toward the old farm dwelling on Kareedoorn Pan Farm (northern direction)

Figure 83: Existing view south-east to south-west toward the proposed development area from the old farm dwelling on Kareedoorn Pan Farm

Figure 84: Visually modelled post-construction view south-east to south-west toward the proposed development area from the old farm dwelling on Kareedoorn Pan Farm

10.7.5 Vantage Point 1c – Within the short distance band at the main dwelling on Kareedoorn Pan Farm

This vantage point is located near the main dwelling on Kareedoorn Pan. Although the primary orientation of the house is in an easterly direction, the visual models (Figure 86 and Figure 88) are indicative of what the inhabitants of this dwelling will see when looking in a northern and western direction from outside the farmhouse. Although several rows of wind turbines are located to the north of this point, only the row of wind turbines closet to the house is visually prominent. The slight undulations in the terrain, which rise up from this point, will partially block out turbines located further to the north, resulting in only the blades being visible for most of the turbines.

Figure 85: Existing view north-west to north-east toward the proposed development area from the main dwelling on Kareedoorn Pan Farm

Figure 86: Visually modelled post-construction view north-west to north-east toward the proposed development area from the main dwelling on Kareedoorn Pan Farm

Figure 87: Existing view west toward the proposed development area from the main dwelling on Kareedoorn Pan Farm

Figure 88: Visually modelled post-construction view west toward the proposed development area from the main dwelling on Kareedoorn Pan Farm

10.7.6 Vantage Point 2 – Within the moderate distance band at the dwelling on Sous Farm

Vantage point 2 is located just outside the farmhouse on Sous Farm, which is located adjacent to the proposed site for the wind farm development. The view depicted is in a northerly direction looking towards the proposed development from a moderate distance away (just over 2km). As depicted in Figure 90 the wind turbines will still be highly visible from this distance and the cluster of vertical white lines create a strong focal point.

Figure 89: Existing view north toward the proposed development area from the dwelling on Sous Farm

Figure 90: Visually modelled post-construction view north toward the proposed development area from the dwelling on Sous Farm

10.7.7 Vantage Point 3 – Within the long distance band at the dwelling on Bitterputs Farm

Vantage point 3 is located approximately 8km north of the turbine buildable area and illustrates how the turbines will appear from the furthest distance band. From this distance, the turbines create a textured contrast within the flat terrain, however the visual impact of the turbines will be significantly reduced. The visibility of the turbines from this vantage point, is largely related to the elevated position of the farmhouse, and it is unlikely that the wind turbines will be as visible from other locations within the long distance band. From this distance even slight topographical variations are likely to block out most of the turbines. For this reason, no visual models were created from the dwelling on Narosies Farm or the dwellings in Klein Rooiberg.

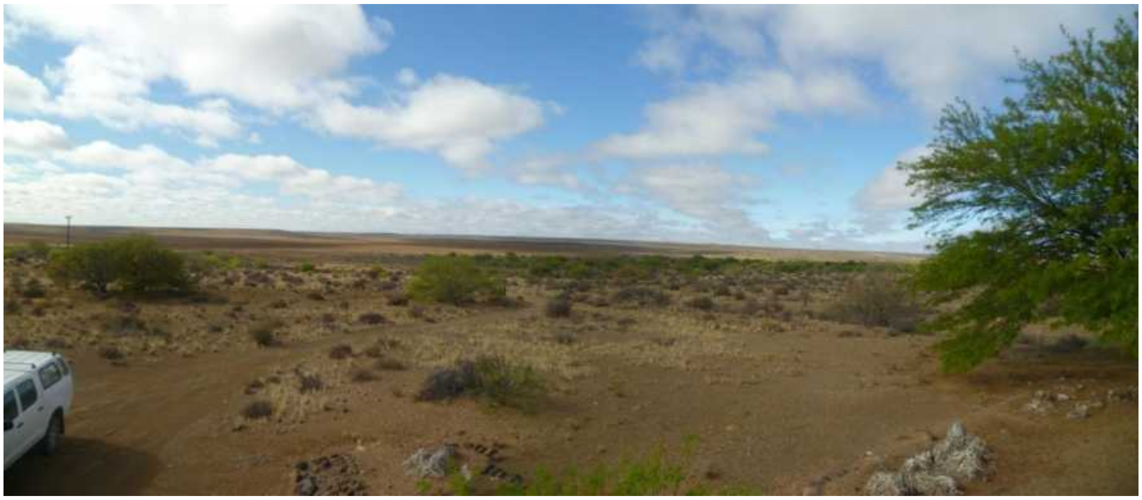


Figure 91: Existing view south-east to south-west toward the proposed development area from the dwelling on Bitterputs Farm

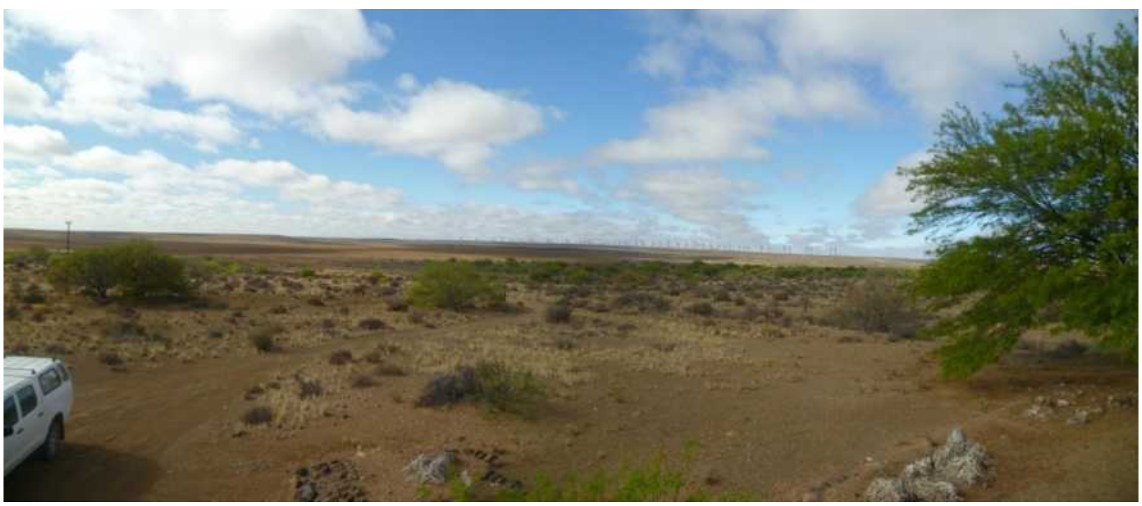


Figure 92: Visually modelled post-construction view south-east to south-west toward the proposed development area from the dwelling on Bitterputs Farm

- Night-time Impact

The visual impact of lighting on the nightscape is largely dependent on the existing lighting present in the surrounding area at night. The night scene in areas where there are numerous light sources will be visually degraded by the existing light pollution and therefore additional light sources are unlikely have a significant impact on the nightscape. In contrast, introducing light sources into a relatively dark night sky will impact on the visual quality of the area at night. It is thus important to identify a night-time visual baseline before exploring the potential visual impact of the proposed wind farm energy facility at night.

The area surrounding the proposed development site is largely uninhabited and as a result, very few light sources are present. The town of Loeriesfontein is also too far away to have an impact on the night scene. At night, the study area is characterised by a picturesque dark starry sky and the visual character of the night environment is considered to be ‘unpolluted’ and pristine. The most prominent light source within the study area at night is the security lighting at Helios Substation which can be seen from approximately 50km away. Other sources of light are limited to, isolated lighting from the few surrounding farmsteads, transient light from the train and passing cars travelling along gravel access roads, as well as occasional light from the Transnet hostels when they are in use.

Operational and security lighting at night will be required for the proposed wind energy facility. In addition, a permanent aviation light will be placed on the top of each wind turbine, which will create a network of red lights in the dark night-time sky. The type and intensity of lighting required was unknown at the time of writing this report and therefore the potential impact of the development at night has been based on the effect that additional light sources will have on the ambiance of the nightscape.

The lighting required for the proposed project will intrude on the nightscape and create glare, which will contrast with the extremely dark backdrop of the surrounding area. Although the area is not generally renowned as a tourist destination, the natural character of the area will increase its sensitivity to the operational and security lighting at night. The night-time visual impact of the wind farm during both the construction and operation phase are provided in below

10.8 Heritage Assessment

10.8.1 Identified sites

Based on the above literature and other sources and the field visit, the following heritage sites, features and objects were identified in the proposed development area:

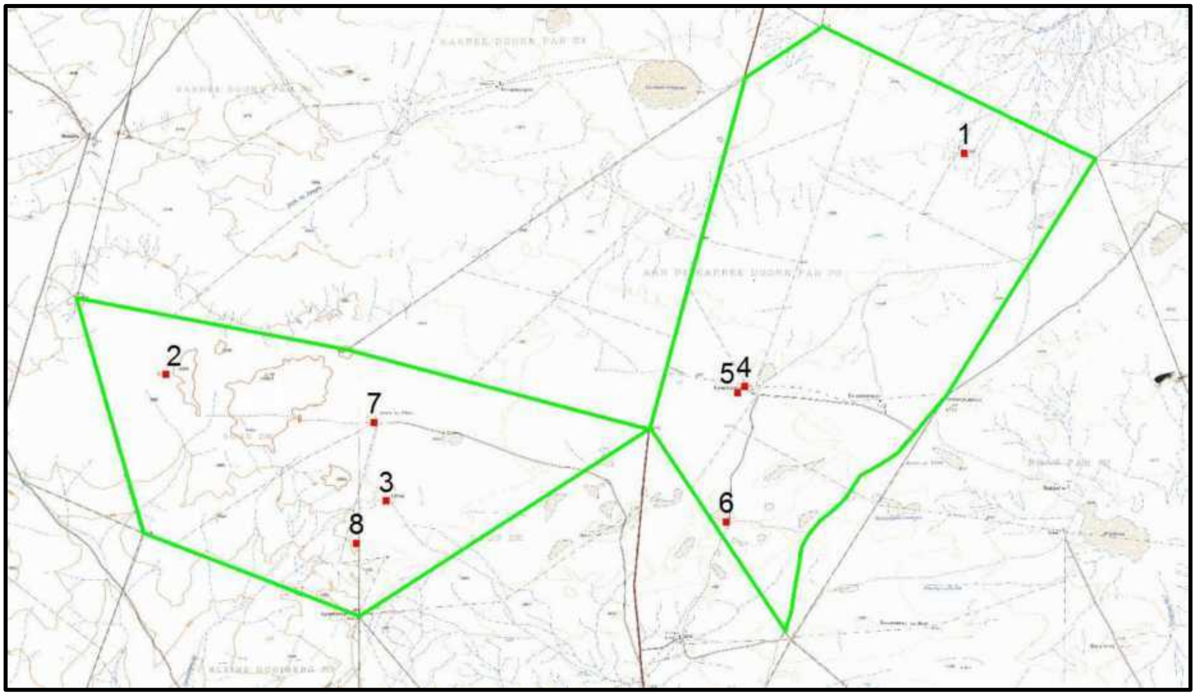


Figure 93: Map showing the location of the identified sites.

- Archaeological sites

Archaeological sites can vary from open sites with surface scatters of material, to shelters sites where continuous occupation took place over shorter or longer periods of time. Sites can also vary according to use, ranging from living sites to special purpose (quarries, ritual significance).

Location	No. 1 No. 2 No. 3	S 30.37768 S 30.42260 S 30.44827	E 19.62242 E 19.46030 E 19.50504
Description			
Sites no. 1 & 2 are both located at the foot of low hills, with no. 1 in close proximity of an old streambed. The sites consist of low density surface scatters of MSA material, mostly of hardened shale and chalcedony. The density for site no. 1 is approximately 2 tools/flakes per m^2, over an area roughly 30 x 30 metres. No. 2 is much smaller, consisting of approximately 1 tool/flake per m^2 over an area of 20 x 20 metres. Site no. 3 is located on top of a small hill, overlooking the region. It is a relatively high density surface scatter of LSA material, mostly of hardened shale and chalcedony. The density is approximately 5 tools/flakes per m^2 over an area of 30 x 30 metres.			
Significance	Low on a regional level – Grade III		
Mitigation			

There must be hundreds of similar occurrences in the larger region. As they are all surface finds, their significance is judged to be low. However, as very little is known about the Stone Age occupation of the larger region, studying of these sites might contribute to a better understanding of the prehistory of the region. As first option it is therefore recommended that these areas are avoided if possible. If that is not possible, it is recommended that systematic surface collections are made and that this material is housed at a museum. This can only be done under a permit from SAHRA.

Figure 94: The material identified on the various Stone Age sites.

- Farmstead

Farmsteads are complex features in the landscape, being made up of different yet interconnected elements. Typically these consist of a main house, gardens, outbuildings, sheds and barns, with some distance from that labourer housing and various cemeteries. In addition roads and tracks, stock pens and wind mills complete the setup. An impact on one element therefore impacts on the whole.

The architecture of these farmsteads can be described as an eclectic mix of styles modified to adapt to local circumstances. Farm buildings were generally single storied. Walls were thick and built in stone. The roof was either flat or ridged and thatched or with corrugated iron and was terminated at either end by simple linear parapet gables.

In some cases outbuildings would be in the same style as the main house, if they date to the same period. However, they tend to vary considerably in style and materials used as they were erected later as and when they were required.

Location	No. 4	S 30.42494	E 19.57780
Description			
An old farmstead was identified on the farm Aan de Karree Doorn Pan. It was built of clay bricks and later cladded with corrugated iron – quite a unique method. An old 'kookskerm", stone walled kraal and garage is found adjacent. Apparently it dates to about the 1920s, or slightly earlier. Considering the scarcity of farm buildings in the larger region and the unique construction method, this site is viewed to have high significance.			
Significance	High on a regional level – Grade III		
Mitigation			
These structures are located in the area where it is planned to develop the wind farm facility. If the buildings cannot be retained, it should be documented (photograph and mapped) in full before they are demolished, for which a permit from SAHRA would be required.			


Figure 95: Views of the farmstead

- Cemeteries

Apart from the formal cemeteries that occur in municipal areas (towns or villages), a number of these, some quite informal, i.e. without fencing, is expected to occur sporadically all over, but probably in the vicinity of the various farmsteads. Many might also have been forgotten, making it very difficult to trace the descendants in a case where the graves are to be relocated.

Most of these cemeteries, irrespective of the fact that they are for land owner or farm labourers (with a few exceptions where they were integrated), are family orientated. They therefore serve as important 'documents' linking people directly by name to the land.

Location	No. 5	S 30.42624	E 19.57634
Description			
Informal cemetery with two graves. Only one has a headstone, that of HGJ Lintvelt, a young boy who died in 1913. These graves can probably be linked to the farmstead discussed above.			
Significance	High on a local level – Grade III		
Mitigation			
These graves are probably linked to the homestead discussed above. As such it forms a unit with it and it is recommended that they are retained in place. If that is not possible, they should be relocated to a formal cemetery after consultation with descendants and obtaining of all the relevant permits.			

Figure 96: The identified cemetery

- Farming related features

In addition roads and tracks, stock pens and wind pumps complete the setup. An impact on one element therefore impacts on the whole.

Location	No. 6	S 30.45250	E 19.57417

	No. 7	S 30.43228	E 19.50254
Description			
Water points for stock served by wind pumps. Although the wind pumps are not that old, it could have been replaced at any point, the associated dams are quite old.			
Significance	Low on a regional level – Grade III		
Mitigation			
These structures are located in the area where it is planned to develop the wind farm facility. As there are probably hundreds similar sites in the contiguous area no further action is required.			

Figure 97: Different wells.

- Indigenous plant use

Location	No. 8	S 30.45687	E 19.49890
Description			
An area where a significant number of ghaap (*Hoodia currori*) occurs. This plant was used by the San as vegetable as well as appetite suppressant. Under agreements with the CSIR the San would share in any commercialised locally derived products made from this plant.			

Figure 98: Some of the *ghaap* plants

10.8.2 Potential Impact

Potential impacts include:

- Physical disturbance of Stone Age sites. The impact will be focused on a particular node, i.e. tower positions or access/ inspection roads. It is however important to note that many sites are still unknown and their potential as well as significance is therefore unknown.
- Farmsteads, cemeteries and farming related features are subject to damage

10.9 Socio-economic Impact Assessment

10.9.1 Potential Impacts: Pre-Construction

The following social change processes are expected during the pre-construction phase:

- Geographical change processes (land use changes), which will mainly relate to establishing site access and the clearing of the site;
- Demographical change processes, which would involve the arrival of the construction team component involved with site clearing (expected to be mostly unskilled workers); and
- Institutional and legal change processes, which would involve finalising the lease agreements with the affected landowners.

These change processes have been discussed in more detail in the following subsections.

- Geographical Change Processes

Based on the results of all the specialist studies, buildable areas within the sites were identified.

Figure 99 below reflects the buildable area that was identified for project 1: 50MW Wind Farm. The buildable area avoids all the identified social sensitive points, but the existing power lines cuts across the area.

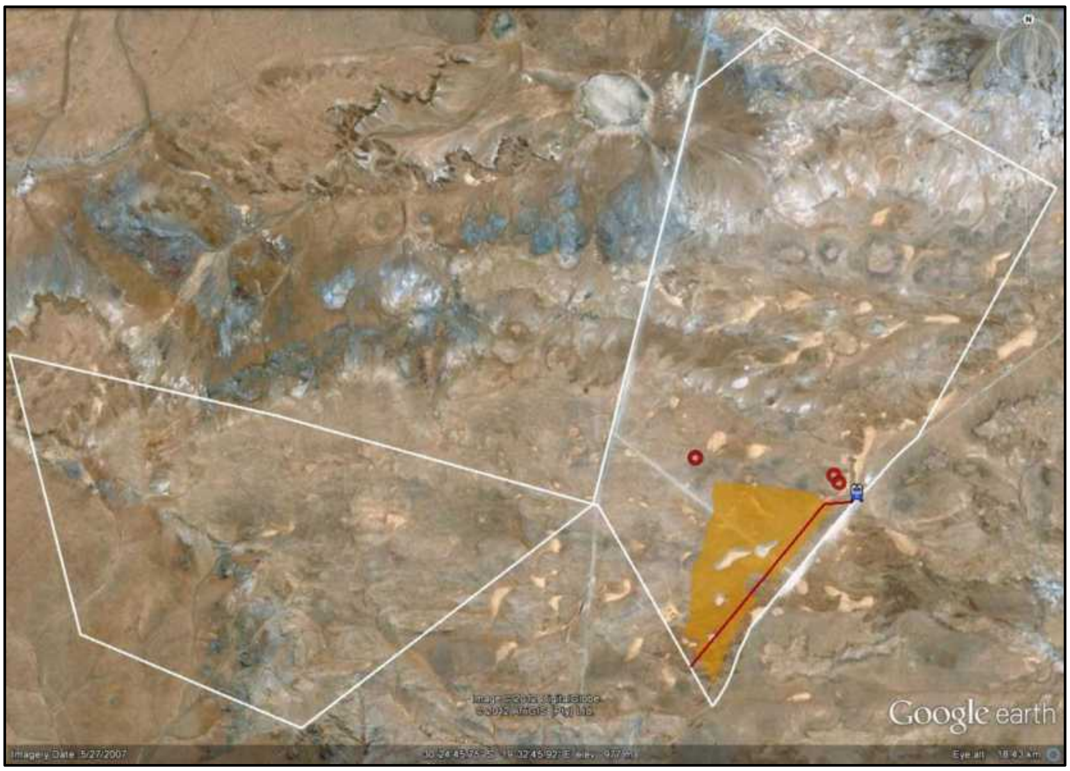


Figure 99: Buildable Area Project 1: 50MW Wind Farm in relation to Social Sensitive Points

The closest wind turbine is located between 480m-600m south from the structure located at point 1, and approximately 800m southeast from point 2. However, again it should be stressed that the land is leased from these landowners and therefore the assumption is that they are in agreement with the location of such structures on their properties.

Figure 100: Turbine lay-out Project 1: 100MW Wind Farm

Figure 101 below reflects the buildable area that was identified for project 2: 420MW Wind Farm. The buildable area avoids all the identified social sensitive points.

Figure 101: Buildable Area Project 2: 420MW Wind Farm in relation to Social Sensitive Points

The closest wind turbine is located between 780m southeast, 1.2km south and 980m southwest from the structures located at point 1, and approximately 680m southeast from point 2. However, again it should be stressed that the land is leased from these landowners and therefore the assumption is that they are in agreement with the location of such structures on their properties.

Figure 102: Turbine lay-out Project 2: 420MW Wind Farm

- Demographical Change Processes

At this stage it is foreseen that a very small team will be involved with the site testing and monitoring and that the site clearing will mostly entail unskilled labour that can be sourced locally. As such it is not foreseen that there will be any significant changes brought about to the size and composition of the local population during the pre-construction phase and hence no impact are foreseen during this phase of the project.

- Institutional and Legal Change Processes

During the preconstruction phase the lease agreements with the affected landowners will be finalised and effected. However, these negotiations are between the landowner and Mainstream and fall outside the scope of the study and as such have not been assessed in detail.

10.9.2 Potential Impacts: Construction

- Demographical Change Processes

During the construction phase of the project, the following demographical change processes are expected:

- Influx of Construction Workers; and
- Influx of Job Seekers.

While Mainstream have largely committed to sourcing local labour where possible, in such a small community any sizeable influx of 'foreign' workers can alter the demographic landscape. On the second note, and from the viewpoint of job seekers from local neighbouring settlements as well as those from further away, such a project may appear as an attractive source of employment and income. The influx of such persons may well alter the demographic landscape as significantly, if not more so, than construction workers.

Mainstream plan to source local workers so that they provide employment and a temporary (and in some cases permanent) injection of economic support to the area. In many instances though, this may not be possible and an inevitable influx of 'foreign' workers may result. The exact number of workers may vary depending on project alterations, unforeseen circumstances, and the nature of skilled activities required. Currently though, Mainstream are only able to provide estimates as to the number of workers required, their respective skill levels and where they will be sourced from during the construction phase. The table below outlines the number of workers and their origin for the wind farm construction.

Table 42: Number of workers required and the nature of their origin during construction – wind farm

Nature of Work	**Number of Workers Required**	**% Sourced from Local District**	**% Sourced Nationally**	**% Sourced Internationally**
Unskilled	214	100% (214)	0% (0)	0% (0)
Semi-skilled	107	70% (75)	30% (32)	0% (0)
Skilled labour	189	5% (9)	80% (151)	15% (29)
Professional	34	1% (1)	80% (27)	19% (6)
Total	**544**	**224**	**285**	**35**

A total of 544 employees will be required for the construction of the proposed wind farm, with the majority being unskilled and semi-skilled. As previously indicated, the total population size in the Hantam Municipality is estimated at 21,235 people, of which approximately 1,831 are resident in Loeriesfontein. When assuming that at least 224 of the construction team will be sourced from within the local area, the majority of the construction team would still have to be from outside the area, which means that a total of 320 people would enter the area. On a population of 1,831, this would imply a population increase of 17.4%.

However, it should be noted that the construction process would follow a phased approach and that the whole construction team will not be on site simultaneously and from the start of construction. For example, for the first 2 months of construction it is expected that only a maximum of 15 people will be on site, steadily ramping up to the full labour force over the next 6-12 months. The full labour force will be on site for 12-18 months, after which the construction team will be ramped down over the next 18-24 months. It is expected that construction on the wind farm will be completed within 24 months.

- In-Migration of Job Seekers

Unlike the regulated circumstances surrounding a construction team, the influx of job seekers is unregulated and often very difficult to control. It is also very difficult to predict how many job seekers could be expected and the extent to which they can change the size and composition of the local population, as the intensity of the effect will be influenced by the actual number of job seekers.

Given the fact that Mainstream intends to offer employment mostly to locals it is highly unlikely that job seekers who are not from the area will find employment by loitering at the construction site. Job seekers from outside the area then become a burden to the host community, as they do not have the means to sustain themselves, thereby becoming dependent on others (usually people who themselves only have limited resources). However, it is likely that most job seekers would be from the area (Loeriesfontein and surrounds) – in some circumstances individuals might let their families from elsewhere know that there are potential job opportunities available, which can lead to, what is expected, a minimal influx of job seekers. The presence of job seekers from elsewhere, who are not related to any of the locals, can lead to the creation and/or expansion of informal settlements.

- Economic Change Processes

Based on similar developments described in literature (EEU, 2011) we assume that the construction of the Loeriesfontein wind farm will be completed within 8 months (between 6 to 10 months). Construction involves:

- Wind turbines generating up to 214MW;
- Access roads;
- Power lines;
- Wind farm control room; and
- Temporary construction lay down area.

- Direct employment and output

i. Wind turbines:

During the construction phase it is estimated that 569 new jobs will be created for a 2 year period of which 313 jobs will sourced locally, 220 from the rest of South Africa and 36 from outside the borders of South Africa. The 569 jobs translates into 1 138 job years given the 2 year construction period and is much lower than the Greenpeace estimate of 4.5 job years per MW (in EEU, 2011) for wind farms in general that would have meant 2 070 job years for the 460 MW planned for the Prieska site.

The 569 new jobs per annum is 14% of the 4 082 jobs created in 2010 (IHS Global Insight, 2012) by the formal economy of Hantam Local Municipality – a significant percentage for a single project. The majority of local jobs will be unskilled (72%) followed by semi-skilled jobs (25%) and skilled (3%) jobs. While this could be good news in terms of job opportunities for the large portion (81%) of the adult population (20+years) without complete secondary education in Hantam Local Municipality (StatsSA Community survey 2007), the opportunity has a limited time span (only 24 months) and could also mean limited opportunities for skills upgrading depending on the policies of the contracting companies in terms of associated training. However it should be mentioned that the sheer scale of the unskilled jobs created (about 225) compared to the unemployment rates in the closest economy of Hantam (around 1400 people in 2010) could have significant short term impact on unemployment and poverty in the Hantam municipal area.

In terms of the direct impact on local output or gross value added (GVA) of the area the estimated additional R220m of value added created per annum for the 2 year construction period could make a rather significant contribution towards the annual domestic production of the surrounding Hantam Local Municipality, representing almost 21% of the entire Hantam Local Municipality gross value added (economic production) – a highly significant percentage for a single project within any area.

- Economic multiplier effects

Construction activities also have an indirect impact on the economy through backward linkages with suppliers of construction materials and other inputs such as consulting services. Based on information supplied by the developers as well as the Northern Cape Social Accounting Matrix (DBSA, 2011), it is estimated that additional temporary jobs in the local economy could be as high as 106 jobs due to increased activity of local traders and producers of construction materials and equipment, transport services, accommodation services etc. Local production could potentially increase by an additional R20m due to supply linkages with the construction of the Loeriesfontein wind farm.

Apart from the indirect contribution of suppliers to the construction of the wind farm, the induced effect relates to the multiplier effect of the income received by construction workers and workers in the supply industries being spent on goods and services in the local economy. It is estimated that the induced effect could create an additional 85 jobs during the 2 year construction period and contribute an additional R24m towards local production.

A large portion of construction inputs will be supplied outside the local economy creating an estimated R 193m value added in the rest of South African economy and an additional 874 jobs for construction suppliers outside the local area. The induced spending is furthermore expected to create an additional 124 jobs during the construction phase and add some R38m towards the rest of the South African economy's output.

- The total impact on the local and national economy during the construction phase

    i. Wind turbines:

The total annual impact of the construction of the Loeriesfontein wind farm on local and national employment and output levels is expected to last two years and can be summarised as follows:

Type of impact	**Local employment (nr of jobs)**	**Local output: Gross value added (Rm)**	**% of local employment (4 082 jobs in 2010)**	**% of local output (R1 053m in 2010)**	**Employment SA (incl local) (nr of jobs)**	**Output SA (incl local) Gross value added (Rm)**	**% of SA employment (total=8.2m formal jobs in 2010)**	**% of SA output (total = R2412 bn in 2010)**
Direct impact	568 (313 locally sourced)	220	13.9	20.8	568	220	0.007	0.009
Indirect impact	93	18	2.3	1.7	967	212	0.01	0.009
Induced impact	85	24	2.1	2.3	209	62	0.002	-
Total impact	746	262	18.3	24.8	1 744	494	0.02	0.02

Sources: Based on information supplied by developer, IHS Global Insight, 2012, Stats SA, 2007 and 2011, DBSA, 2011

The joint impact on the Hantam labour force per annum (for 2 years):

- Number of jobs created for locals by the wind farm and solar plant = 848 jobs
- Total number of formal jobs in local economy = 4 082 in 2010
- Total number of informal jobs = 394 in 2010
- Total number of unemployed people in the local area = 1 313 in 2010
- % unemployment = 23% of the labour force
- Locally created jobs as % of informal employment and unemployment =50 %

▪ Institutional and Legal Change Processes

Institutional and Legal Change Processes assesses the way in which a development of this nature could change the face of service delivery in the affected area and how this change in turn could affect the quality of life of local residents. In line with the Scoping study, the following institutional and legal change processes are expected:

- Increase in housing needs; and
- Additional demand on municipal services

In addition to these change processes, the risk for social mobilisation against the project has also been considered and assessed.

- Increase in housing needs

The in-migration of a construction team consisting of approximately 320 people in the case of the wind farm will create a housing need in Loeriesfontein as the nearest town. The more people are sourced from the local community, the less the demand for additional housing, as local community members are already resident in the area. Loeriesfontein has a small hospitality industry, consisting of one B&B and one hotel. It would therefore appear that accommodation options are fairly restricted in the area, given the fact that Mainstream have opted to not make use of a residential construction camp.

The housing problem would be amplified in the case of the PV plant when 872 people would require housing. Cognisance should therefore be taken in both instances that the hospitality industry in Loeriesfontein might not be able to cater for the needs of the construction team and that alternative arrangements might have to be made in terms of accommodation.

- Additional demand on municipal services

As Mainstream will require the contractor to house the construction team within existing structures (renting houses, B&B or the hotel), the assumption is that the these structures are already serviced by the municipality and that the infrastructure will be able to sustain the additional strain in terms of electricity, water, sewerage and refuse removal within town.

With the site being located some 60km from Loeriesfontein, special arrangements would have to be made with the HLM for municipal services on-site, especially with regards to water which is a huge concern in the area. Water is a great scarcity in the area. Where possible water on site should be collected and stored, whereas the municipality can be contracted for the collection of waste and sanitation[11].

- Socio-Cultural Change Processes

As socio-cultural processes recount the way in which humans behave, interact, and relate to each other and their environment, socio-cultural change processes in turn looks at the way in which the proposed developments can alter the interactions and relationships within the local community. In line with the results of the scoping study, conflict situations are the most important socio-cultural change process expected during the construction phase. In addition to the Scoping study results, health and safety has been identified as an additional socio-cultural change process during the construction phase.

  - Risk for Social Mobilisation

Attitudes are formed by means of people's take on a specific issue, coupled with their past experiences associated with either the issue itself or, more likely, the way it has been dealt with by those responsible for creating the situation in the first place. A person's attitude towards a certain issue or situation can strongly influence the way in which that person views subsequent issues/situations of a similar nature. If local residents are unsupportive of either the proposed project in question or of the project proponent, it could lead to social mobilisation.

The risk for social mobilisation greatly increases if the project proponent is perceived as distrustful, i.e. if they do not deliver on their undertakings with the local residents in terms of employment creation, etc. To ensure support of the project and reduce the risk of social mobilization, the project proponent should at all times be seen to care about the residents of Loeriesfontein as the closest formal human settlement that will be affected by the project. At this stage Mainstream Renewable Power has a 'clean slate' in the area, but to maintain a trust relationship, residents need to feel that they receive some tangible benefits from the project, e.g. direct and/or indirect employment. The undertakings and mitigation/enhancement measures stipulated in the Environmental Management Plan (EMP) should be implemented effectively and

[11] Suggested by members of the Loeriesfontein Ward Committee Meeting, 20 October 2011

with due diligence to show local residents and affected populations that their needs are important and catered for.

A number of I&APs have indicated that they expect that any job opportunities would be primarily afforded to them. Although the risk for social mobilisation at this stage of the project is regarded as low, the situation can easily change if local residents are disregarded. If social mobilisation does occur, it could not only severely delay the construction process, but also lead to intense situations of conflict that ultimately affects social wellbeing.

- Health and Safety

In this context health and safety impacts focus mainly on the spread of certain sexually transmitted infections (STI), including HIV/AIDS. It is not uncommon for construction workers who are separated from their families for a period of time to establish temporary sexual relationships with members of the local community. Disempowered and desperate local women often view construction workers as financially well-off. This can lead to an increase in prostitution. Other women just enter into normal (sexual) relationships with construction workers believing that they will be supported financially. These situations have the potential to lead to an increase in pregnancies within the local community and eventually single parent households without financial support.The spread of STIs and HIV then become matters of great concern, also in light of the fact that construction workers move out of the area into another areas where the spread of STIs and HIV may continue.

The Northern Cape Provincial Government has set HIV/AIDS as a major point of concern and has indicated that one of their core aims is to reverse the HIV prevalence rate by 2014. The Social Development Unit in the Directorate: Community and Social Development Services deal with issues such as TB/STI/HIV/AIDS programmes and poverty alleviation and as such the Unit provides voluntary counselling and testing services and is also involved in the following activities:

- Provision of responsive reaction to TB/STI/HIV/AIDS prevention and treatment through regular education.
- Provision of support through Peer Educators and EAP members and support group.
- Provision of Anti-Retro-Viral drugs (ARVs).
- Provision of condoms at all times.
- Commemoration of special events like TB Day; STI/ Condom Week; ‘Candle-light’ & World Aids Day.
- Monitoring and evaluation of the programme on an annual basis.

In line with the municipality’s efforts in reducing the HIV prevalence rate, the project should ideally develop a comprehensive Health and Safety Plan that includes an HIV prevention plan. The HIV prevention plan should link up with the local municipality's initiatives and should extend to local communities.

Also included under health and safety is the quantity and quality of the water supply and sanitation services. If these services are inadequate and/or not managed properly, it could lead to waterborne diseases and unhygienic living conditions. These conditions will not only affect the construction workers, but can also spread to the local community, more so in the event of a construction village that is not managed properly.

A further consideration under health and safety is the perception amongst local communities (landowners) that the presence of construction workers leads to an increase in crime levels. However, it should be noted that it is most likely not the actual construction worker who engage in criminal activities but more likely job seekers who loiter in the area or at the construction site.

10.9.3 Potential Impacts during Operations and Maintenance

- Geographical Change Processes

The identification and assessment of social impacts arising from geographical change processes within a social context, focuses on how the proposed development might impinge on the behaviour and/or lives of landowners and/or land users in the affected area. The following geographical change processes and resultant impacts were assessed:

i. Long term loss of land; and
ii. Change in access to resources that sustain livelihoods.
iii. Construction of roads and connection routes to the site

- Long Term Loss of Land

There will be a long term loss of land on the site for the operational lifetime of the project. Based on a review of maps and IDP documentation it does not appear that any institutional loss of land will occur due to this project (i.e. planned developments and/or currently existing municipal/institutional infrastructure). For this reason any indication thereof within the scoping report has been dismissed for this SEIA. Potential loss of private land is according to the section below.

- Change in access to resources that sustain livelihoods

Any effect on agricultural processes could hold negative outcomes for those employed in agriculture, those who hold ownership over the agricultural activities, and for food security locally. Mainstream have indicated that they are considering fencing off the find farm which would result in a loss of grazing land for the operational lifetime of the wind farm. It is however assumed that if this decision is taken forward, that it would form part of the lease agreement with the landowner.

The nature of these impacts would largely be of an economic nature and as such have been assessed in the Economic section of this report.

  - Construction of roads and connection routes to the site

Mainstream have stated that they plan to construct roads on the site areas in order to connect turbines, administration buildings and other planned infrastructure. These roads will almost entirely be within the confines of the site area (as existing farm roads will be used as far as possible) which itself will be fenced off and will be home to an array of larger infrastructure. This means that further road infrastructure will be created but largely within an area in which major infrastructure is already planned and in an area that will not be accessed by the general public. Alterations to existing roads would include strengthening them, the creation of turning circles for large trucks, and the construction of culverts over gullies and rivers should this be required.

- Economic Change Processes

  - Direct employment and output

According to figures provided by the developer, 36 permanent jobs is expected to be created in the operation of the wind farm mainly locally sourced jobs (29). The majority of these 29 local jobs will be unskilled (75%) or semi-skilled (18%).

The operation of the plant is furthermore expected to contribute some R 1.35bn towards the value of final goods and services produced within the boundaries of the Hantam Local Municipality. However it should be mentioned that the major part of the value added by the operation of the wind farm (almost 98%) consists of profits that, while some percentage is expected to be ploughed back into the community through corporate social investments (discussed later on), a very small percentage could be expected to be spent in the local or even broader national economy given the foreign status of the investor.

While land leased from local farmers is expected to increase income in the local community, in economic accounting terms this additional income/production is effectively cancelled out by rent paid by the wind farm hence lowering the value added of the wind farm. However in this case we might add the R6.4m lease income to local wages since it might most likely increase local incomes by “retaining” some of the profits expected to be expatriated. We will keep this in mind when calculating the induced effect of local spending below.

- Economic multiplier effects

Linkages to suppliers during the operational phase are mainly restricted to repairs and maintenance of the plant that could add almost R3m to local production annually and some 6 additional jobs. However it is expected that the larger part of maintenance and repair expertise would come from the rest of South Africa with an additional R27m added to national output and 54 additional jobs created outside the local area.

The induced effect relates to the multiplier effect of the income received by workers in operations and maintenance being spent on goods and services in the local economy. As was mentioned above with a large portion of the profits expected to be spent outside the South African economy, the salaries and wages of local workers, the lease income from local farmers and retained profits in the form of corporate social investment could be expected to be spend within the local economy. It is estimated that the induced effect could create an additional 28 jobs and contribute an additional R7.8m towards local production.

In the broader economy the spending of earnings from workers employed by industries that benefit from maintenance and repairs spending of the Loeriesfontein wind farm could potentially contribute to an additional R 5.5m in output and 17 jobs.

- The total impact on the local and national economy during the operational phase

The total impact of the operation and maintenance of the Loeriesfontein wind farm on local and national employment and output levels is summarised below:

Wind turbines:

Type of impact	**Local employment (nr of job years)**	**Local output: Gross value added (Rm)**	**% of local employment (4 082 jobs in 2010)**	**% of local output (R1 053m in 2010)**	**Employment SA (incl local) (nr of job years)**	**Output SA (incl local) Gross value added (Rm)**	**% of SA employment (total=8.2m formal jobs in 2010)**	**% of SA output (total = R2412 bn in 2010)**
Direct impact	36 (29 locally sourced)	1 328 (23 excluding profit)	0.9	126 (2.2% excl profit)	36	1 328	-	0.06

Type of impact	Local employment (nr of job years)	Local output: Gross value added (Rm)	% of local employment (4 082 jobs in 2010)	% of local output (R1 053m in 2010)	Employment SA (incl local) (nr of job years)	Output SA (incl local) Gross value added (Rm)	% of SA employment (total=8.2m formal jobs in 2010)	% of SA output (total = R2412 bn in 2010)
Indirect impact	6	3	0.01	0.3	60	30	-	-
Induced impact	28	8	0.7	0.8	45	13	-	-
Total impact	70	34 (excl profit)	1.4	3.2% (excl profit)	141	1 371 (66m excluding profits)	0.002	0.06

Sources: Based on information supplied by developer, IHS Global Insight, 2012, Stats SA, 2007 and 2011, DBSA, 2011

The total impact on the Hantam labour force:

i. Number of jobs created for local people by the wind farm = 121 jobs
ii. Total number of formal jobs in local economy = 4 082 in 2010
iii. Total number of informal jobs = 394 in 2010
iv. Total number of unemployed people in the local area = 1 313 in 2010
v. % unemployment = 23% of the labour force
vi. Locally created jobs as % of informal employment and unemployment = 7.0%

- Diversification of the local economy

The tress index shows the level of diversification of an economy with an index value of 100 showing an economy relying on only one sector while an index value of 0 shows a perfectly diversifies sector where all sectors contribute equally to the total economy. In 2009 the Northern

Cape economy had a tress index of 47.8, significantly higher than the 39.6 of the national economy (IHS Global Insight, 2012). Underlying the relatively high tress index value of the Northern Cape is the high contributions made by the mining, finance and services sectors.

The Hantam Local Municipality economy is mainly a regional agri-trade centre and is more concentrated than the Northern Cape economy in general with economic activity concentrated in agriculture (19%), trade (33%) and public services (18%) – a typical situation in many undeveloped rural economies. The development of the renewable energy industry could therefore play a significant role to diversify the economy away from the climate-dependent agricultural sector and the public service sector.

- Social income

  i. Additional central government tax revenue

With total tax revenue calculated as 26% of national value added in 2010, it follows that 26% of the total value added generated by the project could probably be added to central tax revenue, R356m (26% of R1.37bn value added). This includes revenue generated for central government through direct taxes (company and personal taxes) as well as indirect taxes (e.g. VAT). This presents about 0.03% of the R 656 bn government tax revenue collected between 2010/11 (SARB, 2012).

  ii. Net income to local government

Municipal income from property tax will increase since the new structure would most probably be classified as public service infrastructure (not exempt) and not as plant and equipment (exempt) (Interview with DDP Valuers, 20120).

The municipal services that the wind farm needs from the local authorities is expected to be minimal, i.e. limited to 5kl fluids/ per month to be removed from a preservation tank and refuse removal equal to that produced by one household. If the local authority will provide the service we could furthermore assume that municipal costs will mainly be offset by charges to the wind farm.

  iii. Corporate social investment

Actualising the total within a ten to fifteen year period after inception, R99.7m per annum or 7.6% of expected profits of R 1 351m will be retained for development in the form of an enterprise development fund (0.4% of profits) socio economic development fund (1.1%) and a community development funds (building up towards 6% of profits after debts has been paid by trust). This is a substantial percentage by any standard and especially high if compared to the Hantam Local Municipality economy, namely 9.4% of local production in 2010. The amount is more than thrice the value of the wages paid to workers in the operation of the wind farm (R23m per annum). Coming from a single project, the R99.7m social funds is more than 20% of the entire social development budget of the entire Northern Cape and almost 2% of the joint provincial budget for health and education budgeted for 2010/11 (Northern Cape Treasury, 2008).

It should be noted that if the solar plant replaces the wind farm, the social funds will decrease significantly from 7.6% of 1 351m profits (R 100m) expected from the wind farm to 7.6% of the R45m profits expected from the 50MW solar plant (3.4m).

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- Corporate social investment structures and approaches

The first question to answer is who are the communities that should participate, ultimately the beneficiaries? The communities need to be defined, communal structures established and representatives identified and/or elected. The leading approaches are based on:

a. Firstly, gaining an understanding of the existing community structures, dynamics and identifying the key socio-economic initiatives, programmes being delivered through e.g. government, Civic organisations, LED forums, NGO’s and private initiatives.
b. Secondly, identify community groupings for participation, such as key civic organisations, forums, societies and other role players.
c. Thirdly, identify community groupings for participation and develop clear criteria for the selection of individual representatives.

In applying this process experience has shown that there are significant benefits to be derived from building on a variety of existing community structures and groupings. Initiatives that strive to develop entirely new community body(s) often find they are undermined by existing structures, frustrated by gate keeping and/or become politicised. The community/beneficiaries would be typically represented by Board members or Trustees depending on the institutional models applied.

It is critical that at the time of establishing the community representative bodies that clear purpose and criteria for the allocation of funds are developed and captured in the founding documentation (statues). These criteria should indicate the criteria on which the basis of funding amounts and allocations are to be made and detail the decision making process to be applied. The criteria and process to be applied need to be openly and effectively communicated to all stakeholders. The majority of problems experienced with community participation models revolve around conflicts pertaining to the allocation of funds, often resulting in the total collapse of the community representative body. Most of these challenges can be address trough developing clearly defined purposes for fund allocation, criteria for funding decisions and defined and transparent decision making process.

The challenge is to ensure that the revenues generated are effectively and efficiently applied in accordance with the community priorities. The community and/or individuals in the community could potentially participate in the benefits of the social trust fund in a variety of ways, namely through:

a. Local government structures
    i. Local Economic development Forums
b. Direct community involvement
    ii. Entrepreneurial participation directly in the venture or provision of supporting services e.g. maintenance and transport
    iii. Community participation (Trusts and section 21 companies), intern investing in or supporting community development initiatives
    iv. Community bodies (societies and associations) addressing a variety of community needs and interests
c. Non-governmental organisations:
    v. Development programmes e.g. school feeding schemes, market gardening schemes, HIV Aids programmes etc.

- Community development priorities

The Northern Cape Provincial Growth and Development Strategy (NCPGDS) states that poverty reduction is the most significant challenge faced by the provincial government and its growth and development partners. Furthermore, it emphasises the following priority areas have to be addressed:

- Reducing the backlog in basic needs such as water, sanitation and housing
- Improving basic services such as health, education and social services
- Reducing the HIV/AIDS prevalence rate
- Creating employment opportunities
- Reducing the crime rate
- Empowering vulnerable groups

Taking a lead from the NCPGDS, drawing from the earlier socio-economic scoping work undertaken, coupled with a cursory review of the local municipal IDP's, the following development priorities emerge.

Priority areas	Key priorities identified
Provision of basic services	Services: Sanitation Water (potable & agricultural) Housing Electricity Roads (gravel upgrades & tarring main roads) Facilities: Community centre Recreational /sports facilities
Poverty alleviation	Poverty relief schemes School feeding schemes
Unemployment	SME and farmer development promotion: Enterprise funding Training and mentorship Training and re-skilling: Adult education Skills training Expanded public works programmes
Health programmes and Social Services (awareness and direct support)	Supporting individual programmes and initiatives to address priority health challenges HIV/AIDS prevalence Alcohol abuse TB

Priority areas	Key priorities identified
Education (enable access to opportunities – mobility)	Investment in school infrastructure (physical facilities and staff) Bursaries to performing students

Increasingly emphasis in CSI programmes is being placed on supporting social investment to address basic needs through the following priority interventions:

- **Provision of basic services**: There is increasing focus in development initiatives on focusing scare resources on providing basic services. In this regard the key priorities are in addressing:
  - The backlogs in sanitation and housing through for example the continued roll out of access to flush toilets in line with the sated National Government priorities.
  - Improving the access to water, particularly potable drinking water and livestock drinking water. This could be through investing in community wells and boreholes following models applied successfully in other parts of Southern Africa.
  - The improvement of road infrastructure, particularly upgrading deteriorating gravel roads and tarring more major roads. In this regard to maximise community participation and also support poverty relief and employment consideration could be given to the Zibambele process applied successfully in KZN, where communities take responsibility for maintaining sections of road for a maintenance fee.
- **Provision of improved education**: There is an increasing acceptance that a key development intervention in depressed rural areas, characterised by limited job opportunities and high unemployment, is to improve education to enable job seekers to migrate and secure jobs in urban centres. In this regard most community based development initiatives are placing significant priority on improving education standards through investing in educational infrastructure.
- **Direct poverty and health interventions**: The Northern Cape rural communities are characterised by significantly high levels of poverty, coupled with specific challenges pertaining to health, particularly in terms of AIDs, Alcohol abuse and TB. In this regard investment into feeding schemes and improvements in access to healthcare facilities and services are regarded as a priority. Integrated models successfully being applied in the Eastern Cape could be considered, where the feeding schemes are integrated with supporting market gardening initiatives, which in turn provide produce to support school feeding schemes.

  - Potential Opportunity Costs of the Development

    i. Development opportunities

No alternative development projects are currently under review for the site.

ii. Agricultural output

Combining the total land area of the Northern Cape of 361,830 square km and 98% used for stock farming (Department of Agriculture, undated) with agricultural output and employment figures of R3 938 m (IHS Global Insight, 2012) and 44 000 jobs respectively in 2010 (Department of Agriculture Forestry and Fisheries, 2010) it is deduced that the average agriculture output and employment for the province is R11 105 and 0.12 jobs per square kilometer respectively.

Of the 546 square kilometres planned for the Loeriesfontein wind farm about 3% of agricultural land (16.9sq km) could be displaced assuming that cattle will be allowed to graze inside the facility that could indicated to an annual agricultural loss of about R 188 000 with two low-paid jobs per annum potentially forfeited by changing the land use of the area from agriculture to a wind farm.

In addition, the solar plant is assumed to take about 3ha per MW, i.e. given the 50MW planned about 150ha or 1.5 square km of agricultural land lost, i.e. an estimated R17 000 agricultural production loss per annum and no job losses.

However it is more likely that excess farming stock will be shifted to adjacent areas with no economic implications but with potentially implications for bio-diversity resulting from over-grazing.

iii. Tourism

The contribution of hotels and accommodation towards total output is relatively low (0.5%) in Hantam Local Municipality compared to the contribution of the sector of 1.4% in the tourism intensive economy of the Western Cape. This suggests the relative low importance of tourism activities in the area (HIS Global Insight, 2012).

Determining how wind farms directly affect the tourist industry is problematic and many researchers believe the evidence is inconclusive. A large number of international surveys conducted among tourists show that most tourists (70 – 91%) are not bothered by the presence of wind farms, and an increase of wind farms in the area would not deter them from visiting again (in EEU, 2011).

It is furthermore suggested that the type of tourism to the area consist of stay-overs, visiting family and business tourism, i.e. tourism categories that will not be affected negatively by the wind farm.

- Impact on Rural/Agricultural Property Prices

International studies reveal conflicting results related to the effect of wind farms on property values. Arguments can go both ways (EEU, 2011).

In a local survey of estate agents with experience of in the Darling and Yzerfontein property markets in the vicinity of the Darling wind farm that has been in operation since 2008, estate agents are unanimous in their opinion that the wind farm had no impact on property prices in the area. The single opinion was also that the wind farm would not deter future investors nor cause people to move out of the area. In an area like Loeriesfontein with vast spaces of open agricultural land and where land uses are predominantly agricultural, it is not likely that the proposed wind farm would impact property values since it will not in any way affect the agricultural activities or productivity on these properties (EEU, 2011).

- Socio-Cultural Change Processes

The most important socio-cultural change during the operation and maintenance phase relates to a change in sense of place.

Much of what is valuable in a culture is embedded in place, which cannot be measured in monetary terms. It is because of a sense of place and belonging that some people loath to be moved from their dwelling place, despite the fact that they will be compensated for the inconvenience and impact on their lives.

Place attachment is a construct that is used to determine and/or explain sense of place. Kyle et al. (2003b page 250) stated that place attachment “is the extent to which the individual values or identifies with a particular environmental setting.” It has to with meaning and value, an intimate connection with an environment.

Place attachment is generally recognised as having two components: *Place Identity* and *Place Dependence*. According to Proshansky et al. (1983) place identity refers to the way in which a person views the self in relation to the environment. It refers to the way in which a person uses a place to construct or maintain self-identity (e.g. a conservationist). In contrast, place dependence refers to the way in which the environment is able to fulfil the intentions of the user (e.g. hunt, farm, relax).

Stedman (2003b) presented research that has found that repeated experience led to strengthening of attachment, including developing emotional ties and self-identity. The familiarity with an area may therefore differ between visitors and local people, leading to differences in attachment. However, research findings indicate that direct contact with a place is not necessary for place attachment to develop. Proponents of the socio-cultural perspective on sense of place support this research. Blake (2002) argued that places could have symbolic and cultural meaning for groups of people, which leads to place attachment even though they have never been there.

Stedman (2003a) uses the term *place meanings* to describe the dimension of sense of place which is more cognitive than emotional (place attachment is more emotional). It has to do with evaluative and symbolic beliefs. For example: “The bushveld is a place favoured by hunters” refers to place meaning, whereas place attachment is communicated by: “My favourite place is the bushveld.” According to Stedman, place meaning can change over time, independently of place attachment. Levels of attachment may not change despite the presence of a wind farm but the meanings that people attach to it may change. Levels of attachment might not change because place attachment may be based on social relationships, rather than the physical appearance of a landscape.

Research on the psychological experience of sense of place suggests that people rapidly discount a landscape as soon as the first scar occurs, rather like a stain ruining a favourite garment (Petrich 1993). Thereafter, any additional impacts on the landscape have a correspondingly smaller effect. Hence, the aesthetic impact of placing any form of development in a landscape that already bears the marks of development would be less than that of placing it in a relatively unspoilt environment. In discussing the diverse research showing that people overwhelmingly prefer “nature scenes” to urban and built environments, Zadik (1985) explains *"people seem to respond to environments as natural if the areas are predominantly vegetation and do not contain human artefacts such as roads or buildings."*

Finally for this section it must be pointed out that the potential impact on socio-cultural behaviour and the related perception of environmental changes can have either a positive or a negative impact on sense of place (e.g. peace of mind vs. frustration/anger). The introduction of a new project to the area can be viewed as a positive impact if people perceive the project as infrastructural and/or economic development that is not intrusive on their lives and does not cause them immediate danger. Potential negative impacts include the visual impact (to be assessed in the visual specialist’s report) and the resultant intrusion on sense of place. Furthermore, much of the possible negative impact rests upon the sentiments of the individual perceiver. Some may find the wind farm to be an unwelcome intrusion which degrade the natural beauty of the landscape and reduce the natural qualities to which they are accustomed. Others may find such it to be a welcome sign of progress and infrastructure development, as well as a conservation effort towards ‘green energy’.

In addition to considering the psychosocial and emotional aspects, an assessment of sense of place also has to consider the physical placement of the infrastructure associated with the wind farm within a demarcated site area that would affect as few people as possible. Problem areas in this regard were highlighted as part of geographical change processes during pre-construction impacts.

11 ENVIRONMENTAL IMPACT ASSESSMENT

11.1 Methodology for Impact Assessment

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

11.1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 44.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

11.1.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

- Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 43: Description

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		

This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).

3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY/ MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.

4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.

74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Table 44: Rating of impacts

IMPACT TABLE FORMAT		
Environmental Parameter	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water	
Issue/Impact/Environmental Effect/Nature	A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water	
Extent	A brief description indicating the chances of the impact occurring	
Probability	A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity	
Reversibility	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water	
Irreplaceable loss of resources	A brief description of the degree in which irreplaceable resources are likely to be lost	
Duration	A brief description of the amount of time the proposed activity is likely to take to its completion	
Cumulative effect	A brief description of whether the impact will be exacerbated as a result of the proposed activity	
Intensity/magnitude	A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily	
Significance Rating	A brief description of the importance of an impact which in turn dictates the level of mitigation required	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	1
Probability	4	1

IMPACT TABLE FORMAT		
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	-96 (high negative)	-6 (low negative)
Mitigation measures	Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analyzing the significance. These measures will be detailed in the EMPr.	

The 2010 regulations also specify that alternatives must be compared in terms of impact assessment.

11.2 Environmental Impact Assessment

11.2.1 Construction Phase - Biodiversity (flora and fauna) Assessment

- Loss of habitat for red data / general species

Table 45: Rating of impacts related to loss of habitat for red data / general species

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Loss of habitat for red data / general species
Extent	The impact is only expected to affect the site.
Probability	The impact may occur (Between a 25% to 50% chance of occurrence).

IMPACT TABLE FORMAT		
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources	
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).	
Cumulative effect	The impact would result in minor cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-6(low negative)
Mitigation measures	▪ Maintain footprint strictly during construction ▪ Appoint Environmental Control Officer (ECO) for the duration of construction. ▪ Conduct construction walk down prior to construction to conduct a search and rescue exercise.	

IMPACT TABLE FORMAT	
	▪ Existing indigenous vegetation must be retained where possible. ▪ Remove and relocate any plants of botanical or ecological significance (these must be indicated by the ECO) ▪ Vegetation to be removed as it becomes necessary ▪ No vegetation to be used for firewood. ▪ Demarcation of sensitive areas prior to construction activities starting.

- Edge effect

Table 46: Rating of impacts related to edge effect

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Edge effect
Extent	The impact is only expected to affect the site.
Probability	Impact will certainly occur (Greater than a 75% chance of occurrence).
Reversibility	The impact is partly reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in marginal loss of resources
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
Cumulative effect	The impact would result in minor cumulative effects
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

IMPACT TABLE FORMAT		
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	4	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-7(low negative)
Mitigation measures	▪ The contractor should be responsible for implementing a programme of weed control (particularly in areas where soil has been disturbed); and grassing of any remaining stockpiles to prevent weed invasion. ▪ The spread of exotic species occurring throughout the site should be controlled. ▪ All exotic vegetation must be removed from the site (if present).	

11.2.2 Construction Phase - Avifauna Assessment

- Displacement of priority species due to disturbance

Table 47: Displacement of priority species due to disturbance during construction phase

IMPACT TABLE 1	
Environmental Parameter	Avifauna

IMPACT TABLE 1	
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance during construction phase.
Extent	The impact will only affect the site.
Probability	Impact will certainly occur (greater than a 75% chance of occurrence) for some species, particularly the larger ones. With appropriate mitigation measures (e.g. buffer zone for breeding Greater Kestrel) the impacts can be partially avoided.
Reversibility	Completely reversible. The construction activities will inevitably cause temporary displacement of some priority species. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, most species should re-colonise the areas which have not been transformed by the footprint.
Irreplaceable loss of resources	Marginal loss of resources. The displacement is likely to be temporary.
Duration	Short term. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, most species should re-colonise the areas which have not been transformed by the footprint.
Cumulative effect	Low cumulative impact. The priority species that occur (or are likely to occur) at the proposed site all have large distribution ranges (except Red Lark and Sclater's Lark which are more range restricted), the cumulative impact of displacement would therefore be locally significant, rather than regional or national.
Intensity/magnitude	High. Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease.
Significance Rating	Medium significance. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, most species should re-colonise the areas which have not been transformed by the footprint.

IMPACT TABLE 1		
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	3	2
Reversibility	1	1
Irreplaceable loss	3	2
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	-30 (Medium negative)	-22 (low negative)
Mitigation measures	Restrict the construction activities to the construction footprint area. Do not allow any access to the remainder of the property during the construction period. A 250m exclusion zone should be implemented around the existing Greater Kestrel breeding pair where no construction activity should take place.	

- Displacement of priority species due to habitat destruction

Table 48: Displacement of priority species due to habitat destruction during construction phase

IMPACT TABLE 2	
Environmental Parameter	Avifauna
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to habitat destruction during construction phase
Extent	The impact will only affect the site.
Probability	Impact will certainly occur (greater than a 75% chance of occurrence)
Reversibility	Irreversible. The footprint of the wind farm is an inevitable result of the development.
Irreplaceable loss of resources	Marginal loss of resources. The overall physical footprint is likely to amount to less than 5% of the development area.
Duration	Long term. The habitat transformation will be permanent
Cumulative effect	Low cumulative impact. The overall physical footprint is likely to amount to less than 5% of the development area.

IMPACT TABLE 2		
Intensity/magnitude	Low. The overall physical footprint is likely to amount to less than 5% of the development area.	
Significance Rating	Low significance. The overall physical footprint is likely to amount to less than 5% of the development area.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2	2
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-16 (low negative)	-16 (low negative)
Mitigation measures	No mitigation is possible to prevent the permanent habitat transformation caused by the construction of the wind farm infrastructure. To prevent unnecessary habitat destruction (i.e. more than is inevitable), the recommendations of the specialist ecological study must be strictly adhered to.	

11.2.3 Construction Phase - Bat Assessment

In this case, the original impact rating procedure has been slightly altered as applying it results in higher significance ratings for some impacts compared to others. With impacts like bat mortality during migration, there are major concerns should the impact occur however the probability of occurrence are usually quite low. But if all factors are multiplied by ‘intensity’ the significance rating would be higher than that of foraging mortality. Moreover in reality for a site like Loeriesfontein foraging mortality impact is a much more significant problem that probably needs to be mitigated (depending on results of monitoring). Therefore it’s more suitable to multiply all the factors with ‘probability’ to achieve a reasonable significance rating. This is because if it’s highly unlikely for an impact to occur, it deserves less attention than one that is definite to happen.

Table 49: Destruction of foraging habitat

Environmental Parameter	Destruction of foraging habitat (construction phase).

Issue/Impact/Environmental Effect/Nature	All major bat foraging habitats on this site are already included within the clients proposed buffer zones and will therefore not be destroyed by construction.	
Geographical extent	Site.	
Probability	Unlikely	
Reversibility	The impact is barely reversible should the turbines be placed in an area of high bat sensitivity.	
Irreplaceable loss of resources	Marginal without mitigation.	
Duration	For the duration of the operating wind farm with or without mitigation.	
Cumulative effect	Negligible	
Intensity/magnitude	Considered low without mitigation.	
Significance Rating	Low without mitigation	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Reversibility	3	1
Irreplaceable loss of resources	2	1
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Probability	1	1
Significance Rating	11 (Negative Low)	8 (Negative low)
Mitigation	None required	

11.2.4 Construction Phase - Surface Water Impact Assessment

Table 50: Construction activities taking place in, near or through watercourses and associated buffer zone areas

IMPACT TABLE	
Environmental Parameter	*Watercourses and associated buffer zones*
Issue/Impact/Environmental Effect/Nature	Construction activities taking place in, near or through watercourse areas and associated buffer zones
Extent	*Site*
Probability	*Definite*
Reversibility	*Irreversible*

Irreplaceable loss of resources	*Marginal to significant loss of resources*	
Duration	*Short term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact is likely to be negligible.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	4	4
Irreplaceable loss	2-3	2
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	- 30 to - 32 (medium negative)	- 14 (low negative)
Mitigation measures	Refer to mitigation measures section below	

Table 51 Construction phase stormwater run-off impacts

IMPACT TABLE		
Environmental Parameter	*Watercourses and associated buffer zones*	
Issue/Impact/Environmental Effect/Nature	Stormwater run-off and consequent erosion impacts to watercourses and associated buffer zones to exposed bare construction areas	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Completely Reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Short term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is low and negative. With appropriate mitigation measures, the impact is likely to be significantly reduced.*	
	Pre-mitigation impact rating	Post mitigation

		impact rating
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	- 20 (low negative)	- 6 (low negative)
Mitigation measures	Refer to mitigation measures section below	

11.2.5 Construction Phase - Agricultural Potential

Table 52: Contamination of local soil and land use resources

IMPACT TABLE	
Environmental Parameter	Soil and Land Use Resources
Issue/Impact/Environmental Effect/Nature	Loss of agricultural land and / or production as a result of the proposed activities
Extent	Impacts will be restricted to the site.
Probability	A marginal loss of grazing land will definitely occur.
Reversibility	The land can be returned to grazing after construction has been completed.
Irreplaceable loss of resources	The construction of the turbines, solar field and associated infrastructure will result in a very marginal loss of agricultural land and production.
Duration	The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.
Cumulative effect	Negligible Cumulative Impact
Intensity/magnitude	Low
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-12 (low negative)	-12 (low negative)
Mitigation measures	Refer to the mitigation measures section below for a list of mitigation measures.	

11.2.6 Construction Phase - Noise Impact Assessment

Table 53: Impact Assessment: Construction Activities without Mitigation

Nature:	Numerous simultaneous construction activities that could impact on NSDs.
Acceptable Rating Level	Rural district with little road traffic: 45 dBA outside during day (refer section 5 of the main Noise report) Use of $L_{Req,d}$ of 45 dBA for rural areas.
Extent ($L_{Aeq} > L_{Req,d}$)	Local – Noise impact does not extend further than 1,000 meters from activity (2).
Duration	Temporary – Noisy activities in the vicinity of the receptors would last only a fraction of the construction period (few months) (1).
Magnitude	Ambient noise levels > Zone Sound Level Change in ambient sound levels > 7dBA (NSD01) High (10)
Probability	The construction noises will significantly change the existing ambient sound levels in the area, especially at NSD01, yet the projected noise levels are still less than the rating level. It is highly likely that the noise levels will be less than typical ambient sound levels associated with a farm dwelling. This is because the noises created by normal daily activities would mask all construction related noises. Improbable (1).

Significance	Low (7 - 13).
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Comments	-
Can impacts be mitigated?	Yes, though mitigation not required.
Mitigation:	Presented in the mitigation section below
Cumulative impacts:	This impact is cumulative with existing ambient background noises as well as other noisy activities conducted in the same area.
Residual Impacts:	This impact will only disappear once construction activities cease.

11.2.7 Construction Phase - Visual Impact Assessment

Table 54: Rating of day-time visual impacts of the wind farm during construction

IMPACT OF THE WIND FARM	
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the landscape.
Issue/Impact/Environmental Effect/Nature	**Day-time visual impact during construction:** Large construction vehicles and equipment during the construction phase will alter the natural character of the study area and expose visual receptors to visual impacts associated with the construction phase.
Extent	Local / District (2)
Probability	Probable (3)
Reversibility	Completely reversible (1)
*Irreplaceable loss of resources **	No loss (1)
Duration	Short term (1)
Cumulative effect	Low cumulative effects (2)
Intensity/magnitude	Medium (2)

IMPACT OF THE WIND FARM		
Significance Rating	**Prior to mitigation measures:** There will be a negative low impact i.e. the anticipated impact will have negligible negative effects and will require little to no mitigation. **After mitigation measures:** The negative low impact will persist after mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	-20 (negative low)	-10 (negative low)
Mitigation measures	▪ Carefully plan to reduce the construction period. ▪ Minimise vegetation clearing and rehabilitate cleared areas as soon as possible. ▪ Maintain a neat construction site by removing rubble and waste materials regularly. ▪ Make use of existing gravel access roads where possible. ▪ Ensure that dust suppression techniques are implemented on all access roads.	

Table 55: Rating of night-time visual impacts of the wind farm during construction

IMPACT OF THE WIND FARM AND PV PLANT	
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the landscape.
Issue/Impact/Environmental Effect/Nature	**Night-time visual impact during construction:** The night scene is characterised by a dark night environment with very few light sources visible. Most construction activities are likely to take place during day-time business hours and therefore the construction phase of the development is unlikely to have a significant impact on the visual quality of the area at night.

IMPACT OF THE WIND FARM AND PV PLANT		
Extent	Local/district (2)	
Probability	Unlikely (1)	
Reversibility	Completely reversible (1)	
*Irreplaceable loss of resources ***	No loss (1)	
Duration	Short term (1)	
Cumulative effect	Negligible cumulative effects (1)	
Intensity/magnitude	Low (1)	
Significance Rating	**Prior to mitigation measures:** There will be a negative low impact i.e. the anticipated impact will have negligible negative effects and will require little to no mitigation. **After mitigation measures:** The negative low impact will persist after mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	1	1
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-7 (negative low)	-6 (negative low)
Mitigation measures	▪ Limit construction activities to day-time hours in order to prevent night lighting during construction.	

11.2.8 Construction Phase - Heritage Assessment

Table 56: Impacts on Stone Age sites

Environmental Parameter	**Pre-colonial: Stone Age sites**

Issue/Impact/Environmental Effect/Nature	Many sites are still unknown. Their potential and significance therefore unknown. The impact will be the physical disturbance of the material and its context. Impact will be focused on a particular node, i.e. tower positions or access/ inspection roads.	
Extent	Local	
Probability	Can occur	
Reversibility	Irreversible	
Duration	Permanent	
Cumulative effect	High	
Intensity/Magnitude	Moderate	
Significance Rating	Sites have a low significance on a region level – viewed as NHRA Grade III sites. Distinguish from find spots, which have low significance	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	3	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Once sites are identified, if the location is to be used for development purposes, then mitigation of the site will be necessary. This could require excavation, or at least mapping and collection of surface material	

Table 57: Impacts on Farmsteads

Environmental Parameter	**Colonial Period: Farmsteads**
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole.
Extent	Local
Probability	Can occur
Reversibility	Reversible with human intervention
Duration	Permanent

Cumulative effect	High
Intensity/Magnitude	Moderate
Significance Rating	Sites have a high significance on a region level – viewed as NHRA Grade III sites.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	3	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed.	

Table 58: Impacts on Cemeteries

Environmental Parameter	**Colonial Period: Cemeteries**
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole.
Extent	Local
Probability	Can occur
Reversibility	Irreversible
Duration	Permanent
Cumulative effect	High
Intensity/Magnitude	Moderate
Significance Rating	Sites have a high significance on a local level – viewed as NHRA Grade III sites

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1

Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	3	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Mitigation should take the form of isolating known sites and declare them as no-go area with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed.	

Table 59: Impacts on farming related features

Environmental Parameter	**Colonial Period: Farming related features**	
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole.	
Extent	Local	
Probability	Can occur	
Reversibility	Reversible with human intervention	
Duration	Permanent	
Cumulative effect	High	
Intensity/Magnitude	Moderate	
Significance Rating	Sites have a low significance on a region level – viewed as NHRA Grade III sites.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	1	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Mitigation should take the form of isolating known sites and	

	declare them as no-go areas with sufficient large buffer zones around them for protection. Mitigation can be implemented after required procedures have been followed.

11.2.9 Construction Phase - Socio-economic Impact Assessment

- Employment and output Creation

Table 60: Employment and output Creation during construction

EMPLOYMENT AND OUTPUT CREATION	
Environmental Parameter	Employment and output creation in the construction phase
Issue/Impact/Environmental Effect/Nature	The creation of local jobs and income during the construction of the wind farm
Extent	Wind farm: 313 local jobs and R 220 towards local production per annum for 24 months; i.e. 7.7% of local employment and 21%of local output.
Probability	High
Reversibility	N/A
Irreplaceable loss of resources	N/A
Duration	2 years
Cumulative effect	Wind farm: An additional 178 jobs and R 42m in local production per annum due to economic multiplier effects during the construction phase. Total impact = 12% of local employment (for the locals) and 25% of local output.
Intensity/magnitude	High
Significance Rating	High

	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Province/region	3	National	4
Probability	Definite	4	Definite	4
Reversibility	Not required	0	Not required	0

Irreplaceable loss	None	0	None	0
Duration	Short term	1	Short term	1
Cumulative effect	Negligible	1	Negligible	1
Intensity / magnitude	Medium	2	High	3
Significance rating	Positive Low	18	Positive Medium	30
Mitigation measures	Ensure that the unskilled local jobs created are linked to a skills development programme for permanent employment			

- Social mobilisation

Table 61: Social mobilisation during construction

SOCIAL MOBILISATION	
Environmental Parameter	*Note: As it would be difficult for the contractor to control conflict situations where they occur when construction workers spend their free time in the local community, this assessment focuses on conflict situations that the contractor can control.* Conflict between Mainstream (or its contractors) and landowners should be avoided by abiding to terms and conditions set out during negotiation process, especially in terms of potential problem areas such as access to properties, fencing and security.
Issue/Impact/Environmental Effect/Nature	Conflict situations that can delay the project and prolong the duration of impacts, which in turn would affect local residents' quality of life and result in economic impacts.
Extent	Where conflict occurs with regard to the issues mentioned above, Mainstream (or its contractors) should aim to restrict it to the landowner in question to prevent problems from extending to other areas.
Probability	The chance of occurrence is dependent on how the construction process is managed, which is difficult to predict – it might therefore be possible that the impact will occur, just as it might be possible that it will not occur.
Reversibility	Conflict situations are for the most part completely reversible if problems are rectified.
Irreplaceable loss of resources	A loss of resources might be the cause for conflict (e.g. a gate left open lead to missing cattle) – again this will be difficult to gauge at this stage and therefore the safest option would be to say that there might be a marginal loss of resources.
Duration	Conflict situations for the most part will be limited to the construction phase.

Cumulative effect	One conflict situation with a particular landowner can spread to other landowners so that they are antagonistic against the contractor even before they arrive on site. Other conflict situations can also arise in other areas as outlined in the body of the report, i.e. between jobseekers and construction workers, between construction workers and the local community and between the local community and Mainstream. Although all of these conflict situations might have small centralised points, collectively the local community as a whole can start resenting the presence of the construction team.
Intensity/magnitude	Conflict can range from barely perceptible (e.g. a contained conflict situation with one landowner that gets resolved quickly) to dispersed conflict situations that lead to high costs of remediation (e.g. community members protesting against the project).
Significance Rating	Negative Low

	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Site	1	Site	1
Probability	Possible	2	Unlikely	1
Reversibility	Partly reversible	2	Completely reversible	1
Irreplaceable loss	Marginal	2	None	1
Duration	Short term	1	Short term	1
Cumulative effect	Low	2	Low	2
Intensity / magnitude	Medium	2	Low	1
Significance rating	Negative Low	-20	Negative Low	-7
Mitigation measures	▪ Problem areas that are brought under the attention of the contractor should be rectified immediately. If the contractor is unable to so, this should be communicated to the landowner along with a plan on how and when the problem will be addressed. The landowner should be given regular feedback on the matter. ▪ All mitigation measures contained in the EMP should be implemented and monitored by an ECO. Remedial action should be taken where the contractor fails to comply with the EMP.			

- Health and safety impacts

Table 62: Health and safety impacts during construction

HEALTH AND SAFETY IMPACTS	
Environmental Parameter	Reduce the risk spreading Sexually Transmitted Infections including HIV.
Issue/Impact/Environmental Effect/Nature	HIV/AIDS has numerous impacts ranging from the obvious health impacts to the less obvious economic impacts as result of a reduced workforce, loss of breadwinners resulting an alteration in family structures.
Extent	For the duration of the project the impact of HIV infections might be restricted to the local area, but as people move to other areas, so too does the virus.
Probability	The probability that construction workers will engage in sexual relationships with locals is quite high. This is beyond the control of the contractor, but the contractor can supply condoms and information material to reduce the probability of HIV and other STI infections.
Reversibility	Once infection has occurred, the impact is irreversible. It is therefore important to develop and implement a Health and Safety Plan, including a HIV/AIDS prevention plan during the construction phase.
Irreplaceable loss of resources	HIV/AIDS will eventually lead to the loss of human resources, which would have an economic impact on the contractor who would have to spend time and money on training new employees
Duration	Until such time that a cure is found, HIV infection is permanent
Cumulative effect	Humans are transportable; therefore these infections can be spread when the construction worker migrates to a new area and perpetuates old behaviour (i.e. engage in a new casual sexual relationship). The death of parents and breadwinners alters family structures so that children become heads of households, restricting them from completing their education, holding them in downward poverty cycles.
Intensity/magnitude	HIV infections can severely impair the functionality of the construction process due to illness and absenteeism.
Significance Rating	Negative High impact (pre-mitigation) to Negative Low impact (post-mitigation)

The health and economic impacts as result of STI and HIV infection is a category 1 impact, as these impacts will occur regardless of the alternative chosen. The impact table below therefore reflects the same numerical value for each of the impact variables as no distinction was made between alternatives.				
	PRE-MITIGATION		POST-MITIGATION	
Extent	National	4	Local	2
Probability	Probable	3	Possible	2
Reversibility	Irreversible	4	Barely reversible	3
Irreplaceable loss	Significant	3	Marginal	2
Duration	Medium	2	Medium	2
Cumulative effect	High	4	Medium	3
Intensity / magnitude	High	3	Medium	2
Significance rating	Negative High	-60	Negative Low	-28
Mitigation measures	▪ Mainstream or its contractor should appoint a service provider or local NGO to develop, implement and manage an HIV/AIDS prevention programme. The service provider or NGO should specialise in the field of HIV/AIDS. ▪ The HIV/AIDS prevention programme should extend to the local community and should pay special attention to vulnerable groups such as women and youth.			

It should be noted that, due to the standard format of the impact rating system, it is not possible to accurately reflect the irreversibility of infection (negative impact) once it has occurred alongside the implementation of an effective HIV/AIDS prevention plan (positive impact) in the table above. Overall the impact therefore appears negative, but the reader should bear in mind that there are positive components in terms of advocating healthier and safer sexual practices that can bear positive impacts within communities.

11.2.10 Operation Phase - Biodiversity (flora and fauna) Assessment

- Loss of habitat for red data / general species

Table 63: Rating of impacts related to loss of habitat for red data / general species

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Loss of habitat for red data / general species
Extent	The impact is only expected to affect the site.

IMPACT TABLE FORMAT		
Probability	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources	
Duration	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years)	
Cumulative effect	The impact would result in minor cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the negative low impact persists.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	1	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	3	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-10 (low negative)	-6(low negative)
Mitigation measures	▪ Maintain footprint strictly during operation ▪ Constant removal of alien invasive species in and around site.	

- Edge effect

Table 64: Rating of impacts related to edge effect

IMPACT TABLE FORMAT		
Environmental Parameter	Biodiversity	
Issue/Impact/Environmental Effect/Nature	Edge effect	
Extent	The impact is only expected to affect the site.	
Probability	The impact may occur (Between a 25% to 50% chance of occurrence).	
Reversibility	The impact is partly reversible but more intense mitigation measures are required.	
Irreplaceable loss of resources	The impact will result in marginal loss of resources	
Duration	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years)	
Cumulative effect	The impact would result in minor cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	**Prior to mitigation measures:** There will be a negative low impact i.e. the anticipated impact will have moderate negative effects and will require moderate mitigation measures **After mitigation measures:** After mitigation measures, a negative low impact will be achieved.	
	Pre-mitigation impact	**Post mitigation impact**

IMPACT TABLE FORMAT		
	rating	**rating**
Extent	1	1
Probability	2	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	3	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	-26 (low negative)	-7(low negative)
Mitigation measures	▪ The client should be responsible for implementing a programme of weed control ▪ The spread of exotic species occurring throughout the site should be controlled. ▪ All exotic vegetation must be removed from the site (if present).	

11.2.11 Operation Phase - Avifauna Assessment

- Displacement of priority species due to disturbance

Table 65: Displacement of priority species due to disturbance during operational phase

IMPACT TABLE 3	
Environmental Parameter	Avifauna
Issue/Impact/Environmental Effect/Nature	Displacement of priority species due to disturbance during operational phase
Extent	The impact will only affect the site.
Probability	Possible. The impact may occur (between a 25% to 50% chance of occurrence).
Reversibility	Completely reversible. The operational activities could cause displacement of some priority species. Once the operation of the wind farm ceases, the birds would re-colonise the area.
Irreplaceable loss of resources	Marginal loss of resources. Once the operation of the wind farm ceases, the birds would most likely re-colonise the area.

IMPACT TABLE 3		
Duration	Long term. Although habituation may happen in some instances, it must be assumed that in some instances the impact may be long term i.e. for the life-time of the activity.	
Cumulative effect	Medium to high cumulative impact. The priority species that occur (or are likely to occur) at the proposed site all have large distribution ranges (except Red Lark and Sclater's Lark which are more range restricted), the cumulative impact of displacement would therefore be locally significant, but for Red Lark it could be regional or national.	
Intensity/magnitude	Medium. Although habituation may happen in some instances, it must be assumed that in some instances the impact may be long term i.e. for the life-time of the activity.	
Significance Rating	Low significance. Once the source of the disturbance has been removed, i.e. the noise and movement associated with the construction activities, most species should re-colonise the areas which have not been transformed by the footprint.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	2	2
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3 - 4	2
Intensity/magnitude	2	2
Significance rating	-24 to -26 (low negative)	-22 (low negative)
Mitigation measures	Post-construction monitoring should be implemented to make comparisons with baseline conditions possible. Operational activities should be restricted to the plant area. Maintenance staff should not be allowed to access other parts of the property unless it is necessary for wind farm related work. If actual displacement levels of priority species prove to be high, particularly Red Lark, appropriate off-sets should be considered.	

- Collisions of priority species with the turbines

Table 66: Collisions of priority species with the turbines in the operational phase

IMPACT TABLE 4		
Environmental Parameter	Avifauna	
Issue/Impact/Environmental Effect/Nature	Collisions of priority species with the turbines in the operational phase.	
Extent	The impact will only affect the site.	
Probability	Probable. The impact will likely occur (between a 50% to 75% chance of occurrence).	
Reversibility	Completely reversible. The operational activities could cause collision mortality of some priority species. Once the operation of the wind farm ceases, the mortality would cease as well.	
Irreplaceable loss of resources	Marginal loss of resources. Collision mortality should not lead to the local extinction of any of the priority species, as the site will most likely be re-colonised after the activity ceases.	
Duration	Long term. The risk of collision will be present for the life-time of the development.	
Cumulative effect	Medium to high cumulative impact. The cumulative impact will depend largely on which species are killed. Bustards and flamingos suffer high mortality on power lines, for these species the cumulative impacts may be high. If Red Larks are killed, the cumulative impacts may likewise be high.	
Intensity/magnitude	Medium. The operational activities could cause mortality of some priority species, but the system should continue to function in a modified way.	
Significance Rating	Medium significance. The anticipated impact will have moderate negative effects and will require moderate mitigation measures.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	3	2

IMPACT TABLE 4		
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3 - 4	2 - 3
Intensity/magnitude	2	2
Significance rating	-28 to -30 (medium negative)	-26 to -28 (low negative)
Mitigation measures	Development of the northern part of the site should be delayed until better information is available on actual bird traffic over the site. Pre-construction monitoring should be implemented to guide the micro-siting of the turbines and to make post-construction comparisons possible. Once the turbines have been constructed, post-construction monitoring should be implemented to compare actual collision rates with predicted collision rates. If actual collision rates indicate high mortality levels, the following mitigation measures will have to be considered: Negotiating appropriate off-set compensation for turbine related collision mortality; As a last resort, halting operation of specific turbines during peak flight periods, or reducing rotor speed, to reduce the risk of collision mortality. A 250m no-turbine zone should be implemented around the existing Greater Kestrel nest. This should reduce the risk of the fledglings flying into the turbines when they start to fly.	

- Mortality of priority species with the power line

Table 67: Mortality of priority species with the power line in the operational phase

IMPACT TABLE 5	
Environmental Parameter	Avifauna
Issue/Impact/Environmental Effect/Nature	Mortality of priority species with the power line in the operational phase

IMPACT TABLE 5	
Extent	Local if Ludwig's Bustard are killed. The impact will be local if a Martial Eagle gets electrocuted, especially if it is one of a breeding pair.
Probability	Probable. The impact will likely occur (between a 50% to 75% chance of occurrence), Ludwig's Bustard are particularly at risk. Electrocution is possible for large raptors.
Reversibility	Completely reversible. If the power line is dismantled at the end of the life-time of the wind farm, the mortality will cease.
Irreplaceable loss of resources	Marginal loss of resources. The loss of several Ludwig's Bustards or a pair of Martial Eagles (and/or their off-spring) should not lead to the local extinction of the species, as the site may be re-colonised by other individuals.
Duration	Long term. The risk of collision will be present for the life-time of the development and may even continue after that if the line is not dismantled.
Cumulative effect	Medium to high cumulative impact. The cumulative impact will depend largely on which species are killed. Bustards, cranes and large eagles suffer high mortality on power lines, for these species the cumulative impacts may well be high.
Intensity/magnitude	Medium. The power line could cause mortality of some priority species, but the system will continue to function in a modified way.
Significance Rating	Medium significance. The anticipated impact will have moderate negative effects and will require moderate mitigation measures.

	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	3	2
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3 - 4	2 - 3
Intensity/magnitude	2	2

IMPACT TABLE 5		
Significance rating	-30 to -32 (medium negative)	-26 to -28 (low negative)
Mitigation measures	The proposed power line should be routed as far as possible from high risk areas, specifically from the pan that borders on the north-western part of the study area. In addition, the entire line should be marked with Bird Flight Diverters, to reduce the risk of collisions of specifically Ludwig's Bustard. The proposed pole design must be assessed to ensure that the power line design poses no potential electrocution risk of large raptors, particularly Martial Eagle, which may use the poles as hunting perches.	

11.2.12 Operation Phase - Bat Assessment

- Bat mortalities due to blade collisions and barotrauma during foraging

Table 68: Bat mortalities due to blade collisions and barotrauma during foraging

Environmental Parameter	Bat mortalities due to blade collisions and barotrauma during foraging (operational phase).
Issue/Impact/Environmental Effect/Nature	Concern of bats and possible wind turbine blade collisions/ barotrauma have been discussed, however international research has been unable to propose sustainable large scale mitigation measures that can downgrade this threat to a category of very low concern.
Geographical extent	Only on the site.
Probability	Should mitigation not be implemented the chances of the impact occurring is possible.
Reversibility	Without mitigation it is partly reversible.
Irreplaceable loss of resources	Marginal.
Duration	For the duration of the operating wind farm with or without mitigation.
Cumulative effect	Over time the mortalities on bats will have a high cumulative effect without mitigation, since bat populations will not be able to recover

	faster than mortalities.	
Intensity/magnitude	Considered medium without mitigation	
Significance Rating	Low without mitigation	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Reversibility	2	1
Irreplaceable loss of resources	2	1
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	2	1
Probability	2	1
Significance Rating	28 (Negative low)	10 (Negative low)
Mitigation	Presented in the Mitigation Measures section below	

- Bat mortalities due to blade collisions and barotrauma during migration

Table 69: Bat mortalities due to blade collisions and barotrauma during migration

Environmental Parameter	Bat mortalities due to blade collisions and barotrauma during migration (operational phase).
Issue/Impact/Environmental Effect/Nature	The migration paths of South African bats in the Northern Cape Province are not well studied and are virtually unknown. Cave dwelling species such *Miniopterus natalensis* and *Myotis tricolor* undertake annual migrations between caves. However, no caves are known to be in close proximity to the study area, and it is not located within any known direct line of path between major caves such that the threat to migrating bats becomes nominal.
Geographical extent	Regional
Probability	Although unlikely the impact is still possible to occur without mitigation
Reversibility	Due to the potential large numbers of bats that can be killed if this impact should occur, the reversibility of populations is partly reversible
Irreplaceable loss of resources	Marginal.
Duration	For the duration of the operating wind farm with or without mitigation.
Cumulative effect	Over time the mortalities on bats will have a high cumulative effect without mitigation, since bat populations will not be able to recover faster than mortalities.
Intensity/magnitude	Considered high without mitigation

Significance Rating	Medium without mitigation	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	3
Reversibility	2	1
Irreplaceable loss of resources	2	1
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	3	2
Probability	2	1
Significance Rating	34 (Negative medium)	13 (Negative low)
Mitigation	Presented in the mitigation measure section below	

11.2.13 Operation Phase - Surface Water Impact Assessment

Table 70: Vehicle damage to watercourses and buffer zones during maintenance

IMPACT TABLE		
Environmental Parameter	*Wetlands and Buffer Zones*	
Issue/Impact/Environmental Effect/Nature	Vehicle damage to watercourses and buffer zones during maintenance	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resource*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is low but negative. With appropriate mitigation measures, the post mitigation impact rating can be limited.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	2	1
Irreplaceable loss	2	1

Duration	4	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	- 28 (low negative)	- 6 (low negative)
Mitigation measures	Refer to mitigation measures section below	

Table 71: Stormwater run-off impacts to watercourses and associated buffer zone areas

IMPACT TABLE		
Environmental Parameter	*Watercourses and Buffer Zones*	
Issue/Impact/Environmental Effect/Nature	Stormwater and consequent erosion impacts to watercourses and associated buffer zones	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*Marginal loss of resource*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is low but negative. With appropriate mitigation measures, the post mitigation impact rating can be limited to a large extent.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	1
Reversibility	1	1
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	- 28 (low negative)	- 8 (low negative)
Mitigation measures	Refer to mitigation measures section below	

11.2.14 Operation Phase - Agricultural Potential

Table 72: Contamination of local soil and land use resources

IMPACT TABLE		
Environmental Parameter	Soil and Land Use Resources	
Issue/Impact/Environmental Effect/Nature	Loss of agricultural land and / or production as a result of the proposed activities	
Extent	Impacts will be restricted to the site.	
Probability	A marginal loss of grazing land will definitely occur.	
Reversibility	The land can be returned to grazing after the operation phase.	
Irreplaceable loss of resources	Very marginal loss of agricultural land and production.	
Duration	The impact and its effects will continue or last for the entire operational life of the development. The life span of the development is greater than 20 years.	
Cumulative effect	Negligible Cumulative Impact	
Intensity/magnitude	Low	
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-12 (low negative)	-12 (low negative)
Mitigation measures	Refer to the mitigation measures section below for a list of mitigation measures.	

11.2.15 Operation Phase - Noise Impact Assessment

Table 73: Impact Assessment: Operational phase without mitigation

Nature:	Numerous turbines operating simultaneously during a period when a quiet environment is desirable.
Acceptable Rating Level	Rural district with little road traffic. Refer to refer to section 5 of the main Noise report for the proposed Night Rating Level that varies with wind speed.
Extent ($\Delta L_{Aeq,n}$>7dBA) $L_{Aeq,n} > L_{Req,n}$	Local – Noise Impact will not extend further than 1,000 meters from the activity (2).
Duration	Long – Facility will operate for a number of years (4)
Magnitude	Low (2 – NSD02) to Medium-high (8 – NSD01)
Probability	Improbable (1 – NSD02) – Highly-likely (4 – NSD01)
Significance	8 (Low) for NSD02 using the Nordex H90 2500HS WTG.
Significance	56 (Medium) for NSD01 using the Nordex H90 2500HS WTG.
Status	Negative.
Reversibility	High.
Irreplaceable loss of resources?	Not relevant.
Comments	-
Can impacts be mitigated?	Yes.
Mitigation:	Presented in mitigation section below
Cumulative impacts:	This impact is cumulative with existing ambient background sounds and other noise in the area.
Residual Impacts:	This impact will only disappear once the operation of the facility stops, or the sensitive receptor no longer exists.

11.2.16 Operation Phase - Visual Impact Assessment

Table 74: Rating of day-time visual impacts of the wind farm during operation

IMPACT OF THE WIND FARM	
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the landscape.

IMPACT OF THE WIND FARM	
Issue/Impact/Environmental Effect/Nature	**Day-time visual impact during operation:** The wind farm and associated infrastructure will alter the natural character of the study area and expose receptors to visual impacts associated with the proposed development during operation.
Extent	Local/district (2)
Probability	Definite (4)
Reversibility	Irreversible (4)
*Irreplaceable loss of resources **	Significant (3)
Duration	Long term (3)
Cumulative effect	Medium cumulative effects (3)
Intensity/magnitude	Medium (2)
Significance Rating	**Prior to mitigation measures:** There will be a negative medium impact i.e. the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** The negative medium impact will persist.

	Pre-mitigation impact rating	Pre-mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	4	4
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-38 (negative medium impact)	-36 (negative medium impact)
Mitigation measures	▪ Select the alternative for the substation and operation and maintenance building that will have the least impact on visual receptors. ▪ Do not locate any turbines within 500m from an existing dwelling. ▪ Bury cables under the ground where possible.	

IMPACT OF THE WIND FARM	
	▪ New overhead power lines should be aligned to follow exiting power lines or other infrastructure, such as roads. ▪ Buildings should be painted with natural tones that fit with the surrounding environment.

Table 75: Rating of night-time visual impacts of the wind farm during operation

IMPACT OF THE WIND FARM		
Environmental Parameter	**Visual environment:** The aesthetic or scenic nature of the environment within a defined time and space, which covers the broad range of visual, cultural and spiritual aspects of the landscape.	
Issue/Impact/Environmental Effect/Nature	**Night-time visual impact during operation:** The night scene is characterised by a dark night environment with very few light sources visible. The proposed wind farm will therefore alter the visual quality of the area at night by introducing an additional light sources in the form of security lighting and a red flashing light placed on the top of each wind turbine.	
Extent	Local/district (2)	
Probability	Definite (4)	
Reversibility	Partly reversible (2)	
*Irreplaceable loss of resources ***	Significant (3)	
Duration	Long term (3)	
Cumulative effect	Low (2)	
Intensity/magnitude	Medium (2)	
Significance Rating	**Prior to mitigation measures:** There will be a negative medium impact i.e. the anticipated impact will have moderate negative effects and will require moderate mitigation measures. **After mitigation measures:** The negative medium impact will persist after mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating

IMPACT OF THE WIND FARM		
Extent	2	2
Probability	4	4
Reversibility	2	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	-32 (negative medium)	-30 (negative medium)
Mitigation measures	▪ Make use of fittings that focus the light and prevent light spill. ▪ Direct perimeter lighting in a downward direction toward the site. ▪ Limit the use of flood lighting where possible.	

11.2.17 Operation Phase - Heritage Assessment

Table 76: Impacts on Stone Age sites

Environmental Parameter	**Pre-colonial: Stone Age sites**	
Issue/Impact/Environmental Effect/Nature	Many sites are still unknown. Their potential and significance therefore unknown. The impact will be the physical disturbance of the material and its context. Impact will be focused on a particular node, i.e. tower positions or access/ inspection roads.	
Extent	Local	
Probability	Can occur	
Reversibility	Irreversible	
Duration	Permanent	
Cumulative effect	High	
Intensity/Magnitude	Moderate	
Significance Rating	Sites have a low significance on a region level – viewed as NHRA Grade III sites. Distinguish from find spots, which have low significance	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1

Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	3	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Once sites are identified, if the location is to be used for development purposes, then mitigation of the site will be necessary. This could require excavation, or at least mapping and collection of surface material	

Table 77: Impacts on Farmsteads

Environmental Parameter	**Colonial Period: Farmsteads**	
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole.	
Extent	Local	
Probability	Can occur	
Reversibility	Reversible with human intervention	
Duration	Permanent	
Cumulative effect	High	
Intensity/Magnitude	Moderate	
Significance Rating	Sites have a high significance on a region level – viewed as NHRA Grade III sites.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	3	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Mitigation should take the form of isolating known sites and declare them as no-go zones with sufficient large buffer	

	zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed.

Table 78: Impacts on Cemeteries

Environmental Parameter	**Colonial Period: Cemeteries**	
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected elements makes up the whole. Impact on part therefore implies an impact on the whole.	
Extent	Local	
Probability	Can occur	
Reversibility	Irreversible	
Duration	Permanent	
Cumulative effect	High	
Intensity/Magnitude	Moderate	
Significance Rating	Sites have a high significance on a local level – viewed as NHRA Grade III sites	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	3	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Mitigation should take the form of isolating known sites and declare them as no-go area with sufficient large buffer zones around them for protection. In exceptional cases mitigation can be implemented after required procedures have been followed.	

Table 79: Impacts on farming related features

Environmental Parameter	**Colonial Period: Farming related features**
Issue/Impact/Environmental Effect/Nature	The various features are subject to damage. Easier to identify and therefore easier to avoid. Variety of interconnected

	elements makes up the whole. Impact on part therefore implies an impact on the whole.
Extent	Local
Probability	Can occur
Reversibility	Reversible with human intervention
Duration	Permanent
Cumulative effect	High
Intensity/Magnitude	Moderate
Significance Rating	Sites have a low significance on a region level – viewed as NHRA Grade III sites.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	1
Reversibility	4	2
Irreplaceable loss	4	3
Duration	4	4
Cumulative effect	4	1
Intensity/magnitude	1	1
Significance rating	75 – Negative, very high impact	12 – Negative, low impact
Mitigation measures	Mitigation should take the form of isolating known sites and declare them as no-go areas with sufficient large buffer zones around them for protection. Mitigation can be implemented after required procedures have been followed.	

11.2.18 Operation Phase - Socio-economic Impact Assessment

- Employment and output creation

Table 80: Employment and output creation during the operation phase

EMPLOYMENT AND OUTPUT CREATION	
Environmental Parameter	Employment and output creation in the operational phase
Issue/Impact/Environmental Effect/Nature	The creation of local jobs and income during the operation of the wind farm and PV plant

Extent	Wind farm: 29 local jobs and R 1 328m towards local domestic production (R23m excluding profits), 0.7% of local employment and 2.2% of local production (excluding profits) PV plant: 41 local jobs and R18m towards local production (excluding profits), i.e. 1% of local employment and 1.7% of local production			
Probability	High			
Reversibility	NA			
Irreplaceable loss of resources	NA			
Duration	average design life of wind farms of (around 25 years)			
Cumulative effect	Wind farm: An additional 34 jobs and R 11m in local production due to economic multiplier effects during the operational phase. Total impact = 1.4% of local employment and 3.2% of local production (excl profits) PV Plant: An additional 17 jobs and R6m towards local production due to multiplier effects. Total impact = 1.4% towards employment and 2.2% towards production			
Intensity/magnitude	Medium			
Significance Rating	Medium			
	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Local (higher per MW for solar)	2	Province/region	3
Probability	Definite	4	Definite	4
Reversibility	Not required	0	Not required	0
Irreplaceable loss	None	0	None	0
Duration	Long term	3	Long term	3
Cumulative effect	Negligible (higher per MW for solar)	1	Low	2
Intensity / magnitude	Medium	2	High	3
Significance rating	Low Positive	20	Medium Positive	36
Mitigation measures	Linking new and existing local businesses to the supply chain of the wind farm			

- Tax income

Table 81: Tax income during the operation phase

TAX INCOME				
Environmental Parameter	Tax income during the operational phase			
Issue/Impact/Environmental Effect/Nature	Increase in central and local tax income during operations			
Extent	Revenue generated for central government through direct taxes (company and personal taxes) as well as indirect taxes (e.g. VAT) an estimated R179m; Net increase in local government income due to increase in property taxes			
Probability	High			
Reversibility	NA			
Irreplaceable loss of resources	NA			
Duration	As long as the wind farm is in operation (average design life of wind farms of around 25 years)			
Cumulative effect	None			
Intensity/magnitude	Small			
Significance Rating	Small in terms of national and local tax revenue			
	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Local	2	Local	2
Probability	Definite	4	Definite	4
Reversibility	Not required	0	Not required	0
Irreplaceable loss	None	0	None	0
Duration	Long term	3	Long term	3
Cumulative effect	High	4	High	4
Intensity / magnitude	Low	1	Low	1
Significance rating	Low Positive	14	Low Positive	14
Mitigation measures	None			

- Corporate social investment

Table 82: Corporate social investment during the operation phase

CORPORATE SOCIAL INVESTMENT	
Environmental Parameter	Corporate social investment

Issue/Impact/Environmental Effect/Nature	7.6% of expected profits of R 1352m will be retained for development in the form of an enterprise development fund (0.4% of profits) socio economic development fund (1.1%) and a community development funds (building up towards 6% of profits after debts has been paid by trust) over ten to fifteen years
Extent	R 99.7 per annum, 9.4% of local production Note: If the solar plant replaces the wind farm, the social funds will decrease significantly to R 3.4m.
Probability	Medium
Reversibility	NA
Irreplaceable loss of resources	NA
Duration	As long as the wind farm is in operation (average design life of wind farms of around 25 years)
Cumulative effect	Development impacts
Intensity/magnitude	High
Significance Rating	High

	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Province	3	National	4
Probability	Possible	2	Possible	2
Reversibility	Not required	0	Not required	0
Irreplaceable loss	None	0	None	0
Duration	Long term	3	Long term	3
Cumulative effect	Negligible	1	Medium	3
Intensity / magnitude	High	3	Very high	4
Significance rating	Low Positive	27	Medium Positive	48
Mitigation measures	Using the most effective community structures for the trust fund, inclusion of existing structures, transparent rules in allocating funds, prioritisation according to community needs and building on existing regional synergies			

- Agricultural output

Table 83: Agricultural output during the operation phase

AGRICULTURAL OUTPUT

Environmental Parameter	Agricultural output			
Issue/Impact/Environmental Effect/Nature	Displacing existing agricultural production			
Extent	Maximum loss of R188 000 in output and 2 jobs per annum due to the wind farm and R17 000 lost in output and no jobs lost due to the solar plant.			
Probability	Low			
Reversibility	High			
Irreplaceable loss of resources	Low			
Duration	As long as the wind farm is in operation (average design life of wind farms of around 25 years)			
Cumulative effect	Low			
Intensity/magnitude	Low			
Significance Rating	Low			
	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Site	1	Site	1
Probability	Possible	2	Possible	2
Reversibility	Barely reversible	3	Barely reversible	3
Irreplaceable loss	None	1	None	1
Duration	Long term	3	Long term	3
Cumulative effect	Negligible	1	Negligible	1
Intensity / magnitude	Low	1	Low	1
Significance rating	Low negative	-11	Low negative	-11
Mitigation measures	None			

- Tourism

Table 84: Tourism impacts during the operation phase

TOURISM	
Environmental Parameter	Local tourism to the area
Issue/Impact/Environmental Effect/Nature	Diverting/Attracting tourism from or to area
Extent	None (the effect could be positive instead of negative)
Probability	Low

Reversibility	High			
Irreplaceable loss of resources	Low			
Duration	As long as the wind farm is in operation (average design life of wind farms of around 25 years)			
Cumulative effect	Low			
Intensity/magnitude	Low			
Significance Rating	Low			
	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Site	1	Site	1
Probability	Unlikely	1	Unlikely	1
Reversibility	Partly reversible	2	Partly reversible	2
Irreplaceable loss	No loss	1	No loss	1
Duration	Long term	3	Long term	3
Cumulative effect	Negligible	1	Negligible	1
Intensity / magnitude	Low	1	Low	1
Significance rating	Negative Low	-10	Negative Low	-10
Mitigation measures	None			

- Property prices

Table 85: Property prices during the operation phase

PROPERTY PRICES	
Environmental Parameter	Property prices
Issue/Impact/Environmental Effect/Nature	Change in property prices adjacent to the new development (positive or negative)
Extent	Unknown.
Probability	Low
Reversibility	High
Irreplaceable loss of resources	Low
Duration	As long as the wind farm is in operation (average design life of wind farms of around 25)
Cumulative effect	Low
Intensity/magnitude	Low

Significance Rating	Low			
	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Site	1	Site	1
Probability	Unlikely	1	Unlikely	1
Reversibility	Partly reversible	2	Partly reversible	2
Irreplaceable loss	No loss	1	No loss	1
Duration	Long term	3	Long term	3
Cumulative effect	Negligible	1	Negligible	1
Intensity / magnitude	Low	1	Low	1
Significance rating	Low Negative	-10	Low Negative	-10
Mitigation measures	None			

- Sense of place

Table 86: Sense of place during the operation phase

SENSE OF PLACE	
Environmental Parameter	Much of what is valuable in a culture is embedded in place, which cannot be measured in monetary terms.
Issue/Impact/Environmental Effect/Nature	The presence of wind farm and associated infrastructure such as the substation and the power lines would change the landscape of the area from open spaces to 'spoilt' which could affect the way in which people related to the land and the sense of connectedness they have with the area, in short, their sense of place.
Extent	The impact on sense of place should be considered in the context of the study area as a whole, as the impact on sense of place per farm portion will depend on a number of variables, such as the visual impact, the biodiversity impact, the placement of turbines in relation to dwellings, the activities on the land, the attachment of the landowner to the land, etc.
Probability	Most of the study area is currently 'unspoiled' with vast open spaces; the negative impact on sense of place is highly probable.
Reversibility	The impact on sense of place can be reversed after decommissioning, provided that rehabilitation is done to a satisfactory level.

Irreplaceable loss of resources	It is not foreseen that an impact on sense of place would lead to any loss of resources.			
Duration	The impact will be experienced during the lifetime of the project, but it can be expected that the wind farm will eventually become part of the landscape and absorbed as part of the cultural landscape.			
Cumulative effect	The presence of such infrastructure can also set an unintended precedent for further land use change in future, which could further alter people's sense of place.			
Intensity/magnitude	The impact on sense of place will be different for different people and will also depend on the way the land is utilised.			
Significance Rating	Negative Low			
	PRE-MITIGATION		**POST-MITIGATION**	
Extent	Local	2	Site	1
Probability	Possible	2	Unlikely	1
Reversibility	Barely reversible	3	Partly reversible	2
Irreplaceable loss	Marginal	2	Marginal	2
Duration	Long term	3	Long term	3
Cumulative effect	Low	2	Negligible	1
Intensity / magnitude	Medium	2	Medium	2
Significance rating	Negative Low	-24	Negative Low	-20
Mitigation measures	Implement mitigation measures detailed in the Visual Impact Assessment The impact on livelihoods should be monitored and evaluated before and after the construction of the wind farm.			

11.2.19 Decommissioning Phase - Biodiversity (flora and fauna) Assessment

- Loss of habitat for red data / general species

Table 87: Rating of impacts related to loss of habitat for red data / general species

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Loss of habitat for red data / general species

IMPACT TABLE FORMAT	
Extent	The impact is only expected to affect the site.
Probability	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
Reversibility	The impact is partly reversible but more intense mitigation measures are required.
Irreplaceable loss of resources	The impact will result in marginal loss of resources
Duration	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
Cumulative effect	The impact would result in negligible to no cumulative effects
Intensity/magnitude	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
Significance Rating	**Prior to mitigation measures:** There will be a positive Low impact i.e. the anticipated impact will have negligible negative effects however mitigation measures must be implemented. **After mitigation measures:** After mitigation measures, the positive low impact persists.

	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	1	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	+8 (low positive)	+6(low positive)
Mitigation measures	▪ Maintain footprint strictly during decommissioning ▪ All infrastructure must be removed from the site. ▪ A rehabilitation plan must be compiled by a qualified	

IMPACT TABLE FORMAT	
	ecologist. ▪ Re-vegetation of affected areas must be made a priority to avoid erosion. ▪ Suitable stormwater / wind controls must be put in place until rehabilitation is complete ▪ Constant removal of alien invasive species in and around plant.

- Edge effect

Table 88: Rating of impacts related to edge effect

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Edge effect
Extent	The impact is only expected to affect the site.
Probability	The impact may occur (Between a 25% to 50% chance of occurrence).
Reversibility	The impact is reversible with implementation of minor mitigation measures
Irreplaceable loss of resources	The impact will result in marginal loss of resources
Duration	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
Cumulative effect	The impact would result in minor cumulative effects
Intensity/magnitude	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
Significance Rating	**Prior to mitigation measures:** There will be a positive low impact i.e. the anticipated impact will have moderate negative effects and will require moderate mitigation measures

IMPACT TABLE FORMAT		
	After mitigation measures: After mitigation measures, a positive low impact will be achieved.	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	2	2
Reversibility	1	1
Irreplaceable loss	2	1
Duration	1	1
Cumulative effect	3	1
Intensity/magnitude	1	1
Significance rating	+10 (low positive)	+7(low positive)
Mitigation measures	▪ The contractor should be responsible for implementing a programme of weed control ▪ The spread of exotic species occurring throughout the site should be controlled. ▪ All exotic vegetation must be removed from the site (if present).	

11.2.20 Decommissioning Phase - Avifauna Assessment

The same impacts experienced during construction would be relevant here

11.2.21 Decommissioning Phase - Bat Assessment

The same impacts experienced during construction would be relevant here

11.2.22 Decommissioning Phase - Surface Water Impact Assessment

Table 89: Removing wind turbines and power line towers from watercourses and associated buffer zones

IMPACT TABLE

Environmental Parameter	*Watercourses and associated buffer zones*	
Issue/Impact/Environmental Effect/Nature	De-construction activities taking place in, near or through watercourse areas and associated buffer zones	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal to significant loss of resources*	
Duration	*Short term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact is likely to be negligible.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	4
Reversibility	4	4
Irreplaceable loss	2-3	2
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	2	1
Significance rating	- 26 to - 28 (medium negative)	- 14 (low negative)
Mitigation measures	***Excavation of Soils from Watercourses and Buffer Zones** – Where appropriate, all removed soils should be backfilled into trenches or excavations. However, where the excavated materials are not suitable, the soils are to be removed from site and dumped at a registered landfill site where sufficient capacity exists.* *All stockpiled soils from the watercourses and associated buffer zones must be bunded by suitable materials (for example, fixed wooden planks or bricks) that can resist rains and increased run-off. The bunded materials of choice should be high enough to prevent overspill (for example 40-50cm high). This will prevent erosion and sedimentation*	

	within the sensitive hydrological systems. *Separate stockpiles must be made for topsoil and sub-soils. Once the foundations have been removed, the backfill of excavated soils must be of a suitable soil type to the surrounding area. Additionally, the backfill of soils needs to be done in a manner that re-instates the proper soil horizons in the correct order. For example, the sub-soils must be back filled first and then the topsoil backfill.* ***Prevention of Pollutants and other potentially Hazardous Substances entering Watercourses and the associated Buffer Zones*** *– Heavy machinery and vehicles must be checked for oil leaks before being allowed to operate in the watercourse and the associated buffer zone areas. Additionally, no fuelling, re-fuelling or stockpiling of hazardous materials (oils, fuels and cement) is allowed to take place in the cleared vegetation areas prepared for construction activities.* ***Sanitary facilities*** *- Sanitary facilities must be available for workers (at a ratio of 1 toilet to ten workers) to use to prevent urine and faecal waste entering the buffer zones of the wetlands and watercourses. Sanitary facilities must be placed at least 100m from the watercourse and associated buffer zones.* ***Movement and Degradation of Vehicles and Workers*** *– Vehicles will be required for the de-construction activities to take place for the wind farm and PV Power Plant. It is important that the lightest possible vehicles and equipment are employed so as to limit damage to the watercourse and associated buffer zone areas. Heavy vehicles with tracks ideally are not to be allowed into the watercourses or the associated buffer zones unless absolutely necessary.*

	Established internal access roads into watercourses and the associated buffer zones will need to be removed and rehabilitated. A site specific rehabilitation plan is to be formulated by a suitably qualified wetland or aquatic specialist and implemented addressing the removal of roads and associated stormwater structures from the watercourse and associated buffer zone areas. This will need to be approved by the relevant environmental determining authority. ***Storage of Construction Vehicles, Materials and Equipment*** *– All vehicles, materials and equipment must be stored at an established de-construction camp away from the watercourse and associated buffer zone areas.*

11.2.23 Decommissioning Phase - Agricultural Potential

The same impacts experienced during construction would be relevant here

11.2.24 Decommissioning Phase - Noise Impact Assessment

The same impacts experienced during construction would be relevant here

11.2.25 Decommissioning Phase - Visual Impact Assessment

Visual impacts during the decommissioning phase are potentially similar to those during the construction phase.

11.2.26 Decommissioning Phase - Heritage Assessment

The same impacts experienced during construction would be relevant here

11.2.27 Decommissioning Phase - Socio-economic Impact Assessment

The same impacts experienced during construction would be relevant here

12 CUMULATIVE IMPACTS AND MITIGATION MEASURES

12.1 Cumulative Impacts

12.1.1 Biodiversity Impact Assessment

- Construction

Due to the negligible amount of infrastructure present within the study area, cumulative impacts are anticipated to be low during construction.

- Operation

The infrastructure to be added is very small in comparison to that already present. No existing wind farms are in place and no cumulative impacts are thus anticipated. Some solar infrastructure is planned for the adjacent farm however this will not isolate the site and movement of fauna and flora will still be possible.

- Decommissioning

Decommissioning of the plant will result in the elimination of the cumulative impacts mentioned above.

12.1.2 Avifauna Assessment

Currently there is no agreed method for determining significant adverse cumulative impacts on ornithological receptors, although clearly a more strategic approach should be followed than is currently the case (Jenkins et al. 2011). SNH (2005) guidance on cumulative effects of wind farms on birds recommends a five-stage process to aid in the ornithological assessment:

- Define the species/habitat to be considered;
- Consider the limits or ‘search area’ of the study;
- Decide the methods to be employed;
- Review the findings of existing studies; and
- Draw conclusions of cumulative effects within the study area.

Unfortunately, due to the early stage of wind energy development in South Africa, is impossible to predict with any confidence at this stage what the cumulative impact of all the proposed wind developments in the Karoo bioregion will be on birds. Firstly there is no baseline to measure it against, secondly the extent of actual impacts will only become known once a few wind farms are developed, and thirdly there is no way of knowing at this stage how many wind farms will actually be developed in the medium term. It is therefore imperative that pre- and post-construction monitoring are implemented at all the new proposed sites, in accordance with the latest *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* (Jenkins *et al.* 2011), and that the results of the various studies are made available for research purposes. This should in time provide the data necessary to improve the assessment of the cumulative impact of wind development on priority species.

Within the context of the previous statement and without detracting from it in any way, it could be speculated that because the priority species that occur (or are likely to occur) at the proposed site all have large distribution ranges (except Red Lark and Sclater's Lark which are more range restricted), the cumulative impacts would be locally significant, rather than regional or national. The potential significance of those local impacts will only become known once the number of wind farms to be developed in the Karoo bioregion is known, and the results of current studies become known. It should also be borne in mind that power lines kill many bustards and cranes in the Karoo (Jenkins & Smallie 2009), therefore any additional mortality may well have a more significant impact than what is evident at first glance. For some large raptors, e.g. Martial Eagle, this would also be true.

12.1.3 Surface Water Impact Assessment

Cumulative impacts may occur. These are assessed from a site specific point of view and a larger regional perspective.

At a site specific scale, where several impacts occur concurrently and where no mitigation measures are applied as stipulated in this report. In particular, during the construction and decommissioning phases, construction related activities in conjunction with storm water impacts can significantly negatively affect watercourses by degrading the condition of the watercourses. Additionally, the cumulative effect of these impacts can physically compromise the integrity of the hydrological system both in situ and downstream off-site. It is therefore critical that the stipulated mitigation measures are applied at the appropriate phases of the proposed development.

From a regional perspective, the impact of a number of wind farms in the local area on a number of properties can negatively impact on surface water resources where construction activities are allowed in surface water resources. Ideally, this should be discouraged and prevented where possible to limit impact from a regional perspective in terms of the type of development (renewable energy development impacts).

12.1.4 Visual Assessment

Cumulative impacts are the impacts, which combine from different developments / facilities and result in significant impacts that may be larger than sum of all the impacts. Several renewable energy facilities are proposed within relatively close proximity to the proposed wind farm. EIAs need to be undertaken for these proposed projects and a number of them are already at advanced stages, or have received an environmental authorisation.

The renewable energy developments that are being proposed in the surrounding area, are indicated in the table below.

Table 90: Large-scale renewable energy developments proposed in close proximity to the wind farm plant

Proposed Development	Current Status of EIA	Proponent	Proposed Capacity	Approximate Location
CPV/PV Plant on the Farm Kaalspruit	Environmental Authorisation Issued by DEA	Mainstream Renewable Power	50MW	Approximately 12km north of Loeriesfontein
Hantam PV Solar Energy Facility	Draft Environmental Impact Report (comment period ended 17 Feb 2012)	Solar Capital (Pty) Ltd	Up to 525MW	Approximately 47km north of Loeriesfontein (just east of Helios Substation).
PV Plant on Klein Rooiberg Farm	Draft Scoping Report – comment period	Orlight SA (Pty) Ltd	Up to 150MW	Approximately 41km north of Loeriesfontein (10km south of Helios Substation).

These pending renewable energy developments and their potential for large scale visual impacts could significantly alter the sense of place and visual character in the study area, if constructed. The cumulative visual impact experienced by each visual receptor will depend on the number of proposed developments within a 10km radius from the receptor location, as beyond 10km the visual impact of the development would diminish to an insignificant level. The number of proposed developments that each receptor would be visually exposed to (i.e. the cumulative impact experienced at each site) is indicated in Table 91 below. It should be noted that the impact on each receptor location is indicative of the 'worst case' scenario which assumes that all of the proposed facilities would be developed.

Table 91: Cumulative visual impact on potentially sensitive receptors

Visual Receptors	Proposed Wind Farm	CPV/PV Plant on the Farm Kaalspruit	Hantam PV Solar Energy Facility	PV Plant on Klein Rooiberg Farm
Dwelling on Bitterputs Farm	✓			
Main dwelling on Kareedoorn Pan Farm	✓		✓	
Old farmhouse on Kareedoorn Pan Farm	✓		✓	
Dwelling on Sous Farm	✓		✓	
Dwelling on Narosies Farm	✓		✓	✓
Dwellings in Klein Rooiberg	✓		✓	✓

As indicated in the table above, the greatest cumulative impact will be experienced by the dwelling on Narosies Farm and the dwellings in Klein Rooiberg as they would be visually exposed to the Hantam PV Solar Energy Facility and the PV Plant on Klein Rooiberg Farm. None of the receptors will be visually exposed to the CPV/PV Plant on the Farm Kaalspruit as this proposed development is too far away.

12.1.5 Social Assessment

- Construction Phase
  - The perception or expectation (even it if is unrealistic on the part of locals) that the project will offer employment often results in locals informing family and friends from elsewhere that there are jobs available in the area, which in turn then leads to the in-migration of jobseekers. This can make it difficult to distinguish between a permanent resident and an opportunistic jobseeker, which in turn can complicate a fair job allocation system should unskilled labour be required – even more so where there is very little demand, but an oversupply of labour.

- If a simultaneous in-migration of unemployed jobseekers occurs, this can intensify the temporary increase in need for housing. Some of the jobseekers might find shelter with friends or family while others are left destitute. This can then lead to the creation and/or expansion of informal settlements, which in turn can place additional strain on already limited resources (municipal services, available land, job opportunities, etc.). The expansion of informal settlement puts the local municipality under pressure as it increases the housing backlog with more and more people requiring formal housing and municipal services on par with RDP standards.
- If a HIV/AIDS prevention plan is implemented effectively within the local communities on a level that they understand, and if the necessary resources are easily available and accessible to the community (e.g. condoms, information posters, VCT centres, support groups) for the duration of the construction phase, this would leave an informed and empowered community behind who would be able to continue to prevent HIV infections by informing and empowering others.

- Operations and Maintenance Phase

  - The presence of the wind farm, and associated infrastructure (substation and transmission line) can set an unintended precedent for further land use change. For example: If additional power lines are required in future it is oftentimes preferred to place such lines next to existing lines as the area is already regarded as disturbed.
  - The cumulative impact of corporate social investments through Mainstream's proposed trust can be high. Economic empowerment (through funds and land), improved healthcare, business growth, skills development, and higher education are massive for the local people. These would increase earning potentials, improve livelihoods, increase life-spans, benefit quality of life variables, hasten local people out of poverty (where applicable), and assist future generations and relatives of those who benefit directly.

12.2 Mitigation Measures

12.2.1 Biodiversity (flora and fauna) Assessment

Mitigation measures in this report are adopted for floral and faunal protection.

- Construction site specific mitigation measures

The following mitigation measures are recommended for the study area:

- An on-site ecologist should be present when excavation takes place to ensure that any uncovered species are protected from destruction (It is important to remember that even though these species have not been encountered, they could be in a dormant stage and suddenly arise during construction due to more favourable conditions.
- Demarcation of sensitive areas prior to construction activities starting
- Use of appropriate construction methods in the sensitive area.
- Intensive environmental audits (frequently in sensitive areas) by an independent party during this construction period.
- A copy of the Environmental Impact Report and associated Environmental Management Programme as well as the specialist study must be present at the construction site for easy reference to specialist recommendations in sensitive areas.
- It is recommended that the construction crew be educated about the sensitivities involved in these areas as well as the potential species they could encounter. A poster of sensitive species (compiled by a qualified specialist) should be kept on the construction site for easy reference.
- Rehabilitation to be undertaken as soon as possible after construction in sensitive area has been completed
- Only vegetation within the study area must be removed.
- Vegetation removal must be phased in order to reduce impact of construction.
- Construction site office and laydown areas must be clearly demarcated and no encroachment must occur beyond demarcated areas.
- All natural areas impacted during construction must be rehabilitated with locally indigenous plant species.
- A buffer zone should be established in areas where construction will not take place to ensure that construction activities do not extend into these areas.
- Construction areas must be well demarcated and these areas strictly adhered to.
- The use of pesticides and herbicides in the study area must be discouraged as these impacts on important pollinator species of indigenous vegetation.
- Soils must be kept free of petrochemical solutions that may be kept on site during construction. Spillage can result in a loss of soil functionality thus limiting the re-establishment of flora.

- Operation Site Specific Mitigation Measures

The following mitigation measures are recommended for the study area

- Six monthly checks of the area should take place for the emergence of invader species.
- Mitigation measures mentioned for the construction phase above must be implemented for any maintenance of the development that may be undertaken during the operation phase.
- Correct rehabilitation with locally indigenous species.
- Monitoring programme to ensure that rehabilitation efforts are successful to ensure that risks such as erosion and the edge effect are avoided.
- Constant maintenance of the area to ensure re-colonisation of floral species.
- Regular removal of alien species which may jeopardise the proliferation of indigenous species.

- Decommissioning Mitigation and Management measures

All mitigation measures applied during construction will apply to the decommissioning phase of the project.

12.2.2 Avifauna Assessment

Mitigation measures fall into two broad categories: best-practice measures which could be adopted by any wind farm development and should be adopted as an industry standard, and additional measures which are aimed at reducing an impact specific to a particular development (Drewitt & Langston 2006).

Examples of **generic** best practice measures are (Drewitt & Langston 2006):

- Ensuring that key areas of conservation importance and sensitivity are avoided;
- Implementing appropriate working practices to protect sensitive habitats;
- Providing adequate briefing for site personnel and, in particularly sensitive locations, employing an on-site ecologist during construction;
- Implementing an agreed post-development monitoring programme;
- Siting turbines close together to minimise the development footprint (subject to technical constraints such as the need for greater separation between larger turbines);
- Grouping turbines to avoid alignment perpendicular to main flight paths and to provide corridors between clusters, aligned with main flight trajectories, within large wind farms;
- Increasing the visibility of rotor blades – research indicates that high contrast patterns might help reduce collision risk (McIsaac 2001; Hodos 2002), although this may not always be acceptable on landscape grounds. Another suggested, but untested possibility is to paint blades with UV paint, which may enhance their visibility to birds;

- Where possible, installing transmission cables underground (subject to habitat sensitivities and in accordance with existing best practice guidelines for underground cable installation);
- Marking overhead cables using deflectors and avoiding use over areas of high bird concentrations, especially for species vulnerable to collision;
- Timing construction to avoid sensitive periods; and
- Implementing habitat enhancement for species using the site.

Other measures which may be suitable in some circumstances include the relocation of proposed or actual turbines responsible for particular problems, halting operation during periods of peak bird usage, reducing rotor speed or negotiating off-sets where impacts cannot be avoided. Again, post-construction monitoring is essential in order to test the effectiveness of such mitigation measures and research is needed to provide more information on specific impacts and novel mitigation measures that might reduce impacts.

Despite the fact that wind power has been a feature of the energy industry in the developed world for more than a decade, best practices with regard to bird mitigation are not universally clear or accepted. In the USA, for example, it would seem that best practices may still be lacking (Smallwood 2008). Mitigation measures would be more effective if consistently based on scientifically founded conclusions of factors affecting bird collisions with wind turbines, which is unfortunately not always the case (at least in the USA). It is essential to perform scientifically rigorous pre- and post-construction monitoring of bird fatalities and flight behaviour in wind farms, as well as ecological investigations. These types of investigations have not been performed at many wind farms in the USA so the scientific basis for mitigation measures remains weak (Smallwood 2008). Avoidance and minimisation measures will be the most effective mitigation at wind farms, but these have yet to be implemented at many US wind farms. Adaptive management is often promised in environmental review documents, but in practice it seldom happens. Off-site compensation may be the only substantial means of mitigating impacts following wind farm development. A scientifically defensible nexus between project impacts and mitigation benefits still needs to be established for compensation ratios directed toward wind farms (Smallwood 2008).

It must be accepted that appropriate best practices and mitigation measures with regard to impacts on birds in a South African context will take a number of years to crystallise, and a measure of trial and error will inevitably be part of the process.

The following **site-specific** mitigation measures are recommended for the **proposed Loeriesfontein wind farm:**

- Due to the uniformity of the habitat at the site itself, no specific key areas of conservation importance and sensitivity have emerged so far that are specifically linked to conditions on the ground, subject to further monitoring at the site.
- There is a potential for waterbird flight paths over the northern part of the study area linked to ephemeral pans outside the actual boundaries of the site. It is recommended that development of the northern part of the site is delayed until better information is available on actual bird traffic over the site, which should emerge as the monitoring for Phase 2 is implemented in due course.
- Habitat destruction should be limited to what is absolutely necessary for the construction of the infrastructure, including the construction of new roads. In this respect, the recommendations from the Ecological Specialist Study should be applied strictly. Personnel should be adequately briefed on the need to restrict habitat destruction, and must be restricted to the actual construction area.
- The proposed power line should be routed as far as possible from high risk areas, specifically from the pan that borders on the north-western part of the study area. In addition, the entire line should be marked with Bird Flight Diverters, to reduce the risk of collisions of specifically Ludwig's Bustard.
- The proposed pole design must be assessed by the author of this report to ensure that the power line design poses no potential electrocution risk of large raptors, particularly Martial Eagle, which may use the poles as hunting perches.
- A 250m exclusion zone should be implemented around the existing Greater Kestrel breeding pair where no construction activity should take place.
- Post-construction monitoring should be implemented as part of the continuation of the current monitoring programme, to assess displacement and actual collision rates. If actual collision and displacement levels are high, the following mitigation measures would need to be considered:
    - Negotiating appropriate off-set compensation for turbine related displacement and collision mortality;
    - As a last resort, halting operation of specific turbines during peak flight periods, or reducing rotor speed, to reduce the risk of collision mortality.

12.2.3 Bat Assessment

- A test done by Baerwald et al. (2008) where they altered the wind speed trigger of 15 turbines at a site with high bat fatalities in south-western Alberta, Canada, during the peak fatality period, showed a reduction of bat fatalities by 60%. Under normal circumstances the turbine would turn slowly in low wind speeds but only starts generating electricity when the wind speed reaches 4 m/s. During the experiment the Vestas V80 type turbines were kept stationary during low wind speeds and only allowed to start turning and generate electricity at a cut-in speed of 5.5 m/s. Another strategy used in the same experiment involved altering blade angles to reduce rotor speed, meaning the blades were near motionless in low wind speeds which resulted in a significant 57.5% reduction in bat fatalities.

- Long term field experiments and studies done by Arnett et al. (2010) in Somerset County, Pennsylvania, showed a 44 – 93% reduction in bat fatalities with marginal annual power generation loss, when curtailment was implemented. However, when using a cut-in speed of 6.5 m/s the annual power loss was 3 times higher than when using a 5.0 m/s cut-in speed. Their study concluded that curtailment can be used as an effective mitigation measure to reduce bat fatalities at wind energy facilities.
- Although the optimum cut-in speed to reduce bat fatalities and keep power loss at a minimum needs to be researched and determined in the local context by means of long term studies in the general area, a cut-in wind speed of 5.0 m/s to 5.5 m/s (meters per second) is preliminarily recommended.
- An ultrasonic deterrent device is a device emitting ultrasonic sound in a broad range that is not audible to humans. The concept behind such devices is to repel bats from wind turbines by creating a disorientating or irritating airspace around the turbine. Research in the field of ultrasonic deterrent devices is progressing and yielding some promising results, although controversy about the effectiveness and a lack of large scale experimental evidence exists.
- Nevertheless, a study done by Szewczak & Arnett (2008), who compared bat activity using an acoustic deterrent with bat activity without the deterrent, showed that when ultrasound was broadcasted only 2.5-10.4% of the control activity rate was observed. A lab test done by Spanjer (2006) yielded promising results, and a field test of such devices done by Horn et al. (2008) indicated that many factors are influencing the effectiveness of the device although it did deter bats significantly from turbines.
- It may be feasible to install such devices on selected functional turbines, and the results being monitored by an appropriately qualified researcher.
- It will be beneficial to collaborate with academic institutions to promote research on the subject, doing affordable long term monitoring and quantifying the risks more accurately to effectively fine tune mitigation and determine if a migration path is crossing the site.

12.2.4 Surface Water Impact Assessment

- Pre-construction
    - Storage of Construction Vehicles, Materials and Equipment – All vehicles, materials and equipment must be stored at an established construction camp away from the watercourse and associated buffer zone areas. No storage of

building materials, equipment and vehicles is to be allowed in the watercourse and buffer zone areas.

- Heavy machinery and vehicles must be checked for oil leaks before being allowed to operate in the watercourse and the associated buffer zone areas. Additionally, no fuelling, re-fuelling or stockpiling of hazardous materials (oils, fuels and cement) is allowed to take place in the cleared vegetation areas prepared for construction activities.
- Sanitary facilities - Sanitary facilities must be available for workers (at a ratio of 1 toilet to ten workers) to use to prevent urine and faecal waste entering the buffer zones of the wetlands and watercourses. Sanitary facilities must be placed at least 100m from the wetland, riparian habitats and buffer zones.
- Movement and Degradation of Vehicles and Workers – Vehicles are most likely to be required in order to clear vegetation from the required construction areas. It is important that the lightest possible vehicles and equipment are employed so as to limit damage to the watercourse and associated buffer zone areas. Heavy vehicles with tracks must not be allowed into the watercourses or the associated buffer zones unless absolutely necessary.
- Establishment of access into watercourses and the associated buffer zones will be required for phase 2 of the wind farm development. Where this takes place and the necessary authorisations and water use licences have been obtained permitting access roads into the watercourse and associated buffer zones, a single access route or "Right of Way" (RoW) is to be established The width of the RoW must be limited to the width of the vehicles required to enter the watercourse and associated buffer zone areas. An additional area around the locations of the wind turbines and new powerline structure locations will be required in order for construction vehicles and machinery to operate in the required areas. This too must be limited to the smallest possible area required to prevent unnecessary degradation. These construction areas must be cordoned off so that access into the watercourse is limited.
- Damage and Removal of Sensitive Vegetation – Should sensitive vegetation be identified by the biodiversity final walkdown assessment, these must not to be damaged or removed unless they are located within the footprint of the requisite construction areas. Removal or relocation will only be allowed where the relevant authority is consulted and advises on the most appropriate plan of action.

- Construction phase
  - Excavation of Soils from Watercourses and Buffer Zones – Where appropriate, all removed soils should be backfilled into trenches or excavations. However, where the excavated materials are not suitable, the soils are to be removed from site and dumped at a registered landfill site where sufficient capacity exists.

- All stockpiled soils from the watercourses and associated buffer zones must be bunded by suitable materials (for example, fixed wooden planks or bricks) that can resist rains and increased run-off. The bunded materials of choice should be high enough to prevent overspill (for example 40-50cm high). This will prevent erosion and sedimentation within the sensitive hydrological systems.
- Separate stockpiles must be made for topsoil and sub-soils. Once the foundations have been constructed, the backfill of excavated soils needs to be done in a manner that re-instates the proper soil horizons in the correct order. For example, the sub-soils must be back filled first and then the topsoil backfill.
- Prevention of Pollutants and other potentially Hazardous Substances entering Watercourses and the associated Buffer Zones – Any mixing of cement must take place outside of the watercourses and the associated buffer zones. Where this cannot be undertaken and cement mixing in the watercourses and associated buffer zones are absolutely necessary, this must either only take place over a covered surface (for example, mixing boards) and must be bunded to prevent spread during mixing and must be nearby or beside the excavation pits or immediate construction areas. Alternatively, cement mixing can take place in the load bin of vehicle. It is important that no cement spills unnecessarily in the area around the powerline construction or wind turbine construction areas for risk of entering the watercourses.
- Heavy machinery and vehicles must be checked for oil leaks before being allowed to operate in the watercourse and the associated buffer zone areas. Additionally, no fuelling, re-fuelling or stockpiling of hazardous materials (oils, fuels and cement) is allowed to take place in the cleared vegetation areas prepared for construction activities.
- Sanitary facilities - Sanitary facilities must be available for workers (at a ratio of 1 toilet to ten workers) to use to prevent urine and faecal waste entering the buffer zones of the wetlands and watercourses. Sanitary facilities must be placed at least 100m from the watercourse and associated buffer zones.
- Movement and Degradation of Vehicles and Workers – Vehicles will be required for construction activities to take place for the powerlines of option 1 of the PV Power Plant (should it be selected) and where access roads and wind turbines are to be constructed for phase 2 of the wind farm. It is important that the lightest possible vehicles and equipment are employed so as to limit damage to the watercourse and associated buffer zone areas. Heavy vehicles with tracks ideally are not to be allowed into the watercourses or the associated buffer zones unless absolutely necessary.
- Establishment of access into watercourses and the associated buffer zones will be required for phase 2 of the wind farm development. Where this takes place and the necessary authorisations and water use licences have been obtained permitting access roads into the watercourse and associated buffer zones, a

single access route or “Right of Way” (RoW) is to be established The width of the RoW must be limited to the width of the vehicles required to enter the watercourse and associated buffer zone areas. An additional area around the locations of the wind turbines and new powerline structure locations will be required in order for construction vehicles and machinery to operate in the required areas. This too must be limited to the smallest possible area required to prevent unnecessary degradation. These construction areas must be cordoned off so that access into the watercourse is limited.

- Storage of Construction Vehicles, Materials and Equipment – All vehicles, materials and equipment must be stored at an established construction camp away from the watercourse and associated buffer zone areas.
- Impacts to Avi-fauna – Where the powerlines are to be strung across the watercourses, the fitment of bird anti-collision devices (flappers) or flight deviators will be required. Importantly, the fitment of such devices must be done prior to the powerlines being strung. For example, the fitment must take place on the ground so that vehicles are not required to enter watercourses unnecessarily for the fitment of the devices to the powerlines.
- Seasonality of Construction Activities – Construction activities should take place during summer months when rainfall is at its lowest (preferably between September to March). This will be significant in negating potential run-off impacts from occurring.
- Construction Phase Stormwater Management Plan - The development and implementation of an adequate storm water management plan to be designed by an appropriate engineer will assist in formulating adequate measures to address any potential stormwater impacts from occuring. Here, the engineer should account for both natural run-off (that which can be released into the natural landscape with no detrimental effect) and excess artificial run-off generated over the exposed bare construction laydown areas. In order to prevent acceleration of stormwater run-off, energy dissipating structures can be used. Such structures can reduce the amount and rate of excess run-off generated by the proposed development entering wetlands and thereby prevent the onset of erosion.
- Stormwater management structures or devices should also take into account the potential for sedimentation and siltation effects associated with stormwater run-off. In this instance, exposed bare areas should be contained by silt fencing or other appropriate devices or materials to trap sediment and dissipate stormwater run-off.

▪ Operation phase

- Use of Existing Roads - It is crucial that existing roads are used so that damage is limited. Where new access roads are required and the necessary authorisations and licences are obtained (i.e. water use licence and environmental authorisation), these roads must be limited in extent (i.e. go directly to the desired tower) and will need to be maintained.

  - Ideally, if access roads are required inside the watercourses, coarse gravel should be used. This material will not erode away easily after rainfall events and will provide a relatively solid foundation when surface water accumulates.
  - If dirt roads will be the means of access, these will have to be regularly monitored and checked for erosion. Monitoring should be conducted on a weekly to monthly basis. Moreover, after short or long periods of heavy rainfall or after long periods of sustained rainfall, the roads will need to be checked for erosion and the necessary rehabilitation measures will need to be employed.
  - Where erosion begins to take place, this must be dealt with immediately to prevent severe erosion damage to the watercourses and the associated buffer zones. Should large scale erosion occur, a rehabilitation plan will be required. Input from a suitably qualified wetland or aquatic specialist must be obtained.
  - Operation Phase Stormwater Management Plan - The development and implementation of an adequate storm water management plan to be designed by an appropriate engineer for the operation phase of the proposed development will assist in formulating adequate measures to address any potential stormwater impacts from occuring. Here, the engineer should account for both natural run-off (that which can be released into the natural landscape with no detrimental effect) and excess artificial run-off generated over the exposed bare construction laydown areas. In order to prevent acceleration of stormwater run-off, energy dissipating structures can be used. Such structures can reduce the amount and rate of excess run-off generated by the proposed development entering wetlands and thereby prevent the onset of erosion.
  - Stormwater management structures or devices should also take into account the potential for sedimentation and siltation effects associated with stormwater run-off. In this instance, exposed bare areas should be contained by silt fencing or other appropriate devices or materials to trap sediment and dissipate stormwater run-off.

- Decommissioning phase

  - Excavation of Soils from Watercourses and Buffer Zones – Where appropriate, all removed soils should be backfilled into trenches or excavations. However, where the excavated materials are not suitable, the soils are to be removed from site and dumped at a registered landfill site where sufficient capacity exists.
  - All stockpiled soils from the watercourses and associated buffer zones must be bunded by suitable materials (for example, fixed wooden planks or bricks) that can resist rains and increased run-off. The bunded materials of choice should be

high enough to prevent overspill (for example 40-50cm high). This will prevent erosion and sedimentation within the sensitive hydrological systems.

- Separate stockpiles must be made for topsoil and sub-soils. Once the foundations have been removed, the backfill of excavated soils must be of a suitable soil type to the surrounding area. Additionally, the backfill of soils needs to be done in a manner that re-instates the proper soil horizons in the correct order. For example, the sub-soils must be back filled first and then the topsoil backfill.
- Prevention of Pollutants and other potentially Hazardous Substances entering Watercourses and the associated Buffer Zones – Heavy machinery and vehicles must be checked for oil leaks before being allowed to operate in the watercourse and the associated buffer zone areas. Additionally, no fuelling, re-fuelling or stockpiling of hazardous materials (oils, fuels and cement) is allowed to take place in the cleared vegetation areas prepared for construction activities.
- Sanitary facilities - Sanitary facilities must be available for workers (at a ratio of 1 toilet to ten workers) to use to prevent urine and faecal waste entering the buffer zones of the wetlands and watercourses. Sanitary facilities must be placed at least 100m from the watercourse and associated buffer zones.
- Movement and Degradation of Vehicles and Workers – Vehicles will be required for the de-construction activities to take place for the wind farm and PV Power Plant. It is important that the lightest possible vehicles and equipment are employed so as to limit damage to the watercourse and associated buffer zone areas. Heavy vehicles with tracks ideally are not to be allowed into the watercourses or the associated buffer zones unless absolutely necessary.
- Established internal access roads into watercourses and the associated buffer zones will need to be removed and rehabilitated. A site specific rehabilitation plan is to be formulated by a suitably qualified wetland or aquatic specialist and implemented addressing the removal of roads and associated stormwater structures from the watercourse and associated buffer zone areas. This will need to be approved by the relevant environmental determining authority.
- Storage of Construction Vehicles, Materials and Equipment – All vehicles, materials and equipment must be stored at an established de-construction camp away from the watercourse and associated buffer zone areas.
- Seasonality of De-construction Activities – De-construction activities should take place during summer months when rainfall is at its lowest (preferably between September to March). This will be significant in negating potential run-off impacts from occurring.
- Decommissioning Phase Stormwater Management Plan – The development and implementation of an adequate storm water management plan to be designed by an appropriate engineer will assist in formulating adequate measures to address any potential stormwater impacts from occurring. Here, the engineer should

account for both natural run-off (that which can be released into the natural landscape with no detrimental effect) and excess artificial run-off generated over the exposed bare construction laydown areas. In order to prevent acceleration of stormwater run-off, energy dissipating structures can be used. Such structures can reduce the amount and rate of excess run-off generated by the proposed development entering wetlands and thereby prevent the onset of erosion.

- Stormwater management structures or devices should also take into account the potential for sedimentation and siltation effects associated with stormwater run-off. In this instance, exposed bare areas should be contained by silt fencing or other appropriate devices or materials to trap sediment and dissipate stormwater run-off.

12.2.5 Agricultural Potential

Due to the overarching site characteristics and the nature of the proposed development viable mitigation measures are limited and will most likely revolve around erosion control:

- Clearing activities should be kept to a minimum (turbine. Road and PV site footprint).
- In the unlikely event that heavy rains are expected activities should be put on hold to reduce the risk of erosion.
- If additional earthworks are required, any steep or large embankments that are expected to be exposed during the 'rainy' months should either be armoured with fascine like structures.

If earth works are required then storm water control and wind screening should be undertaken to prevent soil loss from the site

12.2.6 Noise Impact Assessment

- Construction Phase

The significance of noise during the construction phase is low, yet mitigation measures are included in this report to allow the developer to further reduce the noise levels. It should be noted that both the magnitude and probability of construction noise impacts would reduce with the implementation of the recommendations made for the construction phase. Mitigation options included both management measures as well as technical changes.

Management options to reduce the noise impact during the construction phase include:

- Route construction traffic as far as practically possible from potentially sensitive receptors;
- Ensure a good working relationship between the developer and all potentially sensitive receptors. Communication channels should be established to ensure prior notice to the sensitive receptor if work is to take place close to them. Information that should be provided to the potential sensitive receptor(s) include:
    - i. Proposed working times;
    - ii. how long the activity is anticipated to take place;
    - iii. what is being done, or why the activity is taking place;
    - iv. contact details of a responsible person where any complaints can be lodged should there be an issue of concern.
- When working near (within 500 meters – potential construction of access roads and trenches) to a potential sensitive receptor(s), limit the number of simultaneous activities to the minimum as far as possible;
- When working near to potentially sensitive receptors, coordinate the working time with periods when the receptors are not at home where possible. An example would be to work within the 08:00 to 14:00 time-slot to minimize the significance of the impact because:
    - i. Potential receptors are most likely at school or at work, minimizing the probability of an impact happening;
    - ii. Normal daily activities will generate other noises that would most likely mask construction noises, minimizing the probability of an impact happening.

Technical solutions to reduce the noise impact during the construction phase include:

- Using the smallest/quietest equipment for the particular purpose. For modelling purposes the noise emission characteristics of large earth-moving equipment (typically of mining operations) were used, that would most likely over-estimate the noise levels. The use of smaller equipment therefore would have a significantly lower noise impact;
- Ensuring that equipment is well-maintained and fitted with the correct and appropriate noise abatement measures.

- Operational Phase

The significance of the noise impact is considered to be medium for NSD01 and further mitigation measures are required.

Mitigation measures that could be considered around NSD01 before the development of this wind energy facility would include:

- The selection of a different make and model of wind turbine;

- Ensuring a larger setback around the potentially sensitive receptors taking cognisance of prevailing wind directions;
- The developer should discuss the findings of this report with NSD01, and if required by this NSD, turbines 144 (phase 2) and 4 (phase 1) should be relocated further than 1,000 meters from this NSD.
- The developer can consider larger wind turbines which would require less wind turbines for the same power generation potential, but increase the buffer zone with an appropriate level. Should the developer select to use a larger or different wind turbine the noise impact assessment should again review the potential noise impact if any wind turbines are closer than 1,500 meters from any NSDs;
- A combination of the above options such as the use of more quiet wind turbine closer to potential noise sensitive developments, larger (and possibly louder) machines further from the NSDs, possibly with an increased setback.

Mitigation measures that would reduce a potential noise impact after the implementation of the facility includes (if a reasonable noise complaint is registered):

- Operating all, or selected wind turbines in a different mode. Most manufacturers allow the turbines to be operated in a different mode. This allows the wind turbine generator to operate more silently, albeit with a slight reduction of electrical power generation capability.
- Problematic wind turbines could also be disabled, or the rotational speeds significantly decreased during periods when a quieter environment is desired (and reasonable complaints registered).

- In addition:
  - Good public relations are essential. At all stages surrounding receptors should be educated with respect to the sound generated by wind turbines. The information presented to stakeholders should be factual and should not set unrealistic expectations. It is counterproductive to suggest that the wind turbines will be inaudible, or to use vague terms like “quiet”. Modern wind turbines produce a sound due to the aerodynamic interaction of the wind with the turbine blades, audible as a “swoosh”, which can be heard at some distance from the turbines. The magnitude of the sound will depend on a multitude of variables and will vary from day to day and from place to place with environmental and operational conditions. Audibility is distinct from the sound level, because it depends on the relationship between the sound level from the wind turbines and the ambient background sound level.
  - Community involvement needs to continue throughout the project. Annoyance is a complicated psychological phenomenon; as with many industrial operations, expressed annoyance with sound can reflect an overall annoyance with the project, rather than a rational reaction to the sound itself. Wind projects offer a

benefit to the environment and the energy supply for the greater population, and offer economic benefits to the land owners leasing installation sites to the wind farm. A positive community attitude throughout the greater area should be fostered, particularly with those residents near the wind farm, to ensure they do not feel that advantage have been taken of them.

- The developer must implement a line of communication (i.e. a help line where complaints could be lodged. All potential sensitive receptors should be made aware of these contact numbers. The Wind Energy Facility should maintain a commitment to the local community and respond to concerns in an expedient fashion. Sporadic and legitimate noise complaints could develop. For example, sudden and sharp increases in sound levels could result from mechanical malfunctions or perforations or slits in the blades. Problems of this nature can be corrected quickly, and it is in the developer's interest to do so.

12.2.7 Visual Impact Assessment

- Make use of fittings that focus the light and prevent light spill.
- Direct perimeter lighting in a downward direction toward the site.
- Limit the use of flood lighting where possible.
- Limit construction activities to day-time hours in order to prevent night lighting during construction.
- Bury cables under the ground where possible.
- New overhead power lines should be aligned to follow exiting power lines or other infrastructure, such as roads.
- Buildings should be painted with natural tones that fit with the surrounding environment
- Select the alternative for the substation and operation and maintenance building that will have the least impact on visual receptors.
- Do not locate any turbines within 500m from an existing dwelling.
- Bury cables under the ground where possible.
- New overhead power lines should be aligned to follow exiting power lines or other infrastructure, such as roads.
- Buildings should be painted with natural tones that fit with the surrounding environment

12.2.8 Heritage Assessment

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

- Objectives

  - Protection of archaeological, historical and any other site or land considered being of cultural value within the project boundary against vandalism, destruction and theft
  - The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during mining activities

The following shall apply:

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

- Control

In order to achieve this, the following should be in place:

  - A person or entity, e.g. the Environmental Control Officer, should be tasked to take responsibility for the heritage sites and should be held accountable for any damage.
  - Known sites should be located and isolated, e.g. by fencing them off. All construction workers should be informed that these are no-go areas, unless

accompanied by the individual or persons representing the Environmental Control Officer as identified above.

- In areas where the vegetation is threatening the heritage sites, e.g. growing trees pushing walls over, it should be removed, but only after permission for the methods proposed has been granted by SAHRA. A heritage official should be part of the team executing these measures.

- Safe guarding sites

It is recommended that buffer areas are set out around the identified sites:

- The Stone Age open sites should be demarcated with a buffer of a radius of at least 20 metres form the centre point of the site (see coordinates supplied in Section 5.4).
- The farmstead should be demarcated with a buffer of at least 10 metres from the outer edge of all structures and features such as gardens, orchards, etc.
- The cemetery should be demarcated by a buffer of at least 10 metres from the outer edge of the fence, or the last visible graves if there is no fence.
- The farming related feature should be demarcated by a buffer of at least 10 metres from the outer edge of the individual structures.

12.2.9 Socio-economic Impact Assessment

- Construction Phase

Construction activities have the potential to largely impact on the social environment. Thus social mitigation measures ensure that construction activities are managed in such a manner that the positive impacts may be enhanced and the negative impacts are minimised as far as possible.

- Employment and Output Creation
    i. Ensure that the unskilled local jobs created are linked to a skills development programme for permanent employment
- Social Mobilisation
    i. Problem areas that are brought under the attention of the contractor should be rectified immediately. If the contractor is unable to so, this should be communicated to the landowner along with a plan on how and when the problem will be addressed. The landowner should be given regular feedback on the matter.

ii. All mitigation measures contained in the EMP should be implemented and monitored by an ECO. Remedial action should be taken where the contractor fails to comply with the EMP.

- Health and Safety
  i. Mainstream or its contractor should appoint a service provider or local NGO to develop, implement and manage an HIV/AIDS prevention programme. The service provider or NGO should specialise in the field of HIV/AIDS.
  ii. The HIV/AIDS prevention programme should extend to the local community and should pay special attention to vulnerable groups such as women and youth.

- Operations and Maintenance Phase

  - Employment and Output Creation
    i. Linking new and existing local businesses to the supply chain of the wind farm.
  - Corporate Social Investment
    i. Using the most effective community structures for the trust fund, inclusion of existing structures, transparent rules in allocating funds, prioritisation according to community needs and building on existing regional synergies
  - Sense of Place
    i. Implement mitigation measures detailed in the Visual Impact Assessment
    ii. The impact on livelihoods should be monitored and evaluated before and after the construction of the wind farm.

13 DESCRIPTION AND COMPARATIVE ASSESSMENT OF ALL ALTERNATIVES IDENTIFIED

There are several alternatives proposed for each key component for the proposed development. Each of these alternatives for each key component is comparatively evaluated below in terms of the findings from the specialist studies conducted during the EIA phase.

A negative mapping exercise (form of alternatives assessment) was undertaken by all the specialists on the project which identified the sensitive areas present on the site and ultimately the areas where the infrastructure cannot be placed. This area has been defined in the buildable area on all the maps in this report. Once the buildable area was defined, the various layouts were investigated in terms of associated infrastructure. These alternatives are assessed below at length.

13.1 Alternatives Wind farm project 1

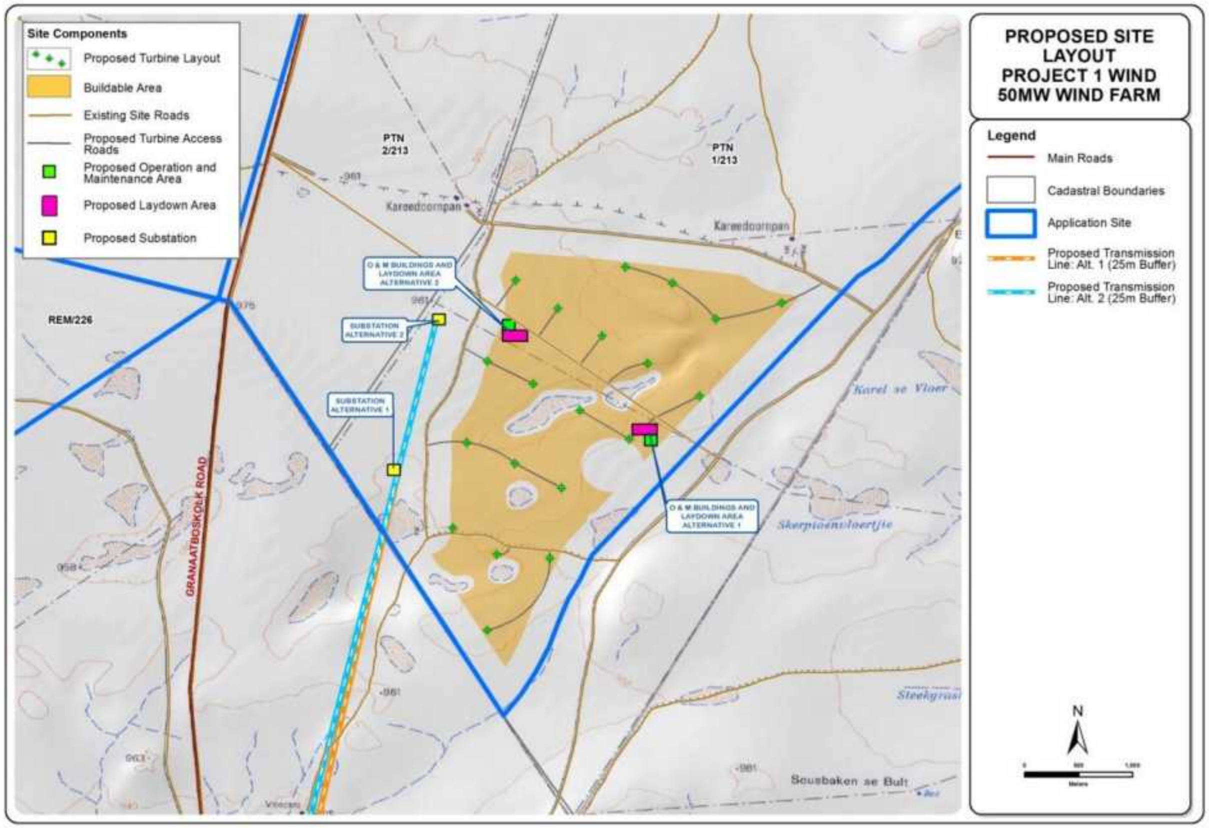

Figure 103: Proposed Alternatives proposed for project 2

Table 92 to Table 95 below highlights issues associated with each alternative thereby identifying the preferred alternative for wind farm project 1.

ELIMINATED
PREFERRED

Table 92: Substation Alternatives Assessment

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
Substation Alternative 1	Biodiversity	No major preference but located in the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The substation alternative is located outside potential waterbird flight path between pans. Furthermore, the area of the substation does not contain any unique habitats or landscape features. No preference in terms of substation alternatives from an avifaunal perspective.	No Fatal Flaws
	Bats	No sensitive areas have been identified therefore no preference from a bat perspective. Both sites are feasible	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The area of alternative 1 has been classified as having a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws
	Noise	Noise can be anticipated during the construction phase of the substation alternative 1. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is slightly more distant to the sensitive receptor north of the buildable area for this project and therefore preferred.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Visual	No major preference, but located further away from the two receptors locations on Kareedoorn Pan Farm.	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and substation alternative 1 is situated distant to a heritage feature north of the buildable area for this project. This site is preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws
Substation Alternative 2	Biodiversity	No major preference but located in the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The substation alternative is located outside potential waterbird flight path between pans. Furthermore, the area of the substation does not contain any unique habitats or landscape features. No preference in terms of substation alternatives from an avifaunal perspective.	No Fatal Flaws
	Bats	No sensitive areas have been identified therefore no preference from a bat perspective. Both sites are feasible	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws
	Soils and Agricultural Potential	The area of alternative 2 also has been classified as having a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
		preference	
	Noise	Noise can be anticipated during the construction phase of the substation alternative 2. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is closer to a sensitive receptor north of the buildable area for this project and therefore not preferred.	No Fatal Flaws
	Visual	Both dwellings on Kareedoorn Pan Farm are orientated in the opposite direction of the substation alternative.	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and substation alternative 2 is situated in close proximity to a heritage feature north of the buildable area for this project. This site is not preferred	
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

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Table 93: Operation and Maintenance Buildings Alternatives Assessment

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
Operation and Maintenance Buildings Alternative 1	Biodiversity	No major preference but located in the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The area presents a low potential for crop production and no centre pivots, irrigation schemes or active agricultural were identified thus no preference in terms of alternatives	No Fatal Flaws
	Noise	Noise of this alternative is expected to be of a low significance during construction and medium during operation phase, to nearby sensitive receptors. This alternative is slightly distant from a sensitive receptor northwest of the buildable area for this project and therefore preferred.	No Fatal Flaws
	Visual	No major preference, but located further away from the old farmhouse on Kareedoorn Pan Farm and the dwelling on Sous Farm.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Heritage	This alternative is slightly distant from the nearby heritage feature northwest of the buildable area for this project, therefore it is preferred	
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws
Operation and Maintenance Buildings Alternative 2	Biodiversity	No major preference but located in the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws
	Soils and Agricultural Potential	The area presents a low potential for crop production and no centre pivots, irrigation schemes or active agricultural were identified thus no preference in terms of alternatives	No Fatal Flaws
	Visual	The primary orientation of the old farmhouse on Kareedoorn Pan Farm and the dwelling on Sous Farm are in the opposite direction. The site is therefore not preferred.	No Fatal Flaws
	Noise	Noise of this alternative is expected to be of a low significance during construction and medium during operation phase, to nearby sensitive receptors. This alternative is slightly closer to a sensitive receptor northwest of the buildable area for this project site	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
		and therefore not preferred.	
	Heritage	This alternative is in close proximity to the nearby heritage feature northwest of the buildable area for this project, therefore it is not ideal	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

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Table 94: Laydown Area Alternatives Assessment

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
Laydown Area Alternative 1	Biodiversity	No major preference but located in the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The area presents a low potential for crop production and no centre pivots, irrigation schemes or active agricultural were identified thus no preference in terms of alternatives	No Fatal Flaws
	Noise	Noise of this alternative is expected to be of a low significance during construction and medium during operation phase, to nearby sensitive receptors. This alternative is slightly distant from a sensitive receptor northwest of the buildable area for this project and therefore preferred.	No Fatal Flaws
	Visual	No major preference, but located further away from the old farmhouse on Kareedoorn Pan Farm and the dwelling on Sous Farm.	No Fatal Flaws
	Heritage	This alternative is slightly distant from the nearby heritage feature northwest of the buildable area for this project, therefore it is preferred	
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws
Laydown Area Alternative 2	Biodiversity	No major preference but located in the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws
	Soils and Agricultural Potential	The area presents a low potential for crop production and no centre pivots, irrigation schemes or active agricultural were identified thus no preference in terms of alternatives	No Fatal Flaws
	Visual	The primary orientation of the old farmhouse on Kareedoorn Pan Farm and the dwelling on Sous Farm are in the opposite direction. The site is thus not preferred.	No Fatal Flaws
	Noise	Noise of this alternative is expected to be of a low significance during construction and medium during operation phase, to nearby sensitive receptors. This alternative is slightly closer to a sensitive receptor northwest of the buildable area for this project and therefore not preferred	No Fatal Flaws
	Heritage	This alternative is in close proximity to the nearby heritage feature northwest of the buildable area for this project, therefore it is not ideal	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

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Table 95: Power Line Alternatives Assessment

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
Power Line Alternative 1	Biodiversity	No major preference – due to the uniform nature of the site moreover the proposed power line alternative follows existing roads.	No Fatal Flaws
	Avi-fauna	This power line alternative is located in the southern part of the proposed site where no potential sensitive areas form an avifauna perspective have been observed. Furthermore the area does not present any unique habitats or landscape features.	No Fatal Flaws
	Bats	No concerns as there are no sensitive areas in the area of this alternative therefore both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The power lines do not run in any sensitive areas from an agricultural potential perspective, as such both alternatives are preferred	No Fatal Flaws
	Noise	Noise is anticipated during the construction phase of the power line alternative 1. However, this is not expected to be of low magnitude and significance to nearby sensitive developments. This alternative is preferable from a noise perspective.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Visual	No major preference, but located further away from the two receptors locations on Kareedoorn Pan Farm.	No Fatal Flaws
	Heritage	Power line alternative 1 runs near one heritage feature situated southeast of the buildable area. Nevertheless, this alternative is more suitable compared to alternative 2	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective	No Fatal Flaws
Power Line Alternative 2	Biodiversity	No major preference – due to the uniform nature of the site moreover the proposed power line alternative follows existing roads	No Fatal Flaws
	Avi-fauna	This alternative is also located in the southern part of the proposed site where no potential sensitive areas form an avifauna perspective have been observed and the area presents no unique habitats or landscape features	No Fatal Flaws
	Bats	No concerns as there are no sensitive areas in the area of this alternative therefore both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Soils and Agricultural Potential	The power lines do not run in any sensitive areas from an agricultural potential perspective, as such both alternatives are preferred	No Fatal Flaws
	Visual	Both dwellings on Kareedoorn Pan Farm are orientated in the opposite direction of the power line alternative.	No Fatal Flaws
	Noise	Noise is anticipated during the construction phase of the power line alternative 2. However, this is not expected to be of low magnitude and significance to nearby sensitive developments. This alternative is suitable but not preferred from a noise perspective.	No Fatal Flaws
	Heritage	Power line alternative 2 runs near several heritage feature situated in the northeast and southeast of the buildable area for this project. Nevertheless, this alternative is less suitable compared to alternative 1	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

13.2 Alternatives Wind farm project 2

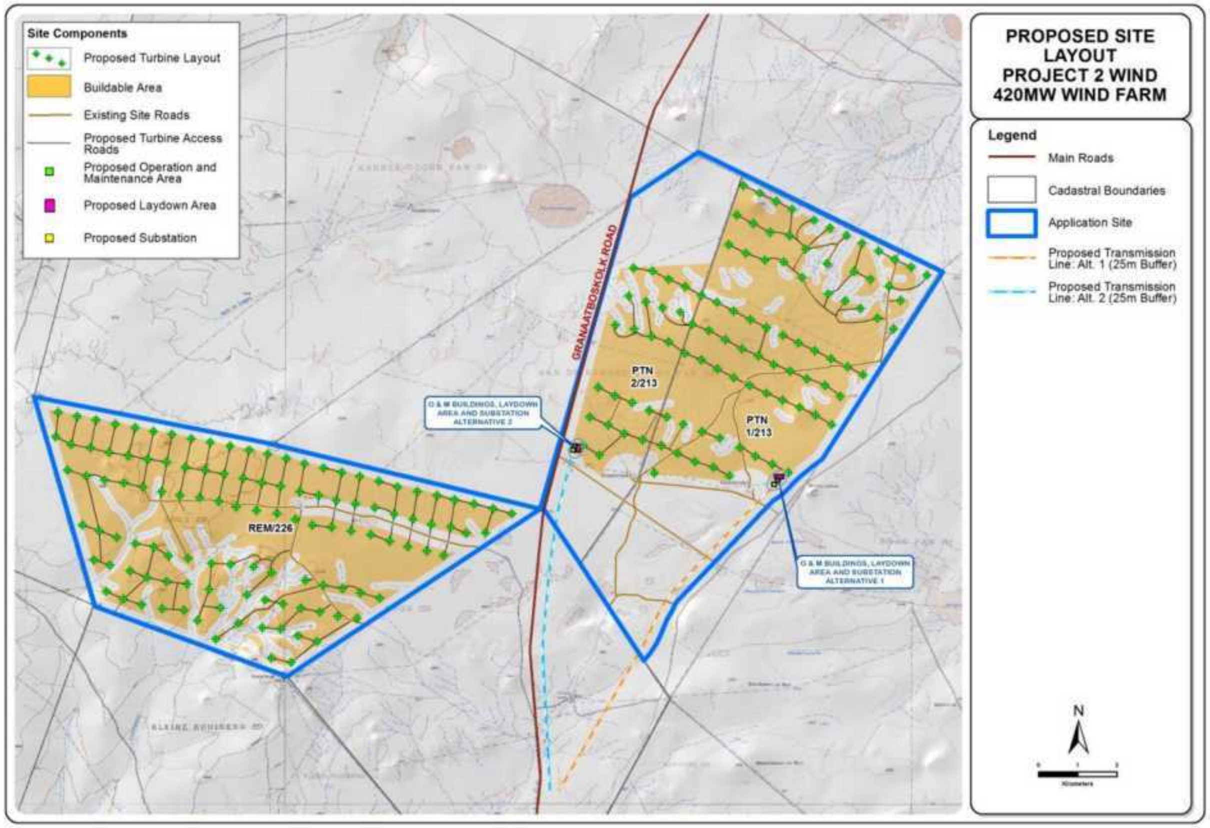

Figure 104: Proposed Alternatives proposed for project 2

Table 96 and Table 99 below highlights issues associated with each alternative thereby identifying the preferred alternative for wind farm project 2.

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Table 96: Substation Alternatives Assessment

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
Substation Alternative 1	Biodiversity	No major preference but the alternative is located in the southern portion of the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The substation alternative is located outside potential waterbird flight path between pans. Furthermore, the area of the substation does not contain any unique habitats or landscape features. No preference in terms of substation alternatives from an avifaunal perspective.	No Fatal Flaws
	Bats	No sensitive areas have been identified therefore no preference from a bat perspective. Both sites are feasible	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Noise	Noise can be anticipated during the construction phase of the substation alternative 1. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is closer to the sensitive receptor south of the buildable area for this project and therefore not preferred.	No Fatal Flaws
	Visual	Located in very close proximity (approximately 500m) to the dwelling on Kareedoorn Pan Farm. The dwelling is also oriented directly towards the substation alternative. Alternative not preferred.	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and substation alternative 1 is located further away from heritage features on the site. This site is preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws
Substation Alternative 2	Biodiversity	No major preference but the alternative is located in the southern portion of the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The substation alternative is located outside potential waterbird flight path between pans. Furthermore, the area of the substation does not contain any unique habitats or landscape features. No preference in terms of substation alternatives from an avifaunal perspective.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Bats	No sensitive areas have been identified therefore no preference from a bat perspective. Both sites are feasible	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws
	Visual	Not within the primary orientation of any receptors that are within a short distance from the substation alternative.	No Fatal Flaws
	Noise	Noise can be anticipated during the construction phase of the substation alternative 2. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is slightly distant from the sensitive receptors south of the buildable area for this project and therefore preferred.	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and substation alternative 1 is located closer to heritage features on the site. This site is not preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

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Table 97: Operation and Maintenance Buildings Alternatives Assessment

Alternative	**Specialist Study**	**Specialist Concerns**	**Fatal Flaws**
Operation and Maintenance Buildings Alternative 1	Biodiversity	No major preference but the alternative is located in the southern portion of the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws
	Noise	Noise can be anticipated during the construction phase of the substation alternative 1. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is closer to the sensitive receptor south of the buildable area for this project and therefore not preferred.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Visual	Located in very close proximity (approximately 500m) to the dwelling on Kareedoorn Pan Farm. The dwelling is also oriented directly towards the building alternative. Not preferred	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and the alternative is located further away from heritage features on the site. This site is preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws
Operation and Maintenance Buildings Alternative 2	Biodiversity	No major preference but the alternative is located in the southern portion of the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws
	Visual	Not within the primary orientation of any receptors that are within a short distance from the building alternative. Preferred alternative	No Fatal Flaws
	Noise	Noise can be anticipated during the construction phase of the substation alternative 2. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is slightly distant from the sensitive receptors south of the buildable area for this project and therefore preferred.	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and the alternative is located closer to heritage features on the site. This site is not preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

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Table 98: Laydown Area Alternatives Assessment

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
Laydown Area Alternative 1	Biodiversity	No major preference but the alternative is located in the southern portion of the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws
	Noise	Noise can be anticipated during the construction phase of the substation alternative 1. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is closer to the sensitive receptor south of the buildable area for this project and therefore not preferred.	No Fatal Flaws
	Visual	Located in very close proximity (approximately 500m) to the dwelling on Kareedoorn Pan Farm. The dwelling is also oriented directly towards the laydown area alternative. Not preferred.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and the alternative is located further away from heritage features on the site. This site is preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws
Laydown Area Alternative 2	Biodiversity	No major preference but the alternative is located in the southern portion of the buildable area near the proposed turbines. No alternative has been eliminated as the impacts associated with all infrastructure will be the same across the site.	No Fatal Flaws
	Avi-fauna	The site presents no unique bird habitats or landscape features and it is anticipated that there are no locally important waterbird fly-ways nearby. No preference from an avi-faunal perspective.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both sites are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Visual	Not within the primary orientation of any receptors that are within a short distance from the laydown area alternative. Preferred alternative	No Fatal Flaws
	Noise	Noise can be anticipated during the construction phase of the substation alternative 2. However, this is expected to be a low significance to nearby sensitive receptors. This alternative is slightly distant from the sensitive receptors south of the buildable area for this project and therefore preferred.	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and the alternative is located closer to heritage features on the site. This site is not preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

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Table 99: Power Line Alternatives Assessment

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
Power Line Alternative 1	Biodiversity	No major preference – due to the uniform nature of the site moreover the proposed power line alternative follows existing roads.	No Fatal Flaws
	Avi-fauna	This power line traverses the southern part of the proposed site where no potential sensitive areas form an avifauna perspective have been observed. Furthermore the area does not present any unique habitats or landscape features.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both alternatives are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore preferred.	No Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws
	Noise	Noise is anticipated during the construction phase of the power line alternative 1. However, this is not expected to be of low magnitude and significance to nearby sensitive developments. This alternative is not preferable from a noise perspective.	No Fatal Flaws
	Visual	Located in very close proximity (approximately 500m) to the dwelling on Kareedoorn Pan Farm. The dwelling is also oriented directly towards the power line alternative. Not preferred	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and the alternative is located further away from heritage features on the site. This site is preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws
Power Line Alternative 2	Biodiversity	No major preference – due to the uniform nature of the site moreover the proposed power line alternative follows existing roads.	No Fatal Flaws
	Avi-fauna	This power line traverses the southern part of the proposed site where no potential sensitive areas form an avifauna perspective have been observed. Furthermore the area does not present any unique habitats or landscape features.	No Fatal Flaws
	Bats	There are no concerns from a bat perspective due to the lack of roosting and foraging opportunities at the proposed site. Both alternatives are preferred.	No Fatal Flaws
	Surface Water	The alternative is not placed in or nearby any watercourses or the associated buffer zones and is therefore favourable	No Fatal Flaws
	Soils and Agricultural Potential	The area is characterized by a low potential for crop production. Furthermore, there are no centre pivots, irrigation schemes or active agricultural fields likely to be influenced by the proposed development. There is no preference	No Fatal Flaws
	Visual	Not within the primary orientation of any receptors that are within a short distance from the power line alternative. Alignment follows the Granaatboskolk road. Preferred alternative	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Noise	Noise is anticipated during the construction phase of the power line alternative 1. However, this is not expected to be of low magnitude and significance to nearby sensitive developments. This alternative is preferable from a noise perspective.	No Fatal Flaws
	Heritage	Several features and objects of cultural heritage significance have been identified on the site and the alternative is located closer to heritage features on the site. This site is preferred	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. Either alternative in this instance may be selected from a socio-economic perspective.	No Fatal Flaws

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Table 100: No-go and Preferred Alternatives Assessment for project 1

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
No Go Alternative	Biodiversity	Should the no-go alternative be selected, the condition and characteristics of the surface water resources as assessed on the study site will remain as is.	No Fatal Flaws
	Avi-fauna	Should the no-Go alternative be selected, the study site would be preserve the status quo as it currently exists.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Bats	Should the no-Go alternative be selected, the study site would be preserve the status quo as it currently exists.	No Fatal Flaws
	Surface Water	Should the no-go alternative be selected, the condition and characteristics of the surface water resources as assessed on the study site will remain as is.	No Fatal Flaws
	Soils and Agricultural Potential	Should the no-go alternative be selected, the condition and characteristics of the soils and agricultural potential as assessed on the study site will remain as is.	No Fatal Flaws
	Visual	Should the no-go alternative be selected, the visual characteristics as assessed on the study site will remain as is with no anticipated visual impacts.	No Fatal Flaws
	Noise	Should the no-go alternative be selected, the sound characteristics and ambient sound levels of the current sound environment would remain as is.	No Fatal Flaws
	Heritage	Should the no-go alternative be selected, the condition and characteristics of the heritage resources as assessed on the study site will remain as is. Degradation through natural means can be expected however. The opportunity to document and report on findings may also not be realised.	No Fatal Flaws
	Socio-economic	The baseline profile of the socio-economic receiving environment would be maintained to a large degree (not taking into account variables outside of the project) in the event that a 'no go' option was implemented. None of the positive socio-economic features would be realised.	No Fatal Flaws
Preferred Alternatives	Biodiversity	From a biodiversity perspective, the operation and maintenance buildings, the substation site, the laydown area, the power lines alternative 1 are preferred.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Avi-fauna	No real preference from an avi-fauna perspective	No Fatal Flaws
	Bats	No real preference from a bat perspective.	No Fatal Flaws
	Surface Water	From a surface water perspective, all of the preferred alternative 1 building and structure locations, laydown area, substations, Operation and Maintenance Buildings, power lines are supported.	No Fatal Flaws
	Soils and Agricultural Potential	No real preference from a soils and Agricultural Potential perspective	No Fatal Flaws
	Visual	From a visual perspective, all of the preferred alternative 1 building and structure locations, laydown area, substations, Operation and Maintenance Buildings, power lines are supported	No Fatal Flaws
	Noise	From Noise perspective, all of the preferred alternative 1 building and structure locations, laydown area, substations and Operation, Maintenance Buildings and Power line are supported.	No Fatal Flaws
	Heritage	From a heritage perspective, all of the preferred alternative 1 building and structure locations, laydown area, substations and Operation, Maintenance Buildings and Power line are supported.	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. However, from a socio-economic perspective the preferred alternative could be supported.	No Fatal Flaws

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Table 101: No-go and Preferred Alternatives Assessment for project 2

Alternative	**Specialist Study**	**Specialist Concerns**	**Fatal Flaws**
No Go Alternative	Biodiversity	Should the no-go alternative be selected, the condition and characteristics of the surface water resources as assessed on the study site will remain as is.	No Fatal Flaws
	Avi-fauna	Should the no-Go alternative be selected, the study site would be preserve the status quo as it currently exists.	No Fatal Flaws
	Bats	Should the no-Go alternative be selected, the study site would be preserve the status quo as it currently exists.	No Fatal Flaws
	Surface Water	Should the no-go alternative be selected, the condition and characteristics of the surface water resources as assessed on the study site will remain as is.	No Fatal Flaws
	Soils and Agricultural Potential	Should the no-go alternative be selected, the condition and characteristics of the soils and agricultural potential as assessed on the study site will remain as is.	No Fatal Flaws
	Visual	Should the no-go alternative be selected, the visual characteristics as assessed on the study site will remain as is with no anticipated visual impacts.	No Fatal Flaws
	Noise	Should the no-go alternative be selected, the sound characteristics and ambient sound levels of the current sound environment would remain as is.	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Heritage	Should the no-go alternative be selected, the condition and characteristics of the heritage resources as assessed on the study site will remain as is. Degradation through natural means can be expected however. The opportunity to document and report on findings may also not be realised.	No Fatal Flaws
	Socio-economic	The baseline profile of the socio-economic receiving environment would be maintained to a large degree (not taking into account variables outside of the project) in the event that a 'no go' option was implemented. None of the positive socio-economic features would be realised.	No Fatal Flaws
Preferred Alternatives	Biodiversity	No major preference from a biodiversity perspective	No Fatal Flaws
	Avi-fauna	No real preference from an avi-fauna perspective	No Fatal Flaws
	Bats	No real preference from a bat perspective.	No Fatal Flaws
	Surface Water	From a surface water perspective, all of the preferred alternative 1 building and structure locations, laydown area, substations, Operation and Maintenance Buildings, power lines are supported.	No Fatal Flaws
	Soils and Agricultural Potential	No real preference from a soils and Agricultural Potential perspective	No Fatal Flaws
	Visual	From a visual perspective, all of the preferred alternative 2 building and structure locations, laydown area, substations, Operation and Maintenance Buildings, power lines are supported	No Fatal Flaws

Alternative	Specialist Study	Specialist Concerns	Fatal Flaws
	Noise	From Noise perspective, all of the preferred alternative 2 building and structure locations, laydown area, substations and Operation, Maintenance Buildings and Power line are supported.	No Fatal Flaws
	Heritage	From a heritage perspective, all of the preferred alternative 1 building and structure locations, laydown area, substations and Operation, Maintenance Buildings and Power line are supported.	No Fatal Flaws
	Socio-economic	The socio-economic environment is assessed in terms of surrounding communities and those which may be affected by the proposed development as a whole. Site specific preferences in the context of this development have therefore not been provided. However, from a socio-economic perspective the preferred alternative could be supported.	No Fatal Flaws

13.3 No Go Alternative

The No-Go Alternative is the option of not establishing the Wind farms on the proposed sites near Loeriesfontein. The No-Go option would therefore result in contributing to the demand for electricity and more specifically renewable energy targets in South Africa not being met. This would also hinder the economic injection that the project promises to provide for the town of Loeriesfontein in the form of increase employment and income generation during the construction phase and long term tax income generation and social corporate investment.

The No-Go alternative has thus been eliminated due to the fact that the identified environmental impacts can be suitably mitigated. Additionally, by not building the project, the socio-economic and biophysical benefits would be lost providing further reason for eliminating the no-go alternative.

Based on the alternatives assessment and the negative mapping exercise that was undertaken by all the specialists, the following sensitivity map was compiled.

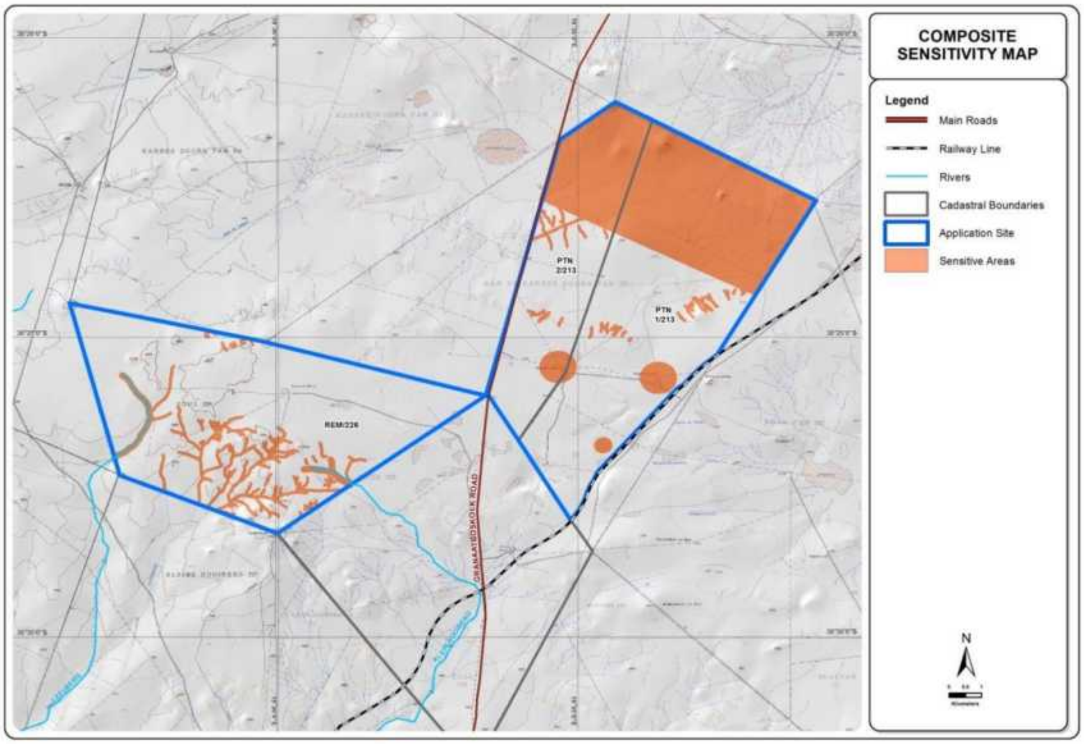

Figure 105: Composite Sensitivity Map

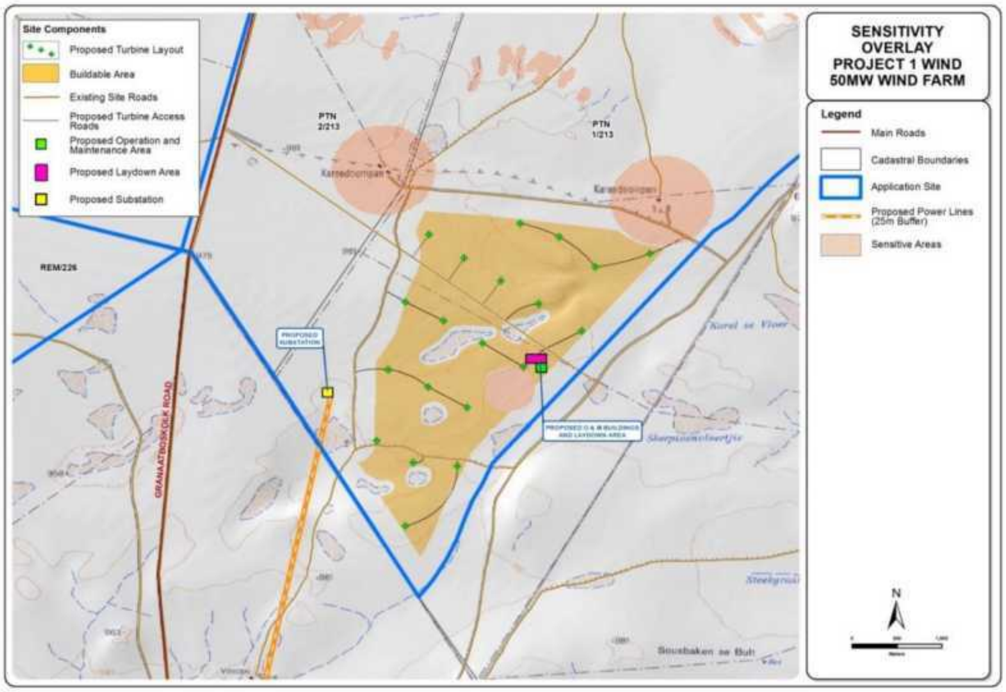

Figure 106: Layout overlayed with the sensitivity mapping – 50MW

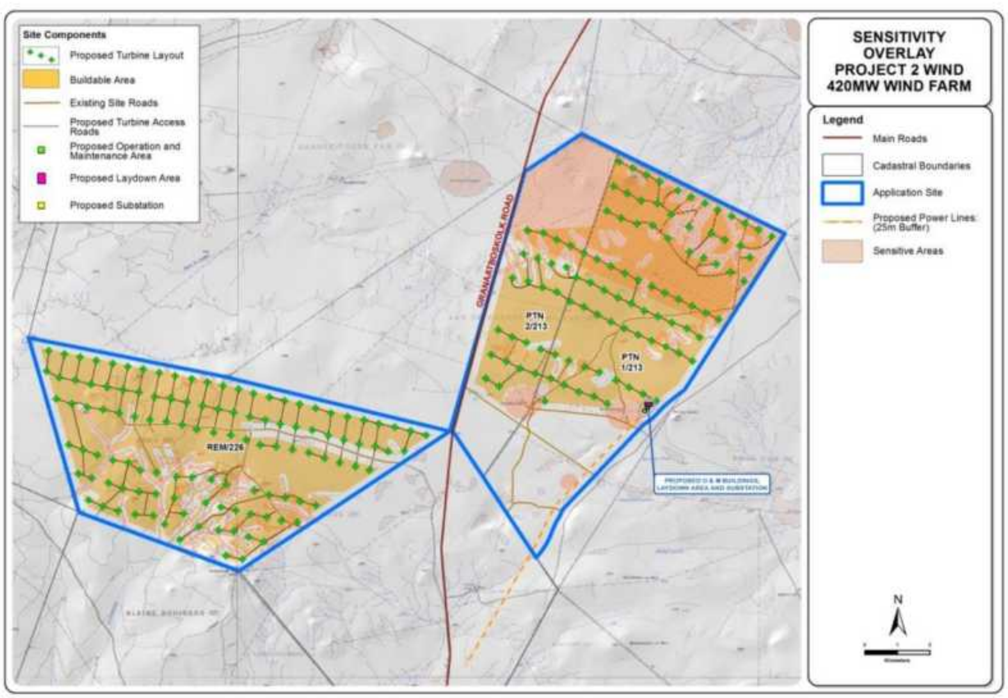

Figure 107: Layout overlayed with the sensitivity mapping - 420MW

Note that although the area to the north was identified as sensitive, it was not considered a fatal flaw by any of the specialists. An area adjacent to the pans (off site) was excluded from the wind farm area to minimize potential impacts on birds.

Based on this sensitivity mapping the following preferred layout was decided upon.

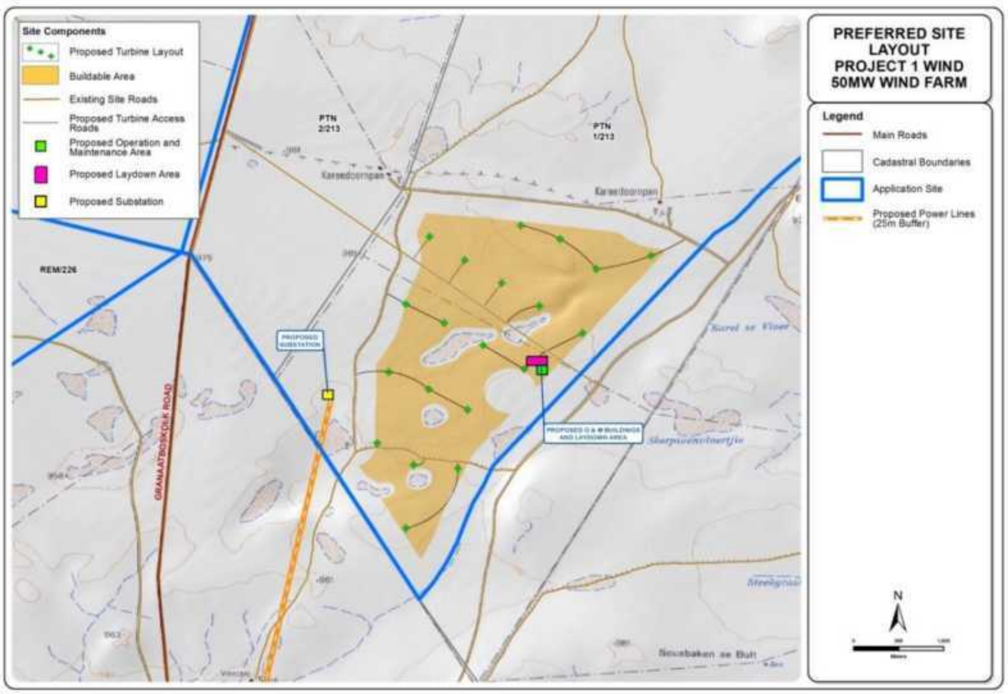

Figure 108: Preferred layout 50MW

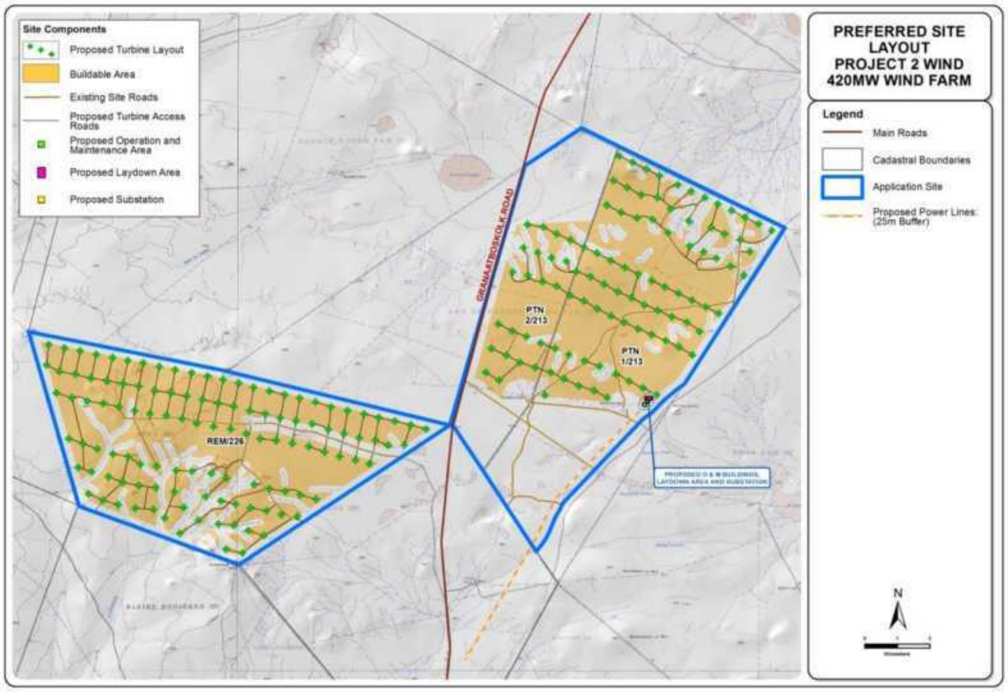

Figure 109: Preferred Layout 420MW

14 ENVIRONMENTAL MONITORING AND AUDITING

The Environmental Management Programme (EMPr) becomes a tool by which compliance on the proposed site can be measured against. In order to utilise this tool, environmental monitoring needs to take place with regular audits against the EMPr to ensure that all aspects are attended to.

Environmental monitoring establishes benchmarks to judge the natural and magnitude of potential environmental and social impacts.

Some of the key parameters for monitoring and auditing of the proposed project include the following inter alia:

- Soil erosion and siltation.
- Oil spillages
- Dust and gaseous emissions.
- Water quality

- Noise and vibration
- Change in biodiversity
- Socio-economic change
- Land use changes.

The overall objective of environmental and social monitoring is to ensure that mitigation measures are implemented and that they are effective. Environmental and social monitoring will also enable responses to new and developing issues of concern. The activities and indicators that have been recommended for monitoring are presented in the EMPr.

Environmental monitoring will be carried out to ensure that all construction activities comply and adhere to environmental provisions and standard specifications, so that all mitigation measures are implemented. The contractor shall employ an officer responsible for implementation of social/ environmental requirements. This person will maintain regular contact with the local / district Environmental Officers. The contractor and proponent will have a responsibility to ensure that the proposed mitigation measures are properly implemented during the construction phase.

The environmental monitoring program will operate through the preconstruction, construction, and operation phases. It will consist of a number of activities, each with a specific purpose with key indicators and criteria for significance assessment. The following aspects will be subject to monitoring:

- Encroachment into sensitive areas
- Maintenance of project footprint
- Vegetation maintenance around project work sites, workshops and camps
- Health & Safety

Monitoring should be undertaken at a number of levels. Firstly, it should be undertaken by the Contractor at work sites during construction, under the direction and guidance of the Supervision Consultant who is responsible for reporting the monitoring to the implementing agencies. It is not the Contractor's responsibility to monitor land acquisition and compensation issues. It is recommended that the Contractor employ local full time qualified environmental inspectors for the duration of the Contract. The Supervision Consultant should include the services of an international environmental and monitoring specialist on a part time basis as part of their team.

Environmental monitoring is also an essential component of project implementation. It facilitates and ensures the follow-up of the implementation of the proposed mitigation measure, as they are required. It helps to anticipate possible environmental hazards and/or detect unpredicted impacts over time.

Periodic ongoing monitoring will be required during the life of the Project and the level can be determined once the Project is operational.

The EMPr is included in Appendix 9.

15 COMPLIANCE WITH WORLD BANK STANDARDS AND EQUATOR PRINCIPLES

This report has been prepared to comply with various environmental legislation as well as World Bank Standards (IFC Guidelines) and the Equator Principles. Thus in order to ensure compliance with these, a checklist has been compiled to ensure that all aspects of these guidelines have been taken into account when compiling this document. Table 102 below indicates that all applicable performance standards have been complied with.

The performance standards which have not been addressed at this stage as indicated in Table 102 below will be addressed at a later stage when the proponent has reached financial closure. Therefore the compliance level is partially compliant at this stage. It is important to note that the project proponent is committed to achieving compliance with the EPs.

The coding key is as follows:

Compliance level			
Clear			
Not assessed/determined	Not compliant	Partially compliant	Compliant

Appendix 10 includes a handbook highlighting how the client plans to comply with the IFC Standards.

Table 102: Compliance with Equator Principles

PRINCIPLES	COMPLIANCE LEVEL	REFERENCE
Performance Standard 1 Environmental & Social Reporting		
1. Baseline Information		Refer to Chapter 8
2. Impacts and Risks		Refer to Chapter 11
3. Global impacts		N/A
4. Transboundary		N/A
5. Disadvantaged / vulnerable groups		Refer to Appendix 10
6. Third party		Refer to Chapter 10.10
7. Mitigation measures		Refer to Chapter 10 and the EMPr
8. Documentation of Assessment process		Refer to Chapter 11
9. Action Plans		No major Action Plans required as mostly generic mitigation measures have

		been required.
10 Organizational capacity		Refer to Appendix 10
11. Training		Refer to Appendix 10
12. Grievance mechanism	The proponent will commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
Performance Standard 2, Labour & Working Conditions		
1. Human Resource Policy	The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
2. Working relationship		Refer to Appendix 10
3. Working conditions with and terms of employment		Refer to Appendix 10
4. Workers organization		Refer to Appendix 10
5. Non discrimination and equal opportunities		Refer to Appendix 10
7. Occupational Health and Safety		Refer to Appendix 10
8. Non-employee workers		Refer to Appendix 10
9. Supply Chain		Refer to Appendix 10
10. Labor Assessment Component of a Social and Environmental Assessment		Refer to Appendix 10
Performance Standard 3, Pollution		
1. Pollution Prevention, Resource		Refer the EMPr

Conservation & Energy Efficiency		
2. Wastes		Refer the EMPr
3. Hazardous material		Refer the EMPr
4. Emergency preparedness & response	The proponent commit to full compliance with this standard when financial closure has been reached. The proponent is fully aware of the implications of this standard and this information will be made available in due course as part of the development planning for the project.	Refer to Appendix 10
5. Technical guidance – ambient considerations		Refer to Appendix 10
6. Greenhouse gas emissions		No greenhouse gas emissions will result from the proposed development
Performance Standard 4, Health & Safety		
1. Hazardous materials safety		Refer the EMPr
2.Environmental and natural resource issues		Refer to chapters 8 and 10
Performance Standard 5, Land Acquisition		**Refer to chapter 5**
Performance Standard 6, Biodiversity		**Refer to Chapter 8 and 10**
Performance Standard 7, Indigenous People		**Refer to Chapter 8 and 10**
Performance Standard 8, Cultural Heritage		**Refer to Chapter 8 and 10**

16 EVALUATION AND RECOMMENDATIONS

Table 103 summarises the key recommendations for the environmental issues identified in the EIR. In order to achieve appropriate environmental management standards and ensure that the findings of the environmental studies are implemented through practical measures, the recommendations from this EIA must be included within an Environmental Management Programme (EMPr). This EMPr should form part of the contract with the contractors appointed to construct and maintain the proposed developments. The EMPr would be used to ensure compliance with environmental specifications and management measures. The implementation of this EMPr for all life cycle phases (i.e. construction, operation and de-commissioning) of the proposed projects is considered to be key in achieving the appropriate environmental management standards as detailed for this project.

An Environmental Management Programme is included with this Environmental Impact Report.

It is also recommended that the process of communication and consultation with the community representatives is maintained after the closure of this EIA process, and, in particular, during the construction phase associated with the proposed project.

16.1 Summary of Findings

Table 103: Summary and Recommendations

Environmental Parameter	Summary of major findings	Recommendations
Biodiversity (flora and fauna) Assessment	The study area is very uniform in nature with characteristic Nama Karoo shrubland exhibiting sparse vegetation. No larger trees are present on the site. The study area currently operates as a functioning sheep farm and is not likely to be pristine in nature. Kareedornpan exhibits slightly more floral diversity than Sous due to different grazing regimes being practiced. The site can thus be considered to be in a fairly natural state. The site is very uniform in nature with very few distinct sensitive areas. Drainage lines on the site are not well defined due to the infrequent rains that occur. Those that have been clearly identified are considered to be sensitive as they provide rare habitat on the site when water is available. Areas of topographical change are also considered to be sensitive as they provide different microclimates on a site that is very uniform in nature. Various mammal, amphibian and reptile species are likely to	Strict implementation of the suggested mitigation measures must be undertaken to ensure that the proposed development is not to the detriment of the biodiversity of the region. Although No Red Data species were noted during the field investigations, this does not however rule out their potential occurrence. Therefore, it is imperative that the mitigation measures are strictly implemented to ensure strict management should these species be encountered.

Environmental Parameter	Summary of major findings	Recommendations
	occur within the study area. No Red Data species were noted during the field investigations. The potential impacts of the proposed development mainly related to loss of habitat for red data and general species; potential loss of species richness, edge effect and erosion. The impact of the proposed development will be limited to the turbine construction areas and the associated infrastructure such as roads. Surrounding vegetation will remain intact and will not be impacted upon. As such the impact is localised and if the mitigation measures are implemented, the overall impact can be reduced. No significant impacts on vegetation and habitat are expected during the operation phase of the proposed development, as long as rehabilitation of the impacted surrounding areas has taken place.	
Avifauna Assessment	The proposed site is characterised by intrinsic avian biodiversity value. It does not contain any unique habitats or landscape features, but it may affect locally important waterbird fly-ways, which may exists in the northern part of the proposed site. There are regionally and/or nationally important impact susceptible species present (or potentially present), and the proposed facility may have a significant detrimental effect on these birds, both during the construction and operational phases	If possible, northern part of the proposed site should be kept free of turbines until more information is available on actual bird traffic over the site. Although regionally and/or nationally important impact susceptible bird species likely to be affected by the proposed facility (both during the construction and operation) are potentially

Environmental Parameter	Summary of major findings	Recommendations
	of the development.	present, implementation of the required mitigation measures should reduce these impacts to Low
Bat Assessment	The Loeriesfontein site does not have any of the three factors of possible roosting space, surface water and probability of insects strongly, with roosting space very limited and some foraging space in the stream beds. Overall the site is very dry and insect numbers as well as surface water would be limited during most of the year. A total of 9 bat species may occur on the site and 3 have a high probability of occurring on the site, with 2 of them having a chance of being impacted by wind turbines (*Nycteris thebaica* is not a high flying bat and therefore presumably less vulnerable to turbines). Two bat species namely Egyptian free-tailed bat (*Tadarida aegyptiaca*) and Cape serotine (*Neoromicia capensis*) were confirmed on site none of them are of conservation concern Generally there was very low bat activity levels due to the lack of roosting and foraging opportunities.	The site needs to be visited by a bat specialist quarterly (4 times during the period) to assess and compare the bat activity on a seasonal basis.
Surface Water Impact Assessment	No wetlands were identified on the study site. However, two Priority Rivers and 233 drainage lines occur on the study namely the Leeuberg River and the Klein-rooiberg River.	Anticipated potential impacts in the pre-construction, construction, operation and decommissioning phases have been scoped and appropriate mitigation measures have

Environmental Parameter	Summary of major findings	Recommendations
		been stipulated for the proposed development. A final walk-down by a suitably qualified wetland specialist will not be required for the proposed development. Sufficient information is available to address identified potential impacts that may result from the proposed development of the wind farm
Agricultural Potential	The study area has an arid Mediterranean type climate with winter rainfall regime i.e. most of the rainfall is confined to early autumn and winter. Mean Annual Precipitation (MAP) is approximately 179 mm per year. The combination of low rainfall and severe moisture deficient means that sustainable arable agriculture cannot take place on the farm without some form of irrigation. The soils identified on the PDA are predominantly calcic and shallow with a low agricultural potential. Rocky and shallow calcic soils (Mispah and Coega Form) cover 97% of the surveyed area. Virtually all the soils encountered had a layer that was limiting to plant growth and the effective soil depth rarely extended below 50 cm. The site is not classified as high potential nor is it a unique dry land agricultural resource. The study area has been classified as	Normal grazing (the dominant agricultural activity) will be permitted around the turbines. All three farms, which constitute the study area, are dominated grazing land and this activity is considered non-sensitive when assessed within the context of the proposed development. Consequently, the impact of the proposed development on the study area's agricultural potential will be extremely low, with the loss of agricultural land being attributed to the creation of the service roads and around the turbine and array foundations. There are no centre pivots, irrigation schemes or active agricultural fields which will be influenced by the proposed development. Therefore, from an agricultural perspective,

Environmental Parameter	Summary of major findings	Recommendations
	having an extremely low potential for crop production due to an arid climate and highly restrictive soil characteristics but are considered to have a moderately low value as grazing land, its current use.	there are no problematic or fatal flaw areas for the site
Noise Impact Assessment	The proposed project will have a noise impact of a low significance on all NSD in the area during the construction phase, but a noise impact of medium significance on NSD01 during the operational phase. As the wind turbine to be selected is not confirmed, modelling made use of the Nordex H90 2500HS wind turbine that might present a worse-case scenario. Mitigation measures are proposed that will reduce the potential noise impact to a more acceptable low significance.	Where potentially sensitive receptors are nearby, care must be taken to ensure that the operations at the wind farm do not cause undue annoyance or otherwise interfere with the quality of life of the receptors. It should be noted that this does not suggest that the sound from the wind turbines should not be audible under all circumstances - this is an unrealistic expectation that is not required or expected from any other agricultural, commercial, industrial or transportation related noise source – but rather that the sound due to the wind turbines should be at a reasonable level in relation to the ambient sound levels
Visual Impact Assessment	Due to the limited human habitation in the surrounding area, very few potentially sensitive receptors are present in the study area and the proposed development will have a low or medium impact on most of these receptors. The proposed wind and solar energy facility will have a negative low visual impact during construction and a negative medium visual impact during	Proposed mitigation measures should be implemented

<table>
<tr><th>Environmental Parameter</th><th>Summary of major findings</th><th>Recommendations</th></tr>
<tr><td></td><td>operation, with very few mitigation measures available</td><td></td></tr>
<tr><td>Heritage Assessment</td><td>Several heritage resources have been identified on site which can be classed as having high significance.</td><td>Sensitive heritage resource areas are to be excluded as no-go areas. Suggested buffer zones must be implemented.

All suggested mitigation measures must be implemented and included in the EMPr for the proposed development.</td></tr>
<tr><td>Socio-economic Impact Assessment</td><td>A summary of the construction impacts

<table>
<tr><th>Change Process</th><th>Issue</th><th>Pre-Mitigation</th><th>Post-Mitigation</th></tr>
<tr><td>Economic</td><td>Employment and output creation</td><td>+18</td><td>+30</td></tr>
<tr><td rowspan="2">Socio-Cultural</td><td>Social mobilisation</td><td>-20</td><td>-7</td></tr>
<tr><td>Health and safety</td><td>-60</td><td>-28</td></tr>
<tr><td>Average</td><td>Overall construction impacts</td><td>-20</td><td>-1.6</td></tr>
</table>

Apart from the possibility of temporary employment, overall the construction phase is characterised by negative low social</td><td>Even though all of the identified social impacts can be mitigated or enhanced successfully, this can only be done if Mainstream, or its appointed contractor(s), commit to the responsibility of ensuring that the level of disturbance brought about to the social environment by the more negative aspects of the project, is minimised as far as possible.

It is therefore recommended that:

▪ Social issues identified during the EIA phase are addressed. This could be done by engaging social specialists where necessary or by ensuring that ECOs used during construction have the necessary knowledge and skills to</td></tr>
</table>

Environmental Parameter	Summary of major findings	Recommendations
	impacts. In certain instances the implementation of mitigation measures can bring about positive changes. One such case would be the implementation of an effective HIV/AIDS prevention programme that extends to the local communities where construction workers will spend their free time, as this can also serve to inform and empower local people to make better and more informed decisions regarding their future (sexual) behaviour. Where Mainstream has the opportunity to bring about positive change to local communities they should pursue such opportunities where possible. The in-migration of a construction team consisting of approximately 320 people in the case of the wind farm will create a housing need in Loeriesfontein as the nearest town. The more people are sourced from the local community, the less the demand for additional housing, as local community members are already resident in the area. Loeriesfontein has a small hospitality industry, consisting of one B&B and one hotel. It would therefore appear that accommodation options are fairly restricted in the area, given the fact that Mainstream have opted to not make use of a residential construction camp. The housing problem would be amplified in the case of the PV plant when 872 people would require housing. Cognisance	identify social problems and address these when necessary. Guidelines on managing possible social changes and impacts could be developed for this purpose. ▪ Alternative accommodation options are considered for the construction phase as it would appear that the hospitality industry in Loeriesfontein would not be able to cater for the quantity of people. ▪ Neighbouring landowners are informed beforehand of any construction activity that is going to take place in close proximity to their property. Prepare them on the number of people that will be on site and on the activities they will engage in. ▪ Employees are aware of their responsibility in terms of Mainstream's relationship with landowners and communities surrounding the site. Implement an awareness drive to relevant parts of the construction team to focus on respect, adequate communication and the 'good neighbour principle.'

<table>
<tr><th>Environmental Parameter</th><th>Summary of major findings</th><th>Recommendations</th></tr>
<tr><td></td><td>should therefore be taken in both instances that the hospitality industry in Loeriesfontein might not be able to cater for the needs of the construction team and that alternative arrangements might have to be made in terms of accommodation.

The majority of impacts that would occur during the construction phase would affect people’s sense of wellbeing and security within their social environment. A number of changes to the socio-economic environment would lead to economic impacts, but for the most part these impacts would be restricted to individuals or individual households and would not extend to the community at large.

A summary of the operations and maintenance impacts

<table>
<tr><th>Change Process</th><th>Issue</th><th>Pre-Mitigation</th><th>Post-Mitigation</th></tr>
<tr><td rowspan="4">Economic</td><td>Employment and output creation</td><td>+20</td><td>+36</td></tr>
<tr><td>Tax income</td><td>+14</td><td>+14</td></tr>
<tr><td>Corporate Social Investment</td><td>+27</td><td>+48</td></tr>
<tr><td>Agricultural</td><td>-11</td><td>-11</td></tr>
</table>
</td><td>▪ All mitigation measures in the SIA are incorporated in the EMP to ensure that Mainstream and the contractor adhere to these.</td></tr>
</table>

<table>
<tr><th>Environmental Parameter</th><th>Summary of major findings</th><th>Recommendations</th></tr>
<tr><td></td><td>

	output		
	Tourism	-10	-10
	Property prices	-10	-10
Socio-cultural	Sense of place	-24	-20
Average	*Overall operations and maintenance impacts*	*+0.9*	*+6.7*

The presence of the wind farm during the operation and maintenance phase overall will have a low positive impact, although certain elements will yield medium positive impacts whereas other elements are expected to have a more negative connotation. Most positive impacts are of an economic nature, most significantly Mainstream's corporate social investment in the area, which in turn could lead to an array of other positive social upliftment projects (outside the scope of this study). Negative impacts are expected to be on the low side and would in all probability be over-shadowed by the more positive contributions that Mainstream will make to the area through their CSI.
</td><td></td></tr>
</table>

Table 104: Impact rating summary for the proposed wind farm during the construction phase

Environmental Parameter	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Loss of habitat for red data / general species	-24 (low negative)	-6 (low negative)
	Edge effect	-28 (low negative)	-7 (low negative)
Avifauna	Displacement of priority species due to disturbance	-30 (Medium negative)	-22 (low negative)
	Displacement of priority species due to habitat destruction	-16 (low negative)	-16 (low negative)
Bats	Destruction of foraging habitat	11 (Negative Low)	8 (Negative low)
Surface Water	Construction activities taking place in, near or through watercourses and associated buffer zone areas	-30 to -32 (negative medium)	-14 (negative low)
	stormwater run-off impacts	- 20 (low negative)	- 6 (low negative)
	Contamination of local soil and land use resources	-12 (low negative)	-12 (low negative)
Agricultural Potential	Loss of agricultural land and / or production	-12 (low negative)	-12 (low negative)
Noise Impact	Numerous simultaneous construction activities that could impact on NSDs	-13(low negative)	-7 (low negative)
Visual Impact	**Day-time visual impact during construction:** Large construction vehicles and equipment during the construction phase will alter the natural character of the study area and expose visual receptors to visual impacts associated with the construction phase.	-20 (negative low)	-10 (negative low)
	Night-time visual impact during construction: The night scene is characterised by a dark night environment with very few light sources visible. Most	-7 (negative low)	-6 (negative low)

Environmental Parameter	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
	construction activities are likely to take place during day-time business hours and therefore the construction phase of the development is unlikely to have a significant impact on the visual quality of the area at night.		
Heritage	Stone Age sites: Physical disturbance of the material and its context	-75 (Negative, very high impact)	-12 (Negative, low impact)
	Damaging of farmsteads	-75 (Negative, very high impact)	-12 (Negative, low impact)
	Damaging of cemeteries	-75 (Negative, very high impact)	-12 (Negative, low impact)
	Damaging of farming related features	-75 (Negative, very high impact)	-12 (Negative, low impact)
Socio-economic	Creation of local jobs and income	+ 18 (Positive low)	+ 30 (Positive medium)
	Social mobilization: Conflict situations that can delay the project and prolong the duration of impacts, which in turn would affect local residents' quality of life and result in economic impacts	-20 (Negative low)	-7 (Negative low)
	Health and safety impacts: Workers at risk of spreading HIV/ AIDs	+60 (Negative high)	-28 (Negative low)

Table 105: Impact rating summary for the proposed wind farm during the operation phase

Environmental Parameter	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation

Environmental Parameter	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
Biodiversity	Loss of habitat for red data / general species	-10 (low negative)	-6 (low negative)
	Edge effect	-26 (low negative)	-7 (low negative)
Avifauna	Displacement of priority species	-24 to -26 (low negative)	-22 (low negative)
	Collisions of priority species with the turbines	-28 to -30 (medium negative)	-26 to -28 (low negative)
	Mortality of priority species with the power line	-30 to -32 (medium negative)	-26 to -28 (low negative)
Bats	Bat mortalities due to blade collisions and barotrauma during foraging	-28 (Negative low)	-10 (Negative low)
	Bat mortalities due to blade collisions and barotrauma during migration	-34 (Negative medium)	-13 (Negative low)
Surface water	Vehicle damage to watercourses and buffer zones during maintenance	- 28 (low negative)	- 6 (low negative)
	Stormwater and consequent erosion impacts to watercourses and associated buffer zones	- 28 (low negative)	- 8 (low negative)
Noise Impact	Numerous turbines operating simultaneously during a period when a quiet environment is desirable	-8 (low negative)	- 8 (low negative)
Visual Impact	**Day-time visual impact during operation:** The wind farm and associated infrastructure will alter the natural character of the study area and expose receptors to visual impacts associated with the proposed development during operation.	-38 (negative medium impact)	-36 (negative medium impact)
	Night-time visual impact during operation: The night scene is characterised by a dark night	-32 (negative medium)	-30 (negative medium)

Environmental Parameter	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
	environment with very few light sources visible. The proposed wind farm will therefore alter the visual quality of the area at night by introducing an additional light sources in the form of security lighting and a red flashing light placed on the top of each wind turbine.		
Heritage	Stone Age sites: Physical disturbance of the material and its context	-75 (Negative, very high impact)	-12 (Negative, low impact)
	Damaging of farmsteads	-75 (Negative, very high impact)	-12 (Negative, low impact)
	Damaging of cemeteries	-75 (Negative, very high impact)	-12 (Negative, low impact)
	Damaging of farming related features	-75 (Negative, very high impact)	-12 (Negative, low impact)
Socio-economic	The creation of local jobs and income	+20 (Positive low)	+36 (Positive medium)
	Increase in central and local tax income	+14 (Positive low)	+14 (Positive low)
	Corporate social investment	+27 (Positive low)	+48 (Positive medium)
	Displacing existing agricultural production	-11 (Negative low)	-11 (Negative low)
	Diverting/Attracting tourism from or to area	-10 (Negative low)	-10 (Negative low)
	Change in property prices adjacent to the new development	-10 (Negative low)	-10 (Negative low)
	The presence of wind farm and associated infrastructure such as the substation and the power power lines would change the landscape of the area from open spaces to 'spoilt' which could affect the	-24 (Negative low)	-24 (Negative low)

Environmental Parameter	Environmental Impacts	Impact Rating without Mitigation	Impact Rating with Mitigation
	way in which people related to the land and the sense of connectedness they have with the area, in short, their sense of place		

Please note that a detailed engineering geotechnical assessment will be conducted by Mainstream prior to construction.

16.2 Preferred Alternative Selection

Based on the findings of the specialists and taking into account the uniformity of the site, the selection of a preferred alternative has been determined based on existing infrastructure. The map below indicates the preferred layout highlighting the location of:

- Substation
- Operation and Maintenance Buildings
- Laydown area
- Power Line

The layout also highlights the preferred wind turbine locations based on the buildable area.

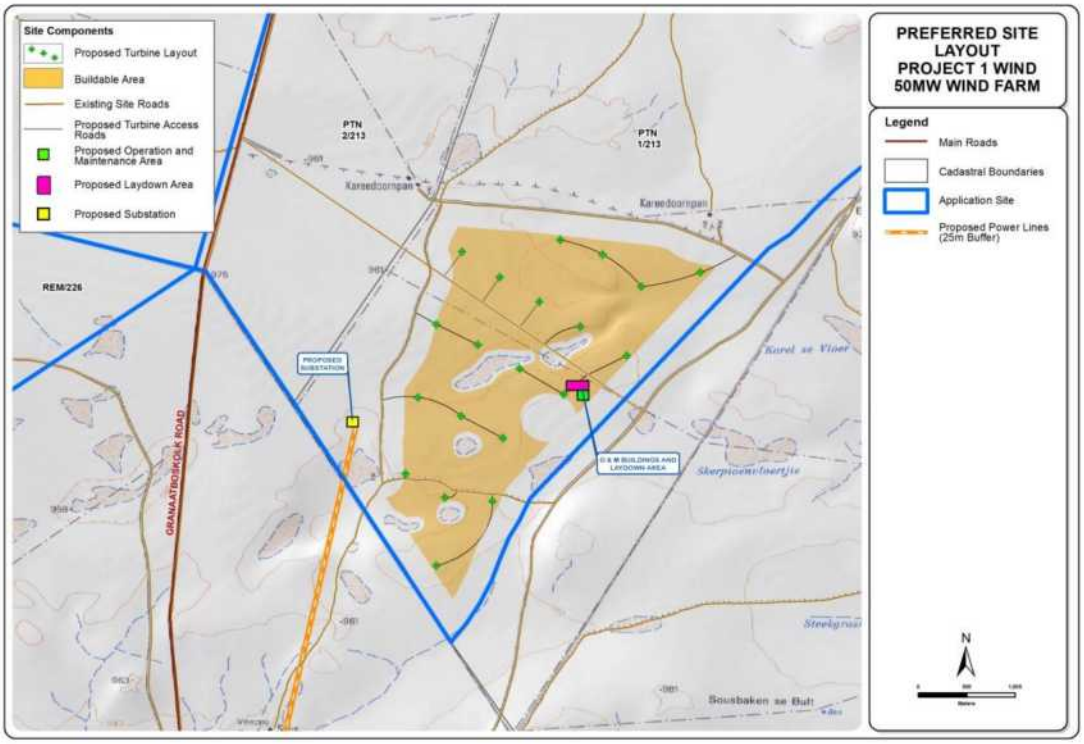

Figure 110: Preferred Site Layout project 1 (Wind farm 50MW)

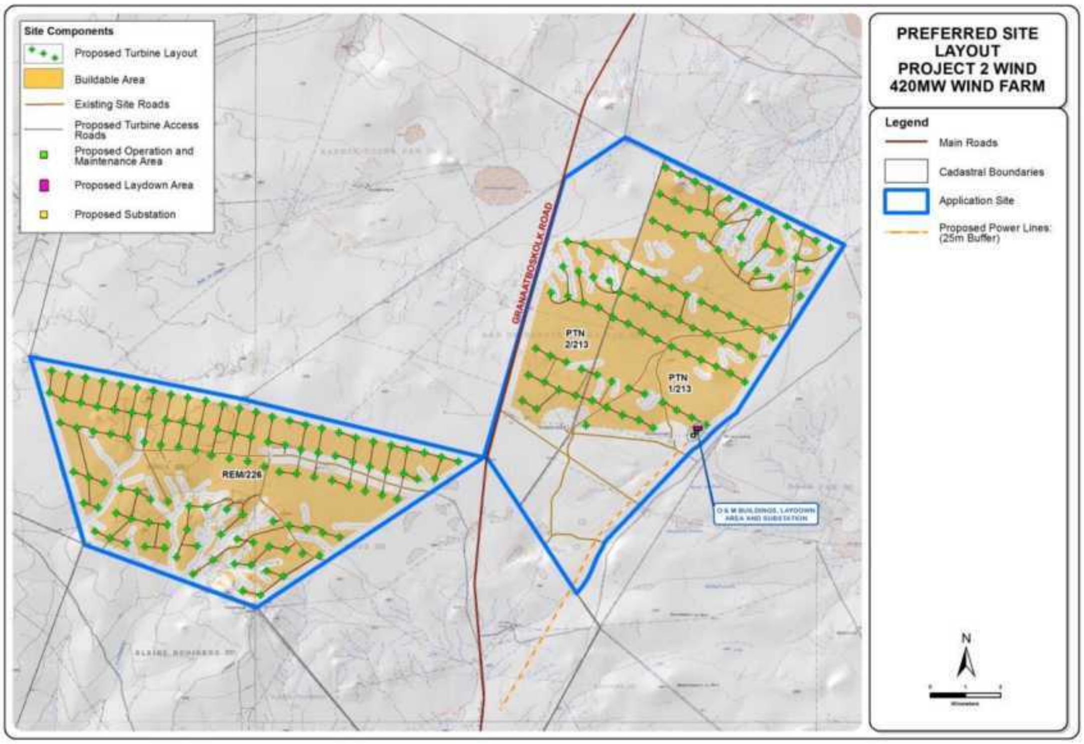

Figure 111: Preferred Site Layout project 2 (Wind farm 420MW)

16.3 Conclusion

The findings of the specialist studies undertaken within this EIA provide an assessment of both the benefits and potential negative impacts anticipated as a result of the proposed wind farm project. The findings conclude that there are no environmental fatal flaws that should prevent the proposed project from proceeding. Areas of special concern have however been identified which will require site specific mitigation measures. These are included within the EMPr to ensure that these areas receive special attention.

It was determined during the EIA that the proposed development will result in potential negative impacts. A preferred site layout has been identified which is less environmentally sensitive and will result in the least environmental impact.

Further to the above, it was demonstrated in the EIR that a detailed public participation process was followed during the EIA process which conforms to the public consultation requirements as stipulated in the EIA Regulations. In addition, all issues raised by I&APs were captured in the EIR and where possible, mitigation measures provided in the EMPr to address these concerns.

As sustainable development requires all relevant factors to be considered, including the principles contained in section 2 of NEMA, the EIR has strived to demonstrate that where impacts were identified, these have been considered in the determination of the preferred site layout.

We are therefore of the view that:

- A preferred site layout has been identified which is less environmentally sensitive compared to the other considered layouts.
- Through the implementation of mitigation measures, together with adequate compliance monitoring, auditing and enforcement thereof by the appointed ECO as well as competent authority, the potential detrimental impacts associated with the Wind farm can be mitigated to acceptable levels

It is trusted that the EIR provides the reviewing authority with adequate information to make an informed decision regarding the proposed project.

It is the opinion of the EAP that the proposed project be allowed to proceed provided that the recommended mitigation measures are implemented.

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