Appendix 6E

Heritage Assessment

(Including Paleontology, Archaeology & Cultural Landscape)

21 February 2019

SiVEST Environmental
P O Box 2921
Rivonia 2128

Attention: Liandra Scott-Shaw

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED 325MW RONDEKOP WIND ENERGY FACILITY, (WEF) BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE PROVINCE (DEA REF: 14/12/16/3/3/2/1115)

Our report reflected in the title above dated 20 October 2018, refers.

PGS Heritage noted the proposed change in the turbine capacity from between 3MW and 6.5MW to be up to 8MW do not affect any of our findings contained in our report.

The overall impact rating reflected in the report, HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED 325 MW RONDEKOP WIND ENERGY FACILITY, (WEF) BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE PROVINCE, dated 20 October 2018, **is not** affected by the following proposed changes:

- All turbines are still valid (slight alignment shifts mainly to turbine 16 [ecology changes] 44 [to avoid the 200m bat and bird buffer surrounding the watercourse]).
- Turbine 25 access road to crane pad: minor alignment change as the current alignment was very close to the edge of the ridge and ecologist was concerned about downslope erosion).
- Turbine 27 access road: minor alignment shift to avoid crossing a rocky ridge / outcrop as per the ecology requirement.
- Road between turbine 28 & 29: minor alignment change to avoid rocky outcrop.
- Crane pad 29 & 35: minor alignment change to avoid the rocky outcrops.
- Access road north 1: shifted the alignment slightly away from the drainage line and then crossing it perpendicularly at a single point.
- Access road 2: shifted to only cross the drainage line at one point.
- Construction Camp 1: shift to follow road alignment.

Any queries can be referred to, Wouter Fourie, at wouter@pgsheritage.co.za

Regards

Wouter Fourie
Director *(Accredited professional Heritage Practitioner – APHP, Accredited Professional Archaeologist – ASAPA)*
PGS Heritage

RONDEKOP WIND FARM (PTY) LTD

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED 325MW RONDEKOP WIND ENERGY FACILITY BETWEEN MATJIESFONTEIN SUTHERLAND IN THE NORTHERN CAPE PROVINCE

Heritage Impact Assessment

Issue Date: 10 September 2018
Revision No.: 0.1
Project No.: 339HIA

Declaration of Independence

I, Ilan Smeyatsky,

as the appointed independent noise specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

HERITAGE CONSULTANT: PGS Heritage (Pty) Ltd

CONTACT PERSON: Ilan Smeyatsky - Archaeologist

Tel: +27 (0) 12 332 5305

Email:Ilan@pgsheritage.co.za

SIGNATURE: ______________________

Report Title	**ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED 325MW RONDEKOP WIND ENERGY FACILITY BETWEEN MATJIESFONTEIN SUTHERLAND IN THE NORTHERN CAPE PROVINCE: HERITAGE IMPACT ASSESSMENT**		
Control	**Name**	**Signature**	**Designation**
Author	Ilan Smeyatsky		Archaeologist/ PGS Heritage
Co-author	Marko Hutten		Archaeologist/PGS Heritage
Reviewed	Wouter Fourie		Principal Heritage Specialist
Reviewed	Andrea Gibb		SiVest/Environmental Division

Date:	*07 11 2018*
Document Title:	Heritage Impact Report
Author:	*Ilan Smeyatsky, Marko Hutten, Wouter Fourie*
Revision Number:	*0.3*
Checked by:	*Andrea Gibb*
For:	*SiVEST SA (PTY) Ltd*

The heritage impact assessment report has been compiled considering the NEMA Appendix 6 requirements for specialist reports as indicated in the table below.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**
1.(1) (a) (i) Details of the specialist who prepared the report	Page 2 of Report – Contact details and company
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1.2 – refer to **Appendix D**
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
(cA) An indication of the quality and age of base data used for the specialist report	Section 1.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1.1
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3.6
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3.6 and **Appendix B**
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 3.6 and 5
(g) An identification of any areas to be avoided, including buffers	Section 5
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3.6
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 5
(k) Any mitigation measures for inclusion in the EMPr	Section 5
(l) Any conditions for inclusion in the environmental authorisation	Section 5
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 5 and 6
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and	
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 6

(o) A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable. A public consultation process was handled as part of the EIA and EMP process.
(p) A summary and copies if any comments that were received during any consultation process	Not applicable. To date not comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	No protocols or minimum standards for HIAs or PIAs promulgated through a governmental notice.

As per the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" The compliance of this HIA to these standards is described in below.

Standards	Compliance
A. **Title Page** with: A Title that identifies this report. It should give the name and geographical location of the site(s) and/ or project, including property or farm name (and magisterial district) and province; Author(s) surname(s) and details, company name and contact details; Developer and consultant's name (who commissioned the report), postal address, telephone and fax numbers; Date of report (including day and month).	Page iii
B. **Executive Summary** including: The purpose of the study; A brief summary of the findings; The recommendations; and Any stakeholders or people responsible for decisions and actions.	Page vi
C. **Table of Contents**, for reports longer than 10 pages.	Page xi - xv
D. **Background Information** on the Project with: Whether the report is part of a scoping report/ EIA/ HIA or not; Type of development (e.g. low cost housing project, mining); Whether re-zoning and/or subdivision of land is involved; Developer and consultant and owner and name and contact details; Terms of Reference; Legislative requirements.	Section 1 and Section 2
E. **Background to the Archaeological and Palaeontology History** and other relevant heritage components of the area with, Literature review or archival research sufficient to place the sites located in context; Reference to museum or university databases and collections; Previous relevant impact assessment reports for the area.	Section 3.2 and section 3.3
F. Description of the Property or Affected Environment its setting and heritage resources, with: Details of the area surveyed including; Full Location Data for Province, Magisterial District/Local Authority and property (e.g. farm/erf) name and number, etc.; Location Map(s)/ orthophotos of the general area. These must include the map name and number (e.g. 3318DC Bellville). Maps must include at least a 1:50 000 and (if available) also a 1:10 000 (i.e. most detailed possible). Large scale colour satellite photos make a useful addition. Maps should be preferably at least A4 in size. Either the Location Map or the Site Map must have the polygon of the area surveyed marked on it and full geographical co-ordinates for all relevant points and,	Section 3.4 Section 2

where applicable, indication of the area to be developed (footprint). The report or map must indicate exactly what area was searched, and if any area was not searched why this was so; and what the probability is of sites being found there. Description of the methodology used including: How the area was searched (e.g. a three-person team for two days, and whether on foot or not!) and what, if any, sampling techniques were used; What the restrictions to the study were, for example: visibility affected by high grass or bush or vegetation cover, walls or concrete surfaces; physical or other impediments (e.g. vlei, swamp, steep kloof, mobile dune) to the assessment of the area; How the data was acquired, and details of research equipment (e.g. GPS).	 Section 3.6 Section 1.4
G. **Description of Sites** identified and mapped with: Details of the location of all the sites including: Site Map or aerial photograph of the specific area with the location of all sites marked on it. Make it clear how this relates to the Location Map described above (7.1Fii). GPS readings with the model and datum used (WGS 84 is considered the most useful). Please comment on the accuracy. If co-ordinates are read off the 1:50 000 map, please indicate this. Wherever possible the GIS track actually surveyed should be mapped. An adequate description of each site including: Type of site (e.g. open scatter; shell midden, cave/shelter); Site categories (e.g. Earlier Stone Age, Late Iron Age); Context (detailed description of depositional history and environment); iv. Cultural affinities, approximate age and significant features of the site; v. Estimation or measurement of the extent (maximum dimensions) and orientation of the site(s); Depth and stratification of the site (where shovel test permits have been given or natural exposures available), both in the text and through photographs of sections; vii. Possible sources of information about past environments, such as stalagtites/ stalagmites, flowstone, dassie middens, peat or organic rich deposits and natural bone accumulations;and viii. Photographs and diagrams, of good quality, with a centimetre scale (e.g. for artefacts) or metre scale (e.g. for large scale village plan) and a caption. Include a 'wide angle' photo of the sites. Threats or sources of risk and their impact on the heritage resources (e.g. earth moving, traffic of vehicles or humans, erosion). If the sites are in KwaZulu-Natal or the Northern Cape please apply to the old Archaeological Data Recording Centres at the Provincial Museums for National Site Numbers (for sites that will be conserved, excavated or collected).	Section 4.1 to 4.3
H. **Description of the Artefacts, Faunal, Botanical or Other Finds and Features** for each site.	Section 4.1

Record meaningful information and consider supplying: Raw material, type, maximum dimensions and relative frequency of and significant attributes of stone tools observed on the surface; Basic description of ceramics, other artefacts and occurrences such as rock art; Description of features (e.g. hearths, bedding, walling); Basic description of faunal or botanical taxa and estimated frequencies; Adequate photographic and graphic representations (with scale in centimetres); and crossreference photographs with a map showing where the objects in the photographs were found; Location of repositories at which artefacts, photographs, rock art tracings and field records (from other sites in the area) are kept.	
I. **Clear Description of Burial Grounds and Graves** with: Clear written and photographic description of any graves; Exact or estimated age and affinities of the burials; Clear discussion for the client of the legal implications (include reference to both the Act and the regulations for s.363 , and particularly the public participation process, and whether this should be done by the archaeologist or may be better done by a social consultant).	N/A – no graves were found
J. **Field Rating** (Recommended grading or field significance) of the site: While grading is actually the responsibility of the heritage resources authorities, all reports should include Field Ratings for the site(s) discussed (proposals for grading), to comply with section 38 of the national legislation, for example: National: This site is considered to be of Field Rating/Grade I significance and should be nominated as such (mention should be made of any relevant international ranking); Provincial: This site is considered to be of Field Rating/Grade II significance and should be nominated as such; Local: this site is of Field Rating/Grade IIIA significance. The site should be retained as a heritage register site (High significance) and so mitigation as part of the development process is not advised; Local: this site is of Field Rating/Grade IIIB significance. It could be mitigated and (part) retained as a heritage register site (High significance); 'General' Protection A (Field Rating IV A): this site should be mitigated before destruction (usually High/Medium significance); 'General' Protection B (Field Rating IV B): this site should be recorded before destruction (usually Medium significance); 'General' Protection C (Field Rating IV C): this site has been sufficiently recorded (in the Phase 1). It requires no further recording before destruction (usually Low significance).	Section 4.1
K. **Statement of Significance** (Heritage Value) giving the significant archaeological heritage value of relevant sites in terms of the legislation (NHRA, section 3 (3) listed below) or any other relevant criteria, and give reasons. a. its importance in the community, or pattern of South Africa's history;	Section 5

its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage; its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage; its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects; its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group; its importance in demonstrating a high degree of creative or technical achievement at a particular period; its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and sites of significance relating to the history of slavery in South Africa.	
L. **Recommendations** including: An assessment of the potential impact of the development on these sites, relative to sustainable social and economic benefits; Proposals for protection or mitigation relating to: Possible alternatives in the development that might allow the protection and conservation of the sites; or The need for mitigation of adverse impacts; or The need to conserve certain sites because of their high heritage value. Detailed recommendations with regard to burial grounds and graves. This must inform the client about the full process and enable the heritage authority to make decisions about permits. This must include: Recommendations for protection of the grave(s) during the development and in the long term, e.g. fencing and plans for maintenance (mini-management plan); OR Recommendations for relocation of the grave(s), public participation and possibly further archival research, or both (i & ii). An indication of what must be done at each site: If the site is of Low4 Significance (see Kg above) the recommendation may be that the site must be mapped, documented and then destroyed (with a permit / letter of permission / Record of Decision from the heritage authority); iIf the site is of Medium5 Significance the recommendation may be for a measure of mitigation after which the site may be destroyed. Mitigation usually involves a requirement to collect or excavate a sample of the cultural and other remains that will adequately allow characterization and dating of the site. (The archaeologist will require a permit for the excavation and collection. If, after this mitigation significant archaeological residues or parts of sites remain, the archaeologist should request the developer to apply for a permit for destruction or fill in the application for them to sign! In this way the heritage resources authority can help the archaeologist ensure that the recommended mitigation takes place;	Section 6

If the site is of High Significance the recommendation may be that it be formally graded and conserved (with. provision of boardwalks, fencing, signage, guides) and protected as a heritage resource (either being listed on the Heritage Register or being declared as a Provincial or National Heritage Site). If sites are to be protected a Site Management Plan should be required. For mini-plans, where small sites are incorporated into developments, this must include an indication of who is responsible for maintenance and how this process will be monitored.	
M. Conclusions.	Section 6
N. Bibliography detailing citations in the text of the report. Remember that all sources should be adequately acknowledged (even the web).	Section 7
O. Appendices if any.	Appendices A-E

EXECUTIVE SUMMARY

PGS Heritage (Pty) Ltd was appointed by SiVEST SA (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) for the development of a Wind Energy Facility (WEF) and associated infrastructure, on parts the following farms:

- Remainder and Portion 1 of the Farm Roodeheuvel 170;
- Remainder and Portion 1 of the Farm Wind Heuvel 190;
- Remainder and Portion 1 of the Farm Bloem Fontein 192;
- Portion 1 and 2 of the Farm Urias Gat 193;
- Remainder, Portion 1 and 3 of the Farm Venters Kraal 166;
- Farm Ashoek 224;
- Remainder of the Farm 220;
- Portion 1 of the Farm Lange Huis 174;
- Remainder of the Farm Vinke Kuil 171; and
- Farm Zeekoegat 169.
- Remainder of the Farm Hout Hoek 191

The proposed development is situated approximately 45km south west of Sutherland in the Karoo Hoogland Local Municipality in the Namakwa District Municipality within the Northern Cape Province.

Heritage resources are unique and non-renewable and as such any impact on such resources must be viewed significant.

Due to the nature of cultural remains, a systematic controlled-exclusive surface survey was conducted on foot and in a vehicle, over a period of four days by two archaeologists from PGS. The fieldwork was conducted on the 20th-24th September 2018. An additional site assessment was also conducted by a Palaeontologist from Banzai Environmental on the 1st – 3rd October 2018. The locations of five (5) individual heritage sites were identified during the field survey, all of them falling within the boundaries of the study area.

Archaeology

The archaeological resources identified within the proposed development site comprise a small number of Stone Age surface artefact scatters. These are primarily from the Later Stone Age (LSA), although Middle Stone Age (MSA) material was also identified. All these artefact assemblages occur in heavily deflated and eroded areas, so their scientific potential and heritage significance is somewhat lowered. Based on findings from a range of other heritage reports in the area, these types of sites are to be expected in this region.

The remaining heritage features included buildings and stone walled structures that are likely the result of early European settlement in the area. Most of these features are likely over 60 years of age and for this reason are protected by current heritage law.

Even though heritage features were detected within the development area, serious mitigation measures will not be required except for the implementation of a chance-finds protocol. However, if the development layout is altered, this position will need to be revaluated.

Palaeontology

The proposed Rondekop development site is underlain by the Abrahamskraal Formation (Adelaide Subgroup, lower Beaufort Group, of the Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup). According to the PalaeoMap on SAHRIS the Abrahamskraal and Waterford Formations have very high Palaeontological sensitivities while the Ecca has a moderate Palaeontological Sensitivity (Almond and Pether 2008, SAHRIS website).

A site-specific field survey of the development footprint were conducted on foot and by motor vehicle from the 1st - 3rd October 2018. Access to all of the locations of the proposed site proved to be difficult. However, as many as possible of the proposed infrastructure locations were investigated. Exposed rock layers were visually inspected but there were no visible evidence of fossiliferous outcrops. For this reason, an overall **low palaeontological sensitivity** is allocated to the development footprint. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Rondekop WEF development will be of a **low significance** in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the **construction of the development**

may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

The proposed development, as well as all alternatives have a similar geology and therefore there is no preferences on the grounds of palaeontological fossil heritage for any specific layout among the different options under consideration. The different options include the on-site substation, construction yards, the access roads to the ridges and turbine layouts along with proposed associated infrastructure. As impacts on fossil heritage usually only occur during the excavation phase and no further impacts on fossil heritage are expected during the operation and decommissioning phases of the WEF.

Cultural Landscape

The visual assessment completed by Gibb et al (2018) for the Rondekop WEF characterised the study area as a "*typical of a Karoo or "platteland" landscape that would characteristically be encountered across the high-lying dry western and central interior of South Africa.*"

They do however find that visual impacts on the cultural landscape would be reduced by the fact that the area is very remote and there are no significant tourism enterprises attracting visitors into the study area. In addition, the nearest major scenic route, the R354, is outside the 8km visual assessment zone and is not expected to experience any visual impacts from the proposed WEF.

The cultural landscape in this area is therefore considered to be of low significance and the impacts on the cultural landscape of low significance.

General

In the event that heritage resources are discovered during site clearance, construction activities must stop in the immediate vicinity of the find, and a qualified archaeologist must be appointed to evaluate and make recommendations on mitigation measures.

The overall impact of the WEF and its associated infrastructure, on the heritage resources identified during this report, is seen as low after the recommendations have been implemented and therefore, impacts can be mitigated to acceptable levels allowing for the development to be authorised. There are no preferences in terms of the proposed layout alternatives as none of them will affect known heritage resources thus no mitigation measures will be required, except for the implementation of a chance-finds protocol. However, if the development layout is altered, this position will need to be revaluated.

Impact ratings summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Stone Age Heritage	Development	-16		-15	
Colonial Structures	Development	-16		-15	
Monuments (memorials)	Development	-16		-15	
Cumulative Impact	Destroy heritage resources such as archaeological or historical sites	-18		-18	
	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	-16	Negative low Impact	-14	Negative low Impact
Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the	-14	(negative low)	-12	(negative low)

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
	ground surface that are then no longer available for scientific study				
Impact associated with the no-go alternative	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study Destroy heritage resources such as archaeological or historical sites	Neutral	Neutral	Neutral	Neutral

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D Project team CV's

TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

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

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Earlier Stone Age

The archaeology of the Stone Age between ~300 000 and 3 300 000 years ago.

Fossil

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

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act (Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Later Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000 - 300 000 years ago, associated with early modern humans.

Palaeontology

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

List of abbreviations used in this report

Abbreviations	Description
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Earlier Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
OES	Ostrich eggshell
LCT	Large Cutting Tool

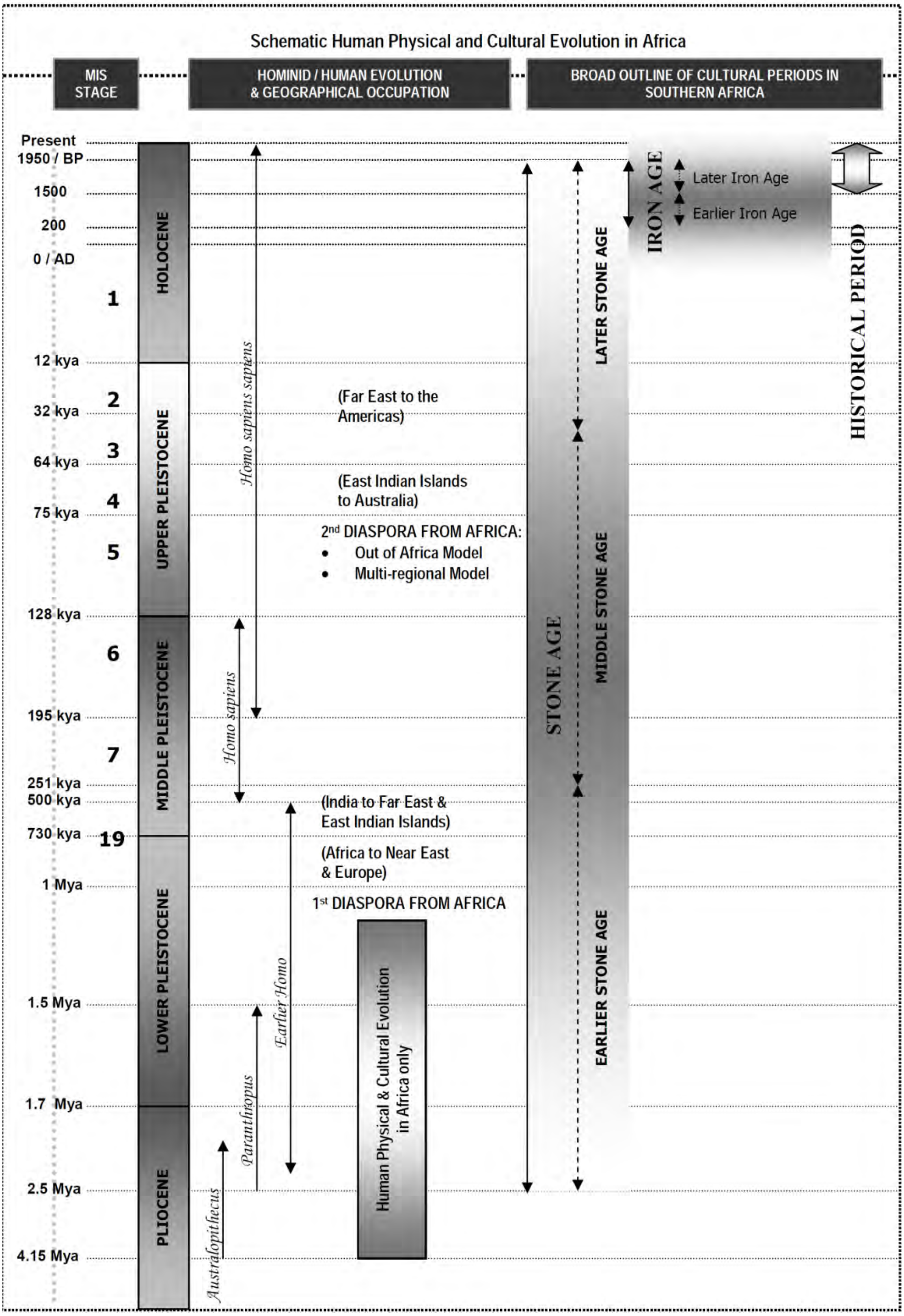

Figure 1 – Human and Cultural Time line in Africa (Morris, 2008)

1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by SiVEST SA (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) for the development of the Rondekop Wind Energy Facility (WEF) and associated infrastructure (proposed development) on the following Farms:

- Remainder and Portion 1 of the Farm Rondeheuvel 170;
- Remainder and Portion 1 of the Farm Wind Heuvel 190;
- Remainder and Portion 1 of the Farm Bloem Fontein 192;
- Portion 1 and 2 of the Farm Urias Gat 193;
- Remainder, Portion 1 and 3 of the Farm Venters Kraal 166;
- Farm Ashoek 224;
- Remainder of the Farm 220;
- Portion 1 of the Farm Lange Huis 174;
- Remainder of the Farm Vinke Kuil 171; and
- Farm Zeekoegat 169.
- Remainder of the Farm Hout Hoek 191

The proposed development is situated approximately 45 km south-west of Sutherland in the Karoo Hoogland Local Municipality in the Namakwa District Municipality within the Northern Cape Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage resources and finds that may occur in the proposed development area. The HIA aims to assist the developer in managing the discovered heritage resources in a responsible manner, to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Terms of Reference

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;

- Provide a thorough overview of all applicable legislation, guidelines
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
- Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
- Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Comparative assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures in order to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).

Specific requirements:

- Describe and map the heritage features of the site and surrounding area. This is to be based on desk-top reviews, fieldwork, available databases, and findings from other heritage studies in the area, where relevant. Include reference to the grade of heritage feature and any heritage status the feature may have been awarded.
- Assess the impacts and provide mitigation measures to include in the environmental management plan
- Map heritage sensitivity for the site. Clearly show any “no-go” areas in terms of heritage (i.e. “very high” sensitivity) and provide recommended buffers or set-back distances.

- Identify and assess potential impacts from the project on the full scope of heritage features, including archaeology, palaeontology and the cultural-historical landscape, as required by heritage legislation.
- Liaise with the relevant authority in order to obtain a final comment in terms of section 38 pf the National Heritage Resources Act, 1999 (Act No. 25 of 1999), including Regulations issued thereunder, as necessary.
- Load the relevant documents on the South African Heritage Resources Information System (SAHRIS) to obtain a comment from SAHRA.

1.3 Specialist Qualifications

This HIA Report was compiled by PGS.

The staff at PGS has a combined experience of nearly 70 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Mr. Ilan Smeyatsky, graduated with his Master's degree (MSc) in Archaeology; is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA) and is accredited as a Field Supervisor.

Mr. Marko Hutten, heritage specialist and Project Archaeologist, has 20 years of experience in the industry and is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is accredited as a Field Director.

Mr. Trent Seiler completed his Masters in 2017 focussing on Later Stone Age in the northern parts of the Limpopo Province. He recently joined PGS as a Field Technician and wishes to have a career in Heritage Management as a Heritage Practitioner.

Elize Butler, palaeontologist, has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 12 years. She has been conducting Palaeontological Impact Assessments since 2014.

Mr. Wouter Fourie, the Project Coordinator, is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).

1.4 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. If any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.

SiVEST under took every effort to obtain the information (including specialist studies, BA / EIA / Scoping and EMPr Reports) for the surrounding developments, however many of the documents are not currently publicly available to download. The information that could be obtained for the surrounding planned renewable energy developments was taken into account as part of the cumulative impact assessment.

1.5 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA), Act 107 of 1998
- National Heritage Resources Act (NHRA), Act 25 of 1999
- Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

- National Environmental Management Act (NEMA) Act 107 of 1998 – Regulation 326 (7 April 2017)
    - Basic Environmental Assessment (BEA) – Appendix 1 s (2)(d)
    - Environmental Scoping Report (ESR) – Appendix 1 s (3)(h)(iv) and Appendix 2 s(2)(g)(iv)
    - Environmental Impact Assessment (EIA) – Appendix 3 s (3)(h)(iv)/
- National Heritage Resources Act (NHRA) Act 25 of 1999
    - Protection of Heritage Resources – Sections 34 to 36; and
    - Heritage Resources Management – Section 38
- Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    - Section 39(3)

The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA. This study falls under s38(8) and requires comment from the relevant heritage resources authority.

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Locality

The proposed development is situated in the Karoo Hoogland Local Municipality in the Namakwa District Municipality within the Northern Cape Province. The relevant properties for the proposed Rondekop WEF development is situated approximately 45km south west of the town of Sutherland (**Figure 2**).

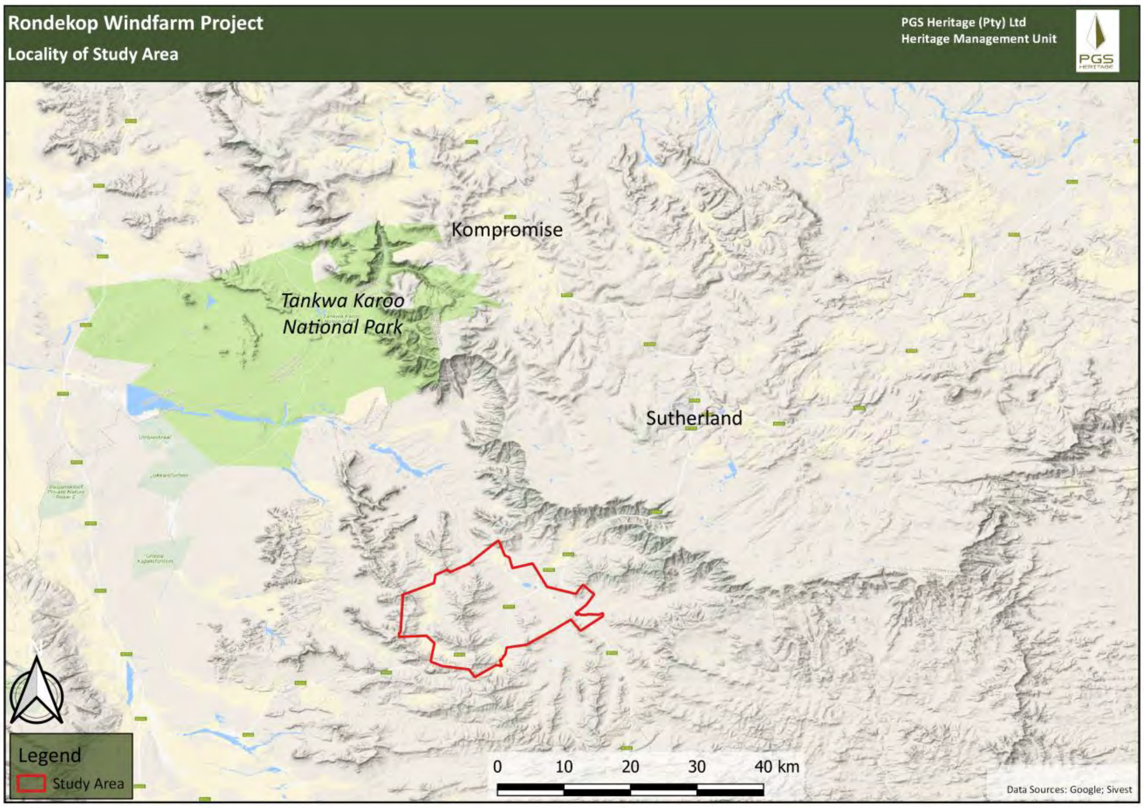

Figure 2 – Locality of study area

2.2 Technical Project Description

The following project background and technical description has been supplied by SiVEST:

Rondekop Wind Farm (Pty) Ltd proposes to develop a Wind Energy Facility (WEF) of up to 325 megawatt (MW), 45 km south-west of Sutherland, in the Northern Cape Province, South Africa. The proposed facility is located within the Karoo Hoogland Local Municipality, which fall within the Namakwa District Municipality.

The Rondekop WEF will have an energy generation capacity (at 132kV point of utility connection) of up to 325 megawatt (MW) (**Figure 3**), and will include the following:

- Up to 48 wind turbines, each between 3MW and 6.5MW in nameplate capacity each with a foundation of up to 30 m in diameter and up to 5 m in depth.
- The hub height of each turbine will be between 90 m and up to 140 m and its rotor diameter between 100 m and up to 180 m.

- Permanent compacted hardstanding laydown areas (also known as crane pads) for each wind turbine of 90 m x 50 m (total footprint 21.6ha) during construction and for ongoing maintenance purposes for the lifetime of the project.
- Electrical transformers (690V/33kV) adjacent to each turbine (typical footprint of 2 m x 2 m but can be up to 10 m x 10 m at certain locations) to step up the voltage to 33kV.
- Underground 33kV cabling between turbines buried along access roads, where feasible, with overhead 33kV lines grouping turbines to crossing valleys and ridges outside of the road footprints to get to the onsite 33/132kV substation.
- Internal access roads up to 12 m wide, including structures for stormwater control would be required to access each turbine and the substation, with a total footprint of about 73 ha. 38,6 ha will be upgrades to existing roads. . Turns will have a radius of up to 50 m for abnormal loads (especially turbine blades) to access the various turbine positions.
- Access roads to the site will be approximately 9 m wide while access roads to the substation will be approximately 6 m wide.
- One 33/132kV onsite substation. The 33kV footprint will need to be assessed as part of the WEF EIA and the 132kV footprint will be assessed in a separate basic assessment (BA) process as the current applicant will remain in control of the low voltage components of the 33/132kV substation, whereas the high voltage components of this substation will likely be ceded to Eskom shortly after the completion of construction. The total footprint of this onsite substation will be approximately 2.25 ha.
- Up to 4 (the height will be the same as the final wind turbine hub height) wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.
- Temporary infrastructure including a construction camp (~13ha) which includes an on-site concrete batching plant for use during the construction phase and for offices, administration, operations and maintenance buildings during the operational phase.
- Fencing will be limited around the construction camp and batching plant. The entire facility would not be fenced off. The height of fences around the construction camp are anticipated to be up to 6 m.
- Temporary infrastructure to obtain water from available local sources/ new or existing boreholes including a potential temporary above ground pipeline (approximately 35cm diameter) to feed water to the on-site batching plant. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the DWS will be applied for separately.
- Application site ~37 543.13 hectares (cadastral units). The total footprint of the wind farm will however be ~ 114 ha (of which ~38ha will be upgrading of existing roads).

2.2.1 Road layout alternatives

Various access road alternatives are currently proposed to connect the R356 to the three ridges. The proposed access to the site is from the tarred R354 connecting Matjiesfontein and Sutherland, turning north-west onto R356 provincial gravel road and heading west from where the access roads branches off. The six (6) access road alternatives (two (2) per ridge) branch off the R356.

Considering that the proposed Rondekop WEF is to be developed on three (3) separate ridges, there are two (2) proposed access roads to each ridge, therefore six (6) access road alternatives in total.

Three access road alternatives would connect the public R356 road to the new wind farm road network between the turbines on the ridges namely:

2.2.1.1 North ridge

- Access road alternative North 1, route is approximately 11.8 km in length, almost all of which comprises an existing farm road that will need to be upgraded; or
- Access road alternative North 2 is approximately 12.8 km in length and branches off the R356 and follows an existing farm road that will need to be upgraded.

2.2.1.2 Centre ridge

- Access road alternative Centre 1 is approximately 2.6 km in length and branches off the R356 to the north and connects between turbine 31 and 32; or
- Access road alternative Centre 2 is approximately 3.1 km in length and branches off the R356 and connects to the site near turbine 28.

2.2.1.3 Southern ridge

- Access road alternative South 1 is approximately 1.9 km in length and branches off the R356 to the south and connects near turbine 45; or
- Access road alternative South 2 is approximately 4.2 km in length and branches off the R356 to the south and connects near turbine 42.

All six (6) alternatives must be assessed with the road network and one access road per ridge would require environmental authorisation in order to enable access to all three ridges. The internal access roads are assessed as part of all access road alternatives.

Each road section will be buffered by approximately 200 m to allow for incremental alternatives i.e. reroute within the buffer in order to avoid any sensitive features identified during the detailed specialist assessments.

2.2.2 Construction camps

Six (6) alternative construction camp layouts, including the area required for a batching plant, will be assessed namely construction camp:

- Construction Camp Alternative 1 is located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;
- Construction camp Alternative 2 is also located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;
- Construction Camp Alternative 3 is located adjacent to and east of the R356 public road on the Remainder of farm 190 Wind Heuvel;
- Construction Camp Alternative 4 is located at the intersection of an existing 4x4 track and the R356 on portion 1 of farm 190 Wind Heuvel;
- Construction Camp Alternative 5, is located at the intersection of the R356, access road alternative centre 2 and access road alternative south 1 extending to the north on the remainder of farm 192 Bloem Fontein; and
- Construction Camp Alternative 6 is located to the west of access road alternative centre 2 north of the R356 on the remainder of farm 192 Bloem Fontein.

2.2.3 Substations

Six (6) onsite 33/132kV substation location alternatives were identified based on technical studies which considered aspects such as topography, earth works and levelling, environmentally sensitive features, electrical losses, turbine locations and existing agricultural use. All six (6) positions are located relatively in the centre of the facility.

- Substation alternative 1 is located south of turbine 22 on the remainder of farm 191 Hout Hoek;

- Substation alternative 2 is located south of substation alternative 1 on the remainder of farm 191 Hout Hoek;
- Substation alternative 3 is located south east of substation alternative 2 on the remainder of farm 190 Wind Heuvel;
- Substation alternative 4 is located north east of substation alternative 3 on the remainder of farm 190 Wind Heuvel;
- Substation alternative 5 is located west of construction camp alternative 4 along an existing 4x4 jeep track; and
- Substation alternative 6 is located adjacent to access road alternative center 1 to the east on portion 1 of farm 190 Wind Heuvel.

2.2.4 No-Go Alternative

It is mandatory to consider the “no-go” option in the EIA process. The no development alternative option assumes the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area and the status quo would proceed.

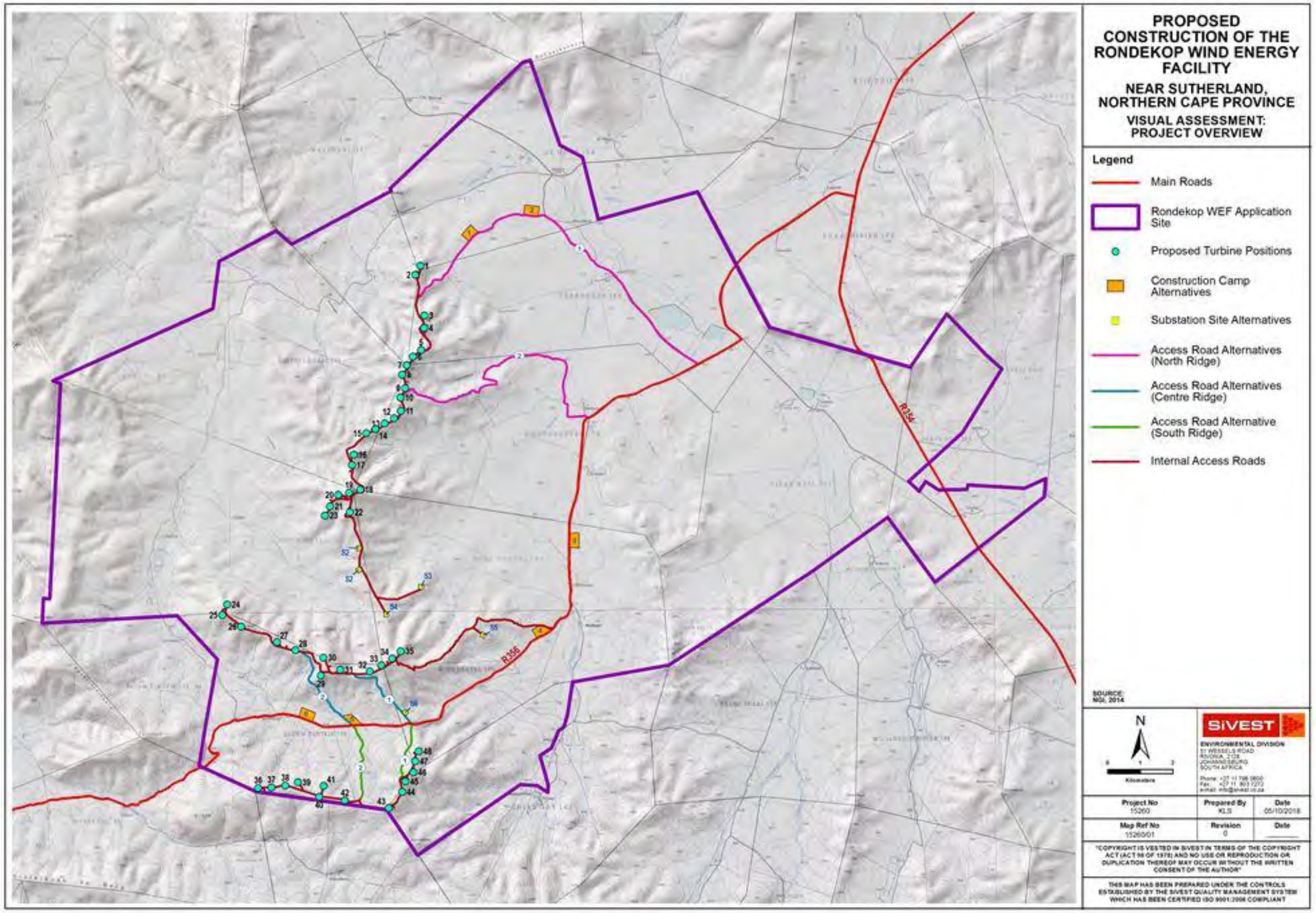

Figure 3 – Proposed Rondekop WEF turbine locations as well as associated infrastructure.

The proposed facility is located partially within the Komsberg Renewable Energy Development Zone (REDZ 2), one of the eight REDZ formally gazetted1 in South Africa indicating the procedure to be followed in applying for environmental authorisation (EA) for large scale solar and wind energy generation facilities. Considering that a portion of the proposed facility is located outside of the Komsberg REDZ, the Rondekop WEF will be subject to a full Environmental Impact Assessment (EIA) process in terms of the NEMA as amended and EIA Regulations, 2014 (as amended).

The proposed site was selected through an environmental and social pre-feasibility assessment commissioned by the applicant for several sites within the Roggeveld area.

This study was undertaken by CES in 2009 and included a high-level screening of potential environmental and socio-economic issues, as well as 'fatal flaws' to determine suitable areas for project development. The consideration of a number of criteria resulted in the selection of the site by the applicant.

Therefore, no further site location alternatives other than Rondekop will be considered in this process.

2.3 Study methodology

The applicable maps, tables and figures are included, as stipulated in the NHRA (Act No 25 of 1999) and NEMA (Act No 107 of 1998). The HIA process consisted of three steps;

Step I – Literature Review - The background information to the field survey relies greatly on the Heritage Background Research.

Step II – Physical Survey - A physical survey was conducted predominantly by foot within the proposed areas by two qualified archaeologists and one palaeontologist, which aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

The significance of identified heritage sites is based on three main criteria -

1. Site integrity (i.e. primary vs. secondary context),
2. Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
3. Density of scatter (dispersed scatter)
    - Low - <10/50m2
    - Medium/High - 10-50/50m2
    - High - >50/50m2
    - Uniqueness; and
    - Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows -

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate development activity position;

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site.

Impacts on these sites by the development will be evaluated based on the assessment criteria described in **Appendix B** of this report.

3 CURRENT STATUS QUO

3.1 Site Description

The proposed development site is situated approximately 45km south-west of the town of Sutherland, The proposed Rondekop WEF is situated in between the Klein Roggeveld Mountains to the south and the Roggeveld Mountains and Plateau to the north, covering approximately 37 646 ha (**Figure 2**).

The proposed development area is currently being used predominantly for agricultural purposes. It is situated approximately 5km to the west of the R354 tar road from Matjiesfontein to Sutherland. The area is largely undisturbed except for several fences which demarcate the individual properties; tracks which cross the properties, leading to several wind mill sites and an access road leading to a communications mast (**Figure 4, Figure 5 & Figure 6**).

The landscape comprises various ridges, valleys and surrounding plains (**Figure 7**, **Figure 8 & Figure 9**). The prevailing vegetation type and landscape features of the area form part of the Central Mountain Shale Renosterveld within the Fynbos Biome and the Koedoesberge-Moordenaars Karoo within the Succulent Karoo Biome (**Figure 10 & Figure 11**)**.** The Central Mountain Shale Renosterveld is described as slopes and broad ridges of low mountains and escarpments, with tall shrub-land dominated by *Renosterbos* and large suites of mainly non-succulent Karoo shrubs and with a rich geophytic flora in the undergrowth or in more open, wetter or rocky habitats. The Koedoesberge-Moordenaars Karoo is described as a slightly undulating to hilly landscape covered by low succulent scrub and dotted by scattered tall shrubs, patches of 'white' grass visible on plains, the most conspicuous dominants being dwarf shrubs of *Pteronia*, *Drosanthemum* and *Galenia*. (Mucina & Rutherford, 2006).

Figure 4 – One of the several windmills located on Wind Heuvel 1/190 facing west, S 32° 45' 11,7''; E 20° 19' 16,1''

Figure 5 – MET mast on Bloem Fontein RE/192 facing east, S 32° 45’ 52,9’’; E 20° 16’ 54,9’’

Figure 6 – Fencing and tracks separating properties on Zeekoegat 169 facing east, S 32° 39’ 56,9’’; E 20° 20’ 28,2’’

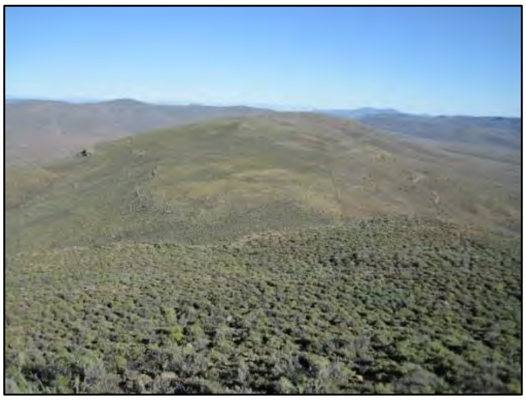

Figure 7 – Characteristic ridge line, one of many that traverses the property on Hout Hoek RE/191 facing south, S 32° 42’ 46,0’’; E 20° 17’ 25,2’’

Figure 8 – Erosion gulley on Hout Hoek RE/191 facing south-west, S 32° 44’ 02,6’’; E 20° 17’ 26,1’’

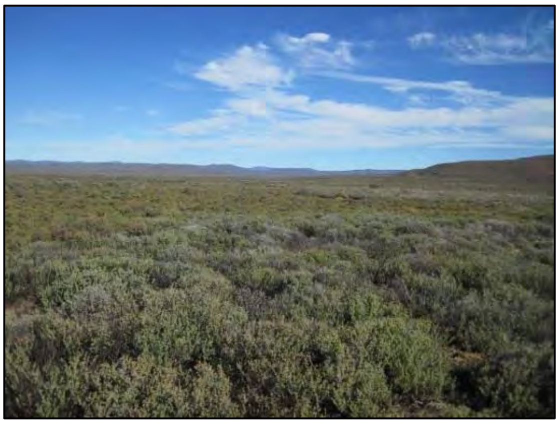

Figure 9 – Vastness of surrounding plains on Roodeheuvel 1/170 facing south, S 32° 40’ 46,5’’; E 20° 21’ 08,4’’

Figure 10 - Blossoming of the local vegetation on Hout Hoek RE/191 facing east, S 32° 44’ 57,9’’; E 20° 15’ 00,2’’

Figure 11 – Sparsely vegetated low-lying ridge (background), with general vegetation in foreground on Wind Heuvel RE/190 facing south, S 32° 44’ 53,8’’; E 20° 17’ 54,5’’

3.2 Archival findings

The archival research focused on available information sources that were used to compile a background history of the study area and surrounds. This data then informed the possible heritage resources to be expected during field surveying.

3.2.1 South African Heritage Resources Information System (SAHRIS)

A scan of SAHRIS has revealed the following studies conducted in and around the study area of this report:

ALMOND, J, & ORTON, J. 2017. Heritage Impact Assessment: Proposed Construction of a Substation and 132 kV Distribution Line to support the Proposed Sutherland 2

WEF, Sutherland and Laingsburg Magisterial Districts, Northern and Western Cape. – **Historical and Stone Age heritage remains as well as several burial grounds and fossil sites were uncovered in this assessment. It was recommended that development may continue under the condition that 30m & 20m buffers are implemented around certain 'no-go' sites and that the relevant contingencies are implement should heritage remains be affected by the development process.**

BANDAMA, F. & MOHAPI, M. 2014. An Archaeological Scoping and Assessment Report for The Proposed Gamma (Victoria West, Northern Cape) - Kappa (Ceres – Western Cape) 765Kv (2) Eskom Power Transmission Line. - **This scoping report identified a range of heritage resources in and around the local area including: stone walling (kraals and possible windbreaks), ESA-LSA artefact scatters, buildings and farm complexes (with associated artefacts like glass, metal and ceramic), rock art and engravings, pottery and graves (both formal and informal).**

BOOTH, C. 2011. An archaeological desktop study for the proposed establishment of the Hidden Valley wind energy facility and associated infrastructure on a site south of Sutherland, Northern Cape Province. **– Desktop level assessment based of previous fieldwork done in the study area. A full Phase 1 AIA was recommended.**

BOOTH, C. 2012. A Phase 1 AIA for the proposed Hidden Valley Wind Energy Facility, near Sutherland, Northern cape Province. **– Historical heritage resources were uncovered in this assessment. It was recommended that an archaeologist be present during all construction related activities in two of the study areas.**

BOOTH, C. 2015. A Phase 1 Archaeological Impact Assessment for the Proposed Karusa Facility Substation and Ancillaries, near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, NC Province. - **No significant heritage resources were uncovered in this assessment. It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

BOOTH, C. 2015. A Phase 1 Archaeological Impact Assessment for the Proposed Eskom Karusa Switching Station, Ancillaries and a 132kV Double Circuit Overhead Power Line, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province. – **Some low significance Historical heritage remains were uncovered in this assessment. It was recommended that a 30m buffer around discovered sites be adhered to and that the relevant**

contingencies are implement should heritage remains be uncovered during the development process.

BOOTH, C. 2015. A Phase 1 Archaeological Impact Assessment for the Proposed Soetwater Substation, 132kvV Overhead Powerline and Ancillaries Soetwater Wind Energy Facility, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province. - **No significant heritage resources were uncovered in this assessment. It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

BOOTH, C. 2015. An Archaeological Walk-Through For The Proposed Karusa Wind Energy Facility Situated On The Farms: De Hoop 202, Standvastigheid 210, Portion 1 Of The Farm Rheebokke Fontein 209, Portion 2 Of The Farm Rheebokke Fontein 209, Portion 3 Of The Farm Rheebokke Fontein 209 And The Remainder Of The Farm Rheebokke Fontein 209, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province. – **Historical heritage resources were uncovered in this assessment. It was recommended that the historical remains be recorded and a destruction permit be applied for if they are not able to be avoided.**

BOOTH, C. 2015. An Archaeological Walk-Through For The Proposed Soetwater Wind Energy Facility Situated On The Farms: The Remainder Of And Portion 1, 2 And 4 Of Farm Orange Fontein 203 And Annex Orange Fontein 185, Farm Leeuwe Hoek 183 And Farm Zwanepoelshoek 184, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province. – **No significant heritage resources were uncovered in this assessment. It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

BOOTH, C. 2015. Phase 1 Archaeological Impact Assessment for the proposed extension of the existing Komsberg Substation (two alternative areas) and widening of the access road, near Sutherland, NC Province. – **No heritage remains were uncovered in this assessment. It was recommended that the development may continue.**

BOOTH, C. 2017. An Archaeological Assessment for the Amendment to Turbine Specifications and the Revised Layout of the Karusa Wind Energy Facility Situated on the Farms De Hoop 202, Standvastigheid 210, Portion 1 of the Farm Rheebokke Fontein 209, Portion 2 of the Farm Rheebokke Fontein 209, Portion 3 of the Farm Rheebokke Fontein 209 and the Remainder of theFarm Rheebokke Fontein 209, Near Sutherland, Karoo Hoggland Local Municipality, Namakwa District Municipality, Northern Cape Province. - **No significant heritage resources were uncovered in this assessment. It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

FOURIE, W. 2010. Archaeological Walk Down Report: Gamma-Omega Transmission Section 1: Gamma-Kappa. - **This study identified a range of heritage resources, the majority of which comprise Stone Age artefact scatters of varying densities. These are primarily ESA and MSA scatters, although LSA artefacts were also located. In addition, rock engravings were also found, along with stone walled structures of varied construction (kraals, walls, possible wind breaks); infrequent non-decorated potsherds were sporadic. Later historical structures were also found (with glass, metal and ceramic fragments), along with associated graves/burial areas. The earliest graves place regional occupation pre-1892.**

FOURIE, W., ALMOND, J. & ORTON J. 2014. National Wind and Solar PV SEA Specialist Assessment Report – Heritage Evaluation. This report provides on overview of potential heritage impacts in the REDZ Komsberg focus area 2. - **The following types of heritage are listed for this area: Middle and Later Stone Age artefact scatters (frequently associated with water sources), rock art (confined to the mountainous areas), colonial farmsteads (18-19th Century – farmhouses, kraals and earth dams), provincial heritage sites (i.e., Matjiesfontein, Karoopoort), South African War period fortifications and cemeteries (dating back to the early 1800s).**

HALKETT, D, & ORTON, J. 2011. Heritage Impact Assessment for the Proposed Phtovoltaic Solar Energy Facility on the Remainder of Farm Jakhalsvalley 99, Sutherland Magisterial District, Western Cape. – **Historical heritage resources were uncovered in this assessment. It was recommended that the development may continue however, the remains should be avoided and that the ECO must make sure of this.**

HALKETT, D. 2011. Heritage Impact Assessment Proposed Renewable Energy Facility at the Sutherland Site, Western and Northern Cape Provinces. – **Some historical and Stone Age heritage remains as well as a burial ground that was uncovered in this assessment. It was recommended that development may**

continue and that the relevant contingencies are implement should heritage remains be affected by the development process.

HALKETT, D. 2017. Heritage Impact Assessment: Proposed Construction of the 132Kv Powerline for the Maralla Wind Energy Facility near Sutherland Northern Cape. – **Historical, Iron Age and Stone Age heritage remains were uncovered in this desktop assessment. A targeted walk-down was recommended and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

KAPLAN, J. 2009. Phase 1 Archaeological Impact Assessment of the Proposed Driefontein Resort (Driefontein Farm No. 127) Sutherland, Northern Cape Province. **Historical heritage remains were uncovered in this assessment. It was recommended that the historical remains be avoided and that a Conservation Management Plan be drafted to protect the remains.**

KAPLAN, J. 2015. Proposed borrow pit (Karusa East) on the Farm Rheebokke Fontein 209/2 & 209/3 near Sutherland, Northern Cape. – **Low significance historical heritage resources were uncovered in this assessment. It was recommended that the development may continue and that the relevant heritage authorities should be contacted if any human remains are uncovered during the development process.**

KAPLAN, J. 2015. Proposed borrow pit (Karusa North) on the Farm Rheebokke Fontein 209 Remainder near Sutherland, Northern Cape Assessment conducted under Section 38 (3) of the National Heritage Resource Act (No. 25 of 1999). – **Historical, Iron Age and Stone Age heritage remains were uncovered in this assessment. Relevant sites should be protected, 20m buffers implemented where necessary and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

KAPLAN, J. 2015. Proposed quarry on the farm Jakhals Valley 99 Portion 3 near Sutherland, Northern Cape. - **No significant heritage resources were uncovered in this assessment. It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

MURIMBIKA, M. 2014. Executive Summary For Phase 1 Heritage Impact Assessment Study Report: Proposed Gamma-Kappa 2nd 765kV Eskom Transmission Powerline and Substations Upgrade Development in Western Cape. - **This report summarises a range of heritage resources in and around the local area including: stone walling (kraals and possible windbreaks), ESA-LSA artefact scatters, buildings and farm complexes (with associated artefacts like glass,**

metal and ceramic), rock art and engravings, pottery and graves (both formal and informal).

ROUSSOUW, L. 2007. Phase 1 Archaeological Impact Assessment and Palaeontological Impact Assessment of 30 Gravel Quarries in the R354 Between Calvinia and Sutherland, Northern Cape Province **– No heritage remains were uncovered.**

SMITH, A.B. 2008. Eskom Gamma-Omega 765kV Transmission Line: Archaeological Desktop Survey. - **This study, focusing on an area defined as the Karoo, identified five farms near to the current study area that contain Stone Age (ESA, MSA and LSA) artefacts, pottery and rock paintings.**

VAN DER RYST, M. & FOURIE, W. 2014. Phase 2 Specialist Study of Affected Stone Age Locality on The Gamma Kappa Transmission Line – Tower GKB-T846 (Site GK062), Tankwa Karoo, Touwsrivier. - **This report documents medium density scatters of ESA, MSA and LSA artefacts at a single deflated, secondary context, locality, with the assemblage comprising a very low quantity of formal tools.**

VAN DER WALT, J. 2015. Archaeological Impact Assessment Report for the Proposed Gunstfontein Wind Energy Facility, Northern Cape. - **Historical remains as well as Rock Art was uncovered in this assessment. It was recommended that the development footprint be updated in order to accommodate the heritage findings and that the ECO must make sure the heritage resources are protected.**

VAN DER WALT, J. 2016. Archaeological impact assessment report for the proposed Gunstfontein 132 kV power line, switching station and ancillaries for the proposed Gunstfontein wind energy facility near Sutherland, Northern Cape. – **Desktop level assessment based of previous fieldwork done in the study area. Historical remains as well as Rock Art was uncovered in this assessment. It is recommended that a full heritage walk down of the of study area must be conducted.**

WEBLEY, L. 2017. Heritage Impact Assessment: Proposed Construction of the Maralla West Wind Energy Facility near Sutherland in the Northern Cape. **– Historical and Stone Age heritage remains were uncovered in this assessment. It was recommended that highly sensitive No-Go area should be avoided, that a walk-down be conducted should the development layout change and that the relevant contingencies are implement should heritage remains be uncovered during the development process.**

3.3 Archaeological background

3.3.1 Early Stone Age (400 000 – 3.3 million years Before Present/BP)

The earliest artefacts from the ESA are produced during the Oldowan. Although the Lomekwian is an earlier industry, found elsewhere in Africa dating to ~3.3 million years ago, it, as well as the Oldowan, is not relevant as it does not occur in these parts of southern Africa. Following the Oldowan is the Acheulean, beginning at around ~1.5 million years ago. This technology is characterised by the presence of Large Cutting Tools (LCTs), in the form of handaxes, cleavers and occasional picks. These are tools that can either be unifacial, partly bifacial or bifacial, and they are important tools that would have been used to perform a range of subsistence-based activities during the Acheulean. In addition to these artefacts, flakes occur that show deliberate shaping (retouch) to create smaller formal tools (e.g., scrapers). A range of cores also occurs, and elsewhere during this period we see the earliest representations of systematic core reduction in the Victoria West Industry, the earliest form of Prepared Core Technology (Li *et al.* 2017). This type of reduction illustrates that stone cores were reduced in ways to attain predetermined flake blanks of specific shapes and sizes. In addition, this core reduction prolongs the usability of the core as core convexities are continually maintained throughout the process of flake removal.

One of the best sites with examples of this phase have been found at Wonderwerk Cave in the Northern Cape (Berna et al. 2012). This site is of particular importance because its excavations have provided some of the first evidence of the controlled use of fire by hominins dating to approximately 1 million years ago (Berna et al. 2012). Other archaeological sites associated with the Earlier Stone Age from the Northern Cape, is Canteen Kopje, Kathu Pan and Rooidam which has yielded many invaluable artefacts primarily associated with the Acheulian, this particular period of Earlier Stone Age (Herries, 2011).

Overall, the presence of ESA artefacts in the study area is low, given the vast amounts of land that have been surveyed in previous reports. Other reports from the area have confirmed that where artefact scatters do occur, they are frequently associated with water resources (or areas where it once occurred, i.e., dry pans and riverbeds). These artefact scatters are also rarely associated with organic remains (Bandama 2017), and their contexts are poor given that they have been exposed at the surface for vast periods of time.

3.3.2 Middle Stone Age (30 000 – 300 000 BP)

The MSA is the second oldest phase identified in South Africa's archaeological history. This phase is associated with flakes, points and blades manufactured by means of the Prepared Core Technique. This phase of stone tool development is associated with modern humans and complex cognition.

Within the Northern Cape examples of such artefacts have been found at the Bundu Farm, Kathu Pan and Wonderwerk Cave sites (Lombard et al. 2012). It is also widely argued that this time period saw the advent of "modern human behaviour".

Based on the pre-existing data obtained from heritage surveys in the area, the vast majority of MSA material is generally found at the surface and in deflated contexts. As a result, the overall significance and value of these assemblages is somewhat reduced, given that their original associations have been modified (or in most cases completely removed).

3.3.3 Later Stone Age (30 000 BP – recent times)

The Later Stone Age (LSA) is the third archaeological phase identified and is associated with an abundance of very small artefacts known as microliths. A vast array of LSA sites from a range of different periods is known for the Northern Cape.

A detailed summary of these is provided by Lombard *et al.* (2012). Early LSA sites are characterised by unstandardized assemblages but given that some of these sites have contextual issues perhaps this can been expected, given that these types of LSA sites are often regarded as being transitional MSA-LSA sites, with a mix of technologies. Robberg LSA sites show systematic blade production, along with high quantities of bladelets and bladelet cores, few formal tools and macroliths (at certain sites). Oakhurst LSA sites show technological trends for these sites include a general absence of microliths, a range of scrapers and adzes, and bone tools. Wilton LSA sites are characterised by numerous microlithic formal tools, showing systematic production of backed artefacts and small convex scrapers; additional cultural items like ostrich eggshell (OES), ochre and bone, shell and wooden artefacts are also common.

There is significant technological variability in the late LSA assemblages, and there are both microlithic and macrolithic components. Scrapers, blades, bladelets, backed tools and adzes do not occur at all of these sites, and informal untrimmed large flakes and macrolithic places are characteristic of Smithfield assemblages. As with the Wilton LSA sites, OES, bone and ochre is common, and iron objects start to appear. The final phase of the LSA is termed the ceramic final LSA, and this is reserved for those assemblages that contain ceramics (pottery), which is thin walled and contains grit or grass temper. The stone artefacts in these late assemblages are variable and can include microliths, grind and ground stone pieces, variable quantities of formal tools, ochre, OES, metal objects, beads and glass.

A large number of Later Stone Age sites are known in the Northern Cape Province. Some of these include those sites found in the Seacow Valley (Sampson, 1988) and Little Witkrans, Powerhouse Cave, and Blinkklipkop (Humphreys & Thackeray, 1983). And the more famous sites such as Wonderwerk Cave in Kuruman and Canteen Kopje in Barkley West, near Kimberley (Forssman et al. 2010).

Canteen Kopje exhibits evidence of a very rich cultural history in the later periods of the Later Stone Age where the hunter-gatherers would interact with Khoekhoe herders that moved into the region, which we can tell from excavated domesticated animal remains such as sheep and goats (Forssman et al. 2010). These communities even entered a network of cultural exchange within the last 2000 years. Similar evidence has also been recovered from Wonderwerk Cave (Forssman et al. 2010).

Elsewhere, surrounding the study area, numerous heritage reports have identified numerous LSA lithic scatters. Importantly, these have also identified the coexistence of LSA sites with both stone walling and pottery. This would suggest later phases of the LSA occur in this region, evidenced by the co-occurrence of these artefacts/structures that suggests a mixed economy. Stone walling in this part of South Africa dates to the Stone Age (Sadr 2012).

3.3.4 Rock Art

By the beginning of the Later Stone Age, human behaviours were undoubtedly modern (Huffman 2005). Uniquely human traits, such as rock art and purposeful burials with ornaments, became regular practice (Huffman 2005). These people were most likely the ancestors of the San, who are well known their fine-lined rock art and rock engravings.

Bushman rock paintings are well known in the Koue Bokkeveld and adjacent regions (Johnson et al 1959; Yates et al 1993). The paintings at Stompiesfontein and Bloubosfontein depict colonial imagery that include a woman in colonial dress, men with guns and on horses, coaches and wagons with mules, horses and oxen (Johnson et al 1959). Karoopoort is also known for the occurrence of rock painting (PGS 2010).

3.3.5 Iron Age Sequence

Despite the widespread occurrence of the Iron Age sequence across the northern portions of South Africa, Iron Age remains south of the Orange River moving into the Northern Cape, is noticeably sparse (Humphreys 1976; Humphreys 1988). Humphreys (1977) suggests that the absence of Iron Age occupation in this part of the country is largely due to the falloff of higher rainfall isohyets in the farther south-west portion of the country. Considering that Iron Age peoples were farmers, they were greatly influenced by climatic factors and were most likely deterred by the arid conditions of the Cape (Humphreys 1977). Another possibility for their absence in the archaeological record could simply be attributed to the lack of Iron Age research conducted in this part of South Africa (Humphreys 1977).

3.3.6 Type R Settlements

Humphreys (1988) claims that the stone wall settlements found on the southernmost frontier of the southern African Iron Age occupation, having been termed the Type R Settlements, were inhabited by peoples with a hunter-gatherer/herder economy. He argues that through interactions with Iron Age farmers to the north, these people picked up on Iron Age traditions such as ceramic production (that was half-way between Later Stone Age and Iron Age ceramic traditions), sheep and cattle herding as well as stone wall settlement construction (Humphreys 1988).

These occurrences tie in with what was known as the *Little Ice Age*, a fluctuation in global climate between 800 to 600 years ago, which may have caused a more hospitable environment for the grazing of cattle and therefore the occupation of Khoekhoen pastoralists in the region (Bandama 2017). From the archaeological evidence of 'lobed' stone walling combined with historical artefactual remains, it is known that Sotho and Xhosa speakers had also entered the region, living alongside Khoisan settler moving into the historical period, all of whom having had interactions with colonial settlers (Bandama 2017).

3.4 Archival/historical maps

Historical topographic maps were available for cultural resources analysis in the study are:

- **Topographical map 3220CA** – First edition 1967. The aerial photography on which the map was based dates to 1960 and its survey work was undertaken in 1967. It was drawn in 1968 by the Trigonometrical Survey Office. The aerial photography on which the map was based dates to 1960 and its survey work was undertaken in 1967. It was drawn in 1968 by the Trigonometrical Survey Office.
- **Topographical map 3220CB** – First edition 1967. The aerial photography on which the map was based dates to 1960 and its survey work was undertaken in 1967. It was drawn in 1968 by the Trigonometrical Survey Office.
- **Topographical map 3220CC –** First edition 1968. The aerial photography on which the map was based dates to 1963 and its survey work was undertaken in 1968. It was drawn in 1969 by the Trigonometrical Survey Office
- **Topographical map 3220CD** – First edition 1968. The aerial photography on which the map was based dates to 1963 and its survey work was undertaken in 1968. It was drawn in 1969 by the Trigonometrical Survey Office.

These maps were utilised to identify structures that could possibly be older than 60 years and thus protected under Section 34 and 35 of the NHRA. One can see many structures spanning the greater study area. Most of which seem to be old dams and windmills, while there are multiple representations of kraals farm houses belonging to the various farms that the application area spans (**Figure 12, Figure 13, Figure 14, Figure 15 & Figure 16**).

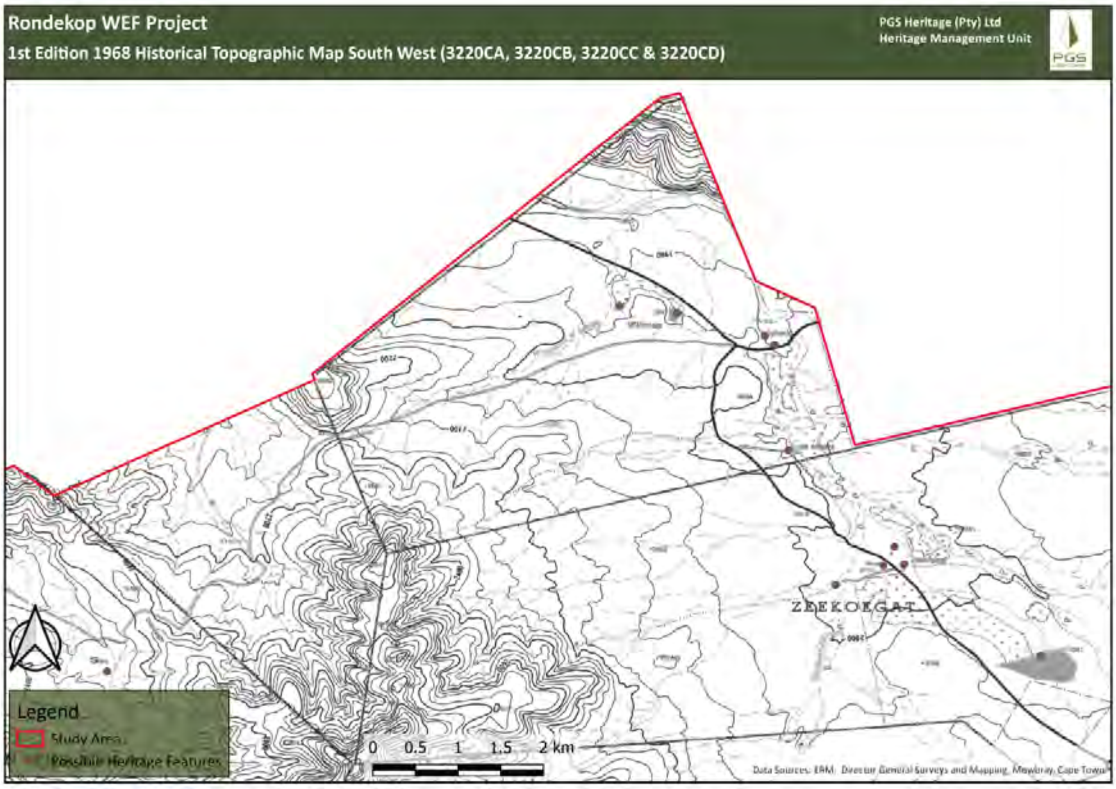

Figure 12 – 1st Edition 1968 Historical Topographic Map (3220CA, 3220CB, 3220CC & 3220CD), potential heritage features include old windmills, dams, original farm structures and kraals

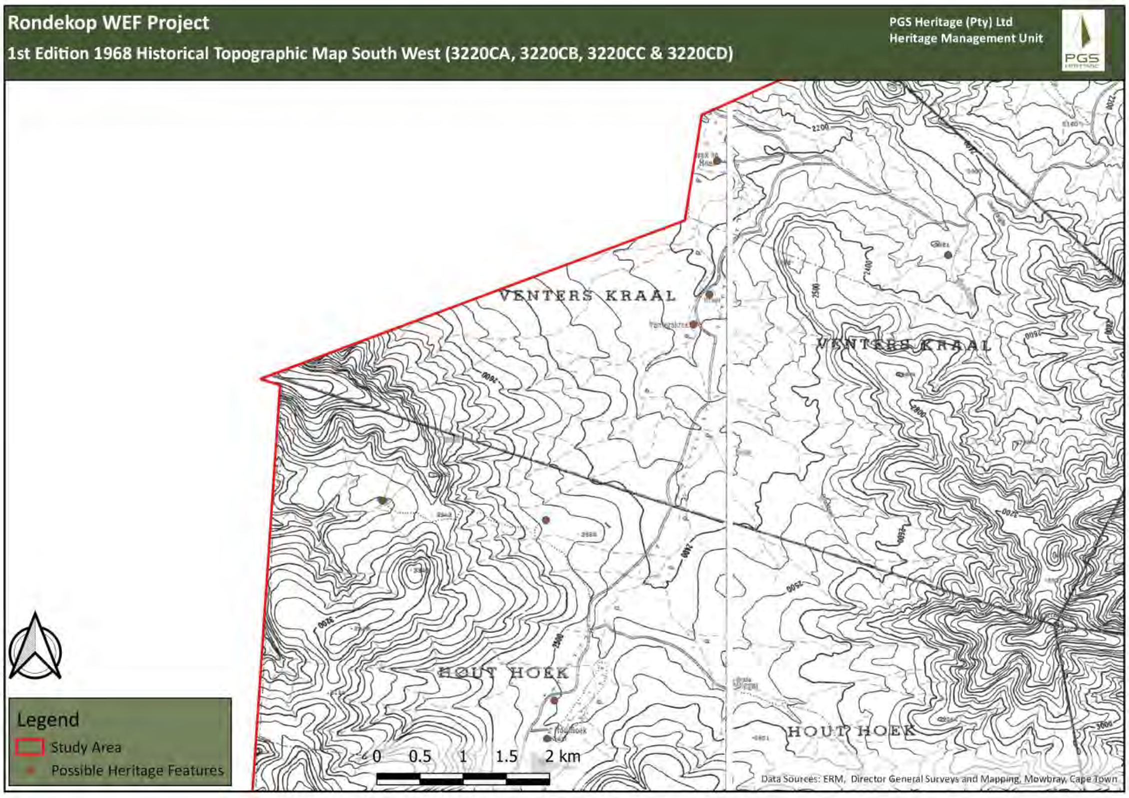

Figure 13 - 1st Edition 1968 Historical Topographic Map (3220CA, 3220CB, 3220CC & 3220CD), potential heritage features include old windmills, dams, original farm structures and kraals

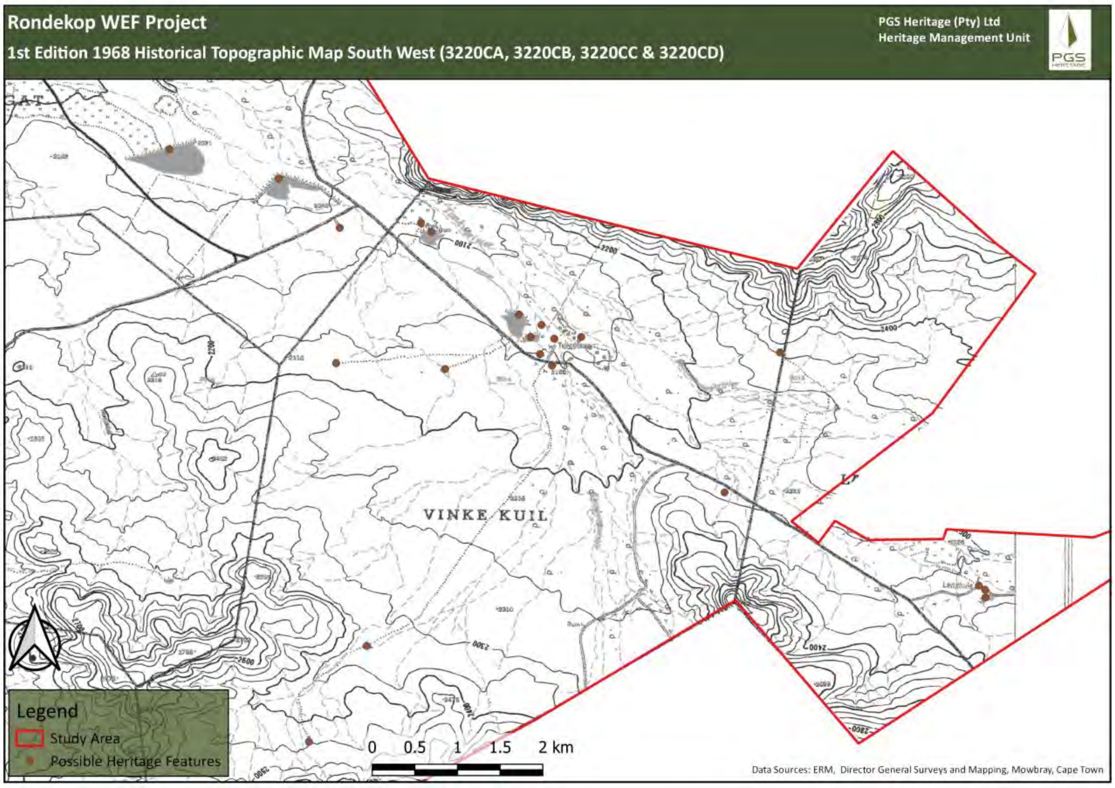

Figure 14 - 1st Edition 1968 Historical Topographic Map (3220CA, 3220CB, 3220CC & 3220CD), potential heritage features include old windmills, dams, original farm structures and kraals

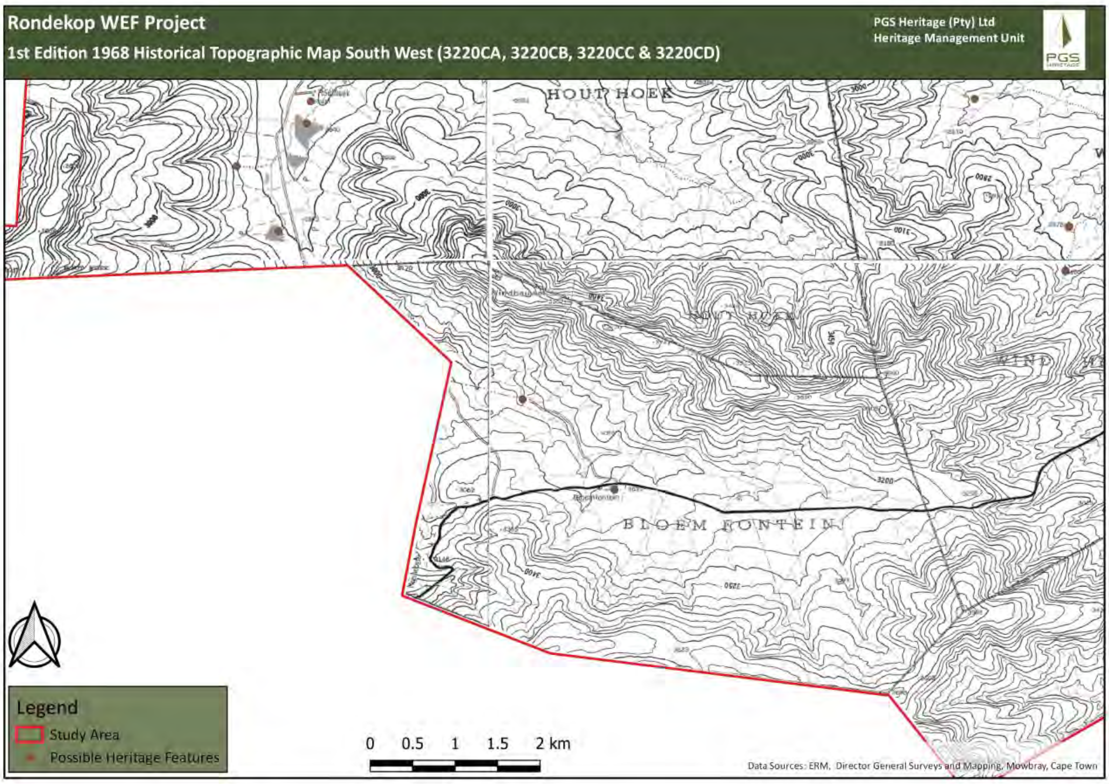

Figure 15 - 1st Edition 1968 Historical Topographic Map (3220CA, 3220CB, 3220CC & 3220CD), potential heritage features include old windmills, dams, original farm structures and kraals

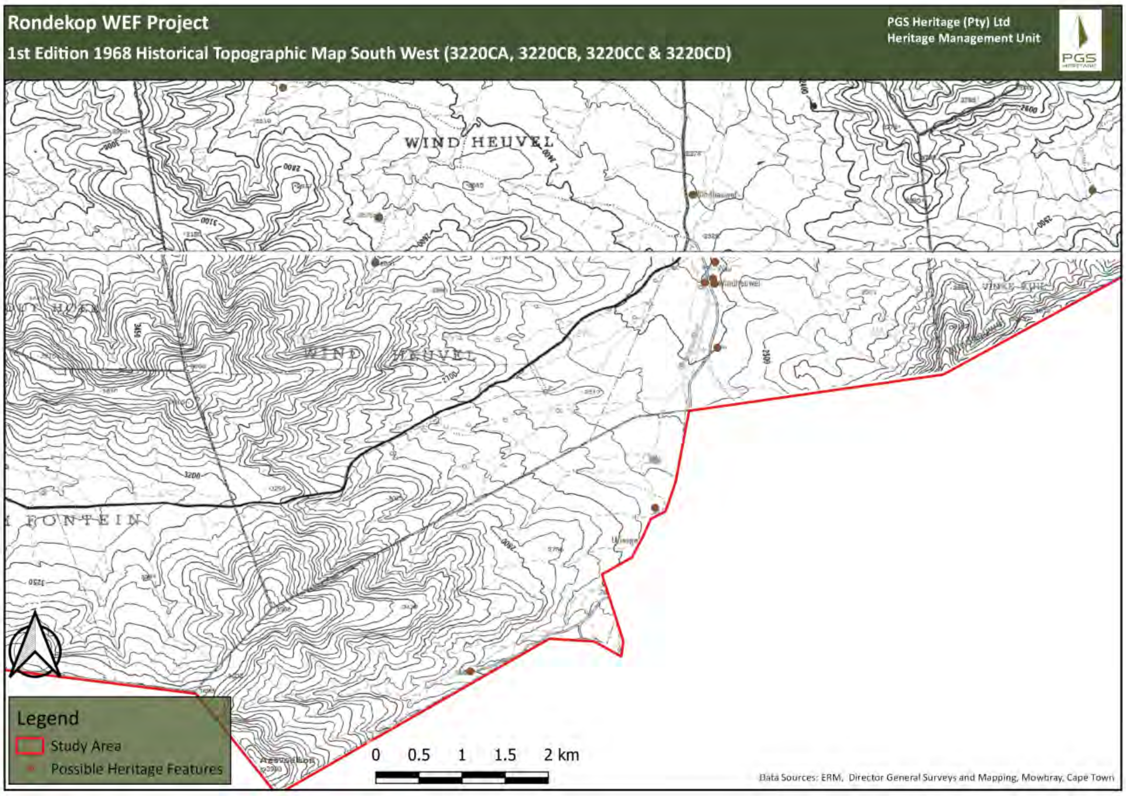

Figure 16 - 1st Edition 1968 Historical Topographic Map (3220CA, 3220CB, 3220CC & 3220CD), potential heritage features include old windmills, dams, original farm structures and kraals

3.5 Aspects of the area's history as revealed by the archival/desktop study

3.5.1 Early Settlement during the Late Iron Age and Historic Period

During the late 1700s, the interactions had intensified between the previously mentioned cultural groups during the later LSA period (Bandama 2017). Major conflict occurred the region between the pastoral groups and the local San people up until the 1880s, who raided the livestock of the pastoral groups in a form of resistance to colonial expansion in the Karoo (Bandama 2017). Some Khoekhoen groups even assisted the Trekboers in the extermination of San groups of the Roggevel and Great Escarpment (Bandama 2017). As a direct result of all these interactions and conflicts between so many different groups during this period, the archaeological signatures of the groups who assisted the Trekboers included various European goods and weapons (Bandama 2017).

The Bantu-speaking (Xhosa) communities had appeared in this part of the Karoo in the late 1700s to take part in the ivory trade and subsequently facilitate their interactions with the local Trekboers and San (Bandama 2017). Although mostly occurring near Victoria West (from 1809) and on the borders of Beaufort West (1830), these communities also built stone walled structures similar to those made by the Khoisan groups however, the of archaeological evidence of their occupations may be to lack of research on this type of archaeology (Bandama 2017). At around the same time, possibly due to migrating refugees incurred by the *Mfecane*, Sotho-speaking communities had begun inhabiting parts of the Karoo, also constructing similar stone structures to those used by the Khoesan and Xhosa (Bandama 2017). During the colonial period, whether by choice or not, Sotho masons would construct kraals and cottages for the Trekboers and such structures became a prominent feature of the 19th century historical period in the Karoo (Bandama 2017).

4 FIELDWORK AND FINDINGS

Due to the nature of cultural remains, a systematic controlled-exclusive surface survey was conducted on foot and in a vehicle, over a period of five days by one archaeologist and field technician from PGS. The heritage fieldwork was conducted on the 20th-24th September while the palaeontological fieldwork was conducted from the 1st – 3rd October. The track logs (in orange) for the heritage survey are indicated in **Figure 17**. The locations of the heritage sites uncovered during the fieldwork component are illustrated in **Figure 18**; five (5) heritage sites were located within the study area, where the focus was placed on the proposed development foot print areas due to the extent of the application area. They are described below in **Table 1.** The various potential sites uncovered during the archival desktop research, were confirmed to not be of heritage value.

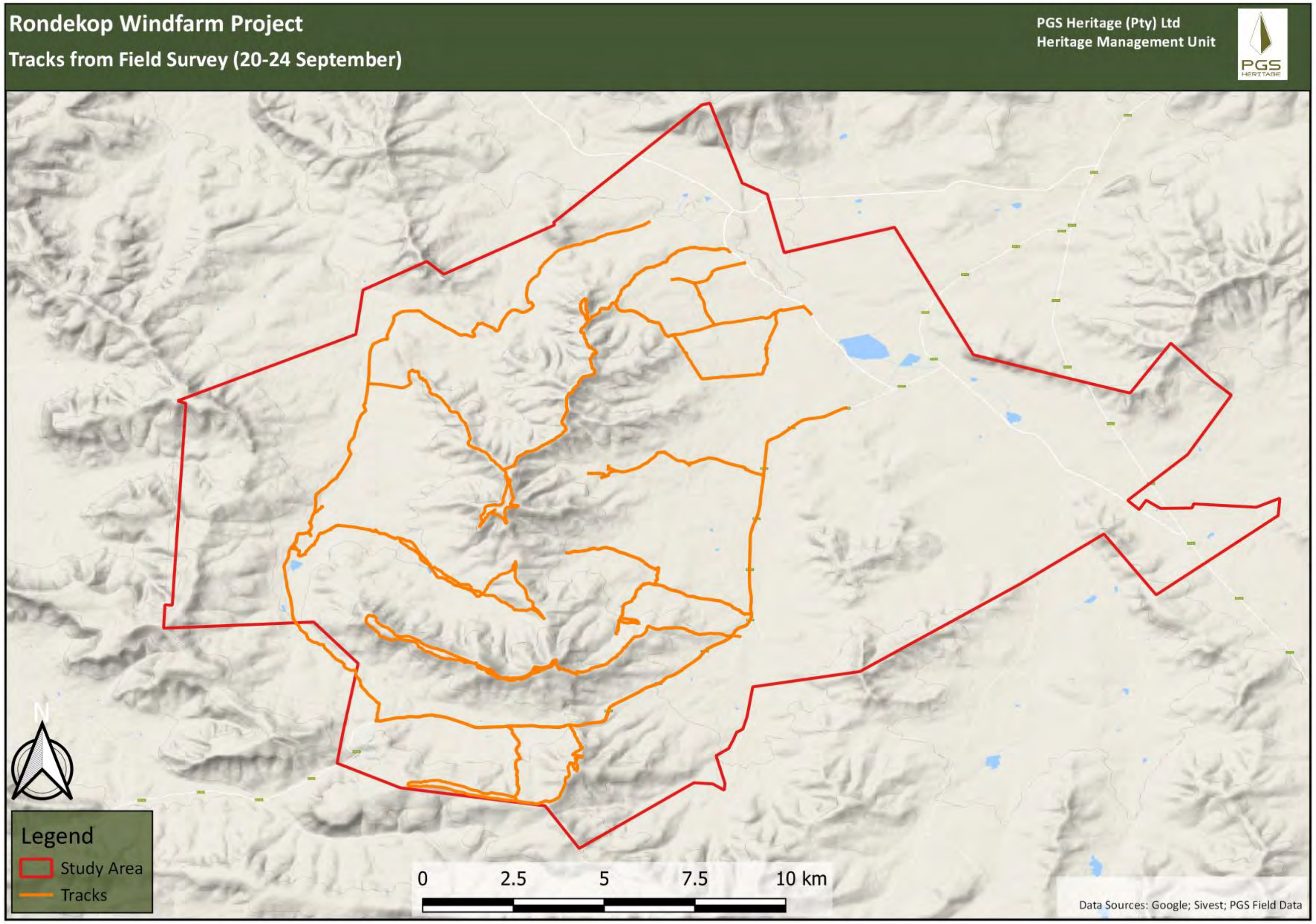

Figure 17 – Track log recordings from site visit (20th-24th September 2018)

Figure 18 – Heritage site locations identified during field survey within and around study area, including potential heritage sites as indicated on the historical topographic maps

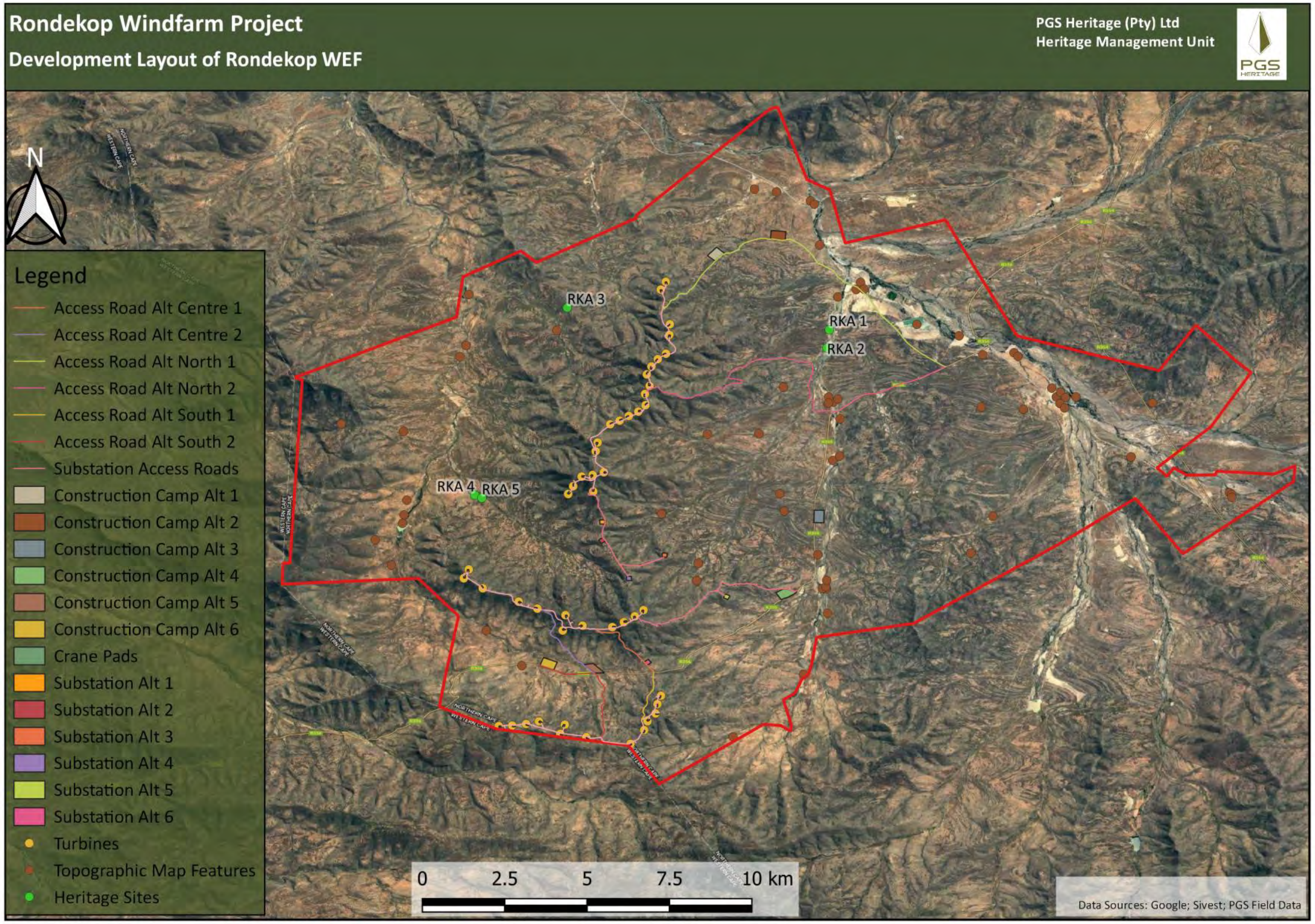

Figure 19 - Proposed Rondekop WEF Development area as well as associated infrastructure alternatives.

4.1 Archaeological and historical resources

Table 1 – List of field survey heritage finds

Site[1] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
RKA01	S32.67025°	E20.36509°	This find spot [2]comprises two MSA flakes that were found in a deflated area. **Site extent**: 1x1m.	Low	GP.C

Figure 20 – View of area exposed by sheet erosion at RKA01

Figure 21 – Ventral view, with clear bulbs of percussion of MSA flakes

[1] *Site in this context refers to a place where a heritage resource is located and not a proclaimed heritage site as contemplated under s27 of the NHRA.*
[2] *Classified as an area where archaeological material isolated but in such low concentrations that it cannot be classified as and archaeological site as per the definition in this report*

Site[3] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
RKA02	S32.67615°	E20.36433°	This site comprises a low-density scatter (2-5 artefacts/10m²) of LSA artefacts that were identified in an open, deflated area. The artefacts were identified in a clearing which is subject to sheet erosion. The artefacts include cores, a scraper, flakes, chips and chunks which were produced from fine- grained dolorite, quarts and CCS (Crypto-crystalline silicates). **Site extent**: 20x20m.	Low	GP.C

Figure 22 – General view of RKA02

Figure 23 – Cores, scraper, flakes, chips produced from fine-grained dolorite, quarts, and CCS uncovered at RKA02

[3] *Site in this context refers to a place where a heritage resource is located and not a proclaimed heritage site as contemplated under s27 of the NHRA.*

Site[3] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
RKA03	S32.66310°	E20.28010°	This site comprises a memorial for D.A.C. Esterhuyse. It is situated next to one of the farm roads, constructed out of stone and cement and has a height of approximately 1m. An inscribed marble plaque was placed at the top end of the memorial reading: “D.A.C. Esterhuyse, 30 – 04 – 1919, 03 – 09 – 1981”. **Site extent**: 1x1m.	Medium	GP.B

Figure 24 – View of memorial constructed out of stone and cement

Figure 25 - Marble plaque reading: "*D.A.C. Esterhuyse, 30 – 04 – 1919, 03 – 09 – 1981*”

Site[3] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
RKA04	S32.72384°	E20.25011°	This site comprises the remains of a stone-built house and attached dry stone walled kraal. The rectangular shaped house has two rooms with doors on the northern side and a window with a wooden window frame on the eastern side. The roof of the structure was removed, but some of the wooden rafters are still in place. Two rectangular shaped kraals were attached to the back of the house on the southern side. The walls of the kraals are approximately 1 meter high and they are connected to each other through a small gate in the middle between them. The second kraal has a stone and cement-built dipping well. The site is marked on the 1967 map with the name "Dipgat" and changed to "Diepgat" on the 1983 topomap. **Site extent**: 5x5m.	Medium	GP.B

Figure 26 – Small stone house and attached cattle kraal at RKA04

Figure 27 – Stone and cement dipping well

Site[3] number	Lat	Lon	Description	Heritage Significance	Heritage Rating
RKA05	S32.72478°	E20.25241°	This site comprises a low-density scatter (2-5 artefacts/10m²) of Later Stone Age artefacts that was situated in a clearing, subject to some measure of sheet erosion exposing them, approximately 50m from a dry river bed and also approximately 50m from the building identified at site RKA 004. The artefacts consist mostly of debitage (waste material such as flakes, chips and chunks) which were produced from fine-grained dolorite, quarts and CCS (Crypto-crystalline silicates). **Site extent**: 15x15m.	Low	GP.C

Figure 28 – General landscape at site RKA05

Figure 29 – Dolerite, quartz and CCS debitage

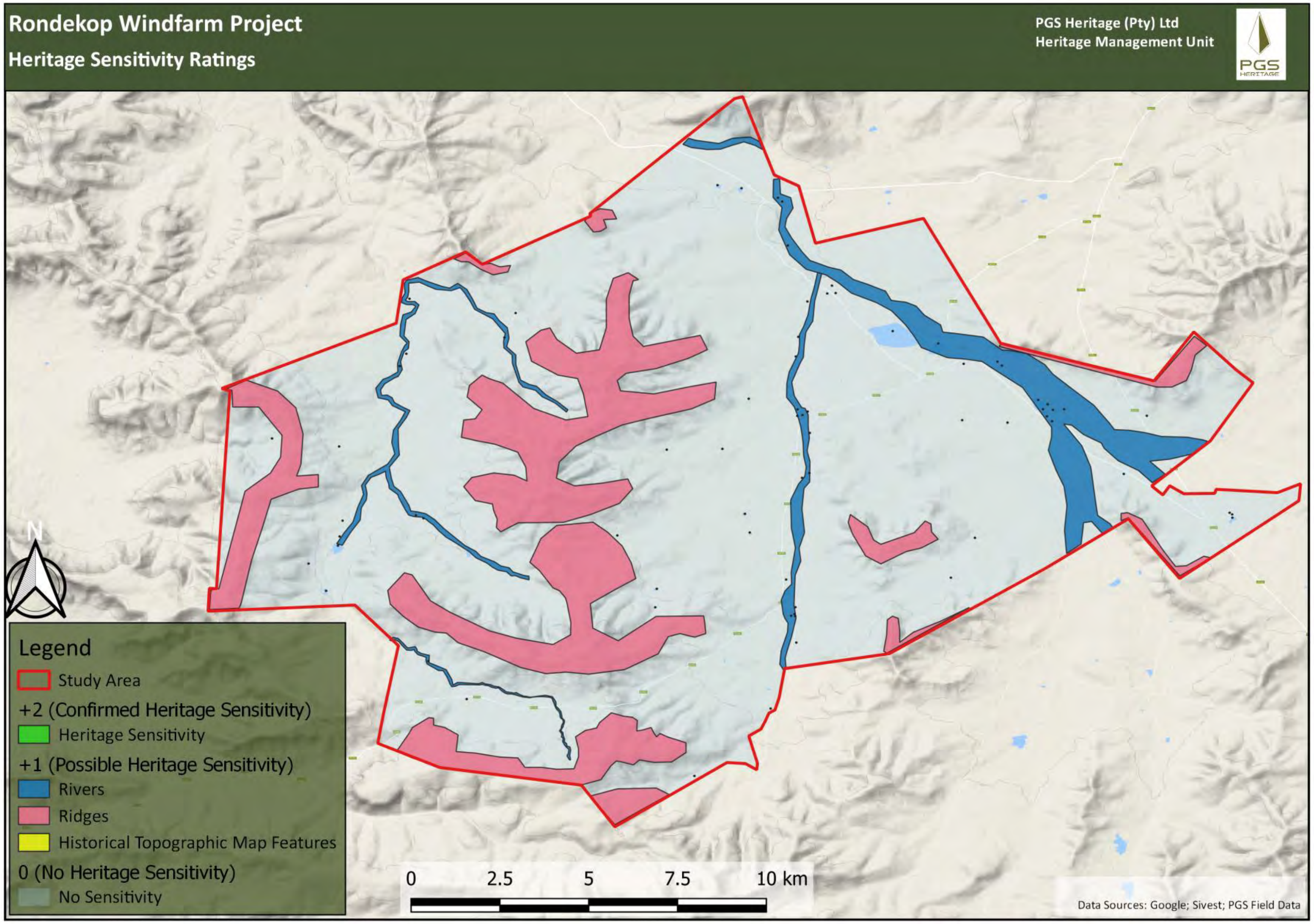

Figure 30 – Sensitivity rating map

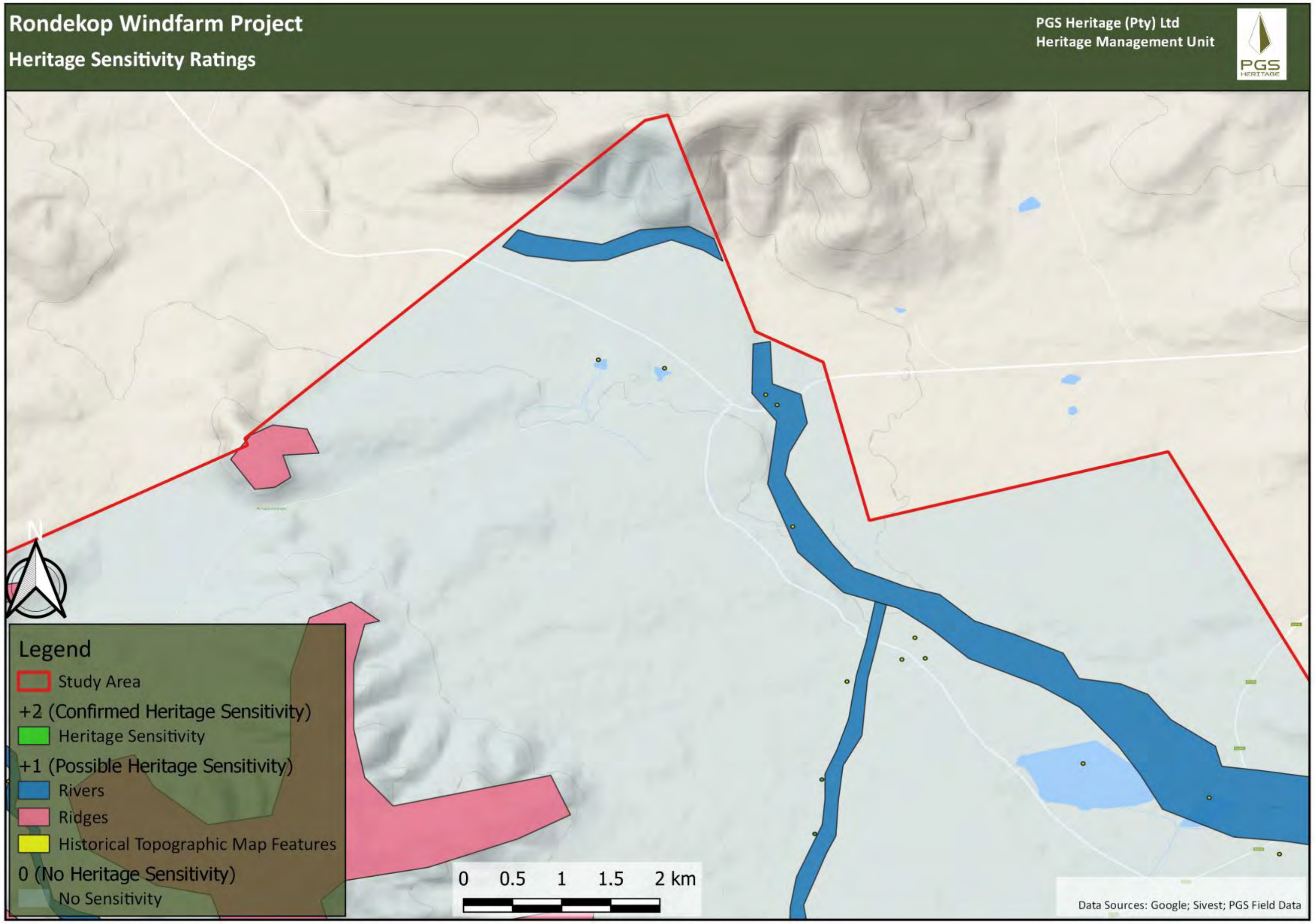

Figure 31 - Sensitivity rating map, Northern section

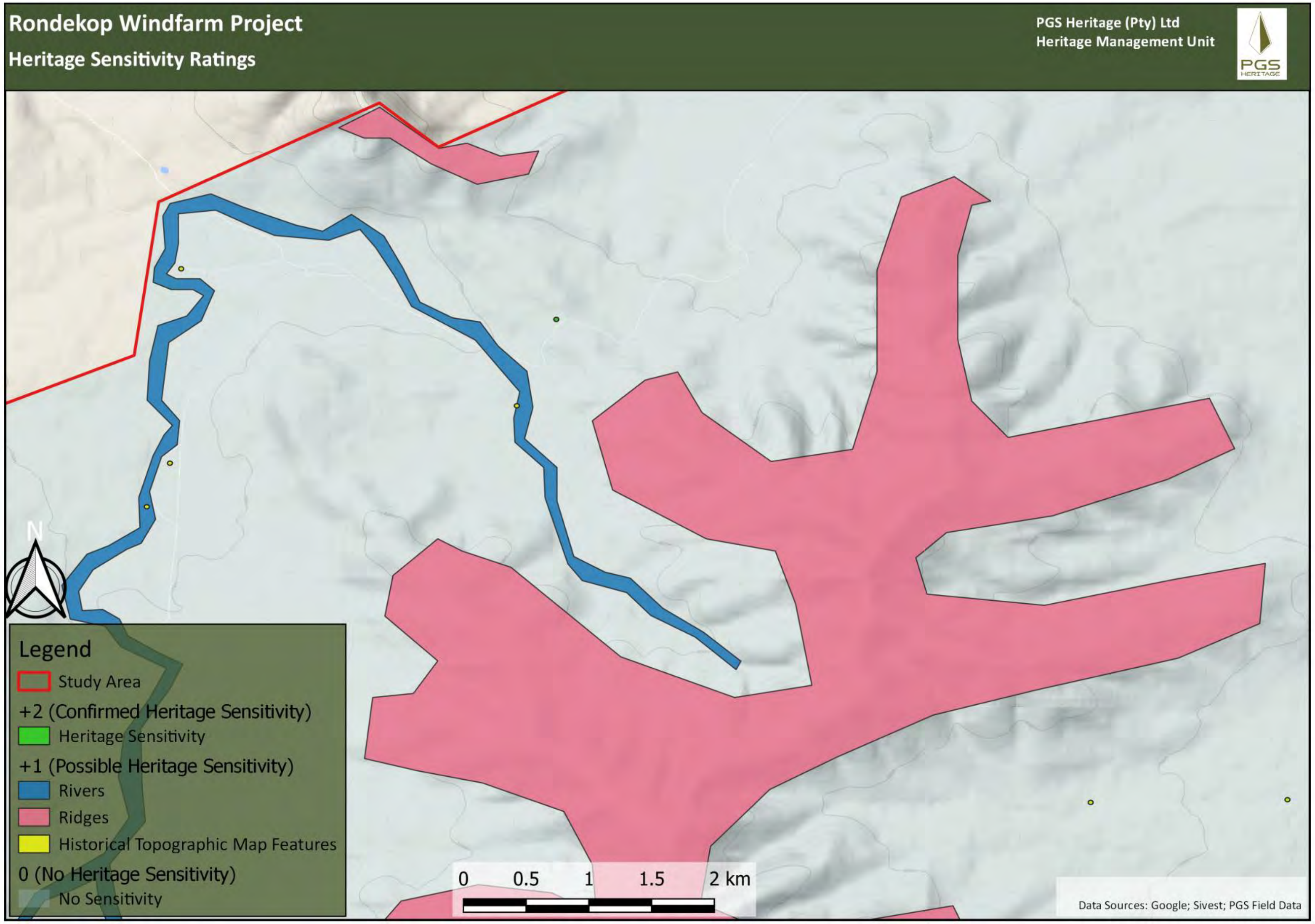

Figure 32 - Sensitivity rating map, North-Mid section

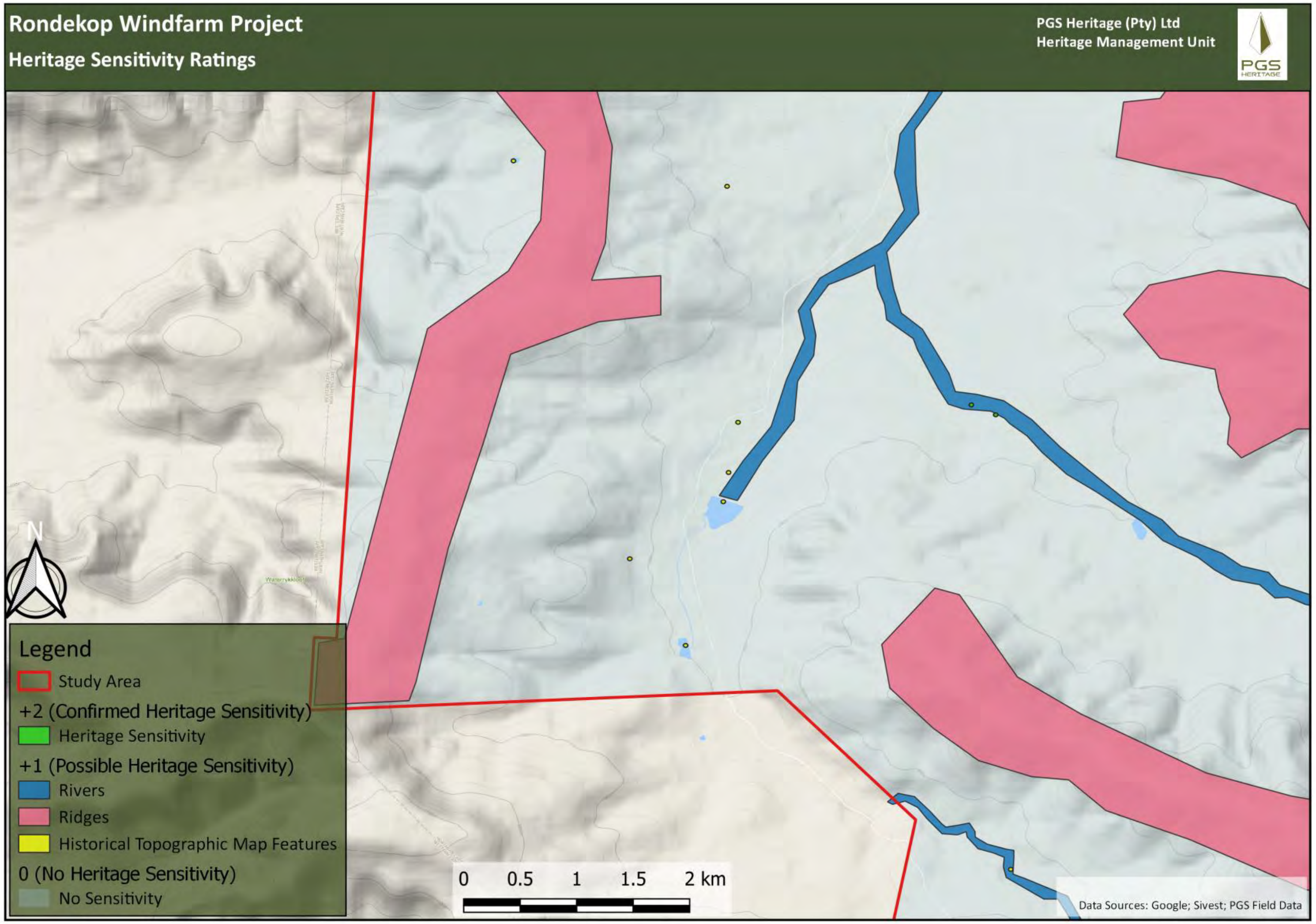

Figure 33 - Sensitivity rating map, South-West section

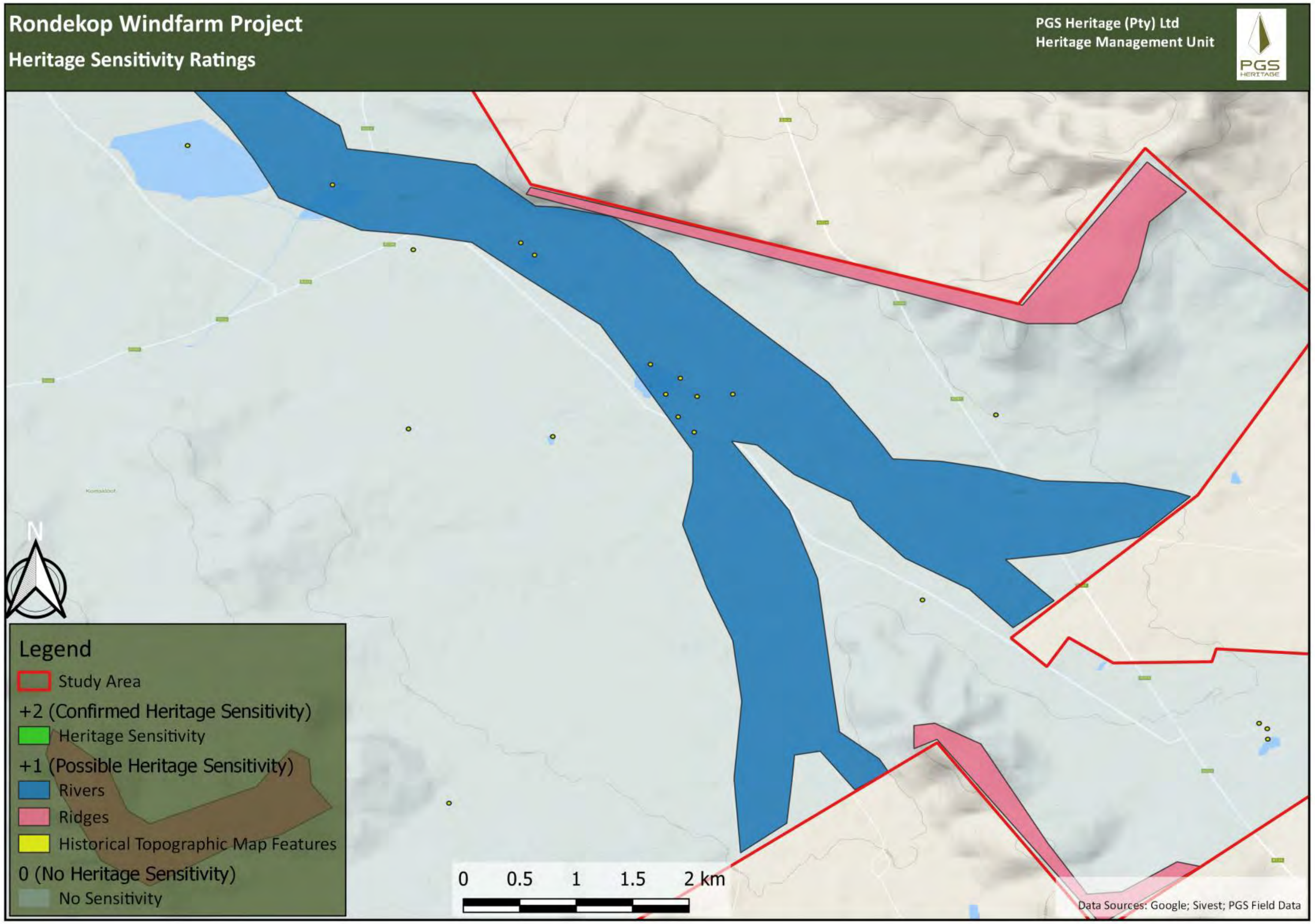

Figure 34 - Sensitivity rating map, East section

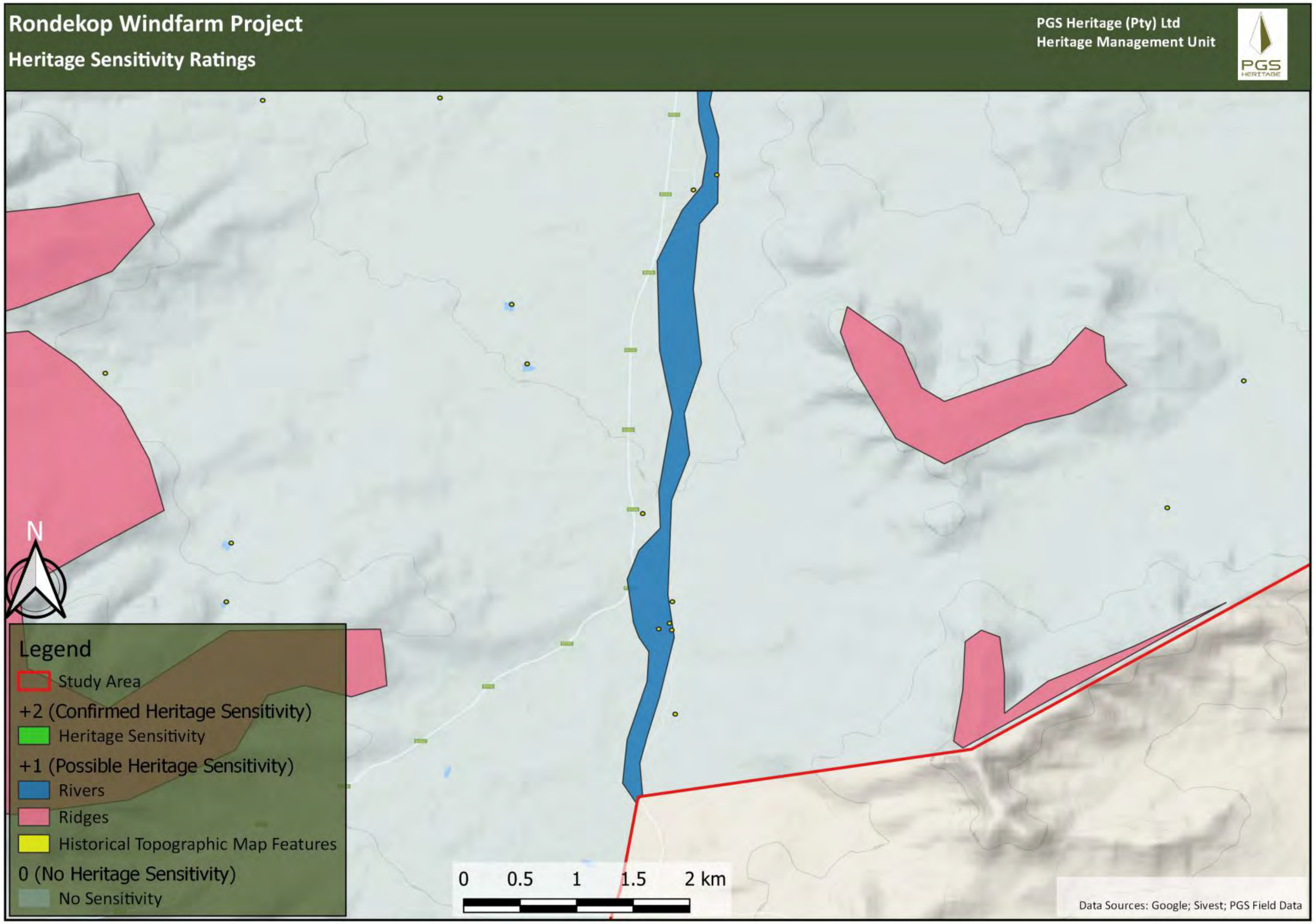

Figure 35 - Sensitivity rating map, South-East section

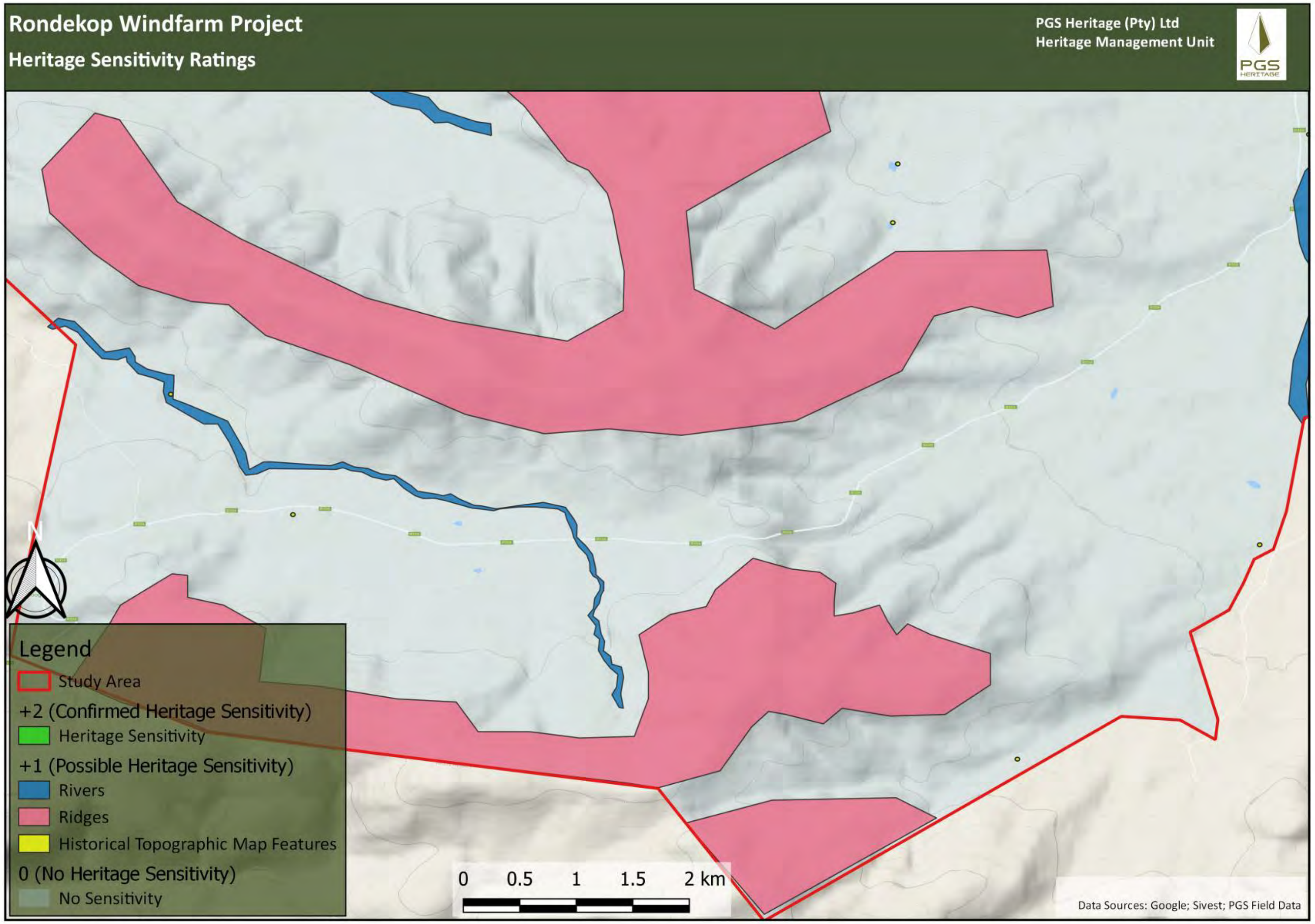

Figure 36 - Sensitivity rating map, South section

Figure 30, Figure 31, Figure 32, Figure 33, Figure 34, Figure 35 & Figure 36 shows the heritage sensitivity ratings of the study area according to confirmed heritage sites through ground trothing and possible heritage sensitive areas indicated by natural features such as ridges and rivers as well as possible heritage features detected on the archival topographic maps.

4.2 Palaeontology

The proposed development site is underlain by the Abrahamskraal Formation, Adelaide Subgroup, of the lower Beaufort Group (Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup) (**Figure 38** and **Figure 39**). The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. The Beaufort Group of the Karoo Basin consists of a lower Adelaide Subgroup and an upper Tarkastad Subgroup. This group is the focus of palaeontological research in South Africa and are internationally renowned for the early diversification of land vertebrates. The Beaufort Group provide the worlds' most complete transition from early "reptiles" to mammals (Butler, 2018).

4.2.1 Ecca Group

4.2.1.1 Waterford Formation

Fossil remains from this formation usually consists of poorly preserved tetrapod bones that could probably belong to the aquatic temnospondyl amphibians. Scattered fish scales and fish coprolites have been recovered as well as several genera of non-marine bivalves. A low diversity of trace assemblages have been described that may belong to the *Scoyenia ichnofacies*. These trace fossils could possibly have been made by small arthropods, earthworms and even insects. Petrified wood of the Glossopteris flora are commonly found in this formation as well as gymnospermous woods namely, *Prototaxoxylon* and *Australoxylon* (Butler, 2018).

4.2.2 Beaufort Group

The Beaufort Group has been divided into a series of fossil biozones known as fossil assemblage zones (AZ) (**Figure 5**). These AZ are distinguished by their characteristic tetrapod faunas. The Abrahamskraal Formation is represented by the *Eodicynodon, Tapinocephalus* and partially by the *Pristerognathus* Assemblage Zones. The AZ present in the proposed Rondekop WEF development is most probably the *Tapinocephalus* Assemblage Zone (Butler, 2018).

4.2.2.1 Tapinocephalus Assemblage Zone

Vertebrate fossils in this assemblage zone is not as abundantly found as in later assemblage zones. Fossils are generally recovered as single specimens and is often covered by brown-weathering calcareous nodular material. Fauna present in this assemblage zone is mostly large bodied dinocephalians and pareiasaurs. Large *Bradysaurus* specimens are found as complete articulated skeletons and in a dorsal-up position while dinocephalian skulls with associated postcrania are extremely uncommon (**Figure 7**). A few isolated carnivore specimens of grogonopsia (also known as sabre toothed reptiles), biarmosuchians and therocephalians have been recovered while pelycosaurus are uncommon (Butler, 2018).

The *Tapinocephalus* AZ is also known for large disarticulated amphibians as well as palaeoniscoid bony fish, mostly represented by scattered scales. Gastropods are represented by freshwater bivalves. Fragmentary vascular plant remains include roots, twigs and leaves and petrified wood. Trace fossils are also known from this assemblage zone and include traces of arthropod, tetrapod and worm burrows, tetrapod trackways, fossilized faeces or coprolites and stem and plant casts (Butler, 2018).

Vertebrate fossils found in the Sutherland area include the tapinocephalid and titanosuchid dinocephalians, the pareiasaur *Bradysaurus*, as well as more uncommon dicynodonts, gorgonopsians and therocephalians. Several examples of plant remains have also been documented from this assemblage zone (Butler, 2018).

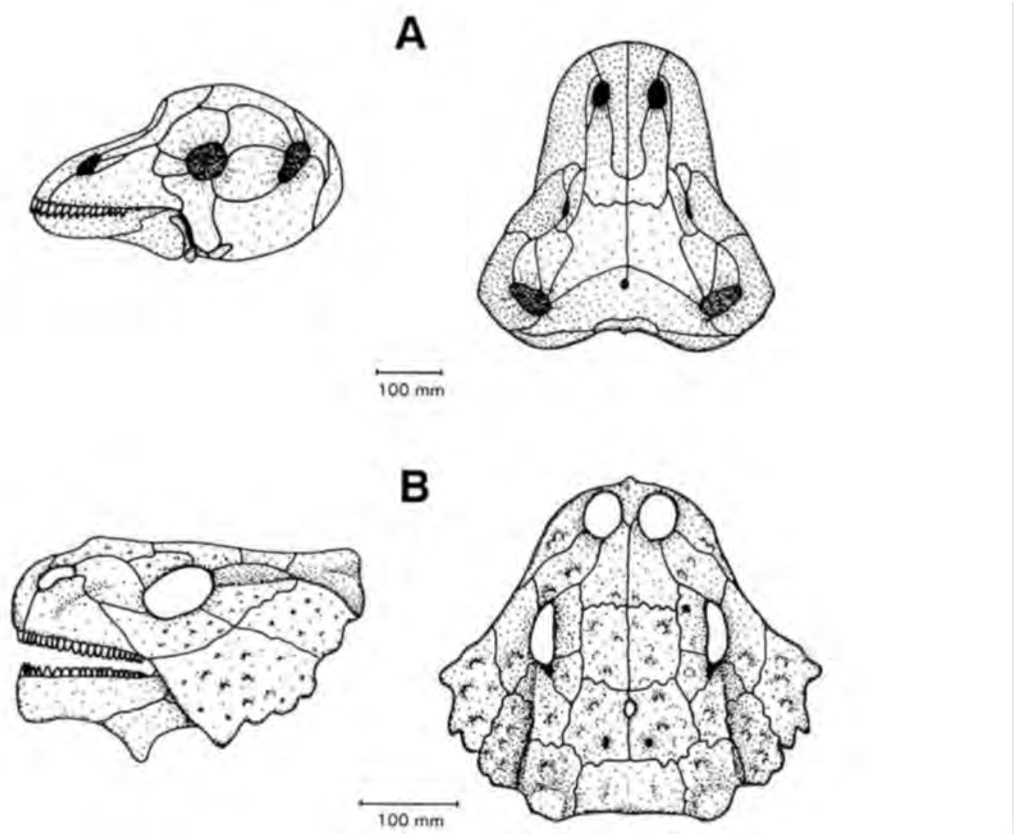

Figure 37 - Fossils characteristic of the Tapinocephalus AZ include A) the dinocephalian therapsid Tapinocephalus and B) the pareiasaur Bradysaurus. Figure taken from (Butler, 2018).

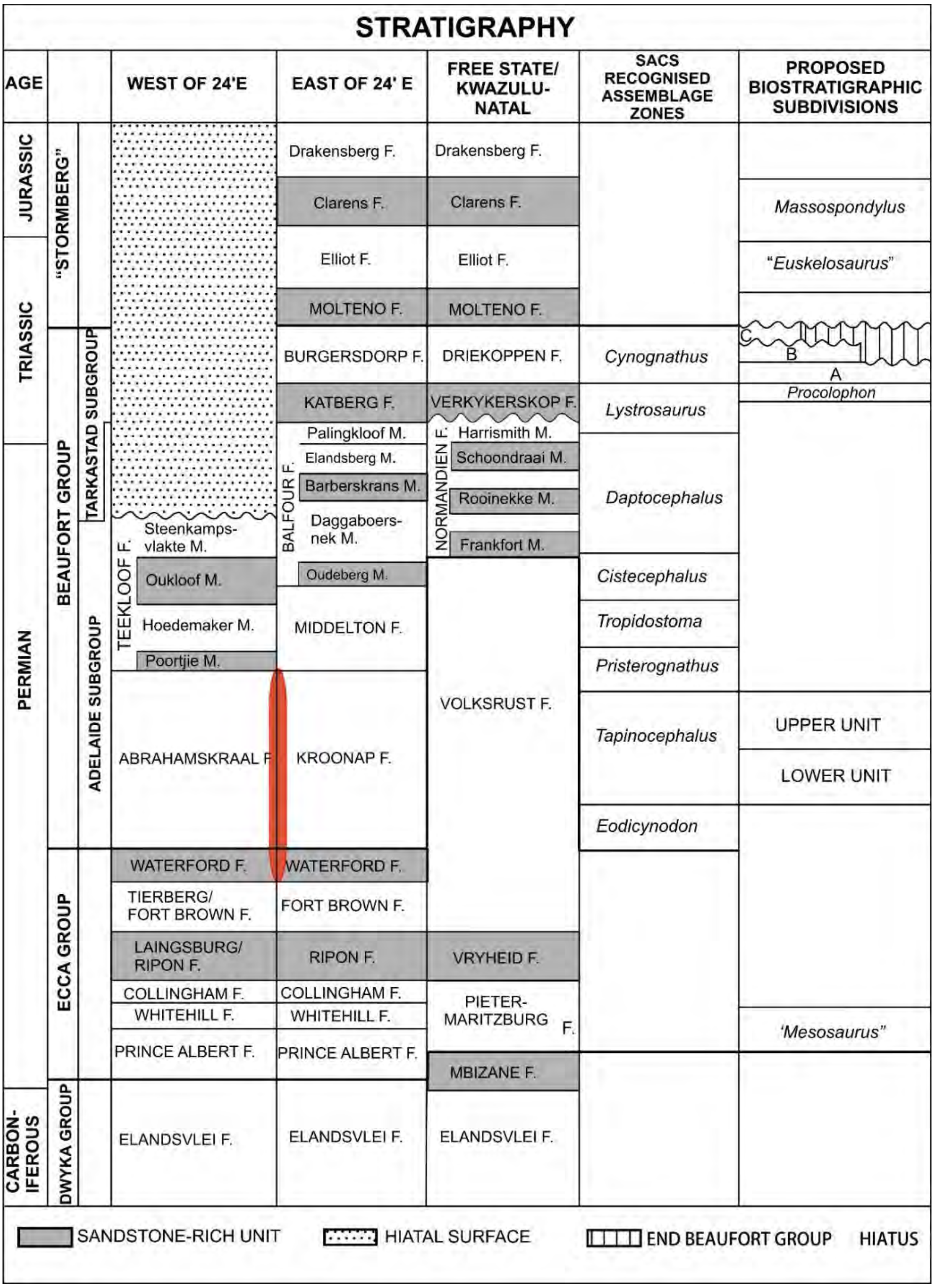

Figure 38 – Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions Beaufort Group of the Karoo Supergroup with rock units and fossil assemblage zones relevant to the present study marked in orange (Modified from Rubidge 1995). Abbreviations: F. = Formation, M. = Member (Figure taken from (Butler, 2018)).

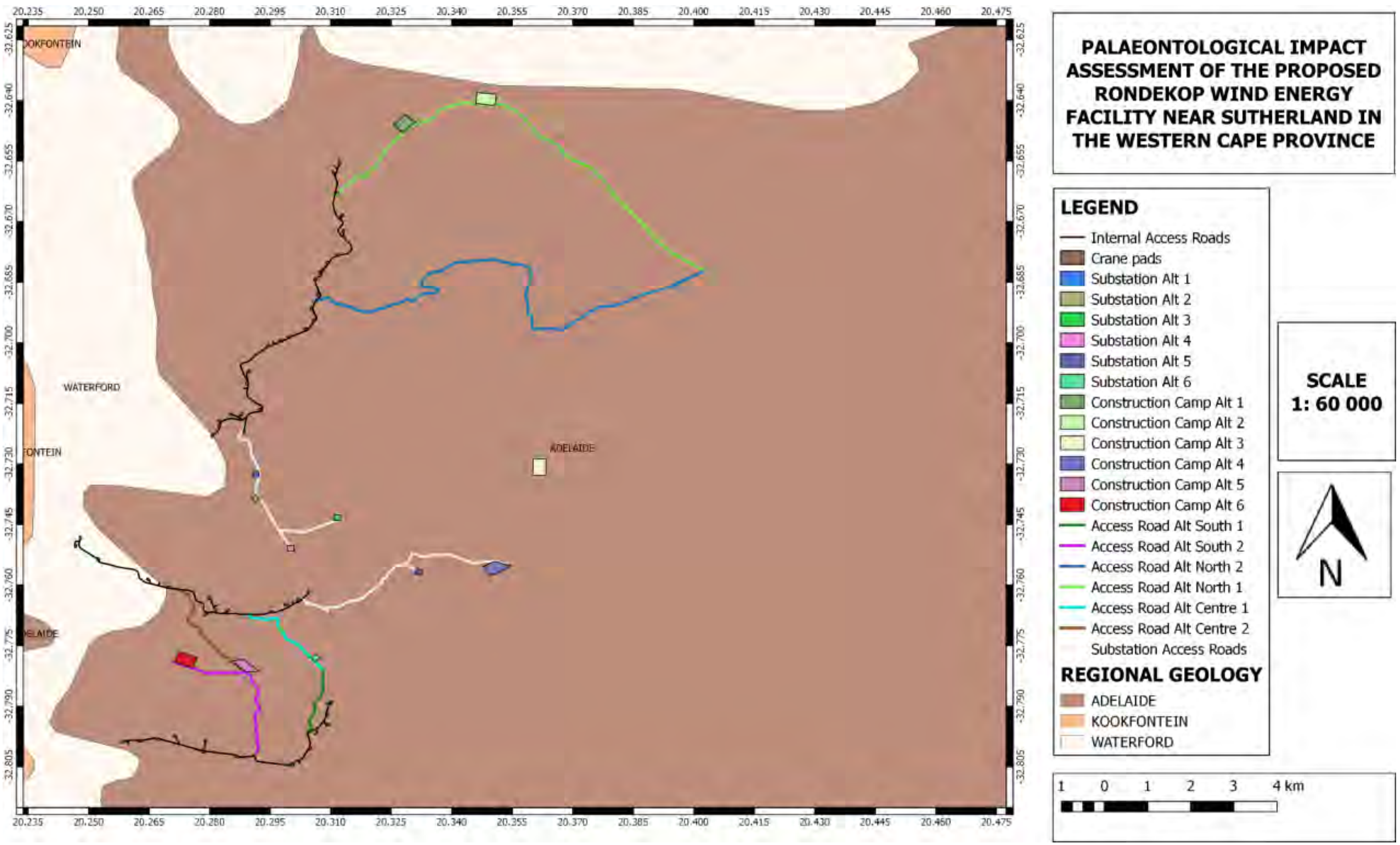

Figure 39 – Surface Geology for the proposed Rondekop Wind Energy Facility near Sutherland in the Western Cape Province. The proposed development site is underlain by the Adelaide Formation of the Beaufort Group (Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup). Figure taken from (Butler, 2018).

4.3 Cultural Landscape

The visual assessment completed by Schwartz et al (2018) for the Rondekop WEF characterised the study area as a ”*typical of a Karoo or “platteland” landscape that would characteristically be encountered across the high-lying dry western and central interior of South Africa.*”

Gibb et al (2018) categorises cultural landscapes as “

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

They further describe the typical Karoo landscape as 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 also a 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 towns, such as Sutherland and Matjiesfontein, 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.

They find that in terms 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.

Schwartz et al (2018) considers that the study area as visible to a viewer thus represents a typical Karoo cultural landscape. They find that this as an important factor in considering visual impacts associated with the development and a potential degrading factor in the context of the Karoo character.

They do however find that visual impacts on the cultural landscape would be reduced by the fact that the area is very remote and there are no significant tourism enterprises attracting visitors into the study area. In addition, the nearest major scenic route, the

R354, is outside the 8km visual assessment zone and is not expected to experience any visual impacts from the proposed WEF.

The cultural landscape in this area is therefore considered to be of low significance and the impacts on the cultural landscape of low significance.

5 IMPACT ASSESSMENT

The impact assessment rating is based on the rating scale as contained in **Appendix B** and **Appendix C**.

Table 2 – Stone Age impact rating

IMPACT TABLE		
Environmental Parameter	*Stone Age find spots and sites*	
Issue/Impact/Environmental Effect/Nature	*Two types of Stone Age heritage have been identified during the survey; both the find spots and sites rated as having low archaeological significance.* *None of the identified find spots or sites will be impacted by construction activities, therefore the impact is seen as negligible.*	
Extent	*Site*	
Probability	*Unlikely*	
Reversibility	*Irreversible*	
Irreplaceable loss of resources	*The nature of heritage resources is such that they are non-renewable. The proper mitigation and documentation of these resources can however preserve the data for research*	
Duration	*Permanent*	
Cumulative effect	*Low*	
Intensity/magnitude	*Low*	
Significance Rating	*Low negative before mitigation and low negative after mitigation*	
	Pre-mitigation impact rating	**Post-mitigation impact rating**

Extent	1	1
Probability	1	1
Reversibility	4	4
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-16 (low negative)	-15 (low negative)
Mitigation measures	1. *A chance find protocol will need to be enacted during construction activities.* 2. *A 20m buffer should be applied to all Stone Age find spots and sites.* 3. *Provide ECO with locations and monitor excavations*	

Table 3 – Colonial buildings impact rating

IMPACT TABLE		
Environmental Parameter	*Colonial buildings and stone walled kraals*	
Issue/Impact/Environmental Effect/Nature	*Given that these features are in relatively good condition, providing decent data about the historic use of the Rondekop properties, and the early settlement history of the area, all colonial buildings and stone walled kraals have been assigned a medium significance rating.*	
Extent	*Site*	
Probability	*Unlikely*	
Reversibility	*Irreversible*	
Irreplaceable loss of resources	*The nature of heritage resources is such that they are non-renewable. The proper mitigation and documentation of these resources can however preserve the data for research*	
Duration	*Permanent*	
Cumulative effect	*Low*	
Intensity/magnitude	*Low*	
Significance Rating	*Low negative before mitigation and low negative after mitigation*	
	Pre-mitigation impact rating	**Post-mitigation impact rating**

Extent	1	1
Probability	1	1
Reversibility	4	4
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-16 (low negative)	-15 (low negative)
Mitigation measures	1. *A 50m buffer should be applied to all Colonial buildings and stone walled kraals.* 2. *Provide ECO with locations and monitor excavations*	

Table 4 – Impact on monuments (memorials)

IMPACT TABLE		
Environmental Parameter	*Monuments (memorials)*	
Issue/Impact/Environmental Effect/Nature	*Given that this feature is in relatively good condition, providing data about the historic use of the Rondekop properties, and the early settlement history of the area, this monument been assigned a medium significance rating.*	
Extent	*Site*	
Probability	*Unlikely*	
Reversibility	*Irreversible*	
Irreplaceable loss of resources	*The nature of heritage resources are such that they are non-renewable. The proper mitigation and documentation of these resources can however preserve the data for research*	
Duration	*Permanent*	
Cumulative effect	*Low*	
Intensity/magnitude	*Low*	
Significance Rating	*Low negative before mitigation and low negative after mitigation*	
	Pre-mitigation impact rating	**Post-mitigation impact rating**
Extent	1	1
Probability	1	1

Reversibility	4	4
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-16 (low negative)	-15 (low negative)
Mitigation measures	1. *A 50m buffer should be applied to all monuments.*	

Table 5 – Chance finds impact rating

IMPACT TABLE	
Environmental Parameter	*Unidentified heritage structures, beyond the already surveyed portions of the property.*
Issue/Impact/Environmental Effect/Nature	*Due to the size of the area assessed, and the design process requiring surveying before identification of the layout, the possibility of encountering heritage features in non-surveyed areas does exist.*
Extent	*Site*
Probability	*Possible*
Reversibility	*Irreversible*
Irreplaceable loss of resources	*The nature of heritage resources are such that they are non-renewable. The proper mitigation and documentation of these resources can however preserve the data for research*
Duration	*Permanent*
Cumulative effect	*Medium*
Intensity/magnitude	*Low*
Significance Rating	*Low negative before mitigation and low negative after mitigation*

	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	2	2
Reversibility	4	4
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	2	1

Intensity/magnitude	1	1
Significance rating	-17 (low negative)	-16 (low negative)
Mitigation measures	1. *An archaeological walk down of the final approved layout will be required before construction commence;* 2. *Any heritage features of significance identified during this walk down will require formal mitigation or where possible a slight change in design could accommodate such resources.* 3. *A management plan for the heritage resources needs then to be compiled and approved for implementation during construction and operations.* 4. A chance finds protocol must be develop that include the process of work stoppage, site protection, evaluation and informing SAHRA of such finds and a final process of mitigation implementation.	

Table 6 - Palaeontological Impact – Chance Finds

IMPACT TABLE		
Environmental Parameter	*Prevent the loss of Palaeontological Heritage not identified during the site survey.*	
Issue/Impact/Environmental Effect/Nature	*Due to the size of the project and the design method requiring surveying before identification of the layout, there is a possibility to come across fossil heritage not surveyed.*	
Extent	*Site (1)*	
Probability	*Possible (3)*	
Reversibility	*Irreversible (4)*	
Irreplaceable loss of resources	*By taking a precautionary approach, an insignificant loss of fossil resources is expected (**No Loss**). (1)*	
Duration	*Permanent (4)*	
Cumulative effect	*Low*	
Intensity/magnitude	*Low*	
Significance Rating	*Low*	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	1	1
Probability	3	1
Reversibility	4	4
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-14 (negative low)	-12(negative low)
Mitigation measures	Monitoring of major excavations for fossil material by the ESO on an on-going basis during construction phase. Significant fossil finds to be reported to SAHRA for recording and sampling by a professional palaeontologist Chance find procedure must be followed. • When a chance find is made the person must instantly stop all work near the find. • The site must be secured to protect it from any additional damage • The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the Mine/development management. The supervisor must in turn report the find to his/her manager and the ECO. The ECO must report the find to the relevant Authorities and a relevant palaeontologist. • The ECO must appoint a relevant palaeontologist to investigate and access the chance find and site. • Both ECO and palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings. • These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site • The reports and all other documents will be submitted to SAHRA by the palaeontologist. • The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development. • Once the required approvals have been issued, the Mine/development may carry on with the development.	

	• The ECO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan.

Table 7 - Palaeontological Impact – Construction Phase

IMPACT TABLE		
Environmental Parameter	Prevent the loss of Palaeontological Heritage	
Issue/Impact/Environmental Effect/Nature	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study.	
Extent	Excavation of the ground surface *of the **site** (1)*	
Probability	As fossil heritage is known from these formations the probability of impacts on palaeontological heritage during the construction phase is probable (3).	
Reversibility	Impacts on fossil heritage are usually **irreversible**. (4)	
Irreplaceable loss of resources	By taking a precautionary approach, an insignificant loss of fossil resources is expected (**No Loss**). (1)	
Duration	The expected duration of the impact is assessed as potentially permanent to **long term**. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent (4).	
Cumulative effect	The cumulative effect of the development of the WEF and associated infrastructure within the proposed location is considered to be **low**. This is as a result of the broader Sutherland area not being considered as fossiliferous.(1)	
Intensity/magnitude	The intensity of the impact on fossil heritage is rated as **low (1)**.	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	1	1
Probability	3	1
Reversibility	4	4
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-14 (negative low)	-12 (negative low)
Mitigation measures	Monitoring of major excavations for fossil material by the ESO on an on-going basis during construction phase. Significant fossil finds to be reported to SAHRA for recording and sampling by a professional palaeontologist Chance find procedure must be followed. • When a chance find is made the person must instantly stop all work near the find. • The site must be secured to protect it from any additional damage • The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the Mine/development management. The supervisor must in turn report the find to his/her manager and the ECO. The ECO must report the find to the relevant Authorities and a relevant palaeontologist. • The ECO must appoint a relevant palaeontologist to investigate and access the chance find and site. • Both ECO and palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings. • These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site • The reports and all other documents will be submitted to SAHRA by the palaeontologist.	

	• The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development. • Once the required approvals have been issued, the Mine/development may carry on with the development. • The ECO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan.

The overall impact of the development will be low on the identified heritage resources while the impact will be very high on palaeontological resources. With the implemented mitigation measures these impacts will be reduced to an acceptable level (low).

Table 8 - No-Go / Status-Quo Alternative

IMPACT TABLE		
Environmental Parameter	*Heritage resources*	
Issue/Impact/Environmental Effect/Nature	*No impact on identified heritage resource are foreseen if a no-go option is considered*	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*The no-go alternative will have no impact on the identified heritage resources of the study area*	
Duration	*Permanent*	
Cumulative effect	*Negligible Cumulative Impact*	
Intensity/magnitude	*Low*	
Significance Rating	*Low negative before mitigation and low negative after mitigation*	
	Pre-mitigation impact rating	**Post-mitigation impact rating**
Extent	1	1
Probability	1	1

Reversibility	1	1
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-9 (low negative)	-9 (low negative)
Mitigation measures	*None required*	

5.1 Cumulative Impacts (CI)

This section evaluates the possible cumulative impacts (CI) on heritage resources with the addition of the Rondekop WEF. The CI on heritage resources evaluated a 50-kilometer radius (**Figure 40**). It must further be noted that the evaluation is based on available heritage studies (**Figure 41**) and cannot take the findings of outstanding studies on current ongoing EIA's in consideration.

The following must be considered in the analysis of the cumulative effect of development on heritage resources:

- **Fixed datum or dataset:** There is no comprehensive heritage data set for the Sutherland region and thus we cannot quantify how much of a specific cultural heritage element is present in the region. The region has never been covered by a heritage resources study that can account for all heritage resources. Further to this none of the heritage studies conducted can with certainty state that all heritage resources within the study area has been identified and evaluated;
- **Defined thresholds**: The value judgement on the significance of a heritage site will vary from individual to individual and between interest groups. Thus implicating that heritage resources' significance can and does change over time. And so will the tipping threshold for impacts on a certain type of heritage resource;
- **Threshold crossing**: In the absence of a comprehensive dataset or heritage inventory of the entire region we will never be able to quantify or set a threshold to determine at what stage the impact from developments on heritage resources has reached or is reaching the danger level or excludes the new development on this basis. (Godwin, 2011)

Keeping the above short comings in mind, the methodology in evaluating cumulative impacts on heritage resources has been as follows.

The analysis of the competed studies as listed in **Table 9 & Table 10,** took in to account the findings and recommendation of each of the sixteen evaluaed HIA's and thirteen RE EIAs. The cumulative impact on the cultural landscape was discounted as the HIA's, in most cases, did not address this and the Visual Impact Assessment covers such analysis in detail.

The overall findings of the 29 studies all concur that the area is characterised by numerous Stone Age findspots and archaeological resources. Many these concentrated around pans and outcrops in a landscape where water, food and shelter came at a premium. The sites around the pans and the outcrops where in most cases given a medium to high heritage significance on a local scale and in the majority of the cases were recommended as being no-go areas or extensive mitigation is required. There are no pans located within the Rondekop project site.

This cumulative assessment has also not addressed the possible cumulative impacts on the heritage landscape. The evaluated studies have in most cases not addressed or quantified the possible impact on the cultural landscape.

Table 9 & Table 10 provide an analysis of the projected cumulative impact this project will add to impact on heritage resources.

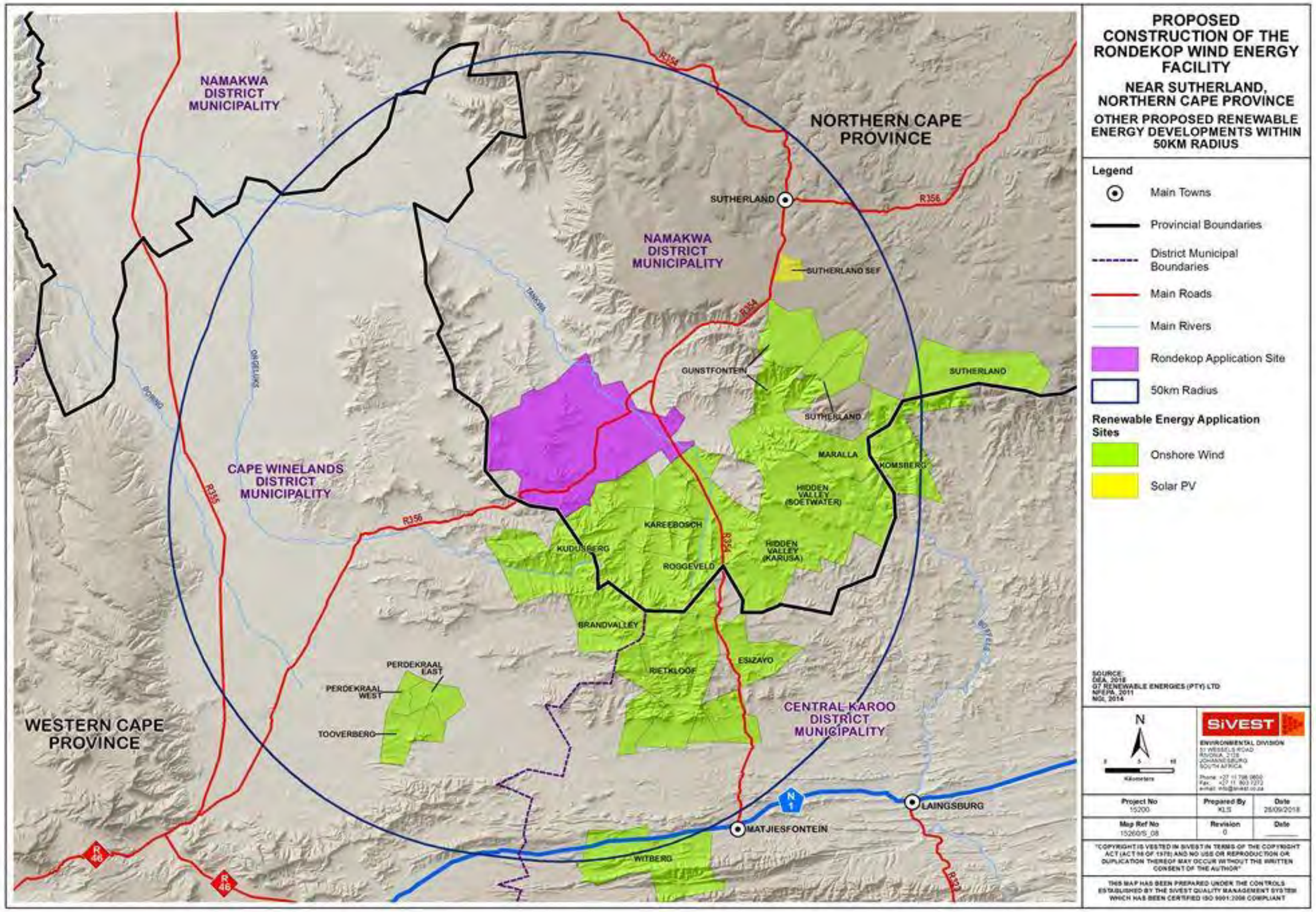

Figure 40 - Other Renewable Energy developments in relation to the Rondekop WEF application area (Sivest 2018)

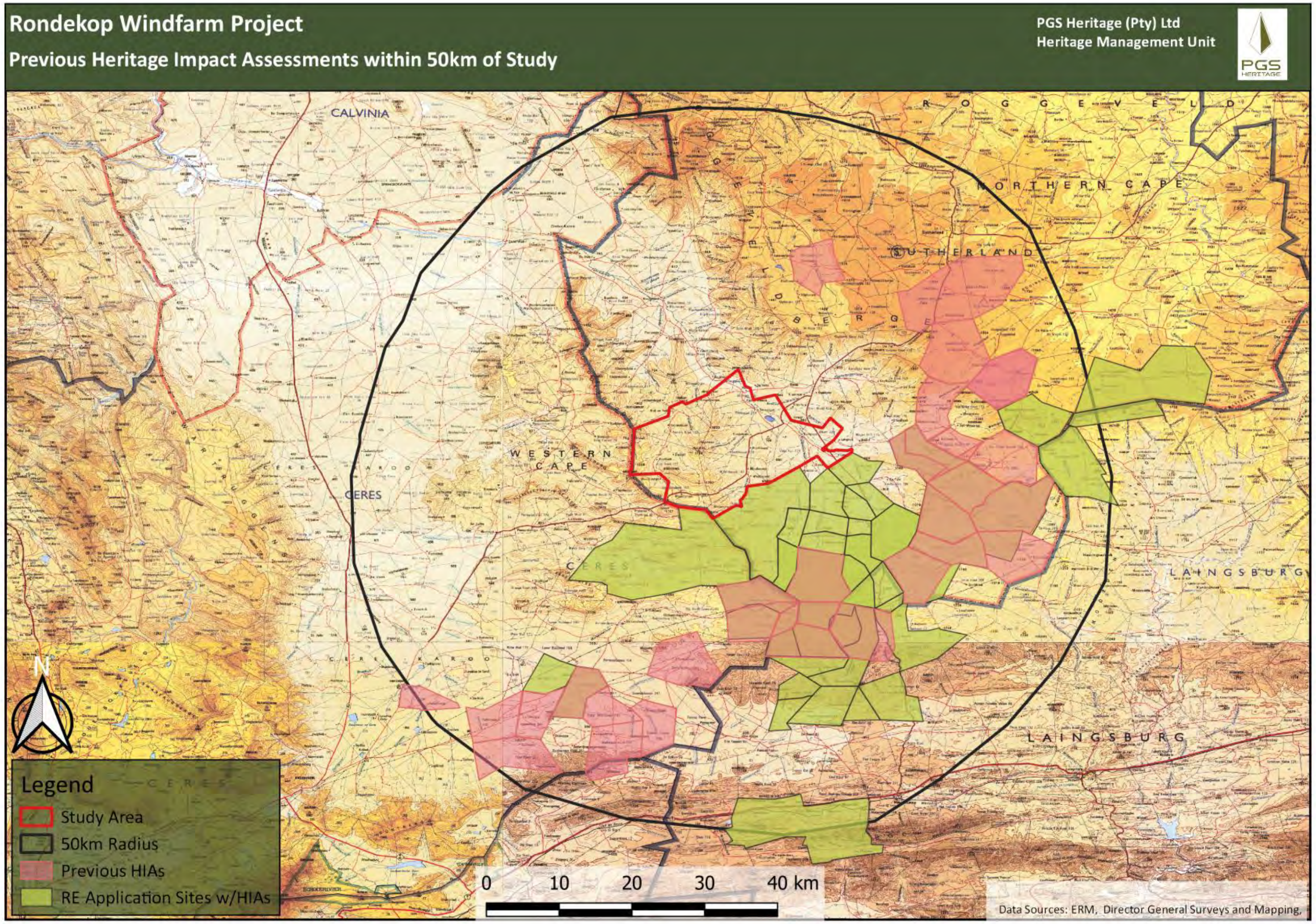

Figure 41 - Other RE developments in relation to the Rondekop WEF application area, where HIAs were completed

Table 9 – Heritage Impact Assessments conducted within 50km of Rondekop WEF application area

Study	Findings	Recommendation
ALMOND, J, & ORTON, J. 2017. Heritage Impact Assessment: Proposed Construction of a Substation and 132 kV Distribution Line to support the Proposed Sutherland 2 WEF, Sutherland and Laingsburg Magisterial Districts, Northern and Western Cape.	*Historical and Stone Age heritage remains as well as several burial grounds and fossil sites were uncovered in this assessment.*	▪ It was recommended that development may continue under the condition that 30m & 20m buffers are implemented around certain 'no-go' sites and that the relevant contingencies are implement should heritage remains be affected by the development process.
BANDAMA, F. & MOHAPI, M. 2014. An Archaeological Scoping and Assessment Report for The Proposed Gamma (Victoria West, Northern Cape) - Kappa (Ceres – Western Cape) 765Kv (2) Eskom Power Transmission Line.	*This scoping report identified a range of heritage resources in and around the local area including: stone walling (kraals and possible windbreaks), ESA-LSA artefact scatters, buildings and farm complexes (with associated artefacts like glass, metal and ceramic), rock art and engravings, pottery and graves (both formal and informal).*	▪ It was recommended that a detailed walkdown of the powerline options be considered due to high number of sites in the area albeit being of low significance.
BOOTH, C. 2012. A Phase 1 AIA for the proposed Hidden Valley Wind Energy Facility, near Sutherland, Northern cape Province.	*Historical heritage resources were uncovered in this assessment.*	▪ It was recommended that an archaeologist be present during all construction related activities in two of the study areas.
BOOTH, C. 2015. A Phase 1 Archaeological Impact Assessment for the Proposed Karusa Facility Substation and Ancillaries, near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, NC Province.	*No significant heritage resources were uncovered in this assessment.*	▪ It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.
BOOTH, C. 2015. A Phase 1 Archaeological Impact Assessment for the Proposed Eskom Karusa Switching Station, Ancillaries and a 132kV Double Circuit Overhead Power Line, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province.	*Some low significance Historical heritage remains were uncovered in this assessment.*	▪ It was recommended that a 30m buffer around discovered sites be adhered to and that the relevant contingencies are implement should heritage remains be uncovered during the development process.

Study	Findings	Recommendation
BOOTH, C. 2015. An Archaeological Walk-Through For The Proposed Karusa Wind Energy Facility Situated On The Farms: De Hoop 202, Standvastigheid 210, Portion 1 Of The Farm Rheebokke Fontein 209, Portion 2 of the Farm Rheebokke Fontein 209, Portion 3 of the Farm Rheebokke Fontein 209 andthe Remainder Of The Farm Rheebokke Fontein 209, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province.	*Historical heritage resources were uncovered in this assessment*.	▪ It was recommended that the historical remains be recorded and a destruction permit be applied for if they are not able to be avoided.
BOOTH, C. 2015. An Archaeological Walk-Through for the Proposed Soetwater Wind Energy Facility Situated On The Farms: The Remainder Of And Portion 1, 2 And 4 Of Farm Orange Fontein 203 And Annex Orange Fontein 185, Farm Leeuwe Hoek 183 And Farm Zwanepoelshoek 184, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province.	*No significant heritage resources were uncovered in this assessment.*	▪ It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.
BOOTH, C. 2015. A Phase 1 Archaeological Impact Assessment for the Proposed Soetwater Substation, 132kvV Overhead Powerline and Ancillaries Soetwater Wind Energy Facility, Near Sutherland, Karoo Hoogland Local Municipality, Namakwa District Municipality, Northern Cape Province.	*No significant heritage resources were uncovered in this assessment.*	▪ It was recommended that the development may continue and that the relevant contingencies are implement should heritage remains be uncovered during the development process.

Study	Findings	Recommendation
BOOTH, C. 2015. Phase 1 Archaeological Impact Assessment for the proposed extension of the existing Komsberg Substation (two alternative areas) and widening of the access road, near Sutherland, NC Province.	*No heritage remains were uncovered in this assessment.*	▪ It was recommended that the development may continue.
FOURIE, W. 2010. Archaeological Walk Down Report: Gamma-Omega Transmission Section 1: Gamma-Kappa.	*This study identified a range of heritage resources, the majority of which comprise Stone Age artefact scatters of varying densities. These are primarily ESA and MSA scatters, although LSA artefacts were also located. In addition, rock engravings were also found, along with stone walled structures of varied construction (kraals, walls, possible wind breaks); infrequent non-decorated potsherds were sporadic. Later historical structures were also found (with glass, metal and ceramic fragments), along with associated graves/burial areas. The earliest graves place regional occupation pre-1892.*	▪ The demarcation of sites as "no-go" areas ▪ Where the demarcation of sites is not sufficient, and the sites are unavoidable by the development, then mitigation measures must be implemented.
FOURIE, W., ALMOND, J. & ORTON J. 2014. National Wind and Solar PV SEA Specialist Assessment Report – Heritage Evaluation. This report provides on overview of potential heritage impacts in the REDZ Komsberg focus area 2.	*The following types of heritage are listed for this area: Middle and Later Stone Age artefact scatters (frequently associated with water sources), rock art (confined to the mountainous areas), colonial farmsteads (18-19th Century – farmhouses, kraals and earth dams), provincial heritage sites (i.e., Matjiesfontein, Karoopoort), South African War period fortifications and cemeteries (dating back to the early 1800s).*	▪ Mitigation: Adjust buffers through site specific management and incorporation of viewshed analysis from VIA's. ▪ Sensitive heritage features such as cultural landscapes and archaeological sites are very localised and can be managed through thorough HIAs as recommended in sensitive areas.
HALKETT, D, & ORTON, J. 2011. Heritage Impact Assessment for the Proposed Phtovoltaic Solar Energy Facility on the Remainder of Farm Jakhalsvalley 99, Sutherland Magisterial District, Wetern Cape.	*Historical heritage resources were uncovered in this assessment.*	▪ It was recommended that the development may continue however, the remains should be avoided and that the ECO must make sure of this.

Study	Findings	Recommendation
HALKETT, D. 2011. Heritage Impact Assessment Proposed Renewable Energy Facility at the Sutherland Site, Western and Northern Cape Provinces.	*Some historical and Stone Age heritage remains as well as a burial ground that was uncovered in this assessment.*	▪ It was recommended that development may continue and that the relevant contingencies are implement should heritage remains be affected by the development process.
KAPLAN, J. 2009. Phase 1 Archaeological Impact Assessment of the Proposed Driefontein Resort (Driefontein Farm No. 127) Sutherland, Northern Cape Province.	*Historical heritage remains were uncovered in this assessment.*	▪ It was recommended that the historical remains be avoided and that a Conservation Management Plan be drafted to protect the remains.
KAPLAN, J. 2015. Proposed borrow pit (Karusa North) on the Farm Rheebokke Fontein 209 Remainder near Sutherland, Northern Cape Assessment conducted under Section 38 (3) of the National Heritage Resource Act (No. 25 of 1999).	*Historical, Iron Age and Stone Age heritage remains were uncovered in this assessment.*	▪ Relevant sites should be protected, 20m buffers implemented where necessary and that the relevant contingencies are implement should heritage remains be uncovered during the development process.
KAPLAN, J. 2015. Proposed borrow pit (Karusa East) on the Farm Rheebokke Fontein 209/2 & 209/3 near Sutherland, Northern Cape.	*Low significance historical heritage resources were uncovered in this assessment.*	▪ It was recommended that the development may continue and that the relevant heritage authorities should be contacted if any human remains are uncovered during the development process.
VAN DER RYST, M. & FOURIE, W. 2014. Phase 2 Specialist Study of Affected Stone Age Locality on The Gamma Kappa Transmission Line – Tower GKB-T846 (Site GK062), Tankwa Karoo, Touwsrivier.	*This report documents medium density scatters of ESA, MSA and LSA artefacts at a single deflated, secondary context, locality, with the assemblage comprising a very low quantity of formal tools.*	▪ The mitigation procedure was deemed satisfactory and it was further recommended that a destruction permit may be applied for from SAHRA.
VAN DER WALT, J. 2015. Archaeological Impact Assessment Report for the Proposed Gunstfontein Wind Energy Facility, Northern Cape.	*Historical remains as well as Rock Art were uncovered in this assessment.*	▪ It was recommended that the development footprint be updated in order to accommodate the heritage findings and that the ECO must make sure the heritage resources are protected.

Study	Findings	Recommendation
VAN DER WALT, J. 2016. Archaeological impact assessment report for the proposed Gunstfontein 132 kV power line, switching station and ancillaries for the proposed Gunstfontein wind energy facility near Sutherland, Northern Cape.	*Desktop level assessment based of previous fieldwork done in the study area. Historical remains as well as Rock Art was uncovered in this assessment.*	▪ It is recommended that a full heritage walk down of the study area must be conducted.
WEBLEY, L. 2017. Heritage Impact Assessment: Proposed Construction of the Maralla West Wind Energy Facility near Sutherland in the Northern Cape.	*Historical and Stone Age heritage remains were uncovered in this assessment.*	▪ It was recommended that highly sensitive No-Go area should be avoided, that a walk-down be conducted should the development layout change and that the relevant contingencies are implement should heritage remains be uncovered during the development process.

Table 10 - Other proposed renewable projects within 50km of Rondekop WEF application site

Study	Findings	Recommendation
UCT Environmental Evaluation Unit. 2011. Touwsrivier Solar Energy Facility.	*This report anticipates the existence of Middle and Early stone age material in the ploughed lands within the study area while they have confirmed several historical structures relating to South African railway history.*	▪ A policy of minimal intervention is recommended with respect to the surviving historical railway infrastructure. In terms of archaeology, the site is considered to be insensitive however a walk-over would be required for the transmission lines once a route has been approved.
ERM. 2012. Proposed renewable energy facility at the Perdekraal Site 2, Western Cape.	*No heritage resources were identified with the proposed study area however two small rockshelters, several grave sites and concentration of historical structures were identified within the general vicinity of the study area.*	▪ If the Ekkraal Valley is to be impacted, then this area has to be thoroughly surveyed and all heritage sites recorded. Sensitive areas must be flagged so that these can be protected from construction related activities. ▪ If human remains are uncovered during the construction phase, work in the specific location should cease, and HWC/SAHRA should be notified.
Savannah Environmental. 2014. Roggeveld Wind farm.	*This report identified several stone age tool scatters and historical farm buildings, all of which considered low significance. Further, a number of collapsing stone structures including buildings, kraals, a well, oven and threshing floor were recorded, considered to be of low significance. Additionally, An unfenced graveyard is located on the Rietpoort farm and a number of stone cairns were identified which could represent graves. There is a high probability that additional*	▪ Avoid disturbance or damage to buildings and structures older than 60 years by maintaining 500m buffers around the on-site dwellings; ▪ Avoid inland water bodies (100m buffer) and rivers (200m buffer); ▪ Maintain a 200m buffer zone around cemeteries or graves onsite; and ▪ Remove turbines from the 'koppie' in the south eastern portion of the site comprising Waaipoort Formation and ensuring palaeontological input prior to or during construction of turbines along the thin band of Whitehill Formation running through the central portion of the Perdekraal farm (Rem of Lower Stinkfontein 245).

Study	Findings	Recommendation
	unmarked graves will be uncovered during the construction phase.	▪ Prior to or during foundation excavations which may be located on the Whitehill Formation, positions and/or excavations must be inspected by a palaeontologist; ▪ Buffer zones around built structures should be maintained during the construction phase to prevent damage to structures of heritage interest; ▪ Mitigation of the pre-colonial, colonial archaeology and avoidance of marked graves which may not have been identified during the site survey should involve micro-siting prior to construction; and ▪ Should any human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to the HWC and/or South African Heritage Resources Agency (SAHRA). After assessment and if appropriate a permit must be obtained from the SAHRA or HWC to remove such remains.
Savannah Environmental. 2014. Hidden Valley WEF.	This report identified multiple grave sites and historical structural remains. The historical sites are of low significance and the grave sites are of high significance.	• A professional archaeologist must be appointed during the construction phase to monitor and identify possible archaeological material remains and features that may occur below the surface and make further appropriate recommendations on removing and/or protecting the archaeological remains and features. • Should any human burials, archaeological or palaeontological materials (fossils, bones, artefacts etc.) be uncovered or exposed during earthworks or excavations, they must immediately be reported to the HWC and/or South African Heritage Resources Agency (SAHRA). After assessment and if appropriate a permit must be obtained from the SAHRA or HWC to remove such remains. • Construction managers/foremen should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites. • A 10m buffer zone must be maintained between sites and construction activities where the activities do encroach on the sites.
Savannah Environmental. 2015. Karreebosch Wind Farm.	This report identified scarce examples of Stone age remains however it found multiple grave sites and historical structural remains. All of which are of low-medium significance save for the grave sites.	▪ None of these heritage artefacts/sites occur within the proposed wind turbine development footprint. The pre-colonial heritage of the area as manifested by archaeological traces is extremely sparse. Very little material was identified and no particular mitigation is suggested. ▪ If any of the valley bottoms are to be impacted or the valley bottom roads widened, then this area will need to be thoroughly surveyed and all heritage sites recorded and mapped on the landscape. Sensitive areas must be flagged so that these can be protected from construction related activities.

Study	Findings	Recommendation
EOH. 2016. Proposed Brandvalley WEF.	This report identified scarce examples of Stone age remains however it found multiple grave sites and historical structural remains. All of which are of low-medium significance save for the grave sites.	• Once the final layout of the Brandvalley WEF has been established a more intensive survey of these areas should be conducted and further recommendations and further migratory be made. • No development should occur within 20 m – 30 m of the stone walling features and associated historical artefacts. The features should be clearly demarcated before any development activities begin to avoid any negative impact. The layout of any infrastructure should be reconsidered to preserve these heritage resources. • The graveyard is already fenced off, however, the area should be clearly demarcated and the upgrade of the road be to the west or the road be diverted further away to avoid any possible negative impact to the graveyard. • Effective rehabilitation of the landscape after decommissioning. • Recommendations for the establishment of 20 m – 30 m buffer zones that are clearly demarcated and in some instances the possible rerouting of the proposed road to avoid negative impact and promote the implementation of precautionary measures be adopted for heritage resources occurring along the route. • If any of the old farm buildings are to intended for rehabilitation or re-use or demolition a qualified and experienced professional (historical archaeologist / historical architect) must be consulted. • No turbines are to be located on Tafelkop or Spitskop. • An archaeological heritage walk-through survey must be conducted if any changes to the positions of the wind turbines, associated infrastructure and roads outside the scope of this study are made for the final layout and further recommendations and mitigation measures be suggested if necessary. • If concentrations of historical and pre-colonial archaeological heritage material and/or human remains (including burials and graves) are uncovered during construction, all work within close vicinity of the find must cease immediately and be reported the South African Heritage Resources Agency (SAHRA) (021 462 4502) or Heritage Western Cape (HWC) (021 483 5959) so that systematic and professional investigation/excavation can be undertaken. Phase 2 mitigation in the form of test-pitting/sampling or systematic excavations and collections of the pre-colonial shell middens and associated artefacts will then be conducted to establish the contextual status of the sites and possibly remove the archaeological deposit before development activities within the specific area can continue.

Study	Findings	Recommendation
		• Construction managers/foremen and/or the ECO should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites.
EOH. 2016. Proposed Rietkloof WEF.	This report identified scarce examples of Stone age remains however it found multiple grave sites and historical structural remains. All of which are of low-medium significance save for the grave sites.	• It would be difficult to avoid encountering Precolonial / Stone Age artefact scatters within areas they occur. Once the final layout of the Rietkloof WEF has been established a more intensive survey of these areas should be conducted and further recommendations and further mitigatory be made to assist with micro-sitting. • No development should occur within 20 m – 30 m of Stone Walling Features and associated Historical Artefact Scatters. The features should be clearly demarcated before any development activities begin to avoid any negative impact. The layout of any infrastructure should be • The graveyard is already fenced off, however, the area should be clearly demarcated and the upgrade of the road be to the west or the road be diverted further away to avoid any possible negative impact to the graveyard. • It is strongly recommended that any proposed access roads avoid using these homesteads as a thoroughfare for the proposed wind energy facility as far as possible. • Effective rehabilitation of the landscape after decommissioning. • No turbines are to be constructed on Tafelkop. • If any of the old farm buildings are to intended for rehabilitation or re-use or demolition a qualified and experienced professional (historical archaeologist / historical architect) must be consulted. • An archaeological heritage walk-through survey must be conducted if any changes to the positions of the wind turbines, associated infrastructure and roads outside the scope of this study are made for the final layout and further recommendations and mitigation measures be suggested if necessary. • If concentrations of historical and pre-colonial archaeological heritage material and/or human remains (including burials and graves) are uncovered during construction, all work within close vicinity of the find must cease immediately and be reported the South African Heritage Resources Agency (SAHRA) (021 462 4502) or Heritage Western Cape (HWC) (021 483 5959) so that systematic and professional investigation/excavation can be undertaken. Phase 2 mitigation in the form of test-pitting/sampling or systematic excavations and collections of the pre-colonial shell middens and associated artefacts will then be conducted to establish the contextual

Study	Findings	Recommendation
		status of the sites and possibly remove the archaeological deposit before development activities within the specific area can continue. • Construction managers/foremen and/or the Environmental Control Officer (ECO) should be informed before construction starts on the possible types of heritage sites and cultural material they may encounter and the procedures to follow when they find sites.
WSP. 2017. Proposed Esizayo Wind Energy Facility near Laingsburg, Western Cape	This report identified the following heritage resources: • A few large scatters of LSA stone artefacts were identified. They are of medium significance; • A few "pastoralist settlements" were identified containing LSA artefacts, ceramics and grindstones along dry river beds in the bottom of valleys. They are of medium significance; • At least two rock art sites. They are of high significance; • The Nuwerus cemetery is located next to the R354. There are also several other potential graves/cairns within the study area. They are of high significance; • A spread of early 20th century historical material on the lower slopes of two koppies, in association with several stone enclosures (fortifications) on the farm Aanstoot. They may represent the debris from the South African War; and • There are numerous roughly-packed, circular enclosures of dry stone walling, which may represent both pre-colonial and colonial era stone kraals, distributed along the lower slopes of small koppies, and close to streams or fountains across the study area. They are of low to medium significance.	The following mitigation and management measures have been recommended: ▪ Construction Phase ○ The hill and surrounds on which substation alternative 1 is located, must be declared a "No-Go" area; ○ The Nuwerus cemetery must be protected during the construction phase; and ○ If any human remains are uncovered during the excavations for the Wind Farm, work must stop in that area and HWC must be alerted immediately. ▪ Operational Phase: ○ Any abandoned farm buildings and the established cemetery should be protected from vandalism during the operational phase of the wind farm.

<table>
<tr><th>Study</th><th>Findings</th><th>Recommendation</th></tr>
<tr><td>WSP. 2017. Proposed Maralla East Wind Energy Facility near Sutherland, Northern and Western Cape.</td><td>This report identified the following heritage resources:
A large and informal graveyard (at least 5-10 graves) on the banks of the Komsberg River in the southern portion of the farm Schalkwykskraal, associated with 19th century historic remains and a nearby stone kraal;
Also on the Komsberg River, are the remains of a late 19th century stone stockpost, with small dwelling and extensive stone kraal complex;
Extensive archaeological and colonial period sites is along the Ventersrivier on the farm Welgemoed, including stone artefact scatters, rock art as well as ruined farm buildings, kraals, stockposts and graves.</td><td>The following mitigation and management measures have been recommended:

It is expected that most of the damage to the heritage resources on Maralla East will occur during construction. Heritage sites are concentrated along river valleys, while the turbines are generally located along the tops of the mountain ridges. Therefore the following activities may result in direct impacts to the landscape and any heritage that lies on it:
Bulldozing of roads across river valleys to the turbine sites;
Upgrading of existing roads particularly where they cut through river valleys or are in close proximity to existing settlements (i.e. farmhouse of Welgemoed);
Excavation of linear trenches for cables through river valleys, resulting in destruction of archaeological sites or graves on the banks of the rivers
During the operational phase of the wind facility the only risks are potential vandalism of heritage sites by staff of the wind facility(s). This includes stripping of fittings from abandoned farm buildings, careless damage to kraal walls, graffiti on rock art sites, etc. No further impacts to heritage would occur during operation of the currently proposed facility, although any expansion to the facility (effectively a new construction phase), would introduce new impacts.
In the case of Maralla East WEF, the proximity of the blue substation to the rock art site on the Venters Rivier may result in damage (graffiti) during the operational life of the wind farm (;
Similarly, the potential adaptive re-use of the Welgemoed farmhouse may result in vandalism and damage</td></tr>
<tr><td>WSP. 2017. Proposed Maralla West Wind Energy Facility near Sutherland, Northern and Western Cape.</td><td>This report identified the following heritage resources:
Several well-defined LSA sites with relatively abundant artefactual material (including Khoekhoen pottery) associated with water sources such as small streams and spring. These “pastoralist” sites are found on sandy river banks, often in proximity to later colonial sites. There are</td><td>The following mitigation and management measures have been recommended:

It is expected that most of the damage to the heritage resources on Maralla West will occur during construction. Heritage sites are concentrated along river valleys, while the turbines are generally located along the tops of the mountain ridges. Therefore the following activities may result in direct impacts to the landscape and any heritage that lies on it:
Bulldozing of roads across river valleys to the turbine sites;</td></tr>
</table>

Study	Findings	Recommendation
	numerous stone kraals and abandoned stockpost dwellings in the same area; • Remains of a large, late 19th century settlement, on Drie Roode Heuvels, on both sides of the public gravel road. It comprises a series of kraal complexes to the west of the road, as well as a threshing floor (trapvloer) and a wide distribution of 19thcentury ceramics and glass. This site has been bisected by the gravel road, as the graveyard, containing at least 12-15 Christian style graves, is located to the east of the road. There is also extensive stone walling, on both sides of the road.	• Upgrading of existing roads particularly where they cut through river valleys or are in close proximity to existing settlements (i.e. farmhouse of Wolven Hoek); • Construction of electrical infrastructure in the form of substations ▪ During the operational phase of the wind facility the only risks are potential vandalism of heritage sites by staff of the wind facility(s). This includes stripping of fittings from abandoned farm buildings, careless damage to kraal walls, graffiti on rock art sites, etc. No further impacts to heritage would occur during operation of the currently proposed facility, although any expansion to the facility (effectively a new construction phase), would introduce new impacts. • The potential adaptive re-use of the Wolven Hoek or Die Kom farmhouses may result in vandalism and damage
Savannah Environmental. 2016. Gunstfontein Wind Energy Facility, Northern Cape Province.	This report identified the following heritage resources: • South African War fortifications • Rock art sites • Stone cairns • Historical stone ruins (farm labourer dwellings)	The following mitigation and management measures have been recommended: • The majority of sites identified in this study will not be directly impacted by the proposed development. • However, where necessary, it is recommended that all proposed infrastructure respect a 60m buffer zone around all sites and; • If development takes place particularly close to a site, then that site must be demarcated during construction.
CSIR. 2016. Amendment Application for the Proposed Splitting of the Sutherland Renewable Energy Facility into three 140 MW Wind Energy Facilities, Sutherland, Northern and Western Cape Provinces.	This report identified the following heritage resources: • Several colonial stone structures • Possible graves • Possible KhoeKhoe hunting hides • Later Stone Age sites	The following mitigation and management measures have been recommended: • A field survey must be undertaken by a palaeontologist prior to any construction taking place; • A few LSA sites containing ceramics and occasional formal stone microliths were identified. These often occur in the lee of ridges and near water sources. Some of these have been accorded high significance and have to be avoided. • A number of colonial household dumps/refuse heaps were recognised associated with domestic elements of the built environment. Some of these are considered to be of high significance and have to be avoided; • Unoccupied standing historic farm buildings as well as ruins are found on Welgemoed and De Kom. These would be accorded high significance and have to be avoided.

<table>
<tr><th>Study</th><th>Findings</th><th>Recommendation</th></tr>
<tr><td></td><td></td><td>A more detailed survey must be conducted along the proposed access roads and connecting cable routes and turbine sites to ensure graves are not disturbed;
If unmarked graves are uncovered during construction, work should cease in that area and either SAHRA or HWC must be notified, depending on the location. A protocol to deal with accidentally discovered burials must be compiled for the construction phase.</td></tr>
<tr><td>Environmental Evaluation Unit. 2011. The Proposed Photovoltaic Solar Energy
Facility
on a site south of Sutherland, Northern Cape Province.</td><td>This report identified the following heritage resources:
Several scatters of stone artefacts were recorded in open areas.
One rock art site, lying in a long, shallow shelter which also contains some piled stone walling forming a small enclosure.
Several pre-colonial stone walled structures.
Several sites were found with scatters of historical artefacts. These artefacts include fragments of glass, metal, ceramics.. Some are associated with the historical use of the area, perhaps having been left by shepherds, but others are more likely connected with the Anglo-Boer War.
Stone-walled sites can be regarded as historical for the regularity of their shapes and the fact that the stones are relatively neatly placed on top of one another, often in courses. These could include huts, kraals, and animal cages.
A number of ruined structures relating to the second Anglo-Boer War were found.</td><td>The following mitigation and management measures have been recommended:
The Environmental Control Officer (ECO) is to ensure that no-one removes any artefacts from the area.
The ECO is to ensure that no-one damages the sites.
As the site has been shifted slightly to the east, it is recommended that an archaeologist shall be contracted to visit the site after the development footprint has been pegged on site, but before construction commences, to search for and ensure that no ephemeral heritage resources (specifically stone -built structures) are found within the facility footprint and are lost without suitable recording due to construction activities.</td></tr>
</table>

Table 11 - Impact rating – Cumulative

IMPACT TABLE	
Environmental Parameter	*Heritage Resources*
Issue/Impact/Environmental Effect/Nature	*The extent that the addition of this project will have on the overall impact of developments in the region on heritage resources*
Extent	*Regional*
Probability	*Possible*
Reversibility	*Irreversible*
Irreplaceable loss of resources	*The nature of heritage resources are such that they are non-renewable. The proper mitigation and documentation of these resources can however preserve the data for research*
Duration	*Permanent*
Cumulative effect	*It is my considered opinion that this additional load on the overall impact on heritage resources will be low. With a detailed and comprehensive regional dataset this rating could possibly be adjusted and more accurate.*
Intensity/magnitude	*Low*
Significance Rating	*Low negative impact before mitigation and low negative after mitigation.*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	4	4
Probability	2	1
Reversibility	4	4
Irreplaceable loss	4	4
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-19 (Low negative)	-18 (Low negative)

Mitigation measures	All projects should implement their specific mitigation measures on a case by case basis.

Table 12 - Rating of Cumulative Impacts – Palaeontology

IMPACT TABLE	
Environmental Parameter	*Prevent the loss of Palaeontological Heritage*
Issue/Impact/Environmental Effect/Nature	*Damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study, this will occur during vegetation clearance or during the construction phase*
Extent	*National (3)*
Probability	*Since fossil heritage is known from these formations the probability of impacts on palaeontological heritage during the construction phase is probable.* *(3)*
Reversibility	*Impacts on fossil heritage are generally **irreversible** (4)*
Irreplaceable loss of resources	*By taking a precautionary approach, an insignificant loss of fossil resources is expected (**No Loss**). (1)*
Duration	*The expected duration of the impact is assessed as potentially permanent to **long term**. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent. (4)*
Cumulative effect	*The cumulative effect of the development of the WEF and associated infrastructure within the proposed location is considered to be **low**. This is as a result of the broader Sutherland area not being considered as fossiliferous (1).*
Intensity/magnitude	*Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as low as fossil heritage*

	is not common in the development area or in the greater Sutherland area (1)	
Significance Rating	*Should the project progress without due care to the possibility of fossils being present at the proposed site in the Abrahamskraal Formation and Waterford Formation. The resultant damage, destruction or inadvertent relocation of any affected fossils will be* ***permanent and irreversible****. Thus, any fossils occurring within the area are potentially scientifically and culturally significant and any negative impact on them would be of* ***high*** *significance (without the implementation of mitigation measures).*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	3
Probability	3	1
Reversibility	4	4
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-16 (negative low)	-14 (negative low)
Mitigation measures	Monitoring of major excavations for fossil material by the ESO on an on-going basis during construction phase. Significant fossil finds to be reported to SAHRA for recording and sampling by a professional palaeontologist The chance find procedure must be followed. • When a chance find is made the person must instantly stop all work near the find. • The site must be secured to protect it from any additional damage • The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the Mine/development management. The supervisor must in turn report the find to his/her manager and the ECO. The ECO must report the find to the relevant Authorities and a relevant palaeontologist.	

	• The ECO must appoint a relevant palaeontologist to investigate and access the chance find and site. • Both ECO and palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings. • These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site • The reports and all other documents will be submitted to SAHRA by the palaeontologist. • The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development. • Once the required approvals have been issued, the Mine/development may carry on with the development. The ECO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan

Overall, the area does contain many instances of Historical and Stone Age heritage resources. While there are a fair number of sites there are few that, in my considered opinion, would have high heritage significance.

It is due to this, coupled with the fact that the development layout of the Rondekop WEF should not have any impact on heritage resources, that the additional load on heritage resources will be low. With a detailed and comprehensive regional dataset this rating could possibly be adjusted and more accurate.

5.2 Comparative Assessment of Layout Alternatives (Heritage)

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	**Preference**	**Reasons (incl. potential issues)**
ACCESS ROADS		
NORTH RIDGE		
Access Road Alternative North 1	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Access Road Alternative North 2	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
CENTRE RIDGE		
Access Road Alternative Centre1	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Access Road Alternative Centre 2	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
SOUTHERN RIDGE		
Access Road Alternative South 1	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Access Road Alternative South 2	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
CONSTRUCTION CAMPS		
Construction Camp Alternative 1	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Construction Camp Alternative 2	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Construction Camp Alternative 3	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Construction Camp Alternative 4	**NO PREFERENCE**	There are no known heritage resources in the vicinity.

Alternative	Preference	Reasons (incl. potential issues)
Construction Camp Alternative 5	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Construction Camp Alternative 6	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
SUBSTATIONS		
Substation Alternative 1	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Substation Alternative 2	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Substation Alternative 3	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Substation Alternative 4	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Substation Alternative 5	**NO PREFERENCE**	There are no known heritage resources in the vicinity.
Substation Alternative 6	**NO PREFERENCE**	There are no known heritage resources in the vicinity.

5.3 Comparative Assessment of Layout Alternatives (Palaeontology)

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)
ACCESS ROADS		
NORTH RIDGE		

Alternative	Preference	Reasons (incl. potential issues)
Access Road Alternative North 1	No Preference	No Fossil Heritage was recovered
Access Road Alternative North 2	No Preference	No Fossil Heritage was recovered
CENTRE RIDGE		
Access Road Alternative Centre1	No Preference	No Fossil Heritage was recovered
Access Road Alternative Centre 2	No Preference	No Fossil Heritage was recovered
SOUTHERN RIDGE		
Access Road Alternative South 1	No Preference	No Fossil Heritage was recovered
Access Road Alternative South 2	No Preference	No Fossil Heritage was recovered
CONSTRUCTION CAMPS		
Construction Camp Alternative 1	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 2	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 3	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 4	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 5	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 6	No Preference	No Fossil Heritage was recovered
SUBSTATIONS		
Substation Alternative 1	No Preference	No Fossil Heritage was recovered
Substation Alternative 2	No Preference	No Fossil Heritage was recovered

Alternative	Preference	Reasons (incl. potential issues)
Substation Alternative 3	No Preference	No Fossil Heritage was recovered
Substation Alternative 4	No Preference	No Fossil Heritage was recovered
Substation Alternative 5	No Preference	No Fossil Heritage was recovered
Substation Alternative 6	No Preference	No Fossil Heritage was recovered

6 CONCLUSIONS AND RECOMMENDATIONS

PGS Heritage (Pty) Ltd was appointed by SiVEST SA (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) for the development of a Wind Energy Facility (WEF) and associated infrastructure, on parts the following farms:

- Remainder and Portion 1 of the Farm Roodeheuvel 170;
- Remainder and Portion 1 of the Farm Wind Heuvel 190;
- Remainder and Portion 1 of the Farm Bloem Fontein 192;
- Portion 1 and 2 of the Farm Urias Gat 193;
- Remainder, Portion 1 and 3 of the Farm Venters Kraal 166;
- Farm Ashoek 224;
- Remainder of the Farm 220;
- Portion 1 of the Farm Lange Huis 174;
- Remainder of the Farm Vinke Kuil 171; and
- Farm Zeekoegat 169.
- Remainder of the Farm Hout Hoek 191

The proposed development is situated approximately 45km south west of Sutherland in the Karoo Hoogland Local Municipality in the Namakwa District Municipality within the Northern Cape Province.

Heritage resources are unique and non-renewable and as such any impact on such resources must be viewed significant.

Due to the nature of cultural remains, a systematic controlled-exclusive surface survey was conducted on foot and in a vehicle, over a period of four days by two archaeologists from PGS. The fieldwork was conducted on the 20th-24th September 2018. An additional site assessment was also conducted by a Palaeontologist from PGS on the 1st – 3rd October 2018. The locations of five (5) individual heritage sites were identified during the field survey, all of them falling within the boundaries of the study area.

6.1 Archaeology

The archaeological resources identified within the proposed development site comprise a small number of Stone Age surface artefact scatters. These are primarily from the Later Stone Age (LSA), although Middle Stone Age (MSA) material was also identified. All these artefact assemblages occur in heavily deflated and eroded areas, so their scientific potential and heritage significance is somewhat lowered. Based on findings from a range of other heritage reports in the area, these types of sites are to be expected in this region.

The remaining heritage features included buildings and stone walled structures that are likely the result of early European settlement in the area. Most of these features are likely over 60 years of age and for this reason are protected by current heritage law.

Even though heritage features were detected within the development area, serious mitigation measures will not be required except for the implementation of a chance-finds protocol. However, if the development layout is altered, this position will need to be revaluated.

6.2 Palaeontology

The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Rondekop WEF development will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the **construction of the development may be authorised in its whole extent**, as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

6.3 Cultural Landscape

The visual assessment completed by Schwartz et al (2018) for the Rondekop WEF characterised the study area as a "*typical of a Karoo or "platteland" landscape that would characteristically be encountered across the high-lying dry western and central interior of South Africa.*"

They do however find that visual impacts on the cultural landscape would be reduced by the fact that the area is very remote and there are no significant tourism enterprises attracting visitors into the study area. In addition, the nearest major scenic route, the R354, is outside the 8km visual assessment zone and is not expected to experience any visual impacts from the proposed WEF.

The cultural landscape in this area is therefore considered to be of low significance and the impacts on the cultural landscape of low significance.

6.4 General

In the event that heritage resources are discovered during site clearance, construction activities must stop in the immediate vicinity of the find, and a qualified archaeologist must be appointed to evaluate and make recommendations on mitigation measures.

The overall impact of the WEF and its associated infrastructure, on the heritage and palaeontological resources identified during this report, is seen as low after the recommendations have been implemented and therefore, impacts can be mitigated to acceptable levels allowing for the development to be authorised. It is consequently recommended that no further palaeontological and heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils. There are no preferences in terms of the proposed layout alternatives as none of them will affect known heritage resources thus no mitigation measures will be required, except for the implementation of a chance-finds protocol. However, if the development layout is altered, this position will need to be revaluated.

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Appendix A

Legislative Requirements – Terminology and Assessment Criteria

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation -

- NEMA;
- National Heritage Resources Act (NHRA) Act 25 of 1999; and
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002.

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

GNR 982 of 2014 (Government Gazette 38282) promulgated under the NEMA:

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Impacts Report (EIR) – Regulation 23
- EMPr – Regulations 19 and 23
- NHRA:
- Protection of Heritage Resources – Sections 34 to 36; and
- Heritage Resources Management – Section 38
- MPRDA Regulations of 2014:
- Environmental reports to be compiled for application of mining right – Regulation 48.

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34 (1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…". The NEMA (Act No 107 of 1998) states that an integrated EMP should, (23 -2 (b)) "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage". In accordance with legislative requirements and EIA rating criteria, the regulations of the South African Heritage Resources Agency (SAHRA) and the Association of Southern African Professional Archaeologists (ASAPA) have also been incorporated to ensure that a comprehensive legally compatible HIA report is compiled.

Appendix B

Heritage Assessment Methodology

The applicable maps, tables and figures are included, as stipulated in the NHRA (Act No 25 of 1999) and NEMA (Act No 107 of 1998). The HIA process consisted of three steps;

Step I – Literature Review - The background information to the field survey relies greatly on the Heritage Background Research.

Step II – Physical Survey - A physical survey was conducted predominantly by foot within the proposed areas by two qualified archaeologists, which aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

The significance of identified heritage sites are based on four main criteria -
Site integrity (i.e. primary vs. secondary context),
Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
Density of scatter (dispersed scatter)

- Low - <10/50m2
- Medium/High - 10-50/50m2
- High - >50/50m2
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows -

A - No further action necessary;
B - Mapping of the site and controlled sampling required;
C - No-go or relocate development activity position;
D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site.

Impacts on these sites by the development will be evaluated as follows -

Site Significance

Site significance classification standards prescribed by the SAHRA (2006) and approved by the ASAPA for the Southern African Development Community (SADC) region, were used for the purpose of this report (**Table 1 -**).

Table 1 - Site significance classification standards as prescribed by SAHRA.

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1		Conservation; National Site nomination
Provincial Significance (PS)	Grade 2		Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)		High / Medium/High Significance	Mitigation before destruction
Generally Protected B (GP.A)		Medium/High Significance	Recording before destruction
Generally Protected C (GP.A)		Low Significance	Destruction

Appendix C

The Significance Rating Scales for the Proposed Prospecting Activities on Heritage Resources

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

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 3.

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.

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.

7.1.1 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:

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.

Appendix D

Project team CV's

ILAN SMEYATSKY

Professional Archaeologist

Personal Details

Name: Ilan

Surname: Smeyatsky

Identity Number: 9109275072080

Date of Birth: 27-09-1991

Citizenship: South African

Gender: Male

Marital Status: Single

Languages Spoken: English

Education History

2010-2013: BSc Bachelors Degree

University of the Witwatersrand, Johannesburg, South Africa

Archaeology

Psychology

Statistics

Research Design and Analysis

67% Pass (2:1 Qualification)

2014: BSc (Hons) in Archaeology

AWARDS:

Received the 2014 Center of Excellence in Palaeoscience award - Bursary to the value of ZAR 30000 ≈ $2500

Received the Post-Graduate Merit Award in 2015 for academic merit for my Honours academic results - Bursary to the value of ZAR 25000 ≈ $1800

University of the Witwatersrand, Johannesburg, South Africa

Archaeology

Excavation techniques

Theory

69% Pass (2:1 Qualification)

Distinction received for thesis entitled: "Stylistic variation in Later Stone Age tanged arrowheads: a pilot study using geometric morphometrics"

2015-2017: MSc by Research (Archaeology)

University of the Witwatersrand, Johannesburg, South Africa
Archaeology
Statistical analysis
GIS (Geographic Information Systems)
Thesis entitled: "Discerning and explaining shape variations in Later Stone Age tanged arrowheads, South Africa"

Aug 2016 –
Jan 2017: Semester of Archaeology Masters

AWARD: Received the 2016 AESOP+ full Masters scholarship to study at Uppsala University, Uppsala, Sweden – **Scholarship to the value of ZAR 160,000 ≈ $11,000**
Uppsala University, Uppsala, Sweden
Archaeological theory
GIS (Geographic Information Systems)
Invitational research

Employment History
Part time employment as a student:

2009-2013: Part-Time Electrician Apprentice: Assisting in home electrical repair jobs.
2014-2015: Lab Research Assistant: Analysing and classifying lithic artefacts, Data capturing, Mentoring trainee research assistants.

Experience in the field of archaeology:

2013-2015: Fieldwork/Excavator - Responsibilities: Feature detection, excavation, sieving, sorting, analysis, soil sampling, field documentation, 'dumpy' operation , Total Station operation, DGPS operation, rock art tracing and photography, engraving tracing and photography.

South African excavations:

Early Stone Age excavation at Maropeng World Heritage Site in Gauteng (1 Week – August 2015)

Pig cadaver exhumation as part of forensic experiment near Pretoria, Gauteng (1 Week – December 2014) - Praised for having the determination of returning for each subsequent excavation day as it was performed on a purely volunteer basis and the work conditions were particularly strenuous - Dr. Coen Nienaber

Iron Age excavation at Komati Gorge, Mpumalanga (1 Week – August 2014) - Praised for being exceptionally "methodical and proficient" with my excavation techniques – Dr. Alex Schoeman

Rock art fieldwork at Komati Gorge, Mpumalanga (1 Week – August 2014)

Underwater archaeology site mapping Komati Gorge, Mpumalanga (1 Week – August 2014)

Early Stone Age excavation at Maropeng World Heritage Site in Gauteng (2 Weeks - September 2013) - Personally uncovered some of the only stone tools (~1.8 million years old) found during that digging season.

2016: Excavation Supervisor - Responsibilities: Supervision of two junior excavators, site detection, decision of excavation grid placement, excavation, sieving, sorting, soil sampling, field documentation.

Historical (farm site) excavation at Graaff-Reinet, Eastern Cape, South Africa (2 Weeks)

Completed dig 1 week ahead of schedule aided by my efficient direction, drive and support to the excavators under my supervision.

April 2017 – April 2018: Intern Archaeologist – PGS Heritage: Heritage Impact assessments, background research, report writing, permit applications, collections management, stakeholder engagement and grave relocation.

April 2018 – PRESENT: Archaeologist – PGS Heritage: Heritage Impact assessments, background research, report writing, permit applications, collections management, stakeholder engagement and grave relocation.

Professional Body Membership:

Professional Archaeologist - Association of Southern African Professional Archaeologists (ASAPA) - Professional Member

CRM Accreditation (ASAPA) -

Field Supervisor – Stone Age, Iron Age & Grave Relocations

MARKO HUTTEN

Professional Archaeologist

Name:	Marko Hutten
Profession:	Archaeologist
Date of birth:	1971-06-24
Parent Firm:	PGS Heritage Pty Ltd
Position at Firm:	Freelance Archaeologist
Years with firm:	9
Years of experience:	20
Nationality:	South African
HDI Status:	White Male

EDUCATION:

Name of University or Institution	: University of Pretoria
Degree obtained	: BA
Major subjects	: Archaeology & Anthropology
Year	: 1996

Name of University or Institution	: University of Pretoria
Degree obtained	: BA [Hons]
Major subjects	: Archaeology
Year	: 1997

Professional Qualifications:

Professional Archaeologist - Association of Southern African Professional Archaeologists - Professional Member CRM Accreditation:

• Field Director - Iron Age

• Field Director - Grave Relocation

Languages:

Afrikaans – First language

English – Speaking (Good) Reading (Good), Writing (Good)

KEY QUALIFICATIONS

Archaeological mitigation and excavations, Social consultation on grave relocation projects, Cultural Resource Management and Heritage Impact Assessment

Management, Historical and Archival Research, Archaeology, Anthropology, Applicable survey methods, Fieldwork and project management.

EXPERIENCE

Archaeological Impact Assessments

1998 – 2016

Performed 300+ Archaeological Impact Assessments (1st phase). Clients include:

- Vodacom
- Telkom
- Eskom
- Roads Agency of Limpopo (RAL)
- Department of Water Affairs and Forestry (DWAF)
- South African National Parks (SANParks)
- Impala Platinum
- Various Environmental Impact Assessment Companies such as: Naledzi Environmental Consultants; Tekplan Environmental; Lokisa Environmental Consulting

Grave Relocation Projects:

- Nandoni Dam Grave Relocation Project, ± 1000 graves, 2000/01 (Field Director)
- Tavistock Colliery Grave Relocation Project, ± 700 graves, 2002 (Field Director)
- Marula Platinum Grave Rescue Project, x 2 graves, 2003 (Field Director)
- Silverlakes Grave Relocation Project, x 5 graves, 2005 (Field Director)
- Bela-Bela (Outpost) Grave Relocation Project, x 80 graves, 2008 (Field Director)
- Potgieters Rus Platinum Mine Grave Relocation Project, x 16 graves, 2008 (Field Director)
- New Vaal Colliery Grave Relocation Project, x 1700 graves, 2007 (Field Director)
- Shakadza Road Upgrade Grave Rescue Project, x 1 grave, 2007 (Field Director)

- Mapungubwe Grave Repatriation Project 2007 (Field Supervisor)
- Atcom Colliery Grave Relocation project, x200 graves 2008-2009 (Field Director)
- Nkomati Mine Grave Relocation project, 100 graves 2009-2010 (Field Director)
- Tweefontein Optimization Grave Relocation Project, 800 graves. 2014-current (Field Director)

Second Phase Investigations/Excavations *(Including Site Stabilization and Rehabilitation):*

- Nandoni Dam Archaeological Project 1998 (Field Supervisor)
- Nandoni Dam Archaeological Project 1998 – 1999 (Field Director)
- Mapungubwe Rehabilitation Project 2003 (Field Director)
- Schroda Rehabilitation Project 2006 (Field Director)
- K2 Rehabilitation Project 2006 (Field Director)
- Mapungubwe Rehabilitation Project 2006 (Field Director)
- Shakadza Rescue and Rehabilitation Project 2007 (Field Director)
- Clanwilliam Dam Mitigation Project, 2014-currnet – Site Manager

2008-2013

Archaeological Impact Assessments (1st phase) *(Projects in conjunction with, in brackets):*

- Premier Mine Heritage Survey 2008 (PGS)
- Gope Transmission Line Survey 2008 (Botswana– Archaeology Africa)
- Argent Siding Heritage Survey 2008 (Archaeology Africa)
- Morgenzon Pipe Line Heritage Survey 2008 (Archaeology Africa)
- Klipfontein Heritage Survey 2008 (PGS)
- Spitzkop Mine Heritage Survey 2008 (PGS)
- Elandsfontein Heritage Survey 2008 (PGS)
- Makobe Township Heritage Survey 2008
- Tswinga Township Heritage Survey 2008
- Mankweng Borrow Pits Heritage Survey 2008
- Knapdaar Heritage Survey 2008 (PGS)
- Hotazel Heritage Survey 2008 (PGS)
- Lisbon Township Heritage Survey 2009
- Koert Louw Heritage Survey 2009 (PGS)
- Knapdaar Heritage Survey 2009 (PGS)
- De Wittekrans Heritage Survey 2009 (PGS)

- Ga-Kgapane Township Heritage Survey 2009
- Guernsey Eco-estate Heritage Survey 2009
- De Deur Heritage Survey 2009 (PGS)
- Bultfontein Heritage Survey 2009 (PGS)
- Optimum Mine Heritage Survey 2009
- Gorkum Eco-Estate Heritage Survey 2009
- Planknek Pipe line Heritage Survey 2009
- Regorogile Ext. 9 Heritage Survey 2009
- Haddon Agricultural Heritage Survey 2009
- Jansenpark Residential Development Heritage Survey 2009
- Klein Kariba Residential Development Heritage Survey 2009
- Kangala Mine Heritage Survey 2009 (PGS)
- Hoedspruit Juice Factory Heritage Survey 2009
- Kameelfontein Heritage Survey 2009 (PGS)
- Leolo Township Heritage Survey 2010
- Rietpol Agricultural Development Heritage Survey 2010
- Lwamondo Mining Heritage Survey 2010
- Vanderbijlpark Heritage Survey 2010 (PGS)
- Kongoni Mine Heritage Survey 2010 (PGS)
- Lehating Mine Heritage Survey 2010 (PGS)
- Donkerpoort Township Heritage Survey 2010
- Klerksdorp Township Heritage Survey 2010 (PGS)
- Boikarabelo Heritage Survey 2010 (PGS)
- Mountain View Township Heritage Survey 2010
- De Put Township Heritage Survey 2010
- Vygeboomfontein Eco-Estate Heritage Survey 2010
- Vuyani-Neptune Power Line Heritage Survey 2010 (PGS)
- Gamma-Kappa Power Line Heritage Survey 2010 (PGS)
- Olifants River Bridge Heritage Survey 2010
- Bon Accord Mine Heritage Survey 2010 (PGS)
- Olifants River Water Scheme Heritage Survey 2010 (PGS)
- Buffelskloof Mine Heritage Survey 2010 (Gem-Science)
- Vlakvarkfontein Mine Heritage Survey 2010 (Gem-Science)
- Spitskop Solar Park Heritage Survey 2011
- Geluksfontein farm Heritage Survey 2011
- Leeuwvallei Town Development Heritage Survey 2011

- De Aar Solar Park Heritage Survey 2011 (PGS)
- Onbekend Mine Heritage Survey 2011 (Gem-Science)
- Witkop Solar Park Heritage Survey 2011
- Bel-Bela Solar Park Heritage Survey 2011
- Delta Solar Park Heritage Survey 2011
- Madibeng Pipe Line Heritage Survey 2011 (PGS)
- Soutpan Solar Park Heritage Survey 2011
- Vlakvarkfontein Mine Heritage Survey 2011 (PGS)
- Vuwani & Valdezia Pipe Lines Heritage Survey 2011

Grave Relocation Projects:

- Zondagsvlei Grave Relocation Project, x 110 graves, 2008 (PGS: Field Director)
- Garstfontein Road Grave Relocation Project, x 15 graves, 2008 (PGS: Field Director)
- Gautrain Grave Relocation Project, x 40 graves, 2008 (PGS: Field Director)
- Zwavelpoort Grave Relocation Project, x 45 graves, 2009 (PGS: Field Director)
- Motaganeng Grave Relocation Project, x 60 graves, 2009 (PGS: Field Director)
- Smokey Hills Platinum Mine Grave Relocation Project, x 10 graves, 2009 (PGS: Field Director)
- Klein Kopje Colliery Grave Relocation Project, x 4 graves, 2009 (PGS: Field Director)
- Lefapa Grave Relocation Project, x 8 graves, 2009 (PGS: Field Director)
- New Clydesdale Colliery Grave Relocation Project, x 7 graves, 2010 (PGS: Field Director)
- Osizwini Grave Relocation Project, x 73 graves, 2010 (PGS: Field Director)
- Straffontein (New Largo Colliery) Grave Relocation Project, x 16 graves, 2010 (PGS: Field Director)
- ATCOM Colliery Grave Relocation Project, x 80 graves, 2010 (PGS: Field Director)
- Welgelegen Mine Grave Relocation Project, x 7 graves, 2010 (PGS: Field Director)
- Ferreiras (Mashala) Grave Relocation Project, x 11 graves, 2011 (PGS: Field Director)

Second Phase Investigations/Excavations:

- Onverwacht Archaeological Project 2008 (Archaeology Africa: Field Supervisor)

- Nandoni Dam Archaeological Project 1998 (Field Supervisor)
- Nandoni Dam Archaeological Project 1998 – 1999 (Field Director)
- Mapungubwe Rehabilitation Project 2003 (Field Director)
- Schroda Rehabilitation Project 2006 (Field Director)
- K2 Rehabilitation Project 2006 (Field Director)
- Mapungubwe Rehabilitation Project 2006 (Field Director)
- Shakadza Rescue and Rehabilitation Project 2007 (Field Director)
- Clanwilliam Dam Mitigation Project, 2014-currnet – Site Manager

EMPLOYMENT SUMMARY

2014/09/01 – Current

Hutten Heritage Consultants: Director/Archaeologist

2013/08/01 – Current

PGS Heritage: Archaeologist

2008 - 2013

Hutten Heritage Consultants: Director/Archaeologist

1998 – 2008

Archaeo-Info Northern Province, (AINP): Director/Archaeologist

1995 – 1997

University of Pretoria (Dept. of Anatomy): Technical Assistant

Countries of work experience:

- South Africa
- Botswana

Mozambique

Trent Seiler CV

Field Technician at PGS

NAME: Trent Seiler
BIRTH DATE: 1991-11-19
IDENTIFICATION NUMBER: 911119 513 6086
DRIVERS LICENSE: Code 08
TRANSPORT: Own Transport
SEX: Male
MARITAL STATUS: Single
NATIONALITY: South African
HOME LANGUAGES: English (speak, read and write)
OTHER LANGUAGES: Afrikaans (speak)

Contact Details

- Cell Phone 079 953 8565
- E-Mail seilertrent@gmail.com

Vocational Skills

Computer training:
- Word, Excel, PowerPoint, Outlook, Publisher, Access, inkscape, basic GIS and QGIS.

Researching and report compiling
- Compiled research reports continuously throughout tertiary education.

Event Management
- The management of staff, distribution of refreshments as well as stock take.

Education

- University of Pretoria BA general 2010 - 2012
- University of Pretoria Honours Archaeology 2013 – 2014
- University of Pretoria Masters in Archaeology 2015 - 2017

-Honours project- Forager/Farmer relations at the Shashe-Limpopo River Confluence Area, with Special Regard to Schroda

-Masters project- An Archaeological Landscape Study of Forager, Farmer interactions in the Matloutse Limpopo Confluence Area, South Africa.

WOUTER FOURIE

Professional Heritage Specialist and Professional Archaeologist and Director PGS Heritage

Summary of Experience

Specialised expertise in Archaeological Mitigation and excavations, Cultural Resource Management and Heritage Impact Assessment Management, Archaeology, Anthropology, Applicable survey methods, Fieldwork and project management, Geographic Information Systems, including *inter alia* -

Involvement in various grave relocation projects (some of which relocated up to 1000 graves) and grave "rescue" excavations in the various provinces of South Africa
Involvement with various Heritage Impact Assessments, within South Africa, including -

- Archaeological Walkdowns for various projects
- Phase 2 Heritage Impact Assessments and EMPs for various projects
- Heritage Impact Assessments for various projects
- Iron Age Mitigation Work for various projects, including archaeological excavations and monitoring
- Involvement with various Heritage Impact Assessments, outside South Africa, including -
- Archaeological Studies in Democratic Republic of Congo
- Heritage Impact Assessments in Mozambique, Botswana and DRC
- Grave Relocation project in DRC

Key Qualifications

BA [Hons] (Cum laude) - Archaeology and Geography - 1997

BA - Archaeology, Geography and Anthropology - 1996

Professional Archaeologist - Association of Southern African Professional Archaeologists (ASAPA) - Professional Member

Accredited Professional Heritage Specialist – Association of Professional Heritage Practitioners (APHP)

CRM Accreditation (ASAPA) -

Principal Investigator - Grave Relocations

Field Director – Iron Age

Field Supervisor – Colonial Period and Stone Age

Accredited with Amafa KZN

Key Work Experience

2003- current - Director – PGS Heritage (Pty) Ltd

2007 – 2008 - Project Manager – Matakoma-ARM, Heritage Contracts Unit, University of the Witwatersrand

2005-2007 - Director – Matakoma Heritage Consultants (Pty) Ltd

2000-2004 - CEO– Matakoma Consultants

1998-2000 - Environmental Coordinator – Randfontein Estates Limited. Randfontein, Gauteng

1997-1998 - Environmental Officer – Department of Minerals and Energy. Johannesburg, Gauteng

Worked on various heritage projects in the SADC region including, Botswana, Malawi, Mozambique, Mauritius and the Democratic Republic of the Congo

Banzai Environmental
14 Eddie De Beer Street
Bloemfontein

23 February 2019

Amendment to Palaeontological Impact Study:

PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED 325MW RONDEKOP WIND ENERGY FACILITY, (WEF) BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE PROVINCE (DEA REF: 14/12/16/3/3/2/1115).

Comments on the implication of changes in the layout of the Rondekop 325 MW Wind Energy Facility on the Paleontological impacts on this development.

The following changes are proposed for the development:

- Change in the turbine capacity from between 3MW and 6.5MW to be up to 8MW
- All turbines are still valid
  - slight alignment shifts mainly to turbine 16 [ecology changes]
  - 44 [to avoid the 200m bat and bird buffer surrounding the watercourse]).
- Turbine 25 access road to crane pad: minor alignment change as the current alignment was very close to the edge of the ridge and ecologist was concerned about downslope erosion).
- Turbine 27 access road: minor alignment shift to avoid crossing a rocky ridge/outcrop as per the ecology requirement.
- Road between turbine 28 & 29: minor alignment change to avoid rocky outcrop.
- Crane pad 29 & 35: minor alignment change to avoid the rocky outcrops.
- Access road north 1: shifted the alignment slightly away from the drainage line and then crossing it perpendicularly at a single point.
- Access road 2: shifted to only cross the drainage line at one point.
- Construction Camp 1: shift to follow road alignment.

During the site, specific field survey exposed rock layers were visually inspected and no visible evidence of fossiliferous outcrops were found. The proposed development site is underlain by the Adelaide Formation of the Beaufort Group (Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup) (Figure 1 and 2). According to the **information provided** all changes to the proposed Rondekop WEF layout is **minor alignment changes**. After these amendments to the Rondekop WEF layout, the overall Geology of the proposed layout is still the same. And as such the change in the layout of the proposed development will not have an influence on the Palaeontological Heritage of the proposed development.

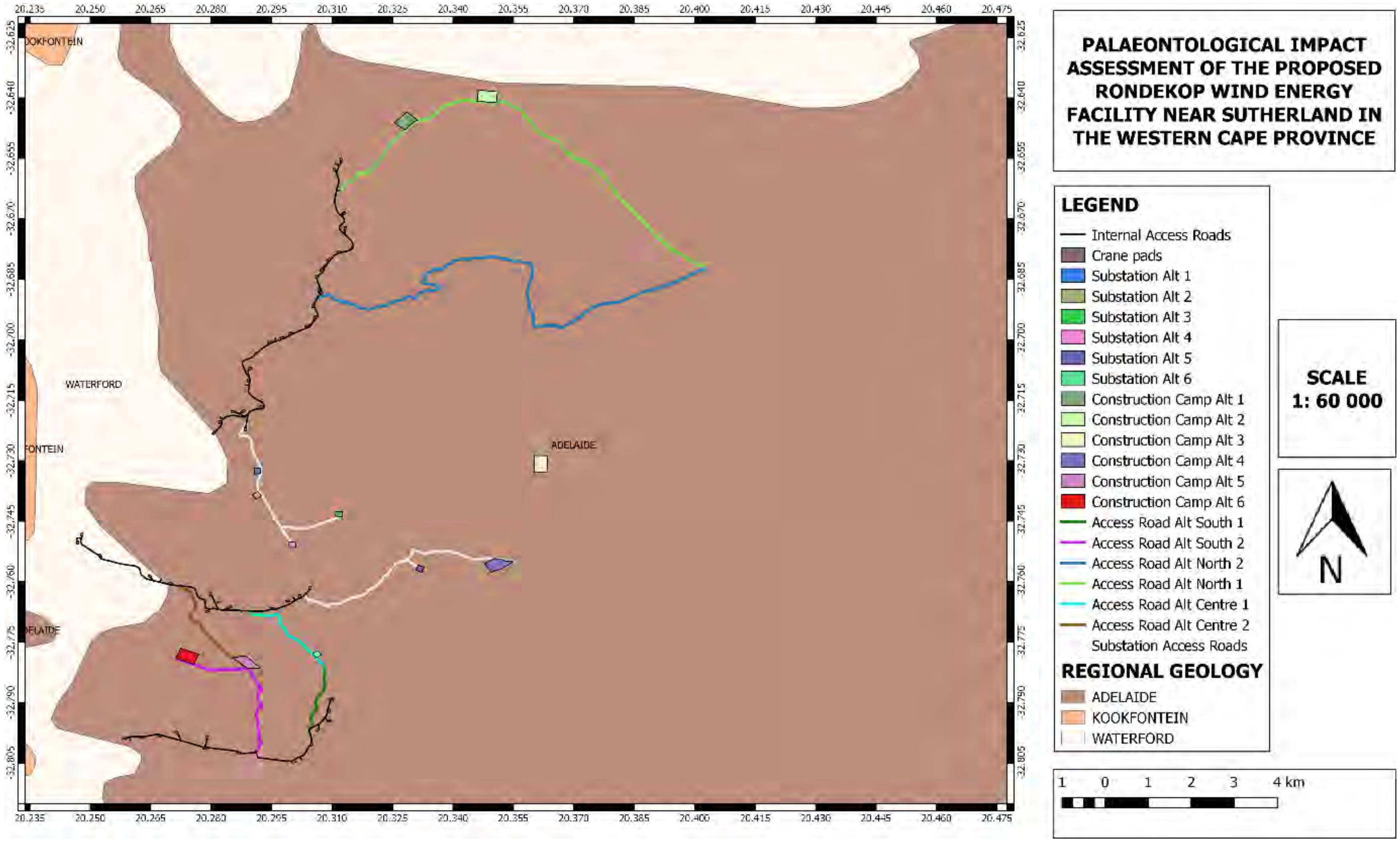

Figure 1: Surface geology of the original Rondekop WEF layout. The proposed development site is underlain by the Adelaide Formation of the Beaufort Group (Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup). The map was drawn QGIS Desktop 2.18.18.

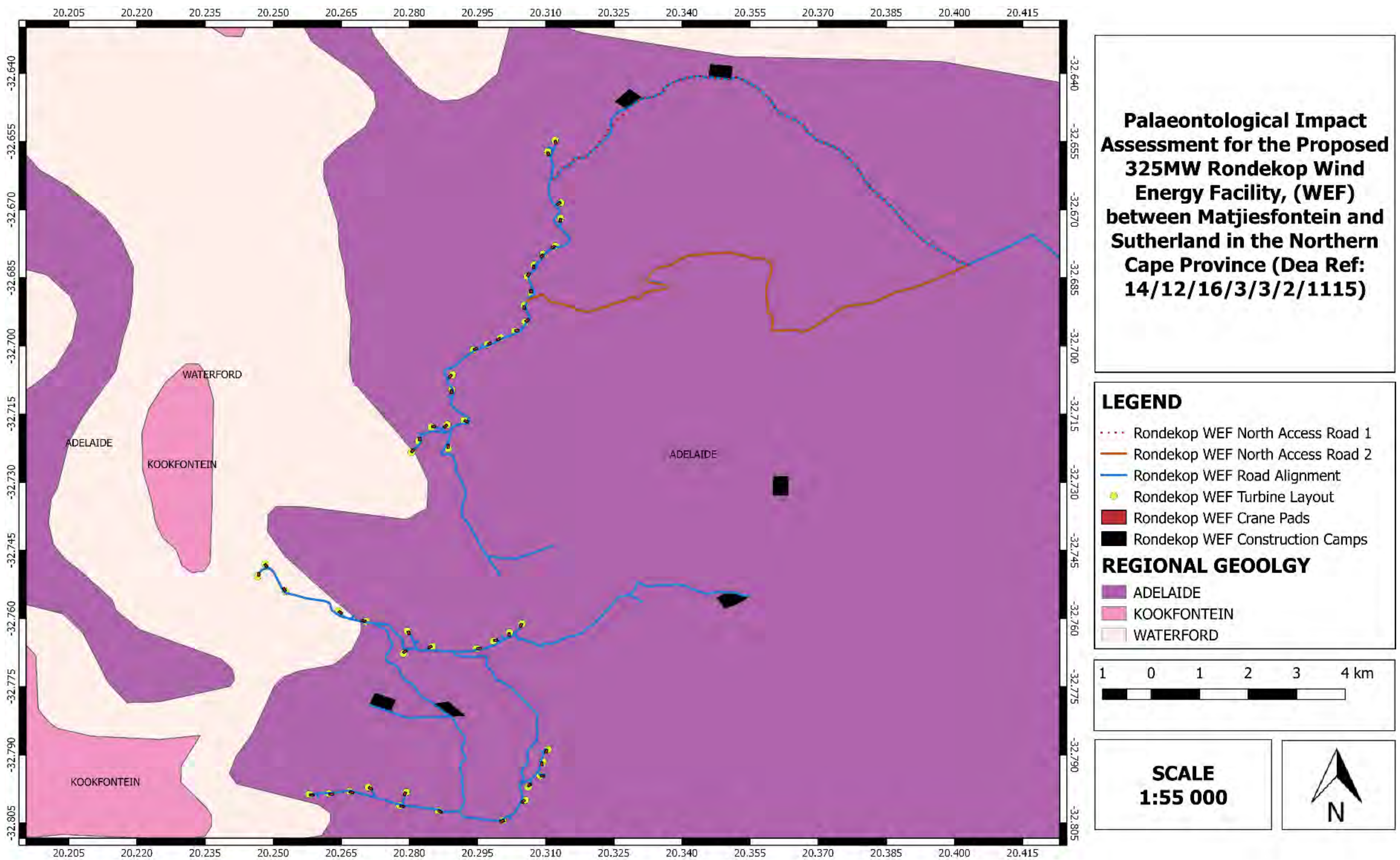

Figure 2. Surface geology of amended Rondekop WEF Layout. The proposed development site is underlain by the Adelaide Formation of the Beaufort Group (Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup). The map was drawn QGIS Desktop 2.18.18.

The overall impact rating reflected in the report **Palaeontological Impact Assessment** for the proposed 325 MW Rondekop Wind Energy Facility, (WEF) between Matjiesfontein and Sutherland in the Northern Cape Province dated 28 October 2018 **is thus not affected** by the layout changes

Yours sincerely

Elize Butler

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED 325 MW RONDEKOP WIND ENERGY FACILITY BETWEEN MATJIESFONTEIN AND SUTHERLAND, IN THE NORTHERN CAPE PROVINCE

PALAEONTOLOGICAL IMPACT ASSESSMENT

Developer – Rondekop WEF (Pty) Ltd,

Client - G7 Renewable Energies (Pty) Ltd.

EAP -Consultant – SiVEST SA (PTY) LTD, PO Box, Rivonia, 2126.

Issue Date:	**29 October 2018**
Revision No.:	v0.2
Client:	SiVEST
PGS Project No:	15260 HIA

+ 27 (0) 12 332 5305
+27 (0) 86 675 8077
contact@pgsheritage.co.za
PO Box 32542, Totiusdal, 0134

Offices in South Africa, Kingdom of Lesotho and Mozambique

Head Office:
906 Bergarend Streets
Waverley, Pretoria,
South Africa

Directors: HS Steyn, PD Birkholtz, W Fourie

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE: 

ACKNOWLEDGEMENT OF RECEIPT

Report Title	Environmental Impact Assessment (EIA) For the Proposed 325MW Rondekop Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape Province		
Control	**Name**	**Signature**	**Designation**
Author	Elize Butler		Palaeontologist
Reviewed	Wouter Fourie		Archaeologist/ PGS Heritage
Client	Rondekop Wind Farm (Pty) Ltd		Applicant

CLIENT: **SiVEST**

CONTACT PERSON: **Andrea Gibb/Shivani Naidoo**

SIGNATURE: ______________________________

The heritage impact assessment report has been compiled taking into account the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

NEMA Regs (2014) - Appendix 6	Relevant section in report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page ii of Report – Contact details and company and Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page iii – refer to **Appendix 2**
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 2 – Objective
(cA) an indication of the quality and age of base data used for the specialist report;	Section 5 – Geological and Palaeontological history
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8 – Site Visit. No existing impacts
d) the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 8 – Site Visit
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 7 Approach and Methodology
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1.1 Project description and Section 11.5 – Comparative Assessment of Alternatives
g) an identification of any areas to be avoided, including buffers;	No sensitive areas identified
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	No sensitive areas identified
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 11 – Impact Assessment and Section 11.4 – Comparative Assessment of alternative
k) any mitigation measures for inclusion in the EMPr;	N/A as no sensitivities were found on site
l) any conditions for inclusion in the environmental authorisation;	N/A as no sensitivities were found on site
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management	Section 12 – Conclusion

and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable. A public consultation process was handled as part of the EIA and EMP process.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable. To date not comments regarding heritage resources that require input from a specialist have been raised.
q) any other information requested by the competent authority.	Not applicable.
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Refer to section 4 compliance with SAHRA guidelines

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Impact Assessment (PIA) for the proposed Rondekop Wind Energy Facility (WEF) near Sutherland in the Northern Cape Province. According to the National Heritage Resources Act (NHRA) (No 25 of 1999, section 38), a PIA is key to discover the presence of fossil material within the planned development footprint and it is thus necessary to evaluate the impact of the construction on the palaeontological resources.

The proposed Rondekop development site is underlain by the Abrahamskraal Formation (Adelaide Subgroup, lower Beaufort Group, of the Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup). According to the PalaeoMap on SAHRIS the *Abrahamskraal* and *Waterford* Formations have very high Palaeontological sensitivities while the Ecca has a moderate Palaeontological Sensitivity (Almond and Pether 2008, SAHRIS website).

A site specific field survey of the development footprint were conducted on foot and by motor vehicle from the 1st - 3rd October 2018. Access to all of the locations of the proposed site proved to be difficult. However, as many as possible of the proposed infrastructure locations were investigated. Exposed rock layers were visually inspected but there were no visible evidence of fossiliferous outcrops. For this reason, an overall **low palaeontological sensitivity** is allocated to the development footprint. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Rondekop WEF development will be of a **low significance** in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the **construction of the development may be authorised in its whole extent**, as the development footprint is not considered sensitive in terms of palaeontological resources.

The proposed development, as well as all alternatives have a similar geology and therefore there is no preferences on the grounds of palaeontological fossil heritage for any specific layout among the different options under consideration. The different options include the on-site substation, construction yards, the access roads to the ridges and turbine layouts along with proposed associated infrastructure. As impacts on fossil heritage usually only occur during the excavation phase and no further impacts on fossil heritage are expected during the operation and decommissioning phases of the WEF.

It is important to note that: "'SiVEST under took every effort to obtain the information (including specialist studies, BA/EIA/Scoping and EMPr Reports) for the surrounding developments, however many of the documents are not currently publically available to download. The information that could be obtained for the surrounding planned renewable energy developments was taken into account as part of the cumulative impact assessment".'

During the construction phase the deeper bedrock excavations (that is deeper than 1 m) should be monitored by the Environmental Control Officer (ECO) for fossil heritage. In the event that fossil remains are uncovered during any phase of construction, operation and decommissioning, either on the surface or unearthed by new excavations and vegetation clearance, the (ECO) in charge of these developments ought to be alerted immediately and the chance find protocol must be followed. These discoveries ought to be protected (if possible *in situ*) and the ECO must report to SAHRA (SAHRA for the Northern Cape (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (*e.g.* recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

Impact Summary

Environmental parameter	**Issues**	**Rating prior to mitigation**	**Average**	**Rating post mitigation**	**Average**
Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	-14	(negative low)	-12	(negative low)
Cumulative impact	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	-16	Negative low Impact	-14	Negative low Impact
Impact associated with the no-go alternative	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	Neutral	Neutral	Neutral	Neutral

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

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

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2 500 000 years ago.

Fossil

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

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Palaeontology

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

Table 1: Abbreviations

Abbreviations	Description
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
ECO	Environmental Control Officer
EA	Environmental Authorization
EIA	Environmental Impact Assessment
ESA	Early Stone Age
FM	Formation
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
REDZ	Renewable Energy Development Zone
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SEF	Solar Energy Farm
WEF	Wind Energy Facility

1 INTRODUCTION

Rondekop Wind Farm (Pty) Ltd plan to develop a 325MW Wind Energy Facility between Maitjiesfontein and Sutherland in the Northern Cape. The proposed development is situated approximately 45 km south-west of Sutherland in the Northern Cape Province (Namakwa District Municipality, Karoo Hoogland Local Municipality) (**Figure 1-3**). The proposed Rondekop Wind Energy Facility (WEF) is partially located within the Komsberg Renewable Energy Development Zone (REDZ 2) (**Figure 4**). This is one of the eight REDZ officially gazetted[1] in South Africa stipulating the procedure in applying for environmental authorization (EA) for large scale solar and wind energy generation facilities. Given that the planned facility is not entirely situated within the Komsberg REDZ, the Rondekop WEF will be focus to a full Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) as amended and EIA Regulations, 2014 (as amended).

PGS Heritage was commissioned by SiVEST SA (Pty) Ltd on behalf of Rondekop Wind Farm to conduct the Heritage impact Assessment. Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Impact Assessment (PIA). According to the National Heritage Resources Act (NHRA) (No 25 of 1999, section 38), a PIA is key to detect the presence of fossil material within the proposed development footprint and it is thus necessary to evaluate the impact of the construction on the palaeontological resources. This Palaeontological Impact Assessment report serves to fulfil the requirement and form part of the EIA.

1

[1] **Formally gazetted on 16 February 2018 (Government notice 114)**

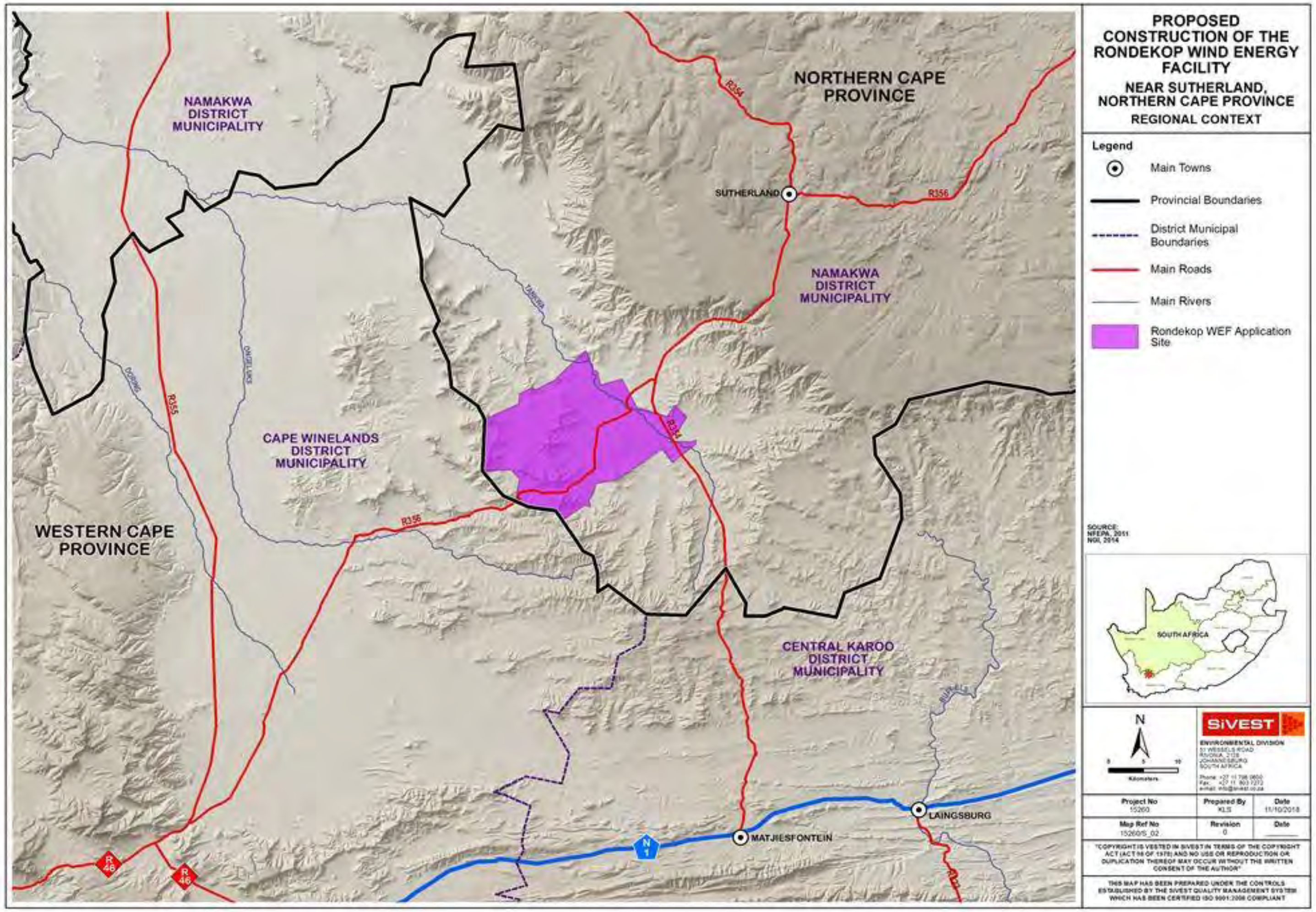

Figure 1: Rondekop WEF locality map. Map provided by SiVEST.

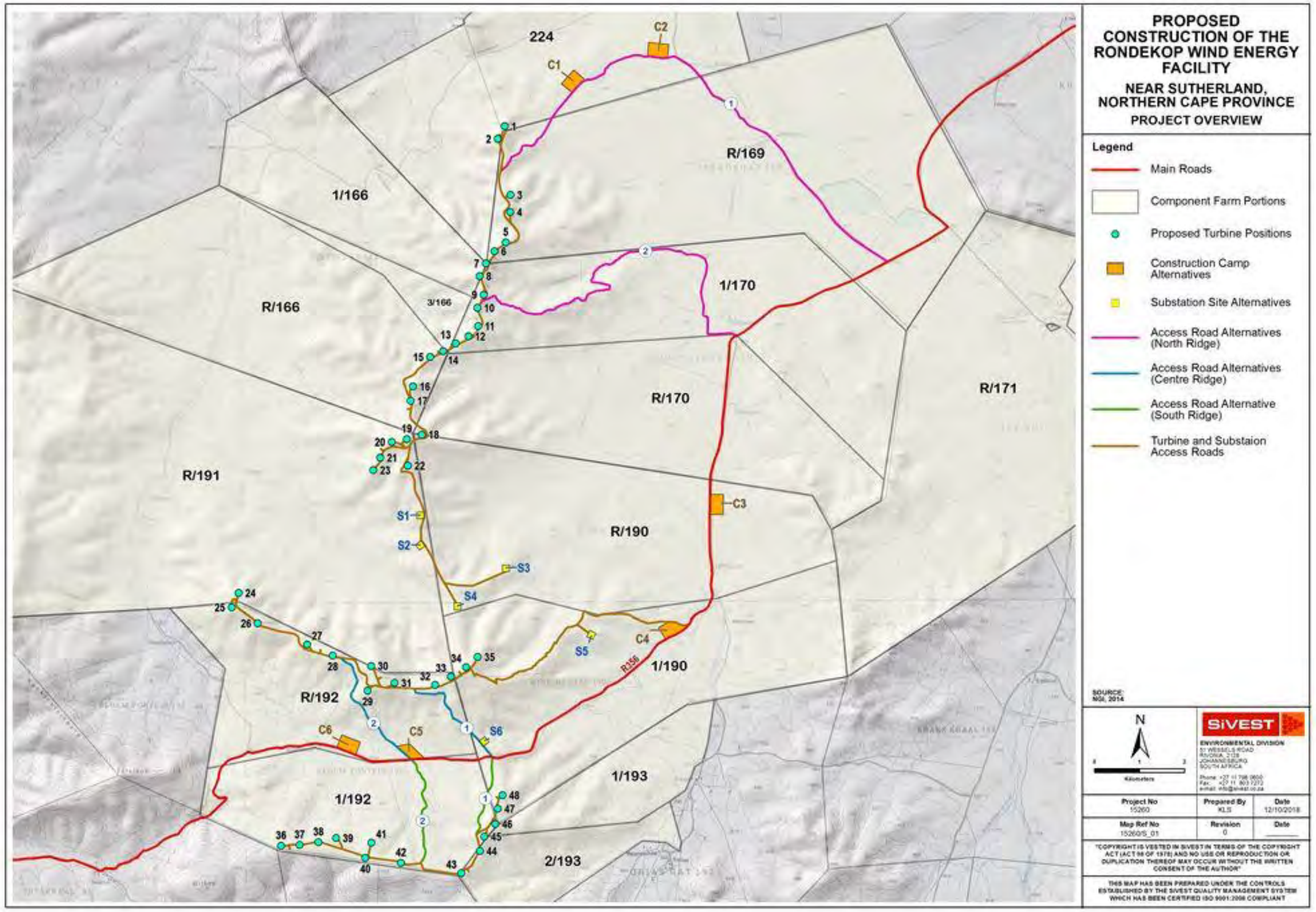

Figure 2: Overview of the Rondekop WEF. Map provided by SiVEST.

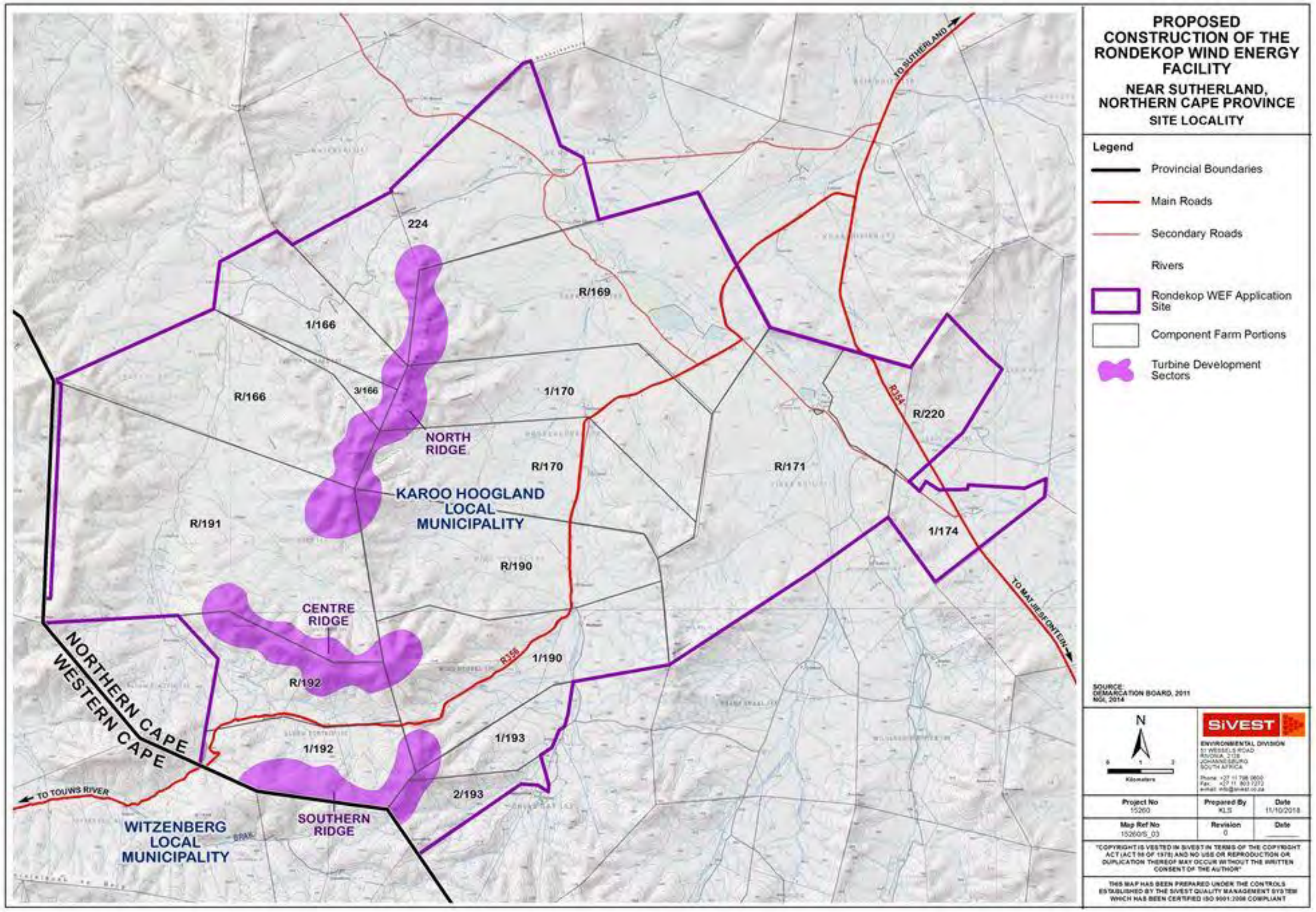

Figure 3: Overview of the Rondekop WEF site layout. Map provided by SiVEST.

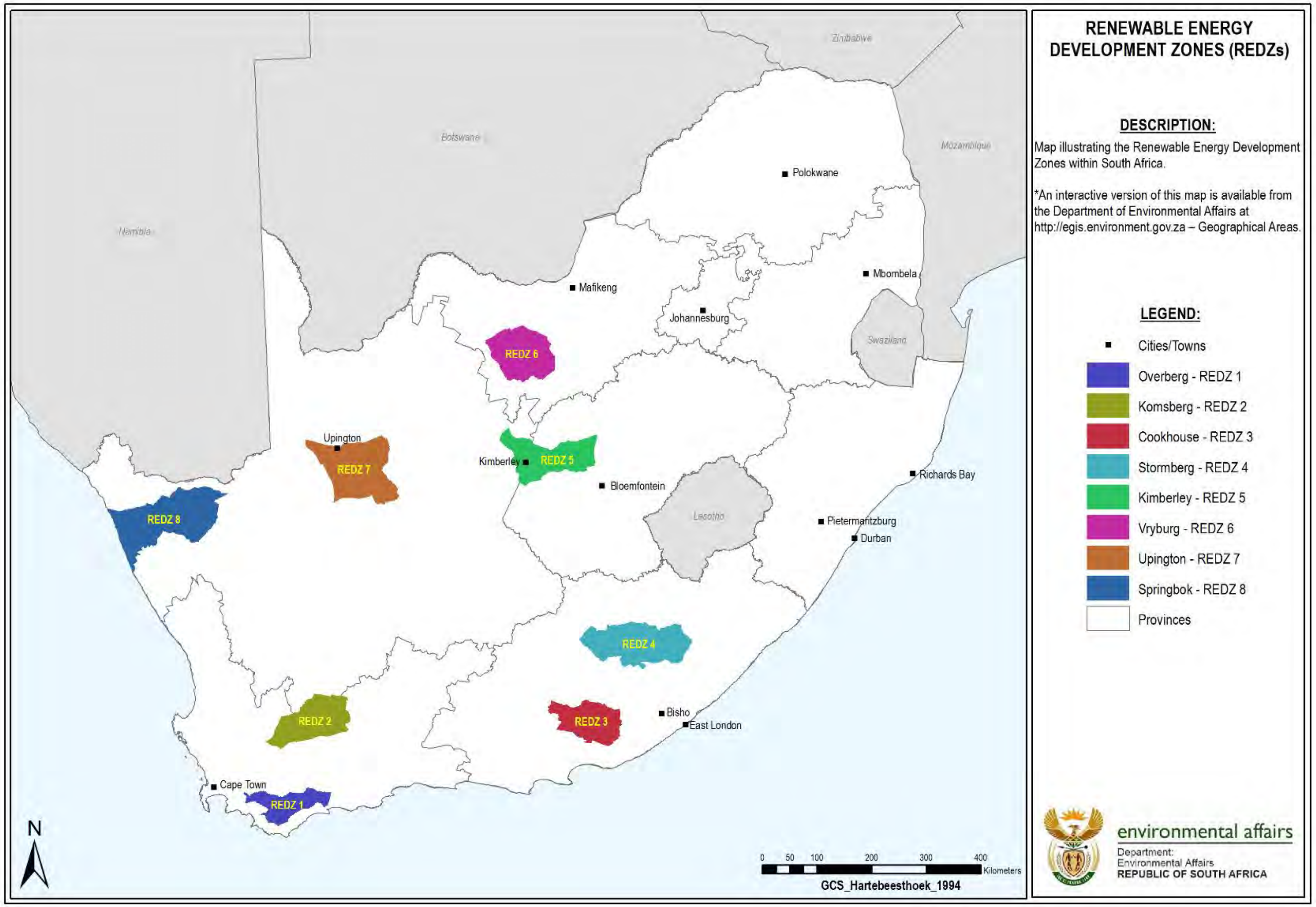

Figure 4. Renewable Energy Development Zones (REDs).

https://sfiler.environment.gov.za:8443/ssf/s/readFile/folderEntry/19030/8afbc1c75aea91ba015b66b85c0d4ad8/1492009145253/last/REDZ_251016.png

1.1 Project Description

Rondekop Wind Farm (Pty) Ltd propose to develop a Wind Energy Facility (WEF) of up to 325 megawatt (MW), 45 km south-west of Sutherland, in the Northern Cape Province, South Africa. The proposed facility is located within the Karoo Hoogland Local Municipality, which fall within the Namakwa District Municipalities.

The Rondekop WEF will have an energy generation capacity (at 132kV point of utility connection) of up to 325 megawatt (MW), and will include the following:

- Up to 48 wind turbines, each between 3MW and 6.5MW in nameplate capacity each with a foundation of up to 30 m in diameter and up to 5 m in depth.
- The hub height of each turbine will be between 90 m and up to 140 m and its rotor diameter between 100 m and up to 180 m.
- Permanent compacted hard-standing laydown areas (also known as crane pads) for each wind turbine of 90 m x 50 m (total footprint 21.6ha) during construction and for ongoing maintenance purposes for the lifetime of the project.
- Electrical transformers (690V/33kV) adjacent to each turbine (typical footprint of 2 m x 2 m, but can be up to 10 m x 10 m at certain locations) to step up the voltage to 33kV.
- Underground 33kV cabling between turbines buried along access roads, where feasible, with overhead 33kV lines grouping turbines to crossing valleys and ridges outside of the road footprints to get to the onsite 33/132kV substation.
- Internal access roads up to 12 m wide, including structures for stormwater control would be required to access each turbine and the substation, with a total footprint of about 73 ha. 38,6 ha will be upgrades to existing roads.. Turns will have a radius of up to 50 m in order for abnormal loads (especially turbine blades) to access the various turbine positions.
- Access roads to the site will be approximately 9 m wide while access roads to the substation will be approximately 6 m wide.
- One 33/132kV onsite substation. The 33kV footprint will need to be assessed as part of the WEF EIA and the 132kV footprint will be assessed in a separate EIA process as the current applicant will remain in control of the low voltage components of the 33/132kV substation, whereas the high voltage components of this substation will likely be ceded to Eskom shortly after the completion of construction. The total footprint of this onsite substation will be approximately 2.25 ha.
- Up to 4 (the height will be the same as the final wind turbine hub height) wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.
- Temporary infrastructure including a construction camp (~13ha) which includes an on-site concrete batching plant for use during the construction phase and for offices, administration, operations and maintenance buildings during the operational phase.

- Fencing will be limited around the construction camp and batching plant. The entire facility would not be fenced off. The height of fences around the construction camp are anticipated to be up to 6 m.
- Temporary infrastructure to obtain water from available local sources/ new or existing boreholes including a potential temporary above ground pipeline (approximately 35cm diameter) to feed water to the on-site batching plant. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the DWS will be applied for separately.
- Application site ~37 543.13 hectares (cadastral units). The total footprint of the wind farm will however be ~ 114 ha (of which ~38ha will be upgrading of existing roads).

Turbine Layout Alternatives

One layout alternative will be assessed for Rondekop WEF based on 48 wind turbines with associated crane pad areas and other associated infrastructure. The proposed layout is spread over three (3) ridges namely northern ridge, centre ridge and southern ridge. The proposed layout will be amended, as needed, based on specialist input and input from I&APs.

Road layout alternatives

Various access road alternatives are currently proposed to connect the public R356 to the three ridges. The proposed access to the site is from the tarred R354 connecting Matjiesfontein and Sutherland, turning north-west onto R356 provincial gravel road and heading west from where the access roads branches off. The six (6) access road alternatives (two (2) per ridge) branch off the public R356.

Considering that the proposed Rondekop WEF is to be developed on three (3) separate ridges, there are two (2) proposed access roads to each ridge, therefore six (6) access road alternatives in total. Three access road alternatives would connect the public R356 road to the new wind farm road network between the turbines on the ridges namely:

North ridge

- Access road alternative North 1, route is approximately 11.8 km in length, almost all of which comprises an existing farm road that will need to be upgraded; or
- Access road alternative North 2 is approximately 12.8 km in length and branches off the R356 and follows an existing farm road that will need to be upgraded.

Centre ridge

- Access road alternative Centre 1 is approximately 2.6 km in length and branches off the R356 to the north and connects between turbine 31 and 32; or
- Access road alternative Centre 2 is approximately 3.1 km in length and branches off the R356 and connects to the site near turbine 28.

Southern ridge

- Access road alternative South 1 is approximately 1.9 km in length and branches off the R356 to the south and connects near turbine 45; or
- Access road alternative South 2 is approximately 4.2 km in length and branches off the R356 to the south and connects near turbine 42.

Each road section will be buffered by approximately 200 m to allow for incremental alternatives i.e. reroute within the buffer in order to avoid any sensitive features identified during the detailed specialist assessments.

Construction camps

Six (6) alternative construction camp layouts, including the area required for a batching plant, will be assessed namely construction camp:

- Construction Camp Alternative 1 is located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;
- Construction camp Alternative 2 is also located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;
- Construction Camp Alternative 3 is located adjacent to and east of the R356 public road on the Remainder of farm 190 Wind Heuvel;
- Construction Camp Alternative 4 is located at the intersection of an existing 4x4 track and the R356 on portion 1 of farm 190 Wind Heuvel;
- Construction Camp Alternative 5, is located at the intersection of the R356, access road alternative centre 2 and access road alternative south 1 extending to the north on the remainder of farm 192 Bloem Fontein; and
- Construction Camp Alternative 6 is located to the west of access road alternative centre 2 north of the R356 on the remainder of farm 192 Bloem Fontein.

Substations

Six (6) onsite 33/132kV substation location alternatives were identified based on technical studies which considered aspects such as topography, earth works and levelling, environmentally sensitive features, electrical losses, turbine locations and existing agricultural use. All six (6) positions are located relatively in the centre of the facility.

- Substation alternative 1 is located south of turbine 22 on the remainder of farm 191 Hout Hoek;
- Substation alternative 2 is located south of substation alternative 1 on the remainder of farm 191 Hout Hoek;
- Substation alternative 3 is located south east of substation alternative 2 on the remainder of farm 190 Wind Heuvel;
- Substation alternative 4 is located north east of substation alternative 3 on the remainder of farm 190 Wind Heuvel;

- Substation alternative 5 is located west of construction camp alternative 4 along an existing 4x4 jeep track; and
- Substation alternative 6 is located adjacent to access road alternative center 1 to the east on portion 1 of farm 190 Wind Heuvel.

No-Go Alternative

It is mandatory to consider the “no-go” option in the EIA process. The no development alternative option assumes the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area and the status quo would proceed

2 OBJECTIVE

The terms of reference of a Palaeontological Impact Assessment are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;
- Provide a thorough overview of all applicable legislation, guidelines;
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
    - Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
    - Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective

impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

- Comparative assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures in order to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).

Specific Requirements:

- Describe and map the palaeontological heritage features of the site and surrounding area. This is to be based on desk-top reviews, fieldwork, available databases, findings from other palaeontological heritage studies in the area, where relevant. Include reference to the grade of heritage feature and any heritage status the feature may have been awarded.
- Assess the impacts and provide mitigation measures to include in the environmental management plan.
- Map palaeontological heritage sensitivity for the site. Clearly show any "no-go" areas in terms of heritage (i.e. "very high" sensitivity) and provide recommended buffers or set-back distances.
- Identify and assess potential impacts from the project on palaeontology, as required by heritage legislation (including cumulative impacts from other wind farms within a radius of 50 km).
- Provide an updated sensitivity map for the Rondekop WEF project site.
- Assess the project alternatives provided, including the no-go alternative

3 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 12 years. She has been conducting PIAs since 2014. A CV has been attached as Appendix 1 to this report.

4 LEGISLATION

4.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, moved, broken or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact Assessment forms part of the Heritage Impact Assessment (HIA) and adheres to the conditions of the NHRA. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

(a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;

(b) the construction of a bridge or similar structure exceeding 50 m in length;

(c) any development or other activity which will change the character of a site—

  i. exceeding 5 000 m^2 in extent; or

  ii. involving three or more existing erven or subdivisions thereof; or

  iii. involving three or more erven or divisions thereof which have been consolidated within the past five years; or

  iv. the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority

(d) the re-zoning of a site exceeding 10 000 m^2 in extent;

(e) or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed development site is underlain by the Abrahamskraal Formation, Adelaide Subgroup, of the lower Beaufort Group (Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup) (**Figure. 5 & 6**). The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. The Beaufort Group of the Karoo Basin consists of a lower Adelaide Subgroup and an upper Tarkastad Subgroup. This group is the focus of palaeontological research in South Africa and are internationally renowned for the early diversification of land vertebrates. The Beaufort Group provide the worlds' most complete transition from early "reptiles" to mammals.

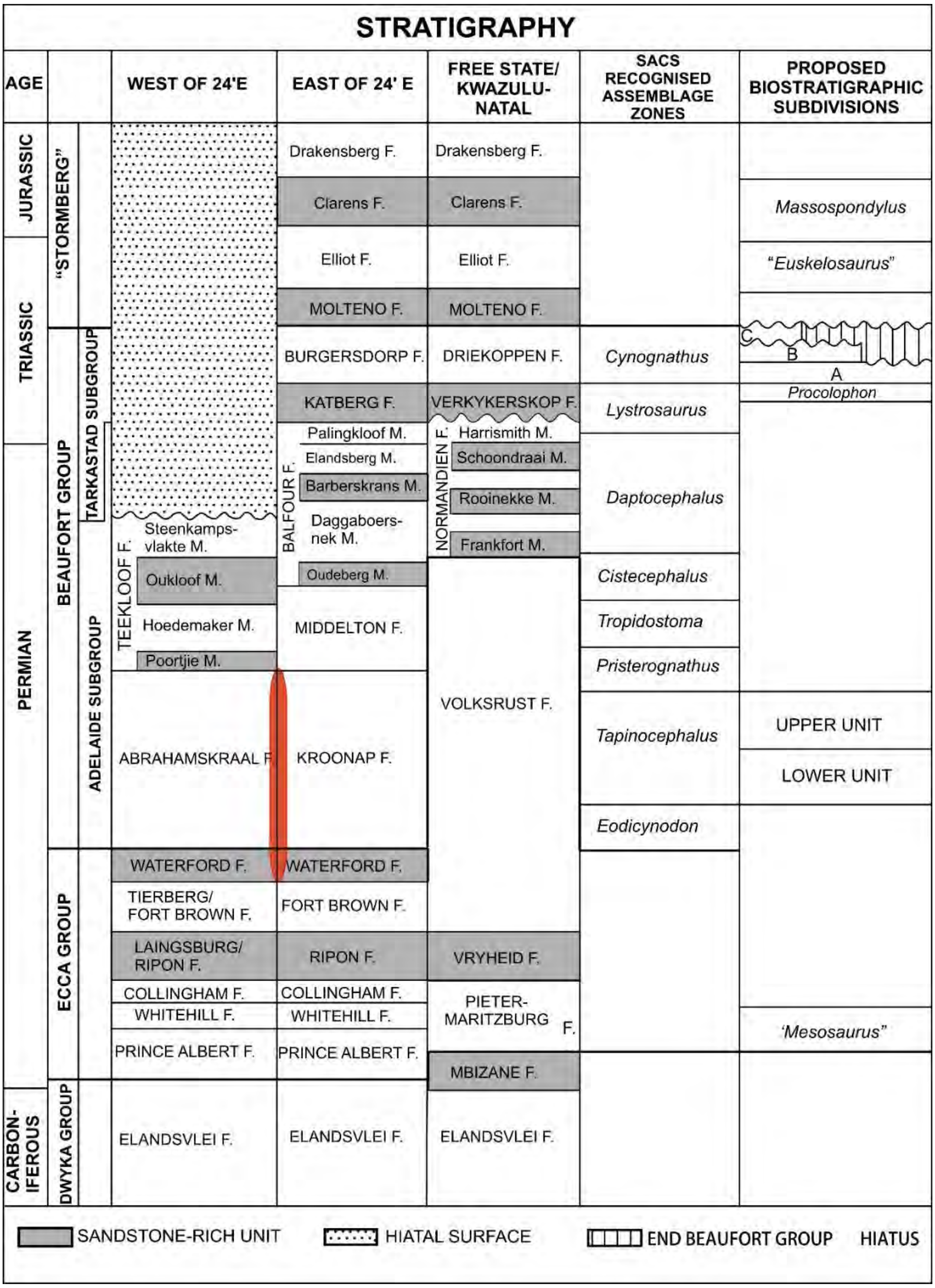

Figure 5: *Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions Beaufort Group of the Karoo Supergroup with rock units and fossil assemblage zones relevant to the present study marked in orange (Modified from Rubidge, 1995). Abbreviations: F. = Formation, M. = Member*

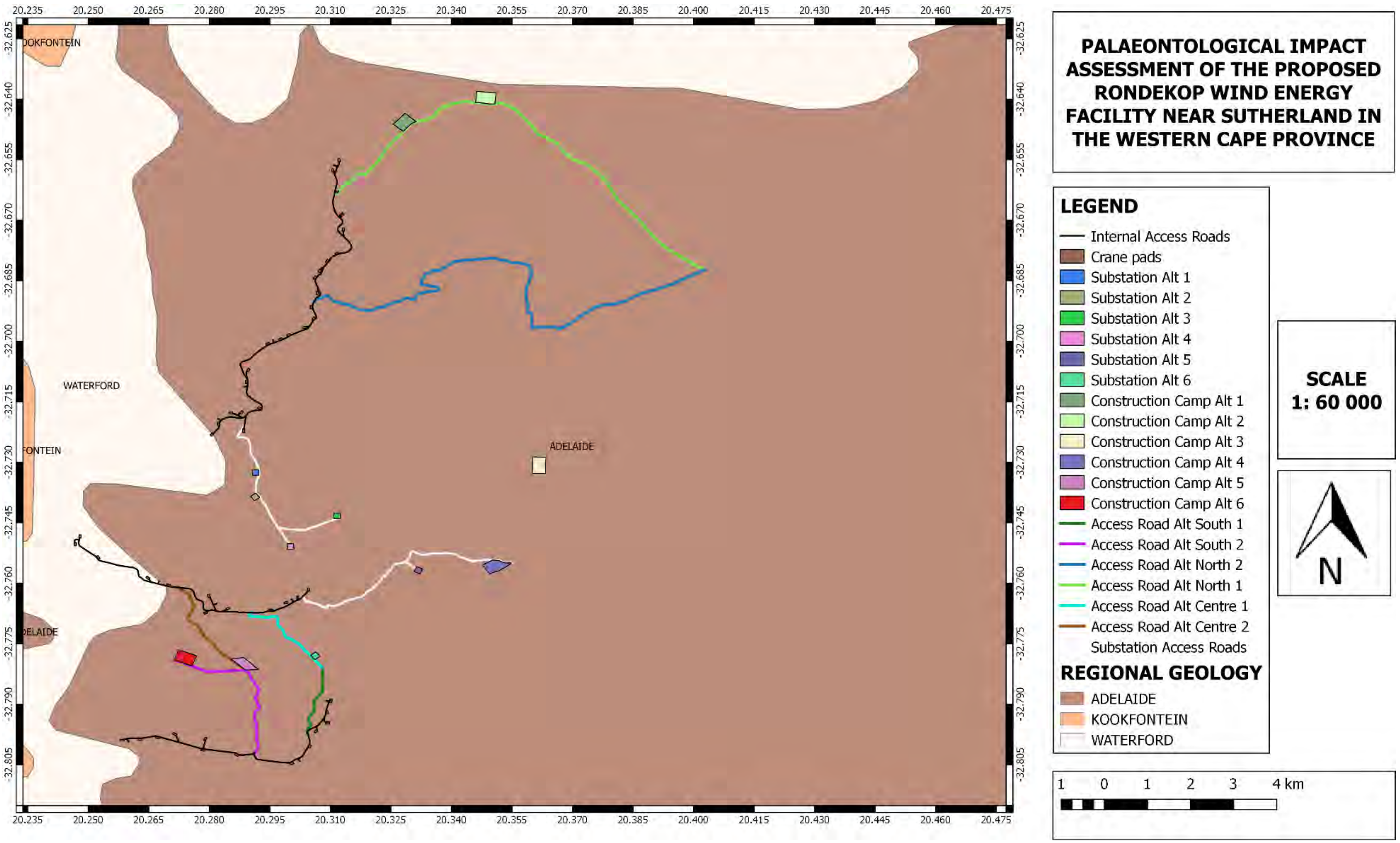

Figure 6: Surface Geology for the proposed Rondekop Wind Energy Facility near Sutherland in the Cape Province. The proposed development site is underlain by the Adelaide Formation of the Beaufort Group (Karoo Supergroup) and the Waterford Formation of the Ecca Group (Karoo Supergroup). Map drawn QGIS Desktop 2.18.18.

5.1 Geology

5.1.1 Ecca Group

The Ecca group forms part of the Karoo Supergroup and is divided into several Formations.

Table 2: Ecca Group and Formations. (Modified from Johnson et al, 2006).

<table>
<tr><th>Period</th><th>Super group</th><th>Group</th><th>Formation West of 24º E</th><th>Formation East of 24º E</th><th>Formation Free State / KwaZulu Natal</th></tr>
<tr><td rowspan="7">Permian</td><td rowspan="7">Karoo Supergroup</td><td rowspan="7">Ecca Group</td><td>Waterford Formation</td><td>Waterford Formation</td><td rowspan="2">Volksrust Formation</td></tr>
<tr><td>Tierberg / Fort Brown Formation</td><td>Fort Brown Formation</td></tr>
<tr><td>Laingsburg / Rippon Formation</td><td>Rippon Formation</td><td>Vryheid Formation</td></tr>
<tr><td>Collingham Formation</td><td>Collingham Formation</td><td rowspan="3">Pietermaritzburg Formation</td></tr>
<tr><td>Whitehill Formation</td><td>Whitehill Formation</td></tr>
<tr><td rowspan="2">Prince Albert Formation</td><td rowspan="2">Prince Albert Formation</td></tr>
<tr><td>Mbizane Formation</td></tr>
</table>

The proposed Rondekop WEF development site is underlain by the arenaceous Waterford Formation which overlies the Fort Brown Formation (Department of Water Affairs DWA), 1998).The formation comprises alternating very fine-grained, lithofeldspathic sandstone and mudrock or clastic rhythmite units. The Waterford Formation, consists of fine- to medium-grained sandstone, siltstone, shale and rhythmite. The lower part of the Formation is characterized by upward-coarsening cycles of sediments, which are capped by extensive sheet-like sandstones and alternating chaotic, slump and slide deposits. The upper portion of the Formation consists of sandstone (approximately 8 m thick), siltstone, ball-and-pillow layers and channel-fill deposits.

5.1.2 Beaufort Group

Table 3: Adelaide Subgroup and Formations. Modified from Modified from Rubidge, 1995)

<table>
<tr><th>Period</th><th>Supergroup</th><th>Group</th><th>Subgroup</th><th>Formation West of 24º E</th><th>Formation East of 24º E</th></tr>
<tr><td rowspan="3">Middle Permian to Middle Triassic</td><td rowspan="3">Karoo Supergroup</td><td rowspan="3">Beaufort Group</td><td rowspan="3">Adelaide Subgroup</td><td></td><td rowspan="2">Balfour Formation</td></tr>
<tr><td rowspan="2">Teekloof Formation</td></tr>
<tr><td>Middleton Formation</td></tr>
</table>

				Abrahamskraal Formation	Kroonap Formation

The proposed Rondekop WEF development site is underlain by a series of Karoo sandstones, mudstones and shales, deposited under fluvial environments of the Adelaide Subgroup that forms part of the Beaufort Group. The Beaufort Group is the third of the main subdivisions of the Karoo Supergroup. The Beaufort group overlays the Ecca Group and consists essentially of sandstones and shales, deposited in the Karoo Basin from the Middle Permian to the early part of the Middle Triassic periods and was deposited on land through alluvial processes. The Beaufort Group covers a total land surface area of approximately 200 000 km^2 in South Africa and is the first fully continental sequence in the Karoo Supergroup, and is divided into the Adelaide subgroup and the overlying Tarkastad subgroup. The Adelaide subgroup rocks are deposited under a humid climate that allowed for the formation of wet floodplains with high water tables and are interpreted to be fluvio-lacustrine sediments.

Stratigraphy

In the south eastern portion of the Karoo Basin the Adelaide Subgroup consists of the Koonap, Middleton and Balfour Formations. West of 24° the Adelaide Subgroup is represented by the Abrahamskraal and Teekloof Formations and in the north the Group is represented by the Normandien Formation. The Adelaide Subgroup is approximately 5 000 m thick in the southeast, but this decreases to about 800 m in the centre of the basin which thinness out to about 100 to 200m in the north. The Kroonap Formation is about 1 300 m, Middleton 1 600 m and the Balfour Formation approximately 200 m thick. The Abrahamskraal Formation is about 2 500 m thick and the Teekloof Formation 1 000 m. The Normandien Formation is only about 320 m thick.

The Lower Adelaide Subgroup consists of the following formations:

- *Kroonap Formation:* Transitional brackish lacustrine to fluvial. Greenish-grey sandstones grading upwards into fine-grained siltstones and mudstones.
- *Abrahamskraal Formation:* Consists of greenish-grey and less commonly of reddish-brown mudrock and subordinate light grey fine-grained sandstone, fining-upward. The 1st to 3rd order cycles range in thickness from a few meters to tens of meters (Cole, 2016). It reaches a maximum thickness in the southwest part of the basin (2200 to 2565 m) and thins northeast-ward. The sedimentary facies represent deposition on a huge alluvial plain with lateral and downstream accretionary sand bodies in fluvial channels and flood basin and subordinate lacustrine muds and silts in the extensive interchannel areas.
- *Middleton Formation:* Semi-arid climate supported a lush flora and fauna that thrived along meander belts and semi-permanent lakes. Cyclic deposits of lenticular sandstone bodies grading into greenish-grey mudstone. The thickest formation in this succession, constituting

37% of the Beaufort Group and 47% of the Adelaide Subgroup. The formation has lenses of red mudstone which are likely to have been deposited in a sub-aerial fluvial environment.

- *Balfour Formation:* The upper part of the Adelaide Subgroup (lower to middle Beaufort).

Composition

The Adelaide Subgroup contains alternating greyish-red, bluish-grey, or greenish-grey mudrocks in the southern and central parts of the Karoo Basin with very fine to medium grained, grey lithofeldspathic sandstones. In the northern Normandien formation the basin consists of coarse to very coarse sandstones and granulostones. Coarsening–upward cycles are present in the lower part of the Normandien Formation while the mudrocks and sandstone units usually form fining-upward cycles. These cycles are positioned on erosion surfaces which is overlain by thin intraformational mud-pellet conglomerate and vary in thickness from a few meters to tens of meters. Singular sandstone units could vary from 6 meters to 60 meters in the south thinning northwards however thick sandstone units are also present in the northern Normandien Formation.

Thicker sandstones of the Adelaide are usually multi-storey and usually have cut-and fill features. The sandstones are characterized internally by horizontal lamination together with parting lineation and less frequent trough cross-bedding as well as current ripple lamination. The bases of the sandstone units are massive beds, while ripple lamination is usually confined to thin sandstones towards the top of the thicker units.

The mudrocks of the Adelaide Subgroup usually has massive and blocky weathering apart from in the Normandien and Daggaboersnek Member. Sometimes desiccation cracks and impressions of raindrops are present. In the mudstones of the Beaufort Group calcareous nodules and concretions occur throughout.

5.2 Palaeontology

5.2.1 Ecca Group

Waterford Formation

Fossil remains from this formation usually consists of poorly preserved tetrapod bones that could probably belong to the aquatic temnospondyl amphibians. Scattered fish scales and fish coprolites have been recovered as well as several genera of non-marine bivalves. A low diversity of trace assemblages have been described that may belong to the *Scoyenia ichnofacies*. These trace fossils could possibly have been made by small arthropods, earthworms and even insects. Petrified wood of the Glossopteris flora are commonly found in this formation as well as gymnospermous woods namely, *Prototaxoxylon* and *Australoxylon*.

5.2.2 Beaufort Group

The Beaufort Group has been divided into a series of fossil biozones known as fossil assemblage zones (AZ) (**Figure 5**). These AZ are distinguished by their characteristic tetrapod faunas. The Abrahamskraal Formation is represented by the *Eodicynodon, Tapinocephalus* and partially by the *Pristerognathus* Assemblage Zones. The AZ present in the proposed Rondekop WEF development is most probably the *Tapinocephalus* Assemblage Zone.

***Tapinocephalus* Assemblage Zone**

Vertebrate fossils in this assemblage zone is not as abundantly found as in later assemblage zones. Fossils are generally recovered as single specimens and is often covered by brown-weathering calcareous nodular material. Fauna present in this assemblage zone is mostly large bodied dinocephalians and pareiasaurs. Large *Bradysaurus* specimens are found as complete articulated skeletons and in a dorsal-up position while dinocephalian skulls with associated postcrania are extremely uncommon (**Figure 7**). A few isolated carnivore specimens of grogonopsia (also known as sabre toothed reptiles), biarmosuchians and therocephalians have been recovered while pelycosaurus are uncommon.

The *Tapinocephalus* AZ is also known for large disarticulated amphibians as well as palaeoniscoid bony fish, mostly represented by scattered scales. Gastropods are represented by freshwater bivalves. Fragmentary vascular plant remains include roots, twigs and leaves and petrified wood. Trace fossils are also known from this assemblage zone and include traces of arthropod, tetrapod and worm burrows, tetrapod trackways, fossilized faeces or coprolites and stem and plant casts.

Vertebrate fossils found in the Sutherland area include the tapinocephalid and titanosuchid dinocephalians, the pareiasaur *Bradysaurus*, as well as more uncommon dicynodonts, gorgonopsians and therocephalians. Several examples of plant remains have also been documented from this assemblage zone.

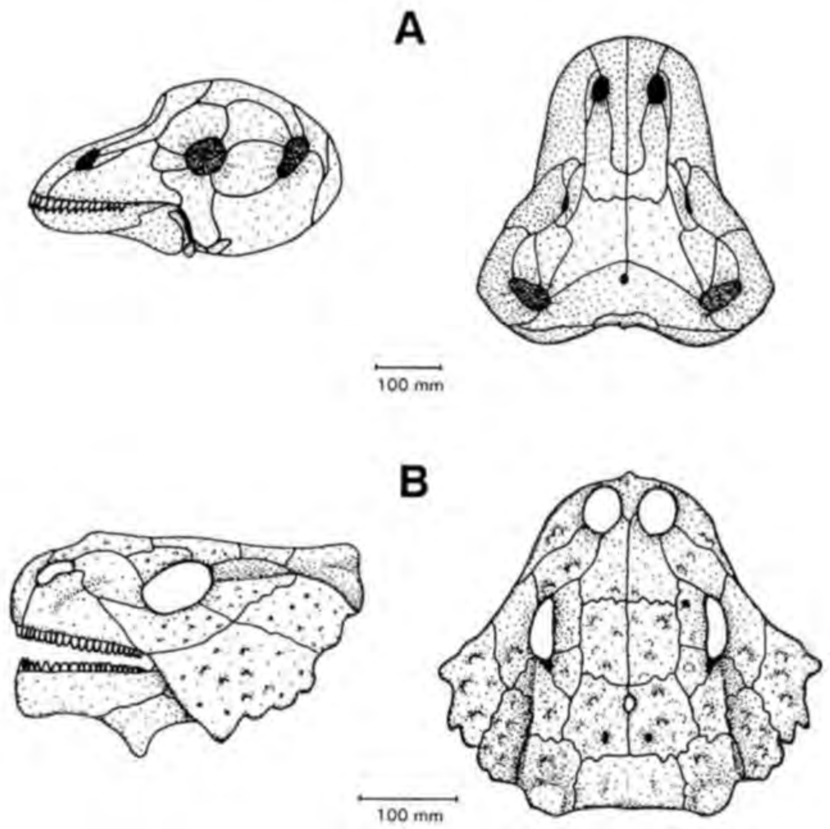

Figure 7: Fossils characteristic of the Tapinocephalus AZ include A) the dinocephalian therapsid Tapinocephalus and B) the pareiasaur Bradysaurus. Figure taken from Smith and Keyser 1995)

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development site comprises of the following farms and portions of farms:

- Remainder and Portion 1 and 3 of the Farm Venters Kraal 166,
- 224 of the Farm Ashoek,
- the Farm Zeekoegat 169,
- the Remainder and Portion 1 of the Farm Roodeheuvel 170,
- the Remainder and Portion 1 of the Farm Wind Heuvel 190,
- the Remainder of the Farm Hout Hoek 191,
- the Remainder and Portion 1 of the Farm Bloem Fontein 192
- Portions 1 and 3 of the Farm Urias Gat 193,
- Portion 1 of Farm Lange Huis 174,
- Remainder of the Farm Vinkie Kuil, and
- Remainder of Farm 220.

The proposed Rondekop WEF is located between the Klein Roggeveld Mountains to the south and the Roggeveld Mountains and Plateau to the north.

The proposed Rondekop WEF development falls into an agriculture zone. However the proposed development will have to be rezoned as a special zone and thus will be zoned as commercial / industrial.

7 APPROACH AND METHODOLOGY

The objective of a Palaeontological Impact Assessment is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the palaeontological impact assessment are:

1. to identify the palaeontological importance of the exposed and rocks below the surface in the development footprint
2. to evaluate the palaeontological importance of the formations
3. to determine the impact of the development on fossil heritage; and
4. to recommend how the developer ought to protect or mitigate damage to fossil heritage.

When a palaeontological desktop study is compiled, the potentially fossiliferous rocks present within the study area are established from 1:250 000 geological maps. The topography of the development area is identified using 1:50 000 topography maps as well as Google Earth Images of the development area. Fossil heritage within each rock formation is obtained from previous palaeontological impact studies in the same region, the PalaeoMap from SAHRIS; and databases of various institutions. The palaeontological importance of each rock unit is calculated. The probable impact of the proposed development footprint on local fossil heritage is established on

1. the palaeontological importance of the rocks,
2. the type and scale of the development, and
3. quantity of bedrock excavated.

When rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a palaeontologist is required. Based on both the desktop data and field assessment, the impact significance of the planned development is determined with recommendations for further studies or mitigation. In general, destructive impacts on palaeontological heritage only happen during construction. The excavations will change the current topography and may destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation involves the collection and recording of fossils preceding construction or during construction when hypothetically fossiliferous bedrock is uncovered. Importantly, preceding the excavation of any fossil heritage a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact is possible because our knowledge of local palaeontological heritage may be increased.

7.1 SAHRA minimum standards for Palaeontology reports

As per the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" it states that "Although the details of the Phase 1 Minimum Standards discussed below may not apply directly where these are specifically archaeological, these standards can be used as a general guide to what is needed in Phase 1 palaeontological reports". The compliance of this PIA to these standards is described in below.

Table 4. Compliance with SAHAR minimum standards

Standards	Compliance
A. **Title Page** with: a) A Title that identifies this report. It should give the name and geographical location of the site(s) and/ or project, including property or farm name (and magisterial district) and province; b) Author(s) surname(s) and details, company name and contact details; c) Developer and consultant's name (who commissioned the report), postal address, telephone and fax numbers; d) Date of report (including day and month).	Yes
B. **Executive Summary** including: a) The purpose of the study; b) A brief summary of the findings; c) The recommendations; and d) Any stakeholders or people responsible for decisions and actions.	Yes
C. **Table of Contents**, for reports longer than 10 pages.	Yes
D. **Background Information** on the Project with: a) Whether the report is part of a scoping report/ EIA/ HIA or not; b) Type of development (e.g. low cost housing project, mining); c) Whether re-zoning and/or subdivision of land is involved; d) Developer and consultant and owner and name and contact details; e) Terms of Reference; f) Legislative requirements.	Yes
E. **Background to the Palaeontology History** and other relevant heritage components of the area with, a) Literature review or archival research sufficient to place the sites located in context; b) Reference to museum or university databases and collections; c) Previous relevant impact assessment reports for the area.	 Section 5.2 N/A Section 11.2
F. Description of the Property or Affected Environment its setting and heritage resources, with: a) Details of the area surveyed including; i. Full Location Data for Province, Magisterial District/Local Authority and property (e.g. farm/erf) name and number, etc.; ii. Location Map(s)/ orthophotos of the general area. These must include the map name and number (e.g. 3318DC Bellville). Maps must include at least a 1:50 000 and (if available) also a 1:10 000 (i.e. most detailed possible). Large scale colour satellite photos	 Figure 1-3 as well as section 6

make a useful addition. Maps should be preferably at least A4 in size. iii. Either the Location Map or the Site Map must have the polygon of the area surveyed marked on it and full geographical co-ordinates for all relevant points and, where applicable, indication of the area to be developed (footprint). The report or map must indicate exactly what area was searched, and if any area was not searched why this was so; and what the probability is of sites being found there. b) Description of the methodology used including: i. How the area was searched (e.g. a three-person team for two days, and whether on foot or not!) and what, if any, sampling techniques were used; ii. What the restrictions to the study were, for example: • visibility affected by high grass or bush or vegetation cover, walls or concrete surfaces; • physical or other impediments (e.g. vlei, swamp, steep kloof, mobile dune) to the assessment of the area; iii. How the data was acquired, and details of research equipment (e.g. GPS).	Section 7 and Section 8 Section 7.1 and 8
G. **Description of Sites** identified and mapped with: a) Details of the location of all the sites including: i. Site Map or aerial photograph of the specific area with the location of all sites marked on it. Make it clear how this relates to the Location Map described above (7.1Fii). ii. GPS readings with the model and datum used (WGS 84 is considered the most useful). Please comment on the accuracy. If co-ordinates are read off the 1:50 000 map, please indicate this. Wherever possible the GIS track actually surveyed should be mapped. b) An adequate description of each site including: i. Type of site (e.g. open scatter; shell midden, cave/shelter); ii. Site categories (e.g. Earlier Stone Age, Late Iron Age); iii. Context (detailed description of depositional history and environment); iv. Cultural affinities, approximate age and significant features of the site; v. Estimation or measurement of the extent (maximum dimensions) and orientation of the site(s); iv. Depth and stratification of the site (where shovel test permits have been given or natural exposures available), both in the text and through photographs of sections; vii. Possible sources of information about past environments, such as stalagtites/ stalagmites, flowstone, dassie middens, peat or organic rich deposits and natural bone accumulations;and viii. Photographs and diagrams, of good quality, with a centimetre scale (e.g. for artefacts) or metre scale (e.g. for large scale village plan) and a caption. Include a 'wide angle' photo of the sites. c) Threats or sources of risk and their impact on the heritage resources (e.g. earth moving, traffic of vehicles or humans, erosion). d) If the sites are in KwaZulu-Natal or the Northern Cape please apply to the old Archaeological Data Recording Centres at the Provincial Museums for National Site Numbers (for sites that will be conserved, excavated or collected).	Section 8 Section 8 Section 11 N/A no sites need to be recorded
H. **Description of the Artefacts, Faunal, Botanical or Other Finds and Features** for each site. Record meaningful information and consider supplying: a) Raw material, type, maximum dimensions and relative frequency of and significant attributes of stone tools observed on the surface;	N/A

b) Basic description of ceramics, other artefacts and occurrences such as rock art; c) Description of features (e.g. hearths, bedding, walling); d) Basic description of faunal or botanical taxa and estimated frequencies; e) Adequate photographic and graphic representations (with scale in centimetres); and crossreference photographs with a map showing where the objects in the photographs were found; f) Location of repositories at which artefacts, photographs, rock art tracings and field records (from other sites in the area) are kept.	Section 8 Section 8
I. **Clear Description of Burial Grounds and Graves** with: a) Clear written and photographic description of any graves; b) Exact or estimated age and affinities of the burials; c) Clear discussion for the client of the legal implications (include reference to both the Act and the regulations for s.363 , and particularly the public participation process, and whether this should be done by the archaeologist or may be better done by a social consultant).	N/A for Palaeontological assessment
J. **Field Rating** (Recommended grading or field significance) of the site: While grading is actually the responsibility of the heritage resources authorities, all reports should include Field Ratings for the site(s) discussed (proposals for grading), to comply with section 38 of the national legislation, for example: a) National: This site is considered to be of Field Rating/Grade I significance and should be nominated as such (mention should be made of any relevant international ranking); b) Provincial: This site is considered to be of Field Rating/Grade II significance and should be nominated as such; c) Local: this site is of Field Rating/Grade IIIA significance. The site should be retained as a heritage register site (High significance) and so mitigation as part of the development process is not advised; d) Local: this site is of Field Rating/Grade IIIB significance. It could be mitigated and (part) retained as a heritage register site (High significance); e) 'General' Protection A (Field Rating IV A): this site should be mitigated before destruction (usually High/Medium significance); f) 'General' Protection B (Field Rating IV B): this site should be recorded before destruction (usually Medium significance); g) 'General' Protection C (Field Rating IV C): this site has been sufficiently recorded (in the Phase 1). It requires no further recording before destruction (usually Low significance).	N/A
K. **Statement of Significance** (Heritage Value) giving the significant archaeological heritage value of relevant sites in terms of the legislation (NHRA, section 3 (3) listed below) or any other relevant criteria, and give reasons. a) a. its importance in the community, or pattern of South Africa's history; b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage; c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage; d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects; e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group; f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;	N/A no sites were found to have any significance

g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons; h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and i) sites of significance relating to the history of slavery in South Africa.	
L. **Recommendations** including: a) An assessment of the potential impact of the development on these sites, relative to sustainable social and economic benefits; b) Proposals for protection or mitigation relating to: i. Possible alternatives in the development that might allow the protection and conservation of the sites; or ii. The need for mitigation of adverse impacts; or iii. The need to conserve certain sites because of their high heritage value. c) Detailed recommendations with regard to burial grounds and graves. This must inform the client about the full process and enable the heritage authority to make decisions about permits. This must include: i. Recommendations for protection of the grave(s) during the development and in the long term, e.g. fencing and plans for maintenance (mini-management plan); OR ii. Recommendations for relocation of the grave(s), public participation and possibly further archival research, or both (i & ii). d) An indication of what must be done at each site: i. If the site is of Low4 Significance (see Kg above) the recommendation may be that the site must be mapped, documented and then destroyed (with a permit / letter of permission / Record of Decision from the heritage authority); ii. If the site is of Medium5 Significance the recommendation may be for a measure of mitigation after which the site may be destroyed. Mitigation usually involves a requirement to collect or excavate a sample of the cultural and other remains that will adequately allow characterization and dating of the site. (The archaeologist will require a permit for the excavation and collection. If, after this mitigation significant archaeological residues or parts of sites remain, the archaeologist should request the developer to apply for a permit for destruction or fill in the application for them to sign! In this way the heritage resources authority can help the archaeologist ensure that the recommended mitigation takes place; iii. If the site is of High Significance the recommendation may be that it be formally graded and conserved (with. provision of boardwalks, fencing, signage, guides) and protected as a heritage resource (either being listed on the Heritage Register or being declared as a Provincial or National Heritage Site). If sites are to be protected a Site Management Plan should be required. For mini-plans, where small sites are incorporated into developments, this must include an indication of who is responsible for maintenance and how this process will be monitored.	Section 11 Section 11 and section 9 N/A for Palaeontological assessment
M. Conclusions.	Section 12
N. Bibliography detailing citations in the text of the report. Remember that all sources should be adequately acknowledged (even the web).	Section 13
O. Appendices if any.	Yes

7.2 Assumptions and Limitation

The accuracy of Palaeontological Impact Assessments is reduced by several factors which may include the following: the databases of institutions are not always up to date and relevant locality and geological information was not accurately documented in the past. Various remote areas of South Africa has not been assessed by palaeontologists and data is based on aerial photographs alone. Geological maps concentre on the geology of an area and the sheet explanations was never intended to focus on palaeontological heritage.

Similar Assemblage Zones, but in different areas is used to provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations and Assemblage Zones generally assume that exposed fossil heritage is present within the development area. The accuracy of the Palaeontological Impact Assessment is thus improved considerably by conducting a field-assessment.

8 SITE VISIT

As part of the PIA, a field-survey of the development footprint was conducted on1-3 October 2018 to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed footprint of the development. A physical field-survey was conducted on foot by two observers within the proposed development footprint. Access to all of the locations of the proposed site proved to be difficult. However, as many as possible locations were investigated. The results of the field-survey, the author's experience, aerial photos (using Google Earth, 2018), topographical and geological maps and other reports from the same area were used to assess the proposed development footprint. No consultations were undertaken for this Impact Assessment as it will be undertaken as part of the EIA process.

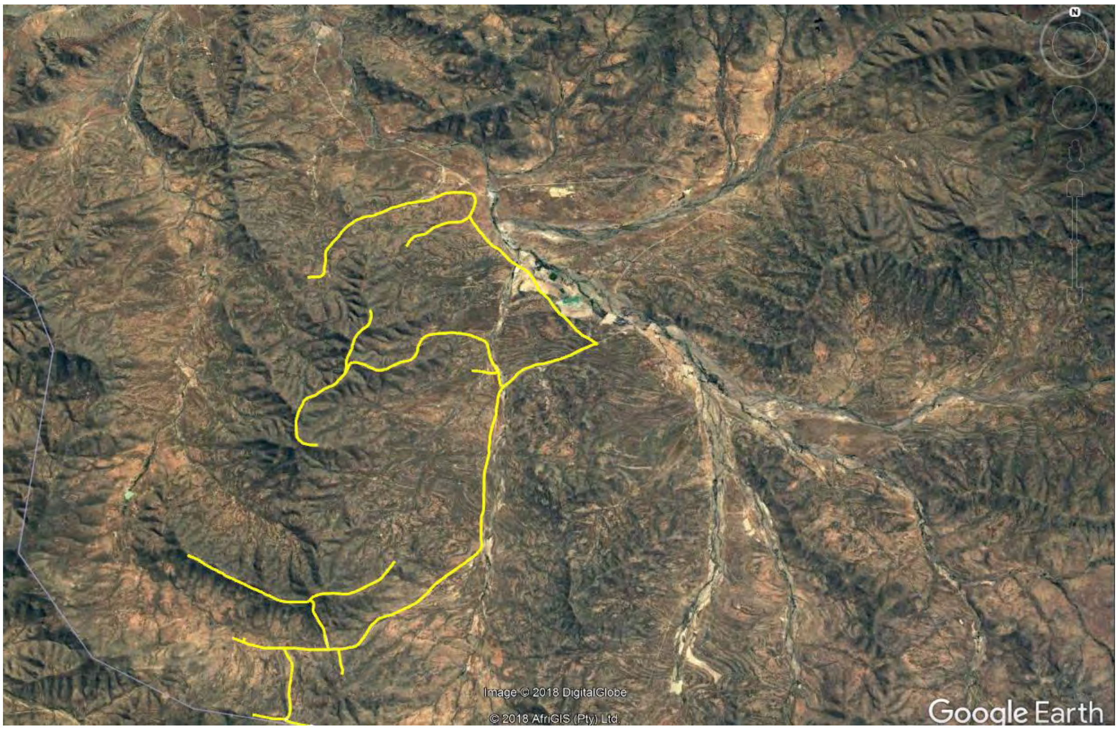

Figure 8: The approximate track followed for the site visit.

Figure 9: The general low-lying hilly terrain of the proposed development. Vegetation covers most of the surface and no outcrops were present. 32 °47' 12" S 20° 32' 05" E

Figure 10: Low lying hilly terrain covered by with vegetation. 32° 39' 27"S 20° 17' 47"E

Figure 11: Small exposure of grey overbank mudrocks, Access road Alternative South 2. Not fossiliferous. 32° 47’ 00”S 20° 17’ 26”E

Figure 12: Small overbank mudrock outcrop with blocky weathering. Not fossiliferous. 32°47'1.75"S 20°17'22.30"E

Figure 13: Drainage channel. Not fossiliferous. 32°47'52.00"S 20°17'30.00"E

Figure 14: Small exposure of grey overbank mudrocks, Access road Alternative South 2. Not fossiliferous. 32° 47’ 00”S 20° 17’ 26”E.

Figure 15: Surface gravels are unfossiliferous. 32°48'5.39"S 20°16'49.30"E

Figure 16: Surface gravels with low laying mountain in the background. One sandstone ridge is present. Not fossiliferous. 32°48’13”S 20°18’05”E

Figure 17: Grey, blocky weathered, mudrocks of the Abrahamskraal Formation. Not fossiliferous. 32°39'31.28"S 20°19'6.33"E.

Figure 18: Surface gravels. 32°45'18.00"S 20°20'59.68"E

Figure 19: Tabular bedded sandstones with grey overbank mudrocks. Not fossiliferous. 32°45'8.03"S 20°20'30.92"E.

9 FINDINGS AND RECOMMENDATIONS

The proposed Rondekop development site is underlain by the Abrahamskraal formation (Adelaide Subgroup, Beaufort group, of the Karoo Supergroup) and the Waterford formation of the Ecca group (Karoo Supergroup). The geologically older Waterford Formation is known for its trace fossils, occasional shelly invertebrates which include brachiopods and bivalves as well as fragmentary fish remains. Fossils of vascular plant (petrified wood), as well as stem and plant fragments are known from this formation as well as plant impressions.

The vertebrate fossils of the *Tapinocephalus Assemblage Zone* is not as abundantly found as in later assemblage zones. Fossils are generally recovered as single specimens and is often covered by brown-weathering calcareous nodular material. Large, complete articulated skeletons of *Bradysaurus* specimens are found in a dorsal-up position, while dinocephalian skulls with associated postcrania are extremely uncommon. Fauna present in this assemblage zone is mostly large bodied dinocephalians and pareiasaurs. A few isolated carnivore specimens of gorgonopsia (also known as sabre toothed reptiles), biarmosuchians and therocephalians have been recovered while pelycosaurus are uncommon.

The *Tapinocephalus* AZ is also known for large disarticulated amphibians as well as palaeoniscoid bony fish. The latter are mostly represented by scattered scales. Gastropods are represented by freshwater bivalves. Fragmentary vascular plant remains include roots, twigs and leaves and petrified wood. Trace fossils are also known from this assemblage zone and include traces of arthropod, tetrapod and worm burrows, tetrapod trackways, fossilized faeces (coprolites) and stem and plant casts are also present

Vertebrate fossils found in the Sutherland area include the tapinocephalid and titanosuchid dinocephalians, the pareiasaur *Bradysaurus*, as well as more uncommon dicynodonts, gorgonopsians and therocephalians. Several examples of plant remains has also been documented from this assemblage zone.

These Waterford and Abrahamskraal Formations have a very high palaeontological sensitivity on the PalaeoMap of SAHRIS (Almond et al, 2013). During a field survey of the development footprint (on foot and by motor vehicle), no fossiliferous outcrops were found. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Rondekop WEF development will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In my opinion the construction of the development may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

During the construction phase the deeper bedrock excavations (that is deeper than 1 m) should be monitored by the Environmental Control Officer (ECO) for fossil heritage. In the event that fossil remains are uncovered during any phase of construction, operation and decommissioning, either on the surface or unearthed by new excavations and vegetation clearance, the (ECO) in charge of these developments ought to be alerted immediately and the chance find protocol must be followed. These discoveries ought to be protected (if possible *in situ*) and the ECO must report to SAHRA (SAHRA for the Northern Cape (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (*e.g.* recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

10 CHANCE FIND PROCEDURE

- When a chance find is made the person must instantly stop all work near the find.
- The site must be secured to protect it from any additional damage
- The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the Mine/development management. The supervisor must in turn report the find to his/her manager and the ECO. The ECO must report the find to the relevant Authorities and a relevant palaeontologist.
- The ECO must appoint a relevant palaeontologist to investigate and access the chance find and site.
- Both ECO and palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings.
- These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site
- The reports and all other documents will be submitted to SAHRA by the palaeontologist.
- The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development.
- Once the required approvals have been issued, the Mine/development may carry on with the development.
- The ECO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan.
- .

11 IMPACT ASSESSMENT

Impact on Palaeontological Heritage will only occur during the construction phase of the proposed development with no impacts on the preconstruction, operational and decommissioning phases. Impacts will only occur when the vegetation is cleared and levelled, and excavations into the bedrock will occur to erect the wind turbines and associated infrastructure in the development footprint.

The no-go alternative is not accessed per se as this option implies that no construction will take place and normal activities (farming) will continue as in the past. Impacts would thus be of very low significance.

11.1 Impact Ratings

Table 4: Palaeontological Impact Rating-Construction phase

IMPACT TABLE	
Environmental Parameter	Prevent the loss of Palaeontological Heritage
Issue/Impact/Environmental Effect/Nature	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study.
Extent	Excavation of the ground surface *of the **site** (1)*
Probability	As fossil heritage is known from these formations the probability of impacts on palaeontological heritage during the construction phase is probable (3).
Reversibility	Impacts on fossil heritage are usually **irreversible**. (4)
Irreplaceable loss of resources	By taking a precautionary approach, an insignificant loss of fossil resources is expected (**No Loss**). (1)
Duration	The expected duration of the impact is assessed as potentially permanent to **long term**. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent (4).
Cumulative effect	The cumulative effect of the development of the WEF and associated infrastructure within the proposed location is considered to be **low**. This is as a result of the broader Sutherland area not being considered as fossiliferous.(1)

Intensity/magnitude	The intensity of the impact on fossil heritage is rated as **low (1)**.	
Significance rating	Low	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	4	4
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-14 (negative low)	-12 (negative low)
Mitigation measures	Monitoring of major excavations for fossil material by the ESO on an on-going basis during construction phase. Significant fossil finds to be reported to SAHRA for recording and sampling by a professional palaeontologist Chance find procedure must be followed. • When a chance find is made the person must instantly stop all work near the find. • The site must be secured to protect it from any additional damage • The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the Mine/development management. The supervisor must in turn report the find to his/her manager and the ECO. The ECO must report the find to the relevant Authorities and a relevant palaeontologist. • The ECO must appoint a relevant palaeontologist to investigate and access the chance find and site.	

	• Both ECO and palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings. • These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site • The reports and all other documents will be submitted to SAHRA by the palaeontologist. • The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development. • Once the required approvals have been issued, the Mine/development may carry on with the development. • The ECO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan.

11.2 Chance finds

Table 5: Chance finds impact rating

IMPACT TABLE	
Environmental Parameter	Prevent the loss of Palaeontological Heritage not identified during the site survey.
Issue/Impact/Environmental Effect/Nature	Due to the size of the project and the design method requiring surveying before identification of the layout, there is a possibility to come across fossil heritage not surveyed.
Extent	*Site (1)*

Probability	Possible (3)	
Reversibility	Irreversible (4)	
Irreplaceable loss of resources	By taking a precautionary approach, an insignificant loss of fossil resources is expected (**No Loss**). (1)	
Duration	Permanent (4)	
Cumulative effect	Low	
Intensity/magnitude	Low	
Significance Rating	*low*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	4	4
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-14 (negative low)	-12(negative low)
Mitigation measures	Monitoring of major excavations for fossil material by the ESO on an on-going basis during construction phase. Significant fossil finds to be reported to SAHRA for recording and sampling by a professional palaeontologist Chance find procedure must be followed. • When a chance find is made the person must instantly stop all work near the find. • The site must be secured to protect it from any additional damage • The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the Mine/development management. The	

	supervisor must in turn report the find to his/her manager and the ECO. The ECO must report the find to the relevant Authorities and a relevant palaeontologist. • The ECO must appoint a relevant palaeontologist to investigate and access the chance find and site. • Both ECO and palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings. • These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site • The reports and all other documents will be submitted to SAHRA by the palaeontologist. • The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development. • Once the required approvals have been issued, the Mine/development may carry on with the development. • The ECO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan. .

11.3 Cumulative Impacts

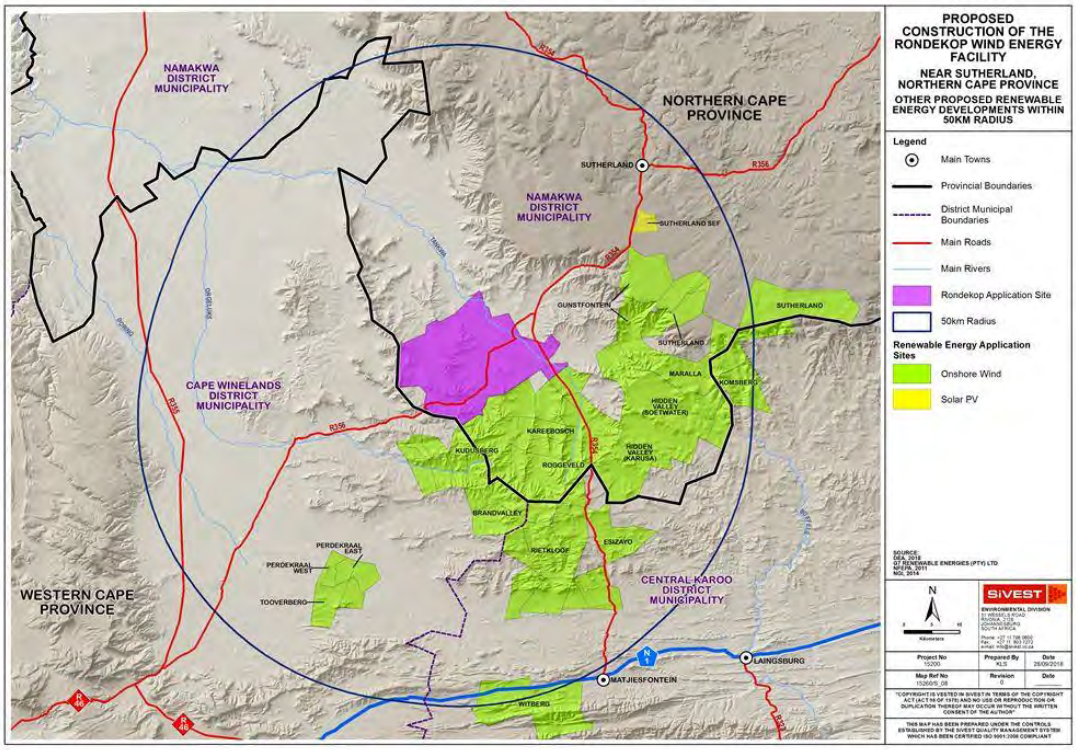

Figure 20: Other Renewable Energy developments in relation to the Rondekop WEF application area (SiVEST 2018)

A total of 17 Renewable Energy Facilities is present in a 50 km radius of the Rondekop WEF. 16 are Wind Energy Facilities with only one (1) Solar Energy Facility. Of these Renewable Energy Facilities 12 have been approved, 2 are in the process of being approved, 1 is currently under construction and in 2019 the construction will commence at 2 facilities (Table 6).

Various Palaeontological Impact assessments have been conducted in the Rondekop development footprint in the past. These PIA's may be used as a reference list for the present impact study. Palaeontological studies (mostly conducted by Almond, see references) in the Klein-Roggeveld and Roggeveld Plateau regions found the palaeontological sensitivity of the general area to be low and thus the impact significance has been rated as Low. Almond found that although scientifically important fossil remains does occur in the area, the probability of significant impacts on scientifically important and rare fossils were small. Although fossils heritage does occur in the formations present, they tend to be extremely rare and the majority of these fossils represent common forms which occur commonly in outcrops of the immediate area. He established that the cumulative impact significance of the proposed WEF and SEF facilities in the Roggeveld area is likely to be *low* (*negative*) provided that all mitigation and monitoring recommendations are adhered to. This negative impact could slightly be improved with the improved knowledge of fossils of the Karoo area. W*ithout* mitigation the magnitude of cumulative impacts of this large number of WEFs and SEFs and associated infrastructure affecting the same fossiliferous rock sequences would be considerably higher and probable. He assessed the cumulative impact significance without mitigation as *medium*.

Table 6: Renewable Energy Facilities within a 50km radius of the Rondekop WEF include: (Information provided by SiVEST).

NAME	**MEGAWATT CAPACITY**	**STATUS**
Brandvalley WEF	140	Approved
Esizayo WEF	140	Approved
Gunstfontein WEF	200	Approved
Hidden Valley (Karusa & Soetwater) WEF	140 each	Preferred bidders. Construction to commence 2019
Hidden Valley (Greater Karoo) WEF	140	Approved
Kareebosch WEF	140	Approved
Komsberg West and East WEF	140 each	Approved
Kudusberg WEF	325	In process
Maralla WEF (East and West)	140 each	Approved
Perdekraal East WEF	110	Under Construction
Perdekraal West WEF	150	Approved
Rietkloof WEF	36	Approved
Roggeveld WEF	140	Preferred bidders. Construction to commence 2019
Sutherland WEF	140	Approved
Sutherland SEF	10	Approved
Tooverberg WEF	140	In process
Witberg WEF	120	Approved

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ALMOND, J.E. 2014. Proposed Karreebosch Wind Farm (Roggeveld Phase 2) near Sutherland, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 63 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015a. Proposed Perdekraal East Wind & Solar Renewable Energy Facility near Touwsrivier, Ceres Magisterial District, Western Cape Province. Palaeontological impact assessment: field study, 68 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015b. Proposed expansion of the existing Komsberg Main Transmission Substation on Farm Standvastigheid 210 near Sutherland, Northern Cape Province. Paleontological heritage assessment: combined desktop & field-based study (basic assessment), 39 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015c. Authorised Karusa Wind Farm near Sutherland, Namaqua District Municipality, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 57 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015d. Authorised Soetwater Wind Farm near Sutherland, Namaqua District Municipality, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 57 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015e Recommended exemption from further palaeontological studies: Proposed exploitation of fresh and weathered dolerite from four quarry sites near Sutherland, Namaqua District Municipality, Northern Cape

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ALMOND, J.E. 2015g. Komsberg West Wind Energy Facility near Sutherland, Laingsburg and Sutherland Districts, Western and Northern Cape. Palaeontological scoping assessment: combined desktop and field-based study, 55 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015h. Proposed Gunstfontein Wind Energy Facility near Sutherland, Karoo Hoogland Local Municipality, Northern Cape Province. Palaeontological heritage assessment: combined desktop & field-based study, 62 pp. Natura Viva cc, Cape Town.

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Table 7: Rating of Cumulative Impacts

IMPACT TABLE	
Environmental Parameter	Prevent the loss of Palaeontological Heritage
Issue/Impact/Environmental Effect/Nature	Damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study, this will occur during vegetation clearance or during the construction phase
Extent	National (3)
Probability	Since fossil heritage is known from these formations the probability of impacts on palaeontological heritage during the construction phase is probable. (3)
Reversibility	Impacts on fossil heritage are generally **irreversible** (4)
Irreplaceable loss of resources	By taking a precautionary approach, an insignificant loss of fossil resources is expected (**No Loss**). (1)
Duration	The expected duration of the impact is assessed as potentially permanent to **long term**. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent. (4)
Cumulative effect	The cumulative effect of the development of the WEF and associated infrastructure within the proposed location is considered to be **low**. This is as a result of the broader Sutherland area not being considered as fossiliferous (1).
Intensity/magnitude	Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as low as fossil

	heritage is not common in the development area or in the greater Sutherland area (1)	
Significance Rating	Should the project progress without due care to the possibility of fossils being present at the proposed site in the Abrahamskraal Formation and Waterford Formation. The resultant damage, destruction or inadvertent relocation of any affected fossils will be **permanent and irreversible**. Thus, any fossils occurring within the area are potentially scientifically and culturally significant and any negative impact on them would be of **high** significance (without the implementation of mitigation measures).	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	3	3
Probability	3	1
Reversibility	4	4
Irreplaceable loss	1	1
Duration	4	4
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-16 (negative low)	-14 (negative low)
Mitigation measures	Monitoring of major excavations for fossil material by the ESO on an on-going basis during construction phase. Significant fossil finds to be reported to SAHRA for recording and sampling by a professional palaeontologist The chance find procedure must be followed. • When a chance find is made the person must instantly stop all work near the find. • The site must be secured to protect it from any additional damage • The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the Mine/development management. The supervisor must in turn report the find to his/her manager and the ECO. The ECO must report the	

	find to the relevant Authorities and a relevant palaeontologist. • The ECO must appoint a relevant palaeontologist to investigate and access the chance find and site. • Both ECO and palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings. • These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site • The reports and all other documents will be submitted to SAHRA by the palaeontologist. • The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development. • Once the required approvals have been issued, the Mine/development may carry on with the development. • The ECO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan. .

11.4 Comparative Assessments of alternatives

The EIA for the proposed 325MW Rondekop Wind Energy Facility between Matjiesfontein Sutherland in the Northern Province comparative assessment of layout alternatives is described in detail below.

Table 8: Comparative Assessments Rating

All alternatives may proceed.

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact

FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)
ACCESS ROADS		
NORTH RIDGE		
Access Road Alternative North 1	No Preference	No Fossil Heritage was recovered
Access Road Alternative North 2	No Preference	No Fossil Heritage was recovered
CENTRE RIDGE		
Access Road Alternative Centre1	No Preference	No Fossil Heritage was recovered
Access Road Alternative Centre 2	No Preference	No Fossil Heritage was recovered
SOUTHERN RIDGE		
Access Road Alternative South 1	No Preference	No Fossil Heritage was recovered
Access Road Alternative South 2	No Preference	No Fossil Heritage was recovered
CONSTRUCTION CAMPS		
Construction Camp Alternative 1	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 2	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 3	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 4	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 5	No Preference	No Fossil Heritage was recovered
Construction Camp Alternative 6	No Preference	No Fossil Heritage was recovered
SUBSTATIONS		
Substation Alternative 1	No Preference	No Fossil Heritage was recovered
Substation Alternative 2	No Preference	No Fossil Heritage was recovered
Substation Alternative 3	No Preference	No Fossil Heritage was recovered
Substation Alternative 4	No Preference	No Fossil Heritage was recovered
Substation Alternative 5	No Preference	No Fossil Heritage was recovered
Substation Alternative 6	No Preference	No Fossil Heritage was recovered

11.5 Impact Summary

Table 9: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post	Average

				mitig ation	
Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	-80	Negative very high Impact	18	Negative low Impact
Chance find impacts	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	-19	Negative low Impact	-18	Negative low Impact
Cumulative impact	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	-96	Negative very high Impact	-18	Negative low Impact
Impact associated with the no-go alternative	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	Neutral	Neutral	Neutral	Neutral

12 CONCLUSION

The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the Rondekop WEF development will be of a **low significance** in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the **construction of the development may be authorised in its whole extent**, as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

During the construction phase the deeper bedrock excavations (that is deeper than 1 m) should be monitored by the Environmental Control Officer (ECO) for fossil heritage. In the event that fossil remains are uncovered during any phase of construction, operation and decommissioning, either on the surface or unearthed by new excavations and vegetation clearance, the (ECO) in charge of these developments ought to be alerted immediately and the chance find protocol must be followed. These discoveries ought to be protected (if possible *in situ*) and the ECO must report to SAHRA (SAHRA for the Northern Cape (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web:

www.sahra.org.za) so that correct mitigation (*e.g.* recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies proposed by SAHRA.

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APPENDIX 3: *Environmental impact assessment methodology*

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.

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 3.

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.

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:

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.

The table below is to be represented in the Impact Assessment section of the report.

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 of the area over which the impact will be expressed*
Probability	*A brief description indicating the chances of the impact occurring*
Reversibility	*A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity*
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
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 EMP.*	

Impact Summary

The impacts will then be summarized and a comparison made between pre and post mitigation phases as shown in Table 4 below. The rating of environmental issues associated with different parameters prior to and post mitigation of a proposed activity will be averaged. A comparison will then be made to determine the effectiveness of the proposed mitigation measures. The comparison will identify critical issues related to the environmental parameters.

The table below is to be represented in the Executive Summary of the report.

Environmental parameter	**Issues**	**Rating prior to mitigation**	**Average**	**Rating post mitigation**	**Average**
Surface water	Erosion	43		16	
	Oil spills	22		22	

	Alteration of aquatic biota	16		3	
			- 27		**-13.67**
			Low Negative Impact		Low Negative Impact

Table 10: Comparison of summarised impacts on environmental parameters

Finally, the 2014 regulations also specify that alternatives must be compared in terms of impact assessment. Hence all alternatives will need to be comparatively assessed.

APPENDIX 4: *CURRICULUM VITAE: ELIZE BUTLER*

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 25 years in Palaeontology

EDUCATION:

B.Sc Botany and Zoology, 1988
University of the Orange Free State

B.Sc (Hons) Zoology, 1991
University of the Orange Free State

Management Course, 1991
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009
University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

Registered as a PhD fellow at the Zoology Department of the UFS

2013 to current

Dissertation title: A new gorgonopsian from the uppermost D*aptocephalus Assemblage Zone*, in the Karoo Basin of South Africa

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

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CONFERENCE CONTRIBUTIONS
NATIONAL

PRESENTATION

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INTERNATIONAL

Attended the Society of Vertebrate Palaeontology 73th Conference in Los Angeles, America. October 2012.

CONFERENCES: POSTER PRESENTATION
NATIONAL

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INTERNATIONAL VISITS

Natural History Museum, London July 2008

Paleontological Institute, Russian Academy of Science, Moscow November 2014

Appendix 6F

Noise Assessment

1st March 2019

Ms L. Scott-Shaw
SiVEST Environmental Division
Johannesburg
South Africa

Dear Ms Scott-Shaw

NOISE IMPACT ASSESSMENT FOR THE PROPOSED 325MW RONDEKOP WIND ENERGY FACILITY, (WEF) BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE PROVINCE (DEA REF: 14/12/16/3/3/2/1115)

This letter confirms that I have considered the intended amendments to the Rondekop Wind Energy Facility regarding the Noise Impact Assessment Report that was issued in 2019 (Report Number 26/8385).

The intended physical changes, as supplied by your client, as well as the information below:

1. A change in the turbine capacity from between 3MW up to 8MW. This change will not affect the noise impact assessment of the final turbine selection has a sound power emission of less than 108.1 decibels as was modelled in the report.

2. The overall impact rating reflected in the Noise Impact Assessment Report will not change due to the following proposed changes:

   - All turbine positions are still valid (a slight alignment shift, ±70m, has been made to Turbine 16 which will not affect the noise modelling).
   - Turbine 25 access road to the crane pad (minor alignment change as the current alignment was very close to the edge of the ridge and the ecologist was concerned about downslope erosion).
   - Turbine 27 access road: minor alignment shift to avoid crossing a rocky ridge / outcrop as per the ecology requirement.
   - Road between turbine 28 & 29: minor alignment change to avoid rocky outcrop.
   - Crane pad 29 & 35: minor alignment change to avoid the rocky outcrops.
   - Access road north 1: shifted the alignment slightly away from the drainage line and then crossing it perpendicularly at a single point.
   - Access road 2: shifted to only cross the drainage line at one point.
   - Construction Camp 1: shift to follow road alignment.

In summary, the proposed changes will not affect the results of the noise monitoring or the overall noise impact rating as described the Noise Impact Assessment Report.

Please feel free to contact us should you have any further requirements.

Yours sincerely

Dr Brett Williams

ENVIRONMENT
HEALTH
SAFETY

NOISE IMPACT ASSESSMENT

ENVIRONMENTAL IMPACT FOR THE PROPOSED DEVELOPMENT OF UP TO 325 MW RONDEKOP WIND ENERGY FACILITY LOCATED BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE

Report prepared for:
SiVEST SA (PTY) LTD
Johannesburg
South Africa

Report prepared by:
Dr Brett Williams
PO Box 27607
Greenacres
6057
Port Elizabeth
South Africa

10th October 2018

Northern Office: PO Box 80171, Doornpoort,
Pretoria, 0017 Tel: +27 (0)82 411 1571
Fax: +27 (0)86 6579864

Southern Office: PO Box 27607, Greenacres, Port Elizabeth 6057
Tel: +27 (0)41 3656846 / Fax: +27 (0)41 3652123
info@safetech.co.za / www.safetech.co.za
Safetrain cc T/A Safetech Reg. No CK/92/34818/23
VAT No. 4180135461
Directors: B Williams, C Williams

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DoL Approved Inspection Authority (OH0049-CI-09)

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SPECIALIST EXPERTISE

Dr Brett Williams

Name of Organization: Safetech
Position in Firm: Owner
Date of Birth: 21/04/1963
Years with Firm: 25
Nationality: South African

MEMBERSHIP OF PROFESSIONAL BODIES

- Southern African Institute of Occupational Hygienists
- Institute of Safety Management
- Mine Ventilation Society
- National Clean Air Association

BIOGRAPHICAL SKETCH

Brett Williams has been involved in Health, Safety and Environmental Management since 1987. He has been measuring noise related impacts since 1996. Brett is the owner of Safetech who have offices in Pretoria and Port Elizabeth. He has consulted to many different industries including, mining, chemical, automotive, food production etc. He is registered with the Department of Labour and Chamber of Mines to measure environmental stressors, which include chemical monitoring, noise and other physical stresses.

PROJECT EXPERIENCE

Dr Williams has been assigned to various projects to assess environmental noise impacts.

The list below presents a selection of Brett Williams' project experience, relevant to noise:

- Arcus Gibb – Kouga Wind Energy Project
- CSIR – Umgeni Water Desalination Plant
- CSIR – Saldanha Desalination Plant
- CSIR – Atlantis Gas to Power Project (current)
- CSIR – Walvis Bay Port Extension
- CSIR – Noise Impact Study of Namwater Desalination Plant
- CSIR – Kouga Wind Energy Project – Background Noise Measurements
- CSIR – Kouga Wind Energy Project
- CSIR – Wind Current Wind Energy Project
- CSIR – Langefontein Wind Energy Project
- CSIR – Mossel Bay Wind Energy Project
- CSIR – Coega IDZ Wind Energy Project
- CSIR – Baakenskop Wind Energy Project
- CSIR – Biotherm Wind Energy Project
- CSIR – Innowind Mossel Bay
- CSIR – Langefontein Wind Energy Project
- CSIR – Bulk Manganese Terminal (Port of Ngqura)
- CSIR – Phyto Amandla Biodiesel Project
- CSIR – Vleesbaai Wind Energy Project
- CES – Coega IDZ Gas to Power Project (Current)
- CES – Coega IDZ Wind Energy Project
- CES – Middleton Wind Energy Project
- CES – Waainek Wind Energy Project
- CES – Ncora Wind Energy Project
- CES – Qunu Wind Energy Project
- CES – Nqamakwe Wind Energy Project
- CES – Plan 8 Wind Energy Project
- CES – Qumbu Wind Energy Project
- CES – Peddie Wind Energy Project
- CES – Cookhouse Wind Energy Project
- CES – Madagascar Heavy Minerals
- CES – Richards Bay Wind Energy Project
- CES – Hluhluwe Wind Energy Project
- CEN – Kwandwe Airport Development Project
- CEN – Swartkops Manganese Project
- CEN – N2 Petro Port Project
- Crown Chickens – The independent report review of a noise specialist report conducted as part of an EIA to establish a new broiler farm.
- BMW – The evaluation of the impact of the Rosslyn production facilities on the surrounding community.
- Victory Race Track - Specialist noise report conducted as part of an EIA to establish a new stock car racing track.
- Continental Tyre - The evaluation of the impact of production facilities on the surrounding community.
- Media 24 – The measurement portion of an investigation on the impact of a printing press on a local community. The main study was conducted by the University of Stellenbosch.
- Zwartebosh Quarry - Specialist noise report conducted as part of an EIA to establish a new quarry.
- Milo Granite - Specialist noise report conducted as part of an EIA to establish a new quarry.
- Dunlop Tyres - The evaluation of the impact of production facilities on the surrounding community.
- Sasol Secunda - Independent report review of a noise specialist report conducted to determine the impact of production facilities on the surrounding community.

- Barlow World Coatings - The evaluation of the impact of production facilities on the surrounding community.
- Western Platinum Refinery - The evaluation of the impact of production facilities on the surrounding community.

TERTIARY EDUCATION

- PhD - University of Pretoria (Environmental Management)
- Various Health & Safety Courses.
- National Diploma Health & Safety Management
- Harvard University – Applications of Industrial Hygiene Principles – including noise
- United States EPA Pollution Measurement course conducted at the University Of Cincinnati (EPA Training Centre)
- US EPA Air Dispersion Modelling Training Course
- Master of Business Administration (University of Wales) with dissertation on environmental reporting in South Africa.
- Environmental Auditor (ISO 14001:2004)

……………………..

SPECIALIST DECLARATION

I, Brett Williams, as the appointed independent noise specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: _ _

Name of Specialist: Brett Williams

Date: 10/10/2018

EXECUTIVE SUMMARY

Safetech were appointed to conduct an Environmental Noise Impact Assessment for the proposed construction of the Rondekop Wind Energy Facility (WEF) 45 km south-west of Sutherland in the Northern Cape Province. The facility will generate a maximum of 325 MW of electricity.

A literature review and desktop modelling were conducted. Baseline monitoring was done of the ambient noise levels at the site.

The results of the study indicate that the following conclusions can be drawn:

a) There will be a short-term increase in noise in the vicinity of the site during the construction phase as the ambient noise level will be exceeded by vehicle operations.
b) The area surrounding the construction sites will be affected for short periods of time in all directions, should numerous construction equipment be used simultaneously.
c) The number of construction vehicles that will be used in the project will add to the existing ambient levels and will most likely cause a disturbing noise for a limited time. The exact number of construction vehicles is not known at present. The duration of impact will however be short-term.
d) The day/night time SANS 10103:2008 noise limit of 45dB(A) will not be exceeded at any of the noise sensitive areas.
e) The night time guideline noise limit of 35dB(A) will in all likelihood not be exceeded at any of the noise sensitive areas except for NSA 15 and 16 above 5m/s windspeed, as wind noise masking will occur as the wind speed increases. Although these homesteads are only occupied for 3 – 4 Months of the year during winter when grazing is optimal.
f) All turbine positions met the 500 m setback distance from noise sensitive receptors.
g) The cumulative impacts will not exceed the day/night time SANS 10103:2008 noise limit of 45dB(A).
h) The cumulative impacts will not exceed the night time SANS 10103:2008 noise limit of 35dB(A).

The construction phase and operational phase will have a very low noise impact on the noise sensitive receptors.

The following is recommended:

a) The noise impacts are re-modelled when the final turbine layout and turbine type is determined only if the chosen turbine has a higher sound power level than the type modelled in this report or if a turbine is moved substantially closer to a noise sensitive receptor (>100m).

b) Periodic noise measurements are taken during the construction and operational phases as per the intervals described in Table 16 and 17.

The table below represents the overall impact rating.

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Noise impacts during Construction	Noise could impact the receptors	-7	-7	-7	-7
Noise impacts during Operations	Noise could impact the receptors	-10	-10	-7	-7
			-8.5		-7
			Low Negative Impact		Low Negative Impact

Due to the potential low impacts associated with the construction and operational phases of the proposed Rondekop WEF, it is recommended that the proposed WEF receives Environmental Authorisation from a noise perspective in relation to the existing layout.

Dr Brett Williams

LIST OF ABBREVIATIONS

dB(A)	Decibels weighted A scale – Value of the sound pressure level in decibels determined using a frequency weighting network A (with reference to 20 µPa unless otherwise indicated).
$L_{Aeq,\ T}$	The equivalent continuous A-weighted sound pressure level.
L_{90}	Sound pressure level exceeded for 90 percent of the measurement time
m	metres
m/s	metres per second
NSA	Noise Sensitive Area
MW	Mega Watt
WEF	Wind Energy Facility
WTG	Wind Turbine Generator

GLOSSARY

DEFINITIONS	
Ambient Noise (General meaning)	Means the reading on an integrating impulse sound level meter taken at a measuring point, in the absence of any alleged disturbing noise, at the end of a total period of at least 10 minutes after such meter was put into operation Authors Note: Ambient noise in layman's terms generally excludes the noise alleged to be causing a noise nuisance or disturbing noise. Ambient noise in this definition is equivalent to Residual Noise as defined in the SANS 10103:2008
Ambient Noise (SANS 10103:2008)	Totally encompassing sound in a given situation at a given time, and usually composed of sound from many sources, both near and far NOTE: Ambient noise includes the noise from the noise source under investigation.
Annoyance	General negative reaction of the community or person to a condition creating displeasure or interference with specific activities.
Disturbing Noise (Western Cape Noise Control Regulations (June 2013)	a noise, excluding the unamplified human voice, which: a) exceeds the rating level by 7 dB(A); b) exceeds the residual noise level where the residual noise level is higher than the rating level; c) exceeds the residual noise level by 3 dB(A) where the residual noise level is lower than the rating level; or d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103.

Equivalent Continuous Rating Level ($L_{Req,T}$)	The equivalent continuous A-weighted sound pressure level ($L_{Aeq,\ T}$) during a specified time interval, plus specified adjustments for tonal character and impulsiveness of the sound and derived from the applicable equation. $L_{Aeq,\ T}$ + Ci + C_t + kn where $L_{aeq,T}$ is the equivalent A-weighted sound pressure level in decibels Ci is the impulse correction C_t is the correction for tonal character Kn is the adjustment for day or night (0dB for day and +10dB for night measurements
Low Frequency Noise	Means sound which contains sound energy at frequencies predominantly below 100 Hz.
Noise Nuisance	Means any sound which impairs or may impair the convenience or peace of a reasonable person.
Noise Rating Level	Means the applicable outdoor equivalent continuous rating level indicated in Table 2 of SANS 10103.
Residual Noise (SANS 10103)	Means the all-encompassing sound in a given situation at a given time, measured as the reading on an integrated impulse sound level meter for a total period of at least 10 minutes, excluding noise alleged to be causing a noise nuisance or disturbing noise.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Section where this is addressed in the Noise Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Specialist Expertise included on page 6
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Specialist Declaration included on page 9
c) an indication of the scope of, and the purpose for which, the report was prepared;	Scope and Purpose - 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Ambient Noise Survey – 3.3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Description of the Affected Environment - 3
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Ambient Noise at Proposed Site - 3.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Approach and Methodology - 1.3
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Identification of Potential Impacts - 6
g) an identification of any areas to be avoided, including buffers;	Identification of Potential Impacts - 6
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Identification of Potential Impacts - 6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Assumptions and Limitations - 1.5
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Assessments of Impacts and Identification of Management Actions - 6
k) any mitigation measures for inclusion in the EMPr;	Input into the EMPr - 6.8
l) any conditions for inclusion in the environmental authorisation;	Input into the EMPr - 6.8
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Input into the EMPr - 6.8
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Executive Summary
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Sources of Information
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	No comments received as the public will be consulted during the EIA process
q) any other information requested by the competent authority.	No comments received
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Noted

NOISE IMPACT ASSESSMENT

1. INTRODUCTION AND METHODOLOGY

1.1 SCOPE AND OBJECTIVES

Rondekop Wind Farm (Pty) Ltd proposes to construct a Wind Energy Facility (WEF) with an installed capacity of up to 325 Megawatts (MW) on several farms situated 45km south-west of Sutherland in Northern Cape Provinces. The WEF will host up to 48 turbines, each with a capacity of between 3MW and 6.5MW.

A Noise Impact Assessment (NIA) for the Environmental Impact Assessment (EIA) was conducted in accordance with Section 8 of SANS 10328. The scope of the project is described below:

- Determine the land use zoning of surrounding land and identify noise sensitive receptors that could be impacted upon by activities relating to the construction, operation and decommissioning of the wind farm.
- Determine the existing ambient levels of noise within the study area.
- Determine the typical rating level for noise on surrounding land at identified noise sensitive receptors.
- Identify all noise sources, relating to the establishment and operation of the proposed wind farm that could potentially result in a noise impact on surrounding land and at the identified noise sensitive receptors.
- Determine the sound power emission levels and nature of the sound emission from the identified noise sources.
- Calculate the expected rating level of noise on surrounding land and at the identified noise sensitive receptors from the combined sound power levels emanating from identified noise sources in accordance with procedures contained in SANS 10357 or similar.
- Calculate and assess the noise impact on surrounding land and at the identified noise sensitive receptors in terms of SANS 10103; the Environment Conservation Act: National Noise Control Regulations (GNR 154 - 1992 and the Western Cape Noise Control Regulations.
- There are no noise control provincial regulations for the Northern Cape.
- Investigate alternative noise mitigation procedures, if required, in collaboration with the design engineers of the facility and estimate the impact of noise upon implementation of such procedures.
- Prepare and submit an environmental noise impact report in line with Appendix 6 of the EIA regulations, containing the procedures and findings of the investigation.

- Prepare and submit recommended noise mitigation procedures as part of a separate environmental noise management plan, if relevant.

1.2 TERMS OF REFERENCE

The Terms of Reference provided by SiVest for this noise study included the following:

Objectives of the noise study:

- Describe the affected environment covered by the scope of the noise specialist study, drawing on existing information, professional experience and limited field work;
- Contribute to the EIA process by identifying issues and concerns that need to be addressed in the specialist study, based on the experience of the specialist;
- Identify relevant protocols, legal and permit requirements (if any); and
- Assess the potential impacts of the project and provide management actions to avoid/reduce negative impacts or enhance benefits, as well as associated monitoring requirements.

The scope of work of the noise study includes the following:

General Requirements

- Provide a thorough overview of all applicable legislation, guidelines
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
    - Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.

  - Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Comparative assessment of alternatives;
- Recommend mitigation measures in order to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).

Specific Requirements:

- Undertake an assessment in accordance with Section 7 of the South African National Standard (SANS) 10328:2008 ("Methods for environmental noise impact assessments in terms of NEMA") and Constitution of the Republic of South Africa, 1996 and Local Government: Municipal Systems Act 32 of 2000 - LAN 54902 in PG 7813 of 25 August 2017. This includes:
- Identification and description of the noise sources associated with the proposed development;
- Identification of potential noise sensitive areas or receptors that could be impacted upon by noise emanating from the proposed development;
- Estimation of the acceptable rating level of noise on identified noise sensitive areas;
- Estimation of the noise emissions from the identified noise sources and estimation of the expected rating level of noise at the identified noise sensitive areas;
- Estimation and assessment of the noise impacts on identified noise sensitive areas or receptors in accordance with SANS 10103:2008 and the National Noise Control Regulations;
- Consideration of possible alternative noise mitigation procedures;
- Determine whether the proposed development has significant noise impact implications;
- A description of the current environmental conditions from a noise perspective in sufficient detail so that there is a baseline description/status quo against which impacts can be identified and measured i.e. sensitive noise receptors, etc.;
- A review of detailed information relating to the project description,) in order to precisely define the environmental risks in terms of noise emissions;
- Identification of issues and potential impacts related to noise emissions, which are to be considered in combination with any additional relevant issues that may be raised through public participation;
- Identification of relevant legislation and legal requirements;
- A description of the regional and local features;

- Calculation of baseline noise measurements (i.e. of the existing ambient noise (day and night time));
- Modelling of the future potential noise impacts during all phases of the proposed development taking into consideration sensitive receptors;
- Identification of buffer zones and no-go areas to inform the turbine layout (if relevant);
- Identify and assess all potential impacts (direct and indirect) of the construction, operational and decommissioning phases of the proposed development;
- Assess all alternatives, including the no-go alternative;
- Provide recommended mitigation measures, management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts to be included in the EMPr; and
- Incorporate and address issues and concerns raised during the EIA process where they are relevant to the specialist's area of expertise.
- Base the assessment on the Nordex N149/4.0-4.5 at 108.1 db

The required EIA end-product from the noise assessment is to provide a comprehensive and detailed Noise Impact Assessment (NIA) that presents and evaluates the noise impact of the wind turbines under different operating conditions which will be incorporated into the EIA report..

1.3 APPROACH AND METHODOLOGY

The methodology used in the study consisted of three approaches to determine the noise impact from the proposed project and associated infrastructure:

- A desktop study to model the likely noise emissions from the site;
- Field measurements of the existing ambient noise at different locations in the vicinity of the project during the day and night-time; and
- The identification of potential noise sensitive areas.

The desktop study was done using the available literature on noise impacts from wind turbines as well as numerical calculations of the possible noise emissions. A Danish modelling program, EMD WindPro Software Version 3 was used which has been developed specifically for wind turbine noise. This program is used extensively worldwide and has been developed and validated in Denmark. The method described in SANS 10357:2004 version 2.1 (The calculation of sound propagation by the Concawe method) was used as a reference for further calculations where required.

WindPro uses the methods described in ISO 9613-2 (Acoustics – Attenuation of sound during propagation outdoors. Part 2 – General method of calculation). This method is very similar to SANS 10357:2004 and is used worldwide for modelling noise from various sources including wind turbine generators (Wind turbines). Where a tonal character is identified in the noise emitted from the turbines, a 5 dB(A) penalty is included in the modelling result.

The numerical results were then used to produce "noise maps" that visually indicate the extent of the noise emissions from the site. The noise emissions were modelled for various wind speeds from 3 m/s to 12 m/s. The direction of the wind was not taken into consideration as the wind could blow from any direction at the speeds that were modelled. The modelling is thus for worst-case scenarios and takes the topography around the turbine and noise sensitive area (NSA) into account. The site elevation data was sourced from the NASA STRM database and imported into WindPro. A comparison was done using the digital elevation data and the contour heights from a 1:50 000 topographical map. The comparison showed that the digital data and the map corresponded well. Furthermore, the digital data provided a better resolution.

1.4 FIELD STUDY

Measurements were taken by avoiding any large flat reflecting surfaces, by placing the noise meter on a tripod and ensuring that it was at least 1.2 m from floor level and 3.5 m.

All measurement periods exceeded at least 10 minutes, except where indicated. The noise meter was calibrated before and after the survey. At no time was the difference in calibration more than one decibel (If the difference is more than 1 decibel the meter is not calibrated properly, and the measurement was discarded). The weighting used was on the A scale and the meter placed on impulse correction, which is the preferred method as per Section 5 of SANS 10103:2008. No tonal correction was added to the data. Measurements were taken during the day and night-time. The meter was fitted with a windscreen, which is supplied by the manufacturer. The screen is designed to reduce wind noise around the microphone and not bias the measurements.

The test environment contained the following noise sources:

- Vehicular traffic that included trucks and cars;
- Birds and insects;
- Farm animals; and
- Wind noise;

The instrumentation that was used to conduct the study is as follows:

- Rion Precision Sound Level Meter (NL32) with 1/3 Octave Band Analyzer Serial No. 00151075;
- Microphone (UC-53A) Serial No. 307806; and
- Preamplifier (NH-21) Serial No. 13814.

All equipment was calibrated in November 2017. The next calibration is due in November 2018 (see Appendix B).

1.5 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are applicable to this study:

- The turbine positions were supplied by the applicant and are accepted as an accurate layout for the purposes of the environmental impact assessment.
- The worst-case scenario impacts were modelled i.e. wind from any direction, not only the prevailing wind, maximum turbine size as required for the site and the worst-case meteorological conditions.
- No wind noise masking effect is considered.
- The noise levels at the identified noise sensitive areas could thus be lower if the wind noise masks the turbine noise emissions.
- For the cumulative impact assessment, it was assumed that all proposed projects would enter into construction. Although this is very unlikely, the assumption was made in order to assess the worst case scenario.

1.6 SOURCES OF INFORMATION

The main sources of information are as follow:

- The project technical information was provided by the applicant e.g. turbine model, turbine positions etc.
- The list of applicable legislation is listed below.
- The reference information to interpret noise impacts is listed in the list of References.
- The digital elevation data was downloaded from EMD in Denmark and is derived from the NSAS STRM (10m resolution).
- Data collected onsite.

2 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO NOISE IMPACTS

The sources of sounds emitted from operating wind turbines can be divided into two categories, firstly mechanical sounds, from the interaction of turbine components, and secondly aerodynamic sounds, produced by the flow of air over the blades.

2.1 MECHANICAL SOUNDS

Mechanical sounds originate from the relative motion of mechanical components and the dynamic response among them. Sources of such sounds include:

- Gearbox;
- Generator;
- Yaw Drives;
- Cooling Fans; and
- Auxiliary Equipment (e.g. hydraulics).

Since the emitted sound is associated with the rotation of mechanical and electrical equipment, it tends to be tonal (of a common frequency), although it may have a broadband component. For example, pure tones can be emitted at the rotational frequencies of shafts and generators, and the meshing frequencies of the gears.

In addition, the hub, rotor, and tower may act as loudspeakers, transmitting the mechanical sound and radiating it. The transmission path of the sound can be air-borne or structure-borne. Air-borne means that the sound is directly propagated from the component surface or interior into the air. Structure-borne sound is transmitted along other structural components before it is radiated into the air.

Figure 1 below shows the type of transmission path and the sound power levels for the individual components for a 2 MW wind turbine (Wagner 1996).

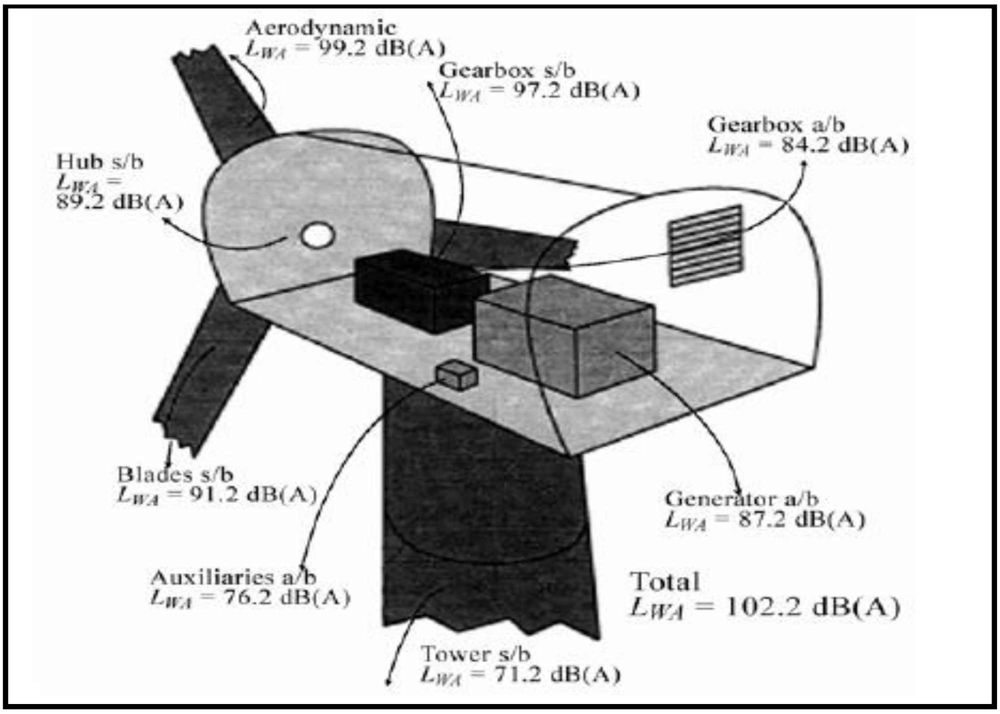

Figure 1 - Typical Sound Power Levels of a 2 MW Turbine

2.2 AERODYNAMIC SOUND

Aerodynamic broadband sound is typically the largest component of wind turbine acoustic emissions. It originates from the flow of air around the blades. A large number of complex flow phenomena occur, each of which might generate some sound (see Figure 2). Aerodynamic sound generally increases with rotor speed. The various aerodynamic sound generation mechanisms that have to be considered are divided into three groups:

- Low Frequency Sound: Sound in the low frequency part of the sound spectrum is generated when the rotating blade encounters localized flow deficiencies due to the flow around a tower, wind speed changes, or wakes shed from other blades;
- Inflow Turbulence Sound: Depends on the amount of atmospheric turbulence. The atmospheric turbulence results in local force or local pressure fluctuations around the blade; and
- Airfoil Self Noise: This group includes the sound generated by the air flow right along the surface of the airfoil. This type of sound is typically of a broadband nature, but tonal components may occur due to blunt trailing edges, or flow over slits and holes.

Source (Wagner 1996)

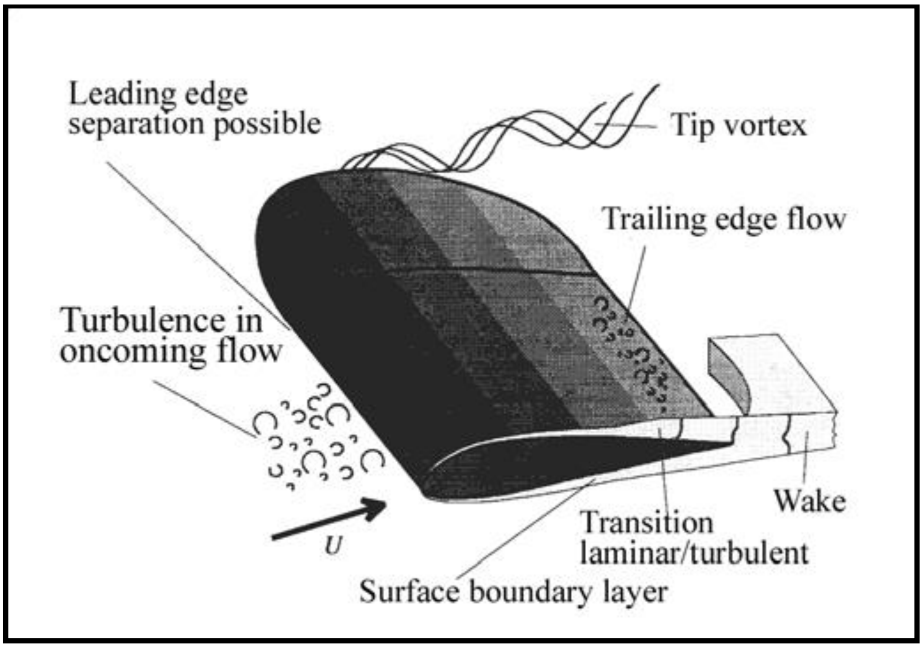

Figure 2 - Sources of Aerodynamic Noise

Modern airfoil design takes all of the above factors into account and is generally much quieter that the first generation of bade design.

2.2.1 Ambient Sound & Wind Speed

The ability to hear a wind turbine in a given installation depends on the ambient sound level. When the background sounds and wind turbine sounds are of the same magnitude, the wind turbine sound gets lost in the background. Both the wind turbine sound power level and the ambient sound pressure level will be functions of wind speed. Thus, whether a wind turbine exceeds the background sound level will depend on how each of these varies with wind speed.

The most likely sources of wind-generated sounds are interactions between wind and vegetation. A number of factors affect the sound generated by wind flowing over vegetation. For example, the total magnitude of wind-generated sound depends more on the size of the windward surface of the vegetation than the foliage density or volume.

The sound level and frequency content of wind generated sound also depends on the type of vegetation. For example, sounds from deciduous trees tend to be slightly lower and more broadband than that from conifers, which generate more sounds at specific frequencies. The equivalent A-weighted broadband sound pressure generated by wind in foliage has been shown to be approximately proportional to the base 10 logarithm of wind speed.

Sound levels from large modern wind turbines during constant speed operation tend to increase more slowly with increasing wind speed than ambient wind generated sound. As a result, wind turbine noise is more commonly a concern at lower wind speeds and it is often difficult to measure sound from modern wind turbines above wind speeds of 8 m/s because the background wind-generated sound masks the wind turbine sound above 8 m/s.

It should be remembered that average sound pressure measurements might not indicate when a sound is detectable by a listener. Just as a dog's barking can be heard through other sounds, sounds with particular frequencies or an identifiable pattern may be heard through background sounds that is otherwise loud enough to mask those sounds. Sound emissions from wind turbines will also vary as the turbulence in the wind through the rotor changes. Turbulence in the ground level winds will also affect a listener's ability to hear other sounds. Because fluctuations in ground level wind speeds will not exactly correlate with those at the height of the turbine, a listener might find moments when the wind turbine could be heard over the ambient sound.

2.2.2 Low Frequency Noise and Infrasound

Infrasound was a characteristic of some wind turbine models that has been attributed to early designs in which turbine blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower. Modern designs generally have the blades upwind of the tower. Wind conditions around the blades and improved blade design minimize the generation of the effect.

Low frequency pressure vibrations are typically categorized as low frequency sound when they can be heard near the bottom of human perception (10-200 Hz), and infrasound when they are below the common limit of human perception. Sound below 20 Hz is generally considered to be infrasound, even though there may be some human perception in that range. Because the ranges of low frequency sound and infrasound overlap it is important to understand how the terms are applied in a given context.

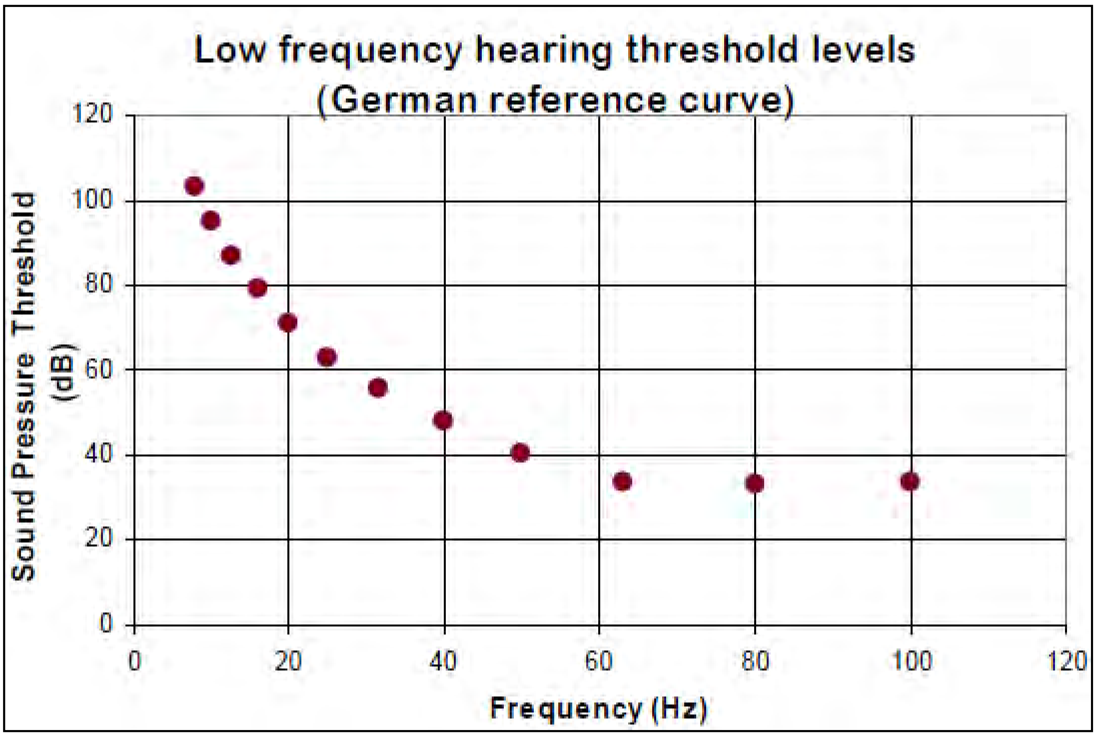

Figure 3 - Low frequency Hearing Threshold Levels

Infrasound is always present in the environment and stems from many sources including ambient air turbulence, ventilation units, waves on the seashore, distant explosions, traffic, aircraft, and other machinery. Infrasound propagates farther (i.e. with lower levels of dissipation) than higher frequencies. To place infrasound in perspective, when a child is swinging high on a swing, the pressure changes on their ears, from top to bottom of the swing, is nearly 120 dB at a frequency of around 1 Hz.

Some characteristics of the human perception of infrasound and low frequency sound are:

- Low frequency sound and infrasound (2-100 Hz) are perceived as a mixture of auditory and tactile sensations;
- Lower frequencies must be of a higher magnitude (dB) to be perceived, e.g. the threshold of hearing at 10 Hz is around 100 dB (see Figure 3 above);
- Tonality cannot be perceived below around 18 Hz; and
- Infrasound may not appear to be coming from a specific location, because of its long wavelengths.

The primary human response to perceived infrasound is annoyance, with resulting secondary effects. Annoyance levels typically depend on other characteristics of the infrasound, including intensity, variations with time, such as impulses, loudest sound, periodicity, etc. Infrasound has three annoyance mechanisms:

- A feeling of static pressure;
- Periodic masking effects in medium and higher frequencies; and
- Rattling of doors, windows, etc. from strong low frequency components.

Human effects vary by the intensity of the perceived infrasound, which can be grouped into these approximate ranges:

- 90 dB and below: No evidence of adverse effects';
- 115 dB: Fatigue, apathy, abdominal symptoms, hypertension in some humans;
- 120 dB: Approximate threshold of pain at 10 Hz; and
- 120 – 130 dB and above: Exposure for 24 hours causes physiological damage.

There is no reliable evidence that infrasound below the perception threshold produces physiological or psychological effects.

The typical range of sound power level for wind turbine generators is in the range of 100 to 105 dB(A) – a much lower sound power level (10 dB or more) than the majority of construction machinery such as bulldozers. For infrasound to be audible even to a person with the most sensitive hearing at a distance of 300 m would require a sound power level of at least 140 dB at 10 Hz and even higher emission levels than this at lower frequencies and at greater distances. There is no information available to indicate that wind turbine generators emit infrasound anywhere near this intensity.

Several studies have confirmed that there are no physiological effects from low frequency or infrasound from wind turbines (Bell Acoustic Consulting, 2004; DEFRA, 2003; DTI, 2006; ISO 9613-2; SANS 10103:2008 Version 6; Swedish Environmental Protection Agency, 2003 and University of Groningen, 2003).

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The proposed Rondekop WEF is to be constructed on farmland. The topography surrounding the site is characterised by steep hills, mountains and valleys.

3.1 SITE LOCATION

The location and position of the various wind turbines are contained in the Table 1 and Figure 5 below.

Table 1 - Wind Turbine Location Co-ordinates for the proposed Rondekop WEF

WTG Number	Longitude	Latitude
1	20°18'43.40"	32°39'16.92"
2	20°18'37.56"	32°39'25.99"
3	20°18'48.10"	32°40'06.43"
4	20°18'47.67"	32°40'18.77"
5	20°18'43.65"	32°40'40.79"
6	20°18'34.07"	32°40'47.14"
7	20°18'26.70"	32°40'55.70"
8	20°18'21.29"	32°41'04.99"
9	20°18'24.60"	32°41'18.39"
10	20°18'19.05"	32°41'27.80"
11	20°18'19.73"	32°41'40.94"
12	20°18'11.30"	32°41'48.39"
13	20°18'00.24"	32°41'53.44"
14	20°17'49.55"	32°41'58.94"
15	20°17'38.48"	32°42'03.13"
16	20°17'23.88"	32°42'24.38"
17	20°17'21.61"	32°42'34.59"
18	20°17'31.07"	32°42'59.11"
19	20°17'18.02"	32°43'02.32"
20	20°17'05.21"	32°43'04.18"
21	20°16'55.29"	32°43'15.50"
22	20°17'18.75"	32°43'21.50"
23	20°16'49.42"	32°43'24.52"
24	20°14'53.49"	32°44'52.48"
25	20°14'47.60"	32°45'02.80"
26	20°15'09.77"	32°45'14.50"
27	20°15'51.67"	32°45'30.10"
28	20°16'13.53"	32°45'38.25"
29	20°16'43.12"	32°46'03.70"
30	20°16'46.30"	32°45'45.84"
31	20°17'06.19"	32°45'58.12"
32	20°17'40.96"	32°45'59.84"
33	20°17'54.50"	32°45'53.94"

WTG Number	Longitude	Latitude
34	20°18'07.37"	32°45'47.09"
35	20°18'17.40"	32°45'39.97"
36	20°15'28.42"	32°47'55.26"
37	20°15'44.08"	32°47'54.66"
38	20°16'00.35"	32°47'52.82"
39	20°16'15.29"	32°47'49.81"
40	20°16'40.30"	32°48'04.35"
41	20°16'45.56"	32°47'53.54"
42	20°17'10.57"	32°48'08.20"
43	20°18'02.21"	32°48'15.88"
44	20°18'18.17"	32°47'59.96"
45	20°18'21.99"	32°47'49.61"
46	20°18'31.47"	32°47'40.57"
47	20°18'33.68"	32°47'29.56"
48	20°18'37.86"	32°47'19.81"

The positions of the turbines and noise sensitive areas are shown in Figures 4 below.

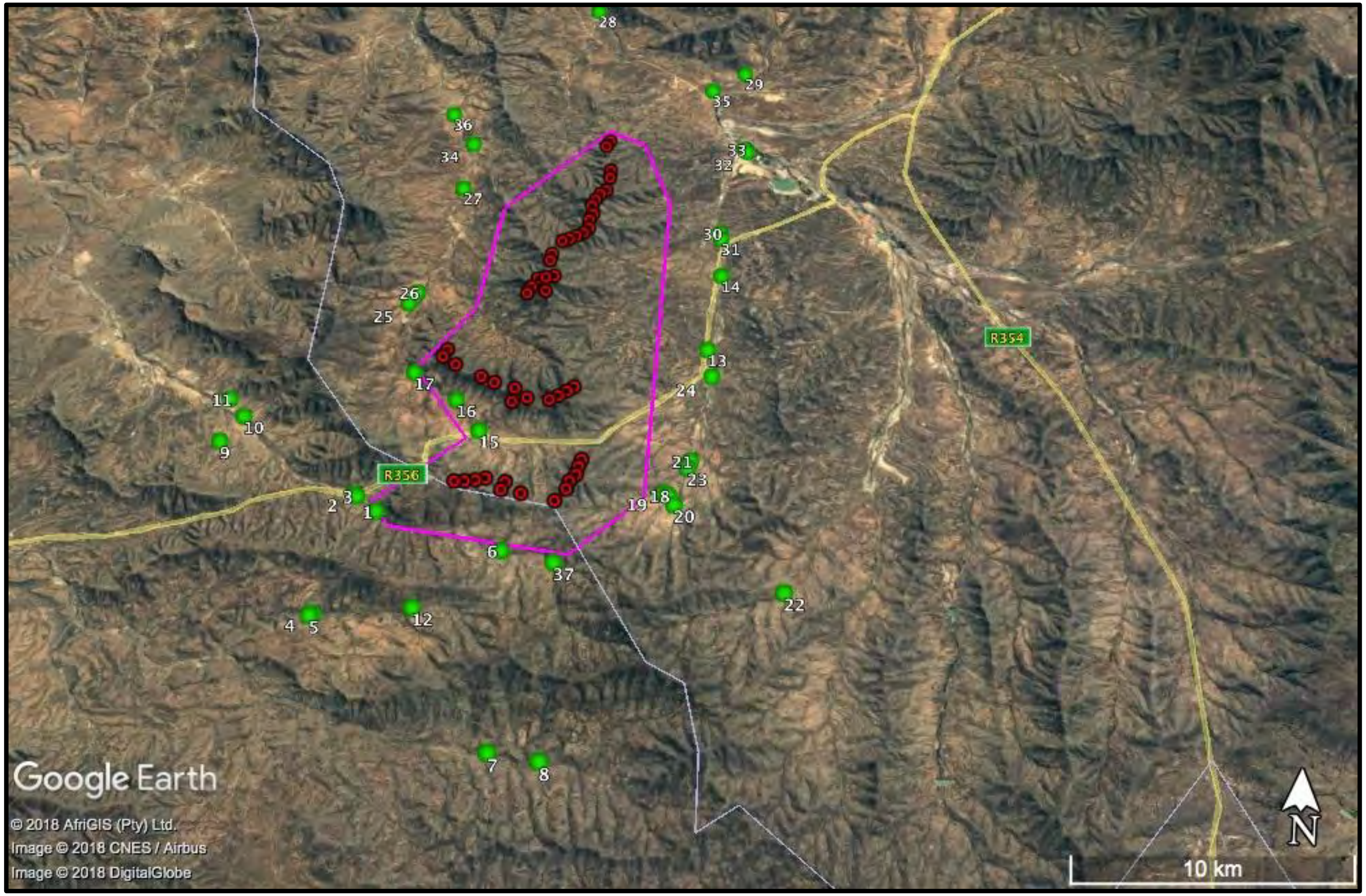

Figure 4 - The proposed positions of the wind turbines and Noise Sensitive Areas

Wind turbines (red dots) and Noise Sensitive Areas (green dots).

The potential sensitive receptors are discussed below. The main noise sensitive receptors that could be affected by noise pollution are humans, terrestrial fauna and avifauna.

3.2 NOISE SENSITIVE AREAS

Human Sensitive Receptors

The site is situated in a farming community. Several homesteads are located on the properties where the turbines will be erected as well as on neighboring farms. The sensitive noise receptors (homesteads) have been recorded in Table 2 below.

Table 2 - Noise Sensitive Areas in relation to the proposed Rondekop WEF

NSA No	Longitude	Latitude	Within the Project Area
1	20°13'33.90"	32°48'37.88"	No
2	20°12'57.05"	32°48'15.89"	No
3	20°13'00.89"	32°48'18.38"	No
4	20°12'21.65"	32°50'50.89"	No
5	20°12'16.91"	32°50'52.74"	No
6	20°16'47.91"	32°49'23.03"	No
7	20°16'56.26"	32°53'26.68"	No
8	20°18'09.71"	32°53'34.26"	No
9	20°09'17.55"	32°47'11.29"	No
10	20°09'47.07"	32°46'35.35"	No
11	20°09'20.19"	32°46'11.63"	No
12	20°14'46.52"	32°50'39.11"	No
13	20°21'40.94"	32°44'36.19"	No
14	20°21'58.09"	32°42'44.81"	No
15	20°15'55.77"	32°46'45.33"	Yes
16	20°15'15.47"	32°46'03.89"	Yes
17	20°14'04.25"	32°45'26.49"	No
18	20°20'50.29"	32°48'01.64"	No
19	20°20'43.60"	32°47'58.94"	No
20	20°21'00.01"	32°48'13.86"	No
21	20°21'21.72"	32°47'13.84"	No

NSA No	Longitude	Latitude	Within the Project Area
22	20°23'46.85"	32°50'01.29"	No
23	20°21'17.46"	32°47'23.73"	No
24	20°21'49.07"	32°45'14.31"	No
25	20°13'39.57"	32°43'44.35"	No
26	20°13'51.11"	32°43'27.67"	No
27	20°14'43.91"	32°40'41.76"	No
28	20°18'04.04"	32°35'26.03"	No
29	20°22'26.47"	32°37'12.58"	No
30	20°21'53.75"	32°41'37.91"	No
31	20°21'55.67"	32°41'46.86"	No
32	20°22'34.16"	32°39'24.64"	No
33	20°22'29.35"	32°39'19.91"	No
34	20°14'50.98"	32°39'27.75"	No
35	20°21'31.72"	32°37'42.57"	No
36	20°14'11.41"	32°38'38.33"	No
37	20°18'06.91"	32°49'35.87"	No

Natural Environment Receptors

The vegetation around the site is characterised by typical Karoo vegetation. The fauna includes bats, birds, commercial livestock, smaller mammals, reptiles and a variety of buck.

3.3 AMBIENT NOISE AT PROPOSED SITE

The ambient noise was measured at several locations as described in the methodology and results thereof are contained in Table 3 below. The author is confident that this represents the ambient noise at the project site at the noise sensitive receptors.

Table 3 - Ambient Noise Results 18th July 2018

DAY

Date:	18/07/2018	18/07/2018	18/07/2018
Position:	NSA 32 (14:30)	Between NSA 4 & 5 (16:05)	Between NSA 6 & 7 (17:00)
Leq dB(A)	50.1	46.0	38.7
Comments	Noise from birds, one car.	Noise from birds, sheep, wind calm.	Noise from birds, consultants' footsteps on gravel. Wind calm

EVENING

Date:	18/07/2018	18/07/2018	18/07/2018
Position:	NSA 32 (20:10)	Between NSA 4 & 5 (18:40)	Between NSA 6 & 7 (19:10)
Leq dB(A)	46.5	45.3	32.7
Comments	Noise from birds, wind calm.	Noise from birds, sheep, wind calm	Noise from birds, consultants' footsteps on gravel. No wind noise.

NIGHT

Date:	18/07/2018	18/07/2018	18/07/2018
Position:	NSA 32 (22:00)	Between NSA 4 & 5 (22:40)	Between NSA 6 & 7 (23:20)
Leq dB(A)	32.5	30.1	28.1
Comments	Noise from birds. Wind calm.	Wind calm	Noise from consultants' footsteps on gravel. Ambient noise almost imperceptible. No wind noise.

The general ambient noise at each location varies as the ambient sound is influenced by human activities, vehicles, wind noise and animal sounds.

3.3.1 Wind Turbine Generators

The Wind Turbine Generator (WTG) that was modelled is described in Table 4 below. This turbine was chosen to represent the worst-case scenario of a wind turbine up to 4.5 MW and up to 140 m hub height. This model of turbine was chosen as it has published noise data in the WindPro catalogue of wind turbines. Furthermore, the noise data has been tested according to the methods described in IEC 61400-11 and are thus traceable. The modelled hub height is 125 m. If a higher or lower final hub height is chosen, the noise impacts could be reduced or increase depending on the sound power of the turbine. Furthermore, if the final turbine that is chosen has a maximum sound power level that is similar or lower than the turbine modelled in this report, it can be assumed that the noise impacts will be similar or lower, irrespective of the turbine manufacturer.

Table 4 - Modelled Turbine Specifications

Manufacturer	Nordex
Type / Version	N149/4.0-4.5
Rated Power	4.5 MW
Rotor Diameter	149m
Tower	Tubular
Grid Connection	50 Hz
Maximum Sound Power Level	108.1 dB
Hub Height	125m

Sound Power Level dB(A) reference to 1pW from WindPro 3.2 Catalogue

*The specifications of this turbine model were used as the data is available in WindPro. This does not bind the applicant to this specific model, and any turbine model with similar turbine specifications. An equal or lower maximum sound power level would be acceptable for the site without re-modelling.

4 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

The South African Noise Control Regulations (National) describe a disturbing noise as any noise that exceeds the ambient noise by more than 7 dB. This difference is usually measured at the complainant's location should a noise complaint arise. Therefore, if a new noise source is introduced into the environment, irrespective of the current noise levels, and the new source is louder than the existing ambient environmental noise by more than 7 dB, the complainant will have a legitimate complaint. A noise disturbance or nuisance as defined in the national legislation means any sound which disturbs or impairs the convenience of any person. The Western Cape Noise Control Regulations are similar to the National Noise Control Regulations in that the definition of a disturbing noise also refers to any noise that exceeds the ambient noise by more than 7 dB.

The Western Cape Strategic Wind Initiative Document (May 2006) can be used for guidance. The Western Cape does not prescribe any specific noise limits for wind turbines other than to recommend a setback distance of 400 m from residences (including rural dwellings). It is recommended that a setback distance of 500 m be used for this project. This is based on this authors experience on similar projects. All turbine positions met the 500m setback distance.

The Western Cape Noise Control Regulations define a disturbing noise as:
a noise, excluding the unamplified human voice, which:
a) exceeds the rating level by 7 dB(A);
b) exceeds the residual noise level where the residual noise level is higher than the rating level;
c) exceeds the residual noise level by 3 dB(A) where the residual noise level is lower than the rating level; or
d) in the case of a low-frequency noise, exceeds the level specified in Annex B of SANS 10103.

4.1 NATIONAL STANDARDS

The most applicable standard for planning purposes used in this study is SANS 10103:2008 which provides typical rating levels for noise in various types of districts, as described in the Table 5 below. Ideally, in such areas one does not want to experience any anthropogenic noise pollution.

Table 5 - Typical rating levels for noise in various types of districts

Type of District	Equivalent Continuous Rating Level, LAeq,T for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Rural Districts	45	45	35	35	35	25
Suburban districts with little road traffic	50	50	40	40	40	30
Urban districts	55	55	45	45	45	35
Urban districts with one or more of the following: Workshops; business premises and main roads	60	60	50	50	50	40
Central business districts	65	65	55	55	55	45
Industrial districts	70	70	60	60	60	50

SANS 10103:2008 defines Daytime as 06:00 to 22:00 hours and night time as 22:00 to 06:00 hours. The rating levels in the table above indicate that in rural districts the ambient noise should not exceed the guideline 35 dB(A) at night and 45 dB(A) during the day. The day / night (24-hour) rating limit is 45 dB(A). These levels can thus be seen as the maximum target levels for any noise pollution sources. If the current ambient (residual) noise exceeds the rating limit, then actual ambient (residual) limit will be used when a noise complaint arises in terms of the Environment Conservation Act - Noise Control Regulations and the Western Cape Noise Control Regulations.

SANS 10103: 2004 also provides a guideline for expected community responses to excess environmental noise above the ambient (residual) noise. These are reflected in the Table 6 below.

Table 6 - Categories of environmental community / group response (SANS 10103:2008)

EXCESS Lr dB(A)	ESTIMATED COMMUNITY/GROUP RESPONSE	
	CATEGORY	DESCRIPTION
0 - 10	Little	Sporadic complaints
5 - 15	Medium	Widespread complaints
10 - 20	Strong	Threats of community / group action
> 15	Very Strong	Vigorous community / group action

4.2 INTERNATIONAL STANDARDS

There are various international criteria levels for ambient sound from wind turbines. These are listed below:

- New Zealand – 40 dB(A)
- Denmark – 42 dB(A) (dwellings in open country)
- United Kingdom (L_{A90}) 35 – 40 dB(A)

Australia has set the following limits that wind turbine noise should not exceed:

- 35 dB(A) at relevant receivers in localities which are primarily intended for rural living, or
- 40 dB(A) at relevant receivers in localities in other zones, or the background noise (LA90) by more than 5 dB(A)

Germany has set the following standards

- Purely residential areas with no commercial developments 50 dB(A) (Day) and 35 dB(A) (Night)
- Areas with hospitals, health resorts, etc. 45 dB(A) (Day) 35 dB(A) (Night)

The rationale behind the criteria levels is that the design limit should be 5 dB below the ambient (residual) limit. This corresponds well with the South African guideline limit of 45 dB(A) (day/night limit) for rural districts.

5 IDENTIFICATION OF KEY ISSUES

5.1 KEY ISSUES IDENTIFIED

The key issues regarding the noise impact are as follow:

- What is the current noise ambient noise in the vicinity of the proposed Rondekop WEF?
- What is the likely noise impact during construction and operation of the site and associated infrastructure?
- Where are local sensitive human receptors located and how is the noise going to affect them?
- Could low frequency sound and infra sound be a problem?

6 IDENTIFICATION OF POTENTIAL IMPACTS

6.1 PREDICTED NOISE LEVELS FOR THE CONSTRUCTION PHASE

The construction noise at the various sites will have a local impact. Safetech has conducted noise tests at various sites in South Africa and have recorded the noise emissions of various pieces of construction equipment. The results are presented in Table 7 below.

Table 7 - Typical Construction Noise

Type of Equipment	$L_{Req.T}$ dB(A)
CAT 320D Excavator measured at approximately 50 m.	67.9
Mobile crane measured at approximately 70 m	69.6
Drilling rig measured at approximately 70 m	72.6

The impact of the construction noise that can be expected at the proposed site can be extrapolated from the Tables above. As an example, if several pieces of equipment are used simultaneously, the noise levels can be added logarithmically and then calculated at various distances from the site to determine the distance at which the ambient level will be reached (refer to Tables 8 – 10 below).

Table 8 - Combining Different Construction Noise Sources – High Impacts (Worst Case)

Description	Typical Sound Power Level (dB)
Overhead and mobile cranes	109
Front end loaders	100
Excavators	108

Bull Dozer	111
Piling machine (mobile)	115
Total I*	117

*The total is a logarithmic total and not a sum of the values (at approximately 3 m).

Table 9 - Combining Different Construction Noise Sources – Low Impacts (at approximately 3 m)

Description	Typical Sound Power Level (dB)
Front end loaders	100
Excavators	108
Truck	95
Total	111

*The total is a logarithmic total and not a sum of the values (at approximately 3 m).

The information in Tables 8 and 9 above can then be used to calculate the attenuation by distance. Noise will also be attenuated by topography and atmospheric conditions such as temperature, humidity, wind speed and direction etc. but this is ignored for this purpose. Therefore, the distance calculated below would be representative of maximum distances to reach ambient noise levels.

An illustration of attenuation by distance from a noise of 117 dB measured from the source is presented in Table 10 below.

Table 10 - Attenuation by Distance

Distance from noise source (metres)	Sound Pressure Level dB(A)
10	89
20	83
40	77
80	71
160	65
320	59
640	53
1280	47

What can be inferred from Table 10 above is that if the ambient noise level is at 45 dB(A), the construction noise will be similar to the ambient level at approximately 1 280 m from the noise source, if the noise characteristics are similar. Beyond this distance, the noise level will be below the ambient noise and will therefore have little impact. The above only applies to the construction noise and light wind conditions. In all likelihood, the construction noise will have little impact on the surrounding community as it will most likely occur during the day when the ambient noise is louder and there are unstable atmospheric conditions.

6.1.1 Low frequency noise concerns

The effects of low frequency noise include sleep disturbance, nausea, vertigo etc. These effects are unlikely to impact upon residents due to the distance between the site and the nearest communities. Sources of low frequency noise also include wind and vehicular traffic.

6.1.2 Predicted noise levels for the Wind Turbines Generators

The tables and figures below indicate the isopleths for the noise generated by the turbines at wind speeds from 3 m/s to 12 m/s. It must be remembered that as the wind speed increases, so too does the background noise. Therefore, the predicted noise levels below 8 m/s are of more concern than those above 8m/s.

The modelling results are contained in Table 11 below.

Table 11 - Table of Results of the Noise Impacts at the NSAs

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
1	3	13.9	35.0	Yes
	4	16.0	35.0	Yes
	5	20.3	35.0	Yes
	6	24.1	35.0	Yes
	7	24.3	35.0	Yes
	8	24.4	35.0	Yes
	9	24.4	35.0	Yes
	10	24.4	35.0	Yes
	11	24.4	35.0	Yes
	12	24.4	35.0	Yes
2	3	12.6	35.0	Yes
	4	14.7	35.0	Yes
	5	18.8	35.0	Yes
	6	22.6	35.0	Yes
	7	22.8	35.0	Yes
	8	22.9	35.0	Yes
	9	22.9	35.0	Yes
	10	22.9	35.0	Yes
	11	22.9	35.0	Yes
	12	22.9	35.0	Yes
3	3	12.7	35.0	Yes
	4	14.8	35.0	Yes
	5	19.0	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	6	22.8	35.0	Yes
	7	23.0	35.0	Yes
	8	23.1	35.0	Yes
	9	23.1	35.0	Yes
	10	23.1	35.0	Yes
	11	23.1	35.0	Yes
	12	23.1	35.0	Yes
4	3	6.5	35.0	Yes
	4	8.6	35.0	Yes
	5	12.4	35.0	Yes
	6	16.2	35.0	Yes
	7	16.4	35.0	Yes
	8	16.5	35.0	Yes
	9	16.5	35.0	Yes
	10	16.5	35.0	Yes
	11	16.5	35.0	Yes
	12	16.5	35.0	Yes
5	3	6.3	35.0	Yes
	4	8.4	35.0	Yes
	5	12.3	35.0	Yes
	6	16.1	35.0	Yes
	7	16.3	35.0	Yes
	8	16.3	35.0	Yes
	9	16.3	35.0	Yes
	10	16.3	35.0	Yes
	11	16.3	35.0	Yes
	12	16.3	35.0	Yes
6	3	19.7	35.0	Yes
	4	21.8	35.0	Yes
	5	26.3	35.0	Yes
	6	30.1	35.0	Yes
	7	30.3	35.0	Yes
	8	30.5	35.0	Yes
	9	30.5	35.0	Yes
	10	30.5	35.0	Yes
	11	30.5	35.0	Yes
	12	30.5	35.0	Yes
7	3	4.5	35.0	Yes
	4	6.6	35.0	Yes
	5	10.3	35.0	Yes
	6	14.1	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	7	14.3	35.0	Yes
	8	14.4	35.0	Yes
	9	14.4	35.0	Yes
	10	14.4	35.0	Yes
	11	14.4	35.0	Yes
	12	14.4	35.0	Yes
8	3	4.1	35.0	Yes
	4	6.2	35.0	Yes
	5	9.9	35.0	Yes
	6	13.7	35.0	Yes
	7	13.9	35.0	Yes
	8	14.0	35.0	Yes
	9	14.0	35.0	Yes
	10	14.0	35.0	Yes
	11	14.0	35.0	Yes
	12	14.0	35.0	Yes
9	3	4.9	35.0	Yes
	4	7.0	35.0	Yes
	5	10.7	35.0	Yes
	6	14.5	35.0	Yes
	7	14.7	35.0	Yes
	8	14.8	35.0	Yes
	9	14.8	35.0	Yes
	10	14.8	35.0	Yes
	11	14.8	35.0	Yes
	12	14.8	35.0	Yes
10	3	6.0	35.0	Yes
	4	8.1	35.0	Yes
	5	11.9	35.0	Yes
	6	15.7	35.0	Yes
	7	15.9	35.0	Yes
	8	16.0	35.0	Yes
	9	16.0	35.0	Yes
	10	16.0	35.0	Yes
	11	16.0	35.0	Yes
	12	16.0	35.0	Yes
11	3	5.3	35.0	Yes
	4	7.4	35.0	Yes
	5	11.1	35.0	Yes
	6	14.9	35.0	Yes
	7	15.1	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	8	15.2	35.0	Yes
	9	15.2	35.0	Yes
	10	15.2	35.0	Yes
	11	15.2	35.0	Yes
	12	15.2	35.0	Yes
12	3	10.7	35.0	Yes
	4	12.8	35.0	Yes
	5	16.9	35.0	Yes
	6	20.7	35.0	Yes
	7	20.9	35.0	Yes
	8	21.0	35.0	Yes
	9	21.0	35.0	Yes
	10	21.0	35.0	Yes
	11	21.0	35.0	Yes
	12	21.0	35.0	Yes
13	3	12.6	35.0	Yes
	4	14.7	35.0	Yes
	5	18.6	35.0	Yes
	6	22.4	35.0	Yes
	7	22.6	35.0	Yes
	8	22.7	35.0	Yes
	9	22.7	35.0	Yes
	10	22.7	35.0	Yes
	11	22.7	35.0	Yes
	12	22.7	35.0	Yes
14	3	12.7	35.0	Yes
	4	14.8	35.0	Yes
	5	18.8	35.0	Yes
	6	22.6	35.0	Yes
	7	22.8	35.0	Yes
	8	22.9	35.0	Yes
	9	22.9	35.0	Yes
	10	22.9	35.0	Yes
	11	22.9	35.0	Yes
	12	22.9	35.0	Yes
15	3	25.0	35.0	Yes
	4	27.1	35.0	Yes
	5	31.8	35.0	Yes
	6	35.6	35.0	No
	7	35.8	35.0	No
	8	36.0	35.0	No

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	9	36.0	35.0	No
	10	36.0	35.0	No
	11	36.0	35.0	No
	12	36.0	35.0	No
16	3	25.2	35.0	Yes
	4	27.3	35.0	Yes
	5	32.1	35.0	Yes
	6	35.9	35.0	No
	7	36.1	35.0	No
	8	36.2	35.0	No
	9	36.2	35.0	No
	10	36.2	35.0	No
	11	36.2	35.0	No
	12	36.2	35.0	No
17	3	23.2	35.0	Yes
	4	25.3	35.0	Yes
	5	30.1	35.0	Yes
	6	33.9	35.0	Yes
	7	34.1	35.0	Yes
	8	34.2	35.0	Yes
	9	34.2	35.0	Yes
	10	34.2	35.0	Yes
	11	34.2	35.0	Yes
	12	34.2	35.0	Yes
18	3	15.4	35.0	Yes
	4	17.5	35.0	Yes
	5	21.8	35.0	Yes
	6	25.6	35.0	Yes
	7	25.8	35.0	Yes
	8	25.9	35.0	Yes
	9	25.9	35.0	Yes
	10	25.9	35.0	Yes
	11	25.9	35.0	Yes
	12	25.9	35.0	Yes
19	3	15.8	35.0	Yes
	4	17.9	35.0	Yes
	5	22.2	35.0	Yes
	6	26.0	35.0	Yes
	7	26.2	35.0	Yes
	8	26.3	35.0	Yes
	9	26.3	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	10	26.3	35.0	Yes
	11	26.3	35.0	Yes
	12	26.3	35.0	Yes
20	3	14.5	35.0	Yes
	4	16.6	35.0	Yes
	5	20.9	35.0	Yes
	6	24.7	35.0	Yes
	7	24.9	35.0	Yes
	8	25.0	35.0	Yes
	9	25.0	35.0	Yes
	10	25.0	35.0	Yes
	11	25.0	35.0	Yes
	12	25.0	35.0	Yes
21	3	13.8	35.0	Yes
	4	15.9	35.0	Yes
	5	20.0	35.0	Yes
	6	23.8	35.0	Yes
	7	24.0	35.0	Yes
	8	24.1	35.0	Yes
	9	24.1	35.0	Yes
	10	24.1	35.0	Yes
	11	24.1	35.0	Yes
	12	24.1	35.0	Yes
22	3	4.8	35.0	Yes
	4	6.9	35.0	Yes
	5	10.7	35.0	Yes
	6	14.5	35.0	Yes
	7	14.7	35.0	Yes
	8	14.7	35.0	Yes
	9	14.7	35.0	Yes
	10	14.7	35.0	Yes
	11	14.7	35.0	Yes
	12	14.7	35.0	Yes
23	3	14.0	35.0	Yes
	4	16.1	35.0	Yes
	5	20.2	35.0	Yes
	6	24.0	35.0	Yes
	7	24.2	35.0	Yes
	8	24.3	35.0	Yes
	9	24.3	35.0	Yes
	10	24.3	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	11	24.3	35.0	Yes
	12	24.3	35.0	Yes
24	3	12.3	35.0	Yes
	4	14.4	35.0	Yes
	5	18.3	35.0	Yes
	6	22.1	35.0	Yes
	7	22.3	35.0	Yes
	8	22.4	35.0	Yes
	9	22.4	35.0	Yes
	10	22.4	35.0	Yes
	11	22.4	35.0	Yes
	12	22.4	35.0	Yes
25	3	16.6	35.0	Yes
	4	18.7	35.0	Yes
	5	23.0	35.0	Yes
	6	26.8	35.0	Yes
	7	27.0	35.0	Yes
	8	27.1	35.0	Yes
	9	27.1	35.0	Yes
	10	27.1	35.0	Yes
	11	27.1	35.0	Yes
	12	27.1	35.0	Yes
26	3	16.4	35.0	Yes
	4	18.5	35.0	Yes
	5	22.8	35.0	Yes
	6	26.6	35.0	Yes
	7	26.8	35.0	Yes
	8	26.9	35.0	Yes
	9	26.9	35.0	Yes
	10	26.9	35.0	Yes
	11	26.9	35.0	Yes
	12	26.9	35.0	Yes
27	3	14.2	35.0	Yes
	4	16.3	35.0	Yes
	5	20.4	35.0	Yes
	6	24.2	35.0	Yes
	7	24.4	35.0	Yes
	8	24.5	35.0	Yes
	9	24.5	35.0	Yes
	10	24.5	35.0	Yes
	11	24.5	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	12	24.5	35.0	Yes
28	3	5.8	35.0	Yes
	4	7.9	35.0	Yes
	5	11.7	35.0	Yes
	6	15.5	35.0	Yes
	7	15.7	35.0	Yes
	8	15.8	35.0	Yes
	9	15.8	35.0	Yes
	10	15.8	35.0	Yes
	11	15.8	35.0	Yes
	12	15.8	35.0	Yes
29	3	6.9	35.0	Yes
	4	9.0	35.0	Yes
	5	12.9	35.0	Yes
	6	16.7	35.0	Yes
	7	16.9	35.0	Yes
	8	17.0	35.0	Yes
	9	17.0	35.0	Yes
	10	17.0	35.0	Yes
	11	17.0	35.0	Yes
	12	17.0	35.0	Yes
30	3	13.5	35.0	Yes
	4	15.6	35.0	Yes
	5	19.7	35.0	Yes
	6	23.5	35.0	Yes
	7	23.7	35.0	Yes
	8	23.8	35.0	Yes
	9	23.8	35.0	Yes
	10	23.8	35.0	Yes
	11	23.8	35.0	Yes
	12	23.8	35.0	Yes
31	3	13.3	35.0	Yes
	4	15.4	35.0	Yes
	5	19.5	35.0	Yes
	6	23.3	35.0	Yes
	7	23.5	35.0	Yes
	8	23.6	35.0	Yes
	9	23.6	35.0	Yes
	10	23.6	35.0	Yes
	11	23.6	35.0	Yes
	12	23.6	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
32	3	10.4	35.0	Yes
	4	12.5	35.0	Yes
	5	16.5	35.0	Yes
	6	20.3	35.0	Yes
	7	20.5	35.0	Yes
	8	20.5	35.0	Yes
	9	20.5	35.0	Yes
	10	20.5	35.0	Yes
	11	20.5	35.0	Yes
	12	20.5	35.0	Yes
33	3	10.5	35.0	Yes
	4	12.6	35.0	Yes
	5	16.6	35.0	Yes
	6	20.4	35.0	Yes
	7	20.6	35.0	Yes
	8	20.7	35.0	Yes
	9	20.7	35.0	Yes
	10	20.7	35.0	Yes
	11	20.7	35.0	Yes
	12	20.7	35.0	Yes
34	3	12.2	35.0	Yes
	4	14.3	35.0	Yes
	5	18.3	35.0	Yes
	6	22.1	35.0	Yes
	7	22.3	35.0	Yes
	8	22.4	35.0	Yes
	9	22.4	35.0	Yes
	10	22.4	35.0	Yes
	11	22.4	35.0	Yes
	12	22.4	35.0	Yes
35	3	9.7	35.0	Yes
	4	11.8	35.0	Yes
	5	15.8	35.0	Yes
	6	19.6	35.0	Yes
	7	19.8	35.0	Yes
	8	19.9	35.0	Yes
	9	19.9	35.0	Yes
	10	19.9	35.0	Yes
	11	19.9	35.0	Yes
	12	19.9	35.0	Yes
36	3	9.3	35.0	Yes

NSA Number	Wind speed [m/s]	From WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	4	11.4	35.0	Yes
	5	15.3	35.0	Yes
	6	19.1	35.0	Yes
	7	19.3	35.0	Yes
	8	19.3	35.0	Yes
	9	19.3	35.0	Yes
	10	19.3	35.0	Yes
	11	19.3	35.0	Yes
	12	19.3	35.0	Yes
37	3	17.7	35.0	Yes
	4	19.8	35.0	Yes
	5	24.3	35.0	Yes
	6	28.1	35.0	Yes
	7	28.3	35.0	Yes
	8	28.4	35.0	Yes
	9	28.4	35.0	Yes
	10	28.4	35.0	Yes
	11	28.4	35.0	Yes
	12	28.4	35.0	Yes

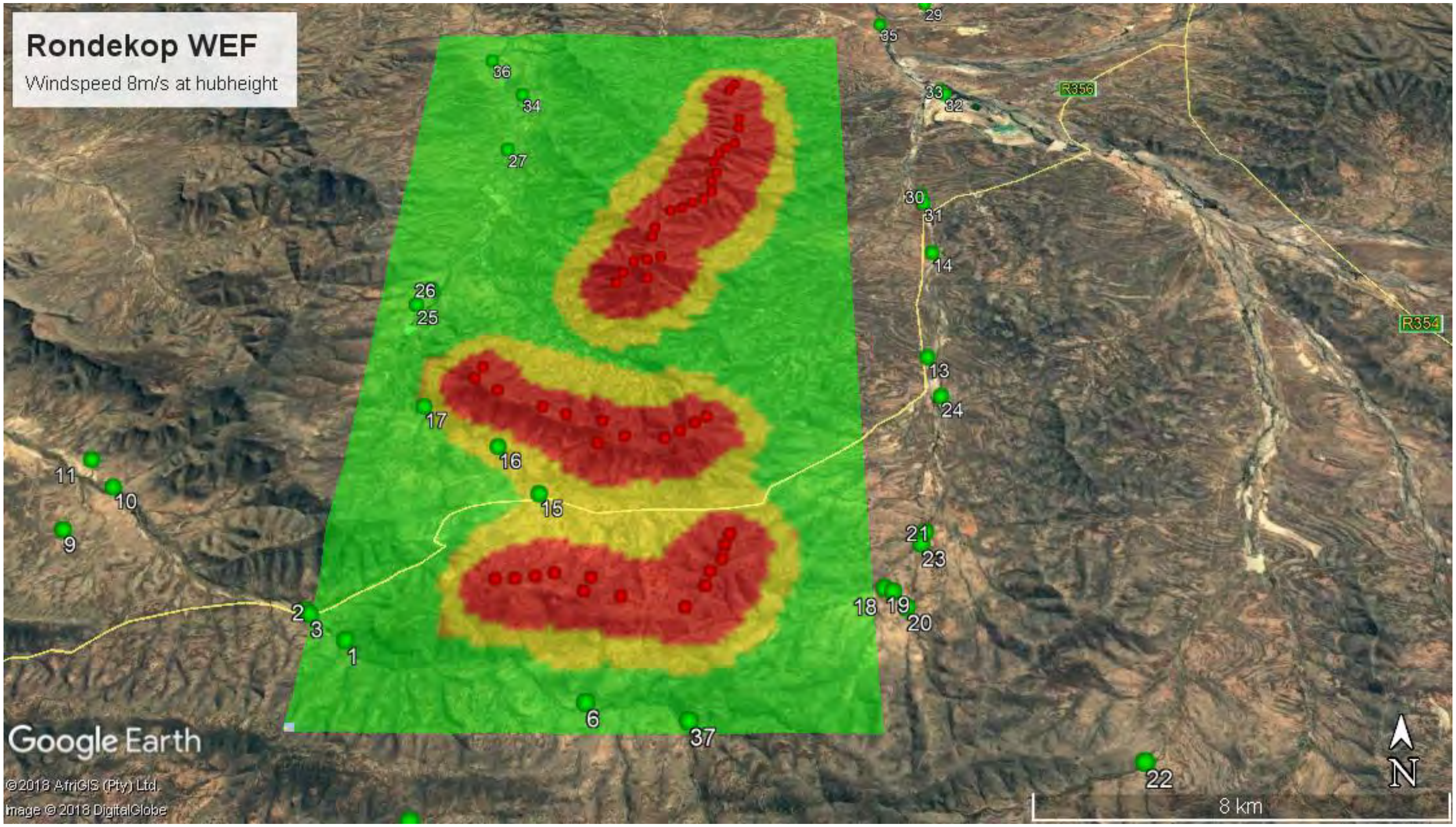

Figure 5 - Raster Image of Noise Isopleths (8m/s Wind Speed) & Noise Sensitive Areas

Green Dot = Noise Sensitive Area

Green Shading = <35 dB(A)

Yellow Shading = 30-45 dB(A)

Red Shading = >45 dB(A)

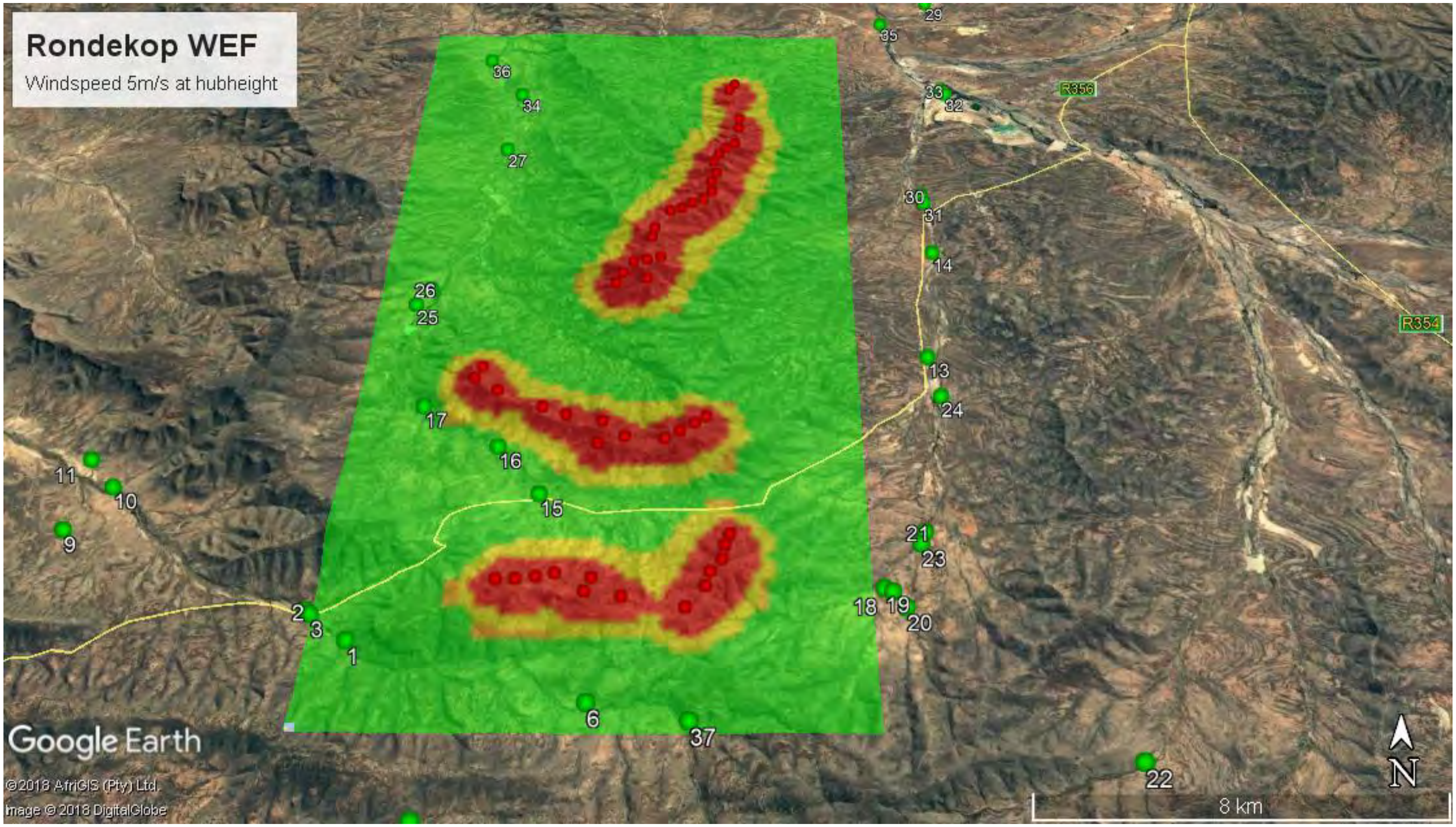

Figure 6 - Raster Image of Noise Isopleths (5m/s Wind Speed) & Noise Sensitive Areas

Green Dot = Noise Sensitive Area

Green Shading = <35 dB(A)

Yellow Shading = 30-45 dB(A)

Red Shading = >45 dB(A)

6.2 CUMULATIVE NOISE IMPACTS

The proposed windfarm is located adjacent to several other windfarms within 50 km of Rondekop Windfarm. The windfarms that were considered are as follows:

- Karreebosch WEF
- Witberg WEF
- Tooverberg WEF
- Guntsfontein WEF
- Hidden Valley (Karusa & Soetwater) – both preferred bidders, to be constructed in 2019
- Hidden Valley (Greater Karoo)
- Kudusberg WEF
- Brandvalley WEF
- Esizayo WEF
- Komsberg (East and West)
- Roggeveld WEF – preferred bidder, to be constructed in 2019
- Maralla (East and West)
- Perdekraal (East & West) – Perdekraal East under construction
- Soetwater WEF
- Karusa WEF
- Rietkloof WEF
- Sutherland WEF

Although there are other facilities proposed within the REDZ, the distance from Rondekop is too great to contribute to the cumulative noise impact.

The locations of the turbines that are in the public domain are recorded in Annexure D as a record of which positions informed the cumulative impact assessment. The same turbine data as described in Table 2 was used to model the cumulative impacts from all the adjacent windfarms. This is thus a worst-case scenario, as it is highly unlikely that all turbines will be operational simultaneously even if all the sites obtain the required regulatory approval. It is **not a**nticipated that any future changes in the other windfarm layouts that were modelled (as included in Appendix A) will negatively impact these results, as future changes will most likely be a reduction in the number of turbines on those windfarms and not an increase in turbine numbers. If the final number of turbines is reduced or the layout changed such that no turbine is moved closer to a noise sensitive area, then remodelling will not be required, provided the final turbine choice sound power level is not greater than that that was used in this report (108.1 dBA). Furthermore, the Kudusberg WEF is the closest project to the Rondekop WEF where turbine position data is available.

The noise impacts from the windfarms that are further away will not impact the identified NSA's as noise decreases in intensity with distance.

The cumulative noise impact modelling result indicated the following:

Table 12 - Cumulative Noise Impacts

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
1	3	8.9	15.1	35.0	Yes
	4	10.3	17.1	35.0	Yes
	5	14.2	21.2	35.0	Yes
	6	18.2	25.1	35.0	Yes
	7	18.9	25.4	35.0	Yes
	8	19.0	25.5	35.0	Yes
	9	19.0	25.5	35.0	Yes
	10	19.0	25.5	35.0	Yes
	11	19.0	25.5	35.0	Yes
	12	19.0	25.5	35.0	Yes
2	3	7.2	13.7	35.0	Yes
	4	8.6	15.6	35.0	Yes
	5	12.5	19.7	35.0	Yes
	6	16.5	23.6	35.0	Yes
	7	17.2	23.9	35.0	Yes
	8	17.3	24.0	35.0	Yes
	9	17.3	24.0	35.0	Yes
	10	17.3	24.0	35.0	Yes
	11	17.3	24.0	35.0	Yes
	12	17.3	24.0	35.0	Yes
3	3	7.3	13.8	35.0	Yes
	4	8.7	15.7	35.0	Yes
	5	12.6	19.8	35.0	Yes
	6	16.6	23.6	35.0	Yes
	7	17.3	23.9	35.0	Yes
	8	17.4	24.0	35.0	Yes
	9	17.4	24.0	35.0	Yes
	10	17.4	24.0	35.0	Yes
	11	17.4	24.0	35.0	Yes
	12	17.4	24.0	35.0	Yes
4	3	11.3	12.6	35.0	Yes
	4	12.7	14.1	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	5	16.8	18.2	35.0	Yes
	6	20.8	22.1	35.0	Yes
	7	21.5	22.7	35.0	Yes
	8	21.6	22.8	35.0	Yes
	9	21.6	22.8	35.0	Yes
	10	21.6	22.8	35.0	Yes
	11	21.6	22.8	35.0	Yes
	12	21.6	22.8	35.0	Yes
5	3	11.0	12.3	35.0	Yes
	4	12.4	13.9	35.0	Yes
	5	16.5	17.9	35.0	Yes
	6	20.5	21.8	35.0	Yes
	7	21.2	22.4	35.0	Yes
	8	21.3	22.5	35.0	Yes
	9	21.3	22.5	35.0	Yes
	10	21.3	22.5	35.0	Yes
	11	21.3	22.5	35.0	Yes
	12	21.3	22.5	35.0	Yes
6	3	15.7	21.2	35.0	Yes
	4	17.1	23.1	35.0	Yes
	5	21.3	27.5	35.0	Yes
	6	25.3	31.4	35.0	Yes
	7	26.0	31.7	35.0	Yes
	8	26.1	31.9	35.0	Yes
	9	26.1	31.9	35.0	Yes
	10	26.1	31.9	35.0	Yes
	11	26.1	31.9	35.0	Yes
	12	26.1	31.9	35.0	Yes
7	3	20.9	21.0	35.0	Yes
	4	22.3	22.4	35.0	Yes
	5	26.7	26.8	35.0	Yes
	6	30.7	30.8	35.0	Yes
	7	31.4	31.5	35.0	Yes
	8	31.6	31.6	35.0	Yes
	9	31.6	31.6	35.0	Yes
	10	31.6	31.6	35.0	Yes
	11	31.6	31.6	35.0	Yes
	12	31.6	31.6	35.0	Yes
8	3	21.3	21.4	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	4	22.7	22.8	35.0	Yes
	5	27.2	27.3	35.0	Yes
	6	31.2	31.3	35.0	Yes
	7	31.9	31.9	35.0	Yes
	8	32.0	32.1	35.0	Yes
	9	32.0	32.1	35.0	Yes
	10	32.0	32.1	35.0	Yes
	11	32.0	32.1	35.0	Yes
	12	32.0	32.1	35.0	Yes
9	3	1.2	6.4	35.0	Yes
	4	2.6	8.3	35.0	Yes
	5	6.2	12.1	35.0	Yes
	6	10.2	15.9	35.0	Yes
	7	10.9	16.2	35.0	Yes
	8	11.0	16.3	35.0	Yes
	9	11.0	16.3	35.0	Yes
	10	11.0	16.3	35.0	Yes
	11	11.0	16.3	35.0	Yes
	12	11.0	16.3	35.0	Yes
10	3	1.1	7.2	35.0	Yes
	4	2.5	9.1	35.0	Yes
	5	6.1	12.9	35.0	Yes
	6	10.1	16.8	35.0	Yes
	7	10.8	17.1	35.0	Yes
	8	11.0	17.2	35.0	Yes
	9	11.0	17.2	35.0	Yes
	10	11.0	17.2	35.0	Yes
	11	11.0	17.2	35.0	Yes
	12	11.0	17.2	35.0	Yes
11	3	0.3	6.4	35.0	Yes
	4	1.7	8.4	35.0	Yes
	5	5.3	12.1	35.0	Yes
	6	9.3	16.0	35.0	Yes
	7	10.0	16.3	35.0	Yes
	8	10.1	16.4	35.0	Yes
	9	10.1	16.4	35.0	Yes
	10	10.1	16.4	35.0	Yes
	11	10.1	16.4	35.0	Yes
	12	10.1	16.4	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
12	3	18.4	19.1	35.0	Yes
	4	19.8	20.6	35.0	Yes
	5	24.3	25.0	35.0	Yes
	6	28.3	29.0	35.0	Yes
	7	29.0	29.6	35.0	Yes
	8	29.1	29.8	35.0	Yes
	9	29.1	29.8	35.0	Yes
	10	29.1	29.8	35.0	Yes
	11	29.1	29.8	35.0	Yes
	12	29.1	29.8	35.0	Yes
13	3	5.0	13.3	35.0	Yes
	4	6.4	15.3	35.0	Yes
	5	10.1	19.2	35.0	Yes
	6	14.1	23.0	35.0	Yes
	7	14.8	23.3	35.0	Yes
	8	14.9	23.4	35.0	Yes
	9	14.9	23.4	35.0	Yes
	10	14.9	23.4	35.0	Yes
	11	14.9	23.4	35.0	Yes
	12	14.9	23.4	35.0	Yes
14	3	1.5	13.0	35.0	Yes
	4	2.9	15.1	35.0	Yes
	5	6.5	19.1	35.0	Yes
	6	10.5	22.9	35.0	Yes
	7	11.2	23.1	35.0	Yes
	8	11.3	23.2	35.0	Yes
	9	11.3	23.2	35.0	Yes
	10	11.3	23.2	35.0	Yes
	11	11.3	23.2	35.0	Yes
	12	11.3	23.2	35.0	Yes
15	3	7.5	25.1	35.0	Yes
	4	8.9	27.2	35.0	Yes
	5	12.8	31.8	35.0	Yes
	6	16.8	35.6	35.0	No
	7	17.5	35.8	35.0	No
	8	17.5	36.0	35.0	No
	9	17.5	36.0	35.0	No
	10	17.5	36.0	35.0	No
	11	17.5	36.0	35.0	No

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	12	17.5	36.0	35.0	No
16	3	5.6	25.3	35.0	Yes
	4	7.0	27.3	35.0	Yes
	5	10.8	32.1	35.0	Yes
	6	14.8	35.9	35.0	No
	7	15.5	36.1	35.0	No
	8	15.5	36.3	35.0	No
	9	15.5	36.3	35.0	No
	10	15.5	36.3	35.0	No
	11	15.5	36.3	35.0	No
	12	15.5	36.3	35.0	No
17	3	3.6	23.2	35.0	Yes
	4	5.0	25.3	35.0	Yes
	5	8.7	30.1	35.0	Yes
	6	12.7	33.9	35.0	Yes
	7	13.4	34.1	35.0	Yes
	8	13.5	34.3	35.0	Yes
	9	13.5	34.3	35.0	Yes
	10	13.5	34.3	35.0	Yes
	11	13.5	34.3	35.0	Yes
	12	13.5	34.3	35.0	Yes
18	3	15.8	18.6	35.0	Yes
	4	17.2	20.3	35.0	Yes
	5	21.4	24.6	35.0	Yes
	6	25.4	28.5	35.0	Yes
	7	26.1	29.0	35.0	Yes
	8	26.3	29.1	35.0	Yes
	9	26.3	29.1	35.0	Yes
	10	26.3	29.1	35.0	Yes
	11	26.3	29.1	35.0	Yes
	12	26.3	29.1	35.0	Yes
19	3	15.5	18.7	35.0	Yes
	4	16.9	20.5	35.0	Yes
	5	21.2	24.7	35.0	Yes
	6	25.2	28.6	35.0	Yes
	7	25.9	29.1	35.0	Yes
	8	26.0	29.2	35.0	Yes
	9	26.0	29.2	35.0	Yes
	10	26.0	29.2	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	11	26.0	29.2	35.0	Yes
	12	26.0	29.2	35.0	Yes
20	3	16.8	18.8	35.0	Yes
	4	18.2	20.5	35.0	Yes
	5	22.5	24.8	35.0	Yes
	6	26.5	28.7	35.0	Yes
	7	27.2	29.2	35.0	Yes
	8	27.4	29.3	35.0	Yes
	9	27.4	29.3	35.0	Yes
	10	27.4	29.3	35.0	Yes
	11	27.4	29.3	35.0	Yes
	12	27.4	29.3	35.0	Yes
21	3	12.3	16.1	35.0	Yes
	4	13.7	17.9	35.0	Yes
	5	17.7	22.0	35.0	Yes
	6	21.7	25.9	35.0	Yes
	7	22.4	26.3	35.0	Yes
	8	22.5	26.4	35.0	Yes
	9	22.5	26.4	35.0	Yes
	10	22.5	26.4	35.0	Yes
	11	22.5	26.4	35.0	Yes
	12	22.5	26.4	35.0	Yes
22	3	17.3	17.6	35.0	Yes
	4	18.7	19.0	35.0	Yes
	5	23.1	23.3	35.0	Yes
	6	27.1	27.3	35.0	Yes
	7	27.8	28.0	35.0	Yes
	8	27.9	28.1	35.0	Yes
	9	27.9	28.1	35.0	Yes
	10	27.9	28.1	35.0	Yes
	11	27.9	28.1	35.0	Yes
	12	27.9	28.1	35.0	Yes
23	3	12.9	16.5	35.0	Yes
	4	14.3	18.3	35.0	Yes
	5	18.4	22.4	35.0	Yes
	6	22.4	26.3	35.0	Yes
	7	23.1	26.7	35.0	Yes
	8	23.2	26.8	35.0	Yes
	9	23.2	26.8	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	10	23.2	26.8	35.0	Yes
	11	23.2	26.8	35.0	Yes
	12	23.2	26.8	35.0	Yes
24	3	6.3	13.2	35.0	Yes
	4	7.7	15.2	35.0	Yes
	5	11.5	19.2	35.0	Yes
	6	15.5	23.0	35.0	Yes
	7	16.2	23.3	35.0	Yes
	8	16.3	23.4	35.0	Yes
	9	16.3	23.4	35.0	Yes
	10	16.3	23.4	35.0	Yes
	11	16.3	23.4	35.0	Yes
	12	16.3	23.4	35.0	Yes
25	3	0.8	16.7	35.0	Yes
	4	2.2	18.8	35.0	Yes
	5	5.8	23.1	35.0	Yes
	6	9.8	26.9	35.0	Yes
	7	10.5	27.1	35.0	Yes
	8	10.6	27.2	35.0	Yes
	9	10.6	27.2	35.0	Yes
	10	10.6	27.2	35.0	Yes
	11	10.6	27.2	35.0	Yes
	12	10.6	27.2	35.0	Yes
26	3	0.5	16.5	35.0	Yes
	4	1.9	18.6	35.0	Yes
	5	5.5	22.9	35.0	Yes
	6	9.5	26.7	35.0	Yes
	7	10.2	26.9	35.0	Yes
	8	10.4	27.0	35.0	Yes
	9	10.4	27.0	35.0	Yes
	10	10.4	27.0	35.0	Yes
	11	10.4	27.0	35.0	Yes
	12	10.4	27.0	35.0	Yes
27	3	-2.6	14.3	35.0	Yes
	4	-1.2	16.4	35.0	Yes
	5	2.4	20.5	35.0	Yes
	6	6.4	24.3	35.0	Yes
	7	7.1	24.5	35.0	Yes
	8	7.3	24.6	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	9	7.3	24.6	35.0	Yes
	10	7.3	24.6	35.0	Yes
	11	7.3	24.6	35.0	Yes
	12	7.3	24.6	35.0	Yes
28	3	-7.4	6.0	35.0	Yes
	4	-6.0	8.0	35.0	Yes
	5	-2.5	11.9	35.0	Yes
	6	1.5	15.7	35.0	Yes
	7	2.2	15.9	35.0	Yes
	8	2.5	16.0	35.0	Yes
	9	2.5	16.0	35.0	Yes
	10	2.5	16.0	35.0	Yes
	11	2.5	16.0	35.0	Yes
	12	2.5	16.0	35.0	Yes
29	3	-5.6	7.2	35.0	Yes
	4	-4.2	9.2	35.0	Yes
	5	-0.6	13.1	35.0	Yes
	6	3.4	16.9	35.0	Yes
	7	4.1	17.1	35.0	Yes
	8	4.3	17.2	35.0	Yes
	9	4.3	17.2	35.0	Yes
	10	4.3	17.2	35.0	Yes
	11	4.3	17.2	35.0	Yes
	12	4.3	17.2	35.0	Yes
30	3	-0.2	13.6	35.0	Yes
	4	1.2	15.7	35.0	Yes
	5	4.8	19.8	35.0	Yes
	6	8.8	23.6	35.0	Yes
	7	9.5	23.8	35.0	Yes
	8	9.6	23.9	35.0	Yes
	9	9.6	23.9	35.0	Yes
	10	9.6	23.9	35.0	Yes
	11	9.6	23.9	35.0	Yes
	12	9.6	23.9	35.0	Yes
31	3	0.0	13.5	35.0	Yes
	4	1.4	15.6	35.0	Yes
	5	5.0	19.6	35.0	Yes
	6	9.0	23.5	35.0	Yes
	7	9.7	23.7	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	8	9.8	23.8	35.0	Yes
	9	9.8	23.8	35.0	Yes
	10	9.8	23.8	35.0	Yes
	11	9.8	23.8	35.0	Yes
	12	9.8	23.8	35.0	Yes
32	3	-3.2	10.5	35.0	Yes
	4	-1.8	12.6	35.0	Yes
	5	1.8	16.6	35.0	Yes
	6	5.8	20.4	35.0	Yes
	7	6.5	20.6	35.0	Yes
	8	6.6	20.7	35.0	Yes
	9	6.6	20.7	35.0	Yes
	10	6.6	20.7	35.0	Yes
	11	6.6	20.7	35.0	Yes
	12	6.6	20.7	35.0	Yes
33	3	-3.3	10.6	35.0	Yes
	4	-1.9	12.7	35.0	Yes
	5	1.7	16.7	35.0	Yes
	6	5.7	20.5	35.0	Yes
	7	6.4	20.7	35.0	Yes
	8	6.5	20.8	35.0	Yes
	9	6.5	20.8	35.0	Yes
	10	6.5	20.8	35.0	Yes
	11	6.5	20.8	35.0	Yes
	12	6.5	20.8	35.0	Yes
34	3	-3.9	12.3	35.0	Yes
	4	-2.5	14.4	35.0	Yes
	5	1.1	18.4	35.0	Yes
	6	5.1	22.2	35.0	Yes
	7	5.8	22.4	35.0	Yes
	8	5.9	22.5	35.0	Yes
	9	5.9	22.5	35.0	Yes
	10	5.9	22.5	35.0	Yes
	11	5.9	22.5	35.0	Yes
	12	5.9	22.5	35.0	Yes
35	3	-5.1	9.8	35.0	Yes
	4	-3.7	11.9	35.0	Yes
	5	-0.2	15.9	35.0	Yes
	6	3.8	19.7	35.0	Yes

NSA Number	Wind speed [m/s]	Noise Only From Kudusberg WTGs [dB(A)]	Combined Noise Kudusberg and Rondekop WTGs [dB(A)]	Noise Limit (Night) [dB(A)]	Noise Limit complied with?
	7	4.5	19.9	35.0	Yes
	8	4.7	20.0	35.0	Yes
	9	4.7	20.0	35.0	Yes
	10	4.7	20.0	35.0	Yes
	11	4.7	20.0	35.0	Yes
	12	4.7	20.0	35.0	Yes
36	3	-5.0	9.4	35.0	Yes
	4	-3.6	11.5	35.0	Yes
	5	0.0	15.4	35.0	Yes
	6	4.0	19.2	35.0	Yes
	7	4.7	19.4	35.0	Yes
	8	4.9	19.5	35.0	Yes
	9	4.9	19.5	35.0	Yes
	10	4.9	19.5	35.0	Yes
	11	4.9	19.5	35.0	Yes
	12	4.9	19.5	35.0	Yes
37	3	19.0	21.4	35.0	Yes
	4	20.4	23.1	35.0	Yes
	5	24.8	27.5	35.0	Yes
	6	28.8	31.4	35.0	Yes
	7	29.5	31.9	35.0	Yes
	8	29.6	32.0	35.0	Yes
	9	29.6	32.0	35.0	Yes
	10	29.6	32.0	35.0	Yes
	11	29.6	32.0	35.0	Yes
	12	29.6	32.0	35.0	Yes

The modelling indicates that the cumulative impact will not exceed the night limit of 35 dB(A) or the day limit of 45 dB(A) **except at NSA 15 and 16 above 5m/s windspeed**. As can be seen from Table 12, the modelling indicated that the noise impact of ONLY the Kudusberg WEF noise did not exceed the night limit of 35 dB(A). The combined noise impact is thus NOT from the Kudusberg WEF, but from the Rondekop WEF. The wind masking effect above 5m/s will mitigate the noise impact.

6.3 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

The impact of the noise pollution that can be expected from the site during the construction and operational phases is presented below. The no-go alternative was not assessed as there will be no noise impact if the site is not developed. During the de-commissioning phase the noise impacts will be the same as the construction phase. A summary of the noise impact assessment using the standard assessment criteria is provided in Tables 13 and Table 14.

6.4 ASSESSMENT AND MITIGATION FOR CONSTRUCTION PHASE

- There will be an impact on the immediate surrounding environment from the construction activities, especially if pile driving is to be done. This, however, will only occur if the underlying geological structure requires piling.
- The area surrounding the construction site will be affected for a short period of time in all directions by construction noise impacts, should several pieces of construction equipment be used simultaneously.
- The number of construction vehicles that will be used in the project will add to the existing ambient levels and will most likely cause a disturbing noise, albeit for a short period of time.

In conclusion, there will be a short-term increase in noise in the vicinity of the site during the construction phase as the ambient noise level will be exceeded. The impact during the construction phase will be difficult to mitigate. The significance of the construction noise impact is predicted to be low (before and after mitigation).

The following mitigation measures are recommended for construction activities:

- All construction operations should only occur during daylight hours, if possible.
- No construction piling should occur at night. Piling should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions.
- Construction staff should be given “noise sensitivity” training to mitigate the noise impacts caused during construction as well as noise protective gear.

6.5 ASSESSMENT AND MITIGATION FOR OPERATIONAL PHASE

The ambient noise increases as the wind speed increases and the masking effect increases i.e. the audible noise from the wind farm becomes less as wind noise masking increases. Under very stable atmospheric conditions, a temperature inversion or a light wind, the turbines will in all likelihood not be operational as the cut-in speed is 3 m/s. As the wind speed increases above the cut-in speed the ambient noise will also increase. If the atmospheric conditions are such that the wind is very light (<4 m/s), at ground level, but the wind speed exceeds the cut-in speed at hub height, then the turbines will begin to operate. It is thus feasible that little ambient noise masking will occur at this low windspeed. The critical wind speeds are thus between 4-5 m/s at hub height when there may be little possibility of masking at ground level.

The noise modelling indicates that, in general, noise from the turbines will be below the SANS10103 limits for rural areas at a distance of approximately 500 m from the turbines at all NSA's except NSA 15 and 16 (above 5m/s wind speed at hub height) although these homesteads are only occupied for 3 – 4 Months of the year during winter when grazing is optimal. However, the ambient noise measurements show that the lowest noise measured was 28dB(A) under no wind conditions at NSA 16. The modelled noise at this receptor from the turbines (27dB(A)) does not exceed this level. I**t is thus highly unlikely that the turbine noise will be audible given the distance of NSA 15 and 16 from the nearest turbines (2 043 m and 1 395 m respectively).** The significance of the potential noise impacts during the operational phase were assessed to be low before mitigation.

6.6 RESULTS OF THE FIELD STUDY

The field study indicated that the ambient noise at the time of the survey was varied between 28 dB(A) and 46 dB(A) under calm wind conditions. The field study showed that there are natural noise sources that will provide a masking effect when the wind blows.

6.7 IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above and collated in 13- 14 below.

Table 13 - Impact assessment summary table for the Construction Phase

IMPACT TABLE FORMAT	
Environmental Parameter	*Noise emissions during the* ***Construction Phase***
Issue/Impact/Environmental Effect/Nature	*Noise impacts could affect human receptors negatively and cause a noise disturbance.*
Extent	*The impact will only affect the site*
Probability	*Unlikely*
Reversibility	*Reversible*
Irreplaceable loss of resources	*No loss of resource*
Duration	*Short term*
Cumulative effect	Negligible Cumulative Impact

Intensity/magnitude	*Low*	
Significance Rating	*6 – Negative low impact*	
	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 (low negative)	-7 (low negative)
Mitigation measures	• Staff to receive noise sensitivity training; Monitoring of noise as per Table 16; • Limit high noise activities to daytime operations when possible, noting that operational requirements might not allow this due to various factors e.g. Crane use optimization, weather conditions etc.	

Table 14 - Impact assessment summary table for the Operational Phase

IMPACT TABLE FORMAT	
Environmental Parameter	*Noise emissions during the* ***Operational Phase***
Issue/Impact/Environmental Effect/Nature	*Noise impacts could affect human receptors negatively and cause a noise disturbance.*
Extent	Will affect the local area
Probability	*Unlikely*
Reversibility	*Reversible*
Irreplaceable loss of resources	*No loss of resource*
Duration	*Long term*
Cumulative effect	Negligible Cumulative Impact
Intensity/magnitude	*Low*
Significance Rating	*-10 Negative low impact*

IMPACT TABLE FORMAT		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	1	1
Reversibility	1	1
Irreplaceable loss	1	1
Duration	3	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-10 (low negative)	-7 (low negative)
Mitigation measures	Ambient noise monitoring to be conducted at NSA 15 & 16 as per Table 16 as well as any other areas that other specialist studies may identify.	

Table 15 - Impact assessment summary table for the Cumulative Impacts

IMPACT TABLE FORMAT		
Environmental Parameter	*Noise emissions for the **Cumulative Impacts** during the Operational Phase*	
Issue/Impact/Environmental Effect/Nature	*Noise impacts could affect human receptors negatively and cause a noise disturbance.*	
Extent	Will affect the local area	
Probability	*Unlikely*	
Reversibility	*Reversible*	
Irreplaceable loss of resources	*No loss of resource*	
Duration	*Long term*	
Cumulative effect	Negligible Cumulative Impact	
Intensity/magnitude	*Low*	
Significance Rating	*7– Negative low impact*	
	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

IMPACT TABLE FORMAT		
Significance rating	-7 (low negative)	-7 (low negative)
Mitigation measures	None	

6.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

Table 16 - Table of monitoring actions (Construction)

Impact	Mitigation/Management action	Monitoring		
		Methodology	Frequency	Responsibility
Reduce construction noise	Conduct noise sensitivity training for all construction staff. No construction piling should occur at night. Piling should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions	Training	Before construction commences	Holder of the EA
Monitor construction noise	Ambient noise monitoring to be conducted at NSA' 15 and 16	As per the requirements of SANS 10103	Four times during the construction phase	Specialist noise consultant

Table 17 - Table of monitoring actions (Operations)

Impact	Mitigation/Management action	Monitoring		
		Methodology	Frequency	Responsibility
Reduce operational noise	Ambient noise monitoring to be conducted at the onsite NSA 15 and 16 when operations commence to verify the noise emissions meet the noise rating limit. Mitigation measures to be implemented if the noise impact exceeds the 35dB(A) noise rating limit.	As per the requirements of SANS 10103	Once off during project operations	Specialist noise consultant

7 CONCLUSION AND RECOMMENDATIONS

Provided that the mitigation measures presented in the noise specialist study are implemented effectively, the noise from the turbines at the identified noise sensitive areas is predicted to be less than the 35 dB(A) night limit and 45 dB(A) day/night limit for rural areas presented in SANS 10103:2008. This will be confirmed with onsite measurements at NSA 15 and 16 during the operational phase, as above 5m/s the turbine noise exceeds the night limit. The wind masking noise will however mitigate this impact. The overall noise impact with recommended mitigation is expected to be negative and of low significance before and after mitigation.

The results of the study indicate that the following conclusions can be drawn:

- There will be a short-term increase in noise in the vicinity of the site during construction as the ambient level will be exceeded at NSA 15 and 16. The impact during construction will be difficult to mitigate, although these homesteads are only occupied for 3 – 4 Months of the year during winter when grazing is optimal. However, the assessment did not consider masking effect and also considered a 125m hub height. A higher hub height and the masking effect of wind could reduce the noise impact.
- The impact of low frequency noise and infra sound will be negligible and there is no evidence to suggest that adverse health effects will occur as the sound power levels generated in the low frequency range are not high enough to cause physiological effects.

The following is recommended:

7.1.1 Construction Activities

- All construction operations should only occur during daylight hours if possible.
- No construction piling should occur at night. Piling should only occur during the hottest part of the day to take advantage of unstable atmospheric conditions.
- Ensuring that construction staff is given “noise sensitivity” training prior to construction commencing along with suitable noise protective gear.

7.1.2 Operational Activities

a) Ambient noise monitoring is recommended at NSA 15 and 16 once the turbines are erected. This is to determine whether or not the noise rating limits are being exceeded and to confirm the modelling results.

It is my recommendation that based on the results presented here, an Environmental Authorisation can be granted from a noise impact perspective irrespective of the future alternatives that may be considered provided that no turbine is located closer to a noise sensitive receptor by more than 100m. The project can thus proceed.

8 REFERENCES

1)	Australia Environmental Protect Agency - Wind farms - environmental noise guidelines. July 2009.
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3)	DEFRA – United Kingdom A Review of Published Research on Low Frequency Noise and its Effects. Geoff Leventhal. 2003
4)	DTI – United Kingdom The measurement of low frequency noise at 3 UK Wind Farms. Hayes Mackenzie. 2006
5)	Gold Coast Desalination Alliance (GCDA) – 2006 Environmental Impact Assessment Queensland Desalination Plant (Chapter 11).
6)	International Finance Corporation – 2007 General EHS Guidelines: Environmental Noise.
7)	ISO 9613-2 - Acoustics – Attenuation of sound during propagation outdoors. Part 2 – General method of calculation.
8)	Renewable Energy Research Laboratory - Department of Mechanical and Industrial Engineering. University of Massachusetts at Amherst. A White Paper on Wind Turbine Acoustic Noise. Authors: Anthony L. Rogers, Ph.D. James F. Manwell, Ph.D. Sally Wright. Amended January 2006
9)	South Africa - GNR.154 of January 1992: Noise control regulations in terms of section 25 of the Environment Conservation Act (ECA), 1989 (Act No. 73 of 1989)
10)	South Africa - GNR.155 of 10 January 1992: Application of noise control regulations made under section 25 of the Environment Conservation Act, 1989 (Act No. 73 of 1989)
11)	South Africa - SANS 10210:2004 Edition 2.2 – Calculating and predicting road traffic noise
12)	South Africa - SANS 10357:2004 Version 2.1 - The calculation of sound propagation by the Concawe method
13)	South Africa - SANS 10103:2008 Version 6 - The measurement and rating of environmental noise with respect to annoyance and to speech communication.
14)	Swedish Environmental Protection Agency – Noise Annoyance from Wind Turbines – a Review. Authors: Eja Pedersen, Högskolan i Halmstad. August 2003.
15)	University of Groningen - 11th International Meeting on Low Frequency Noise and Vibration and its Control. Do wind turbines produce significant low frequency sound levels? GP. van den Berg. September 2003.
16)	World Health Organization – Guidelines for Community Noise. 1999
17)	Larom, D, Garstang, M., Payne, K., Raspet, R. & Lindeque, M. 1997. The Journal of Experimental Biology 200, 421–431.
18)	Wagner, S., Bareib, R. and Guidati, G., Wind Turbine Noise, Springer, Berlin, 1996

APPENDICES

8.1 APPENDIX A - AIA CERTIFICATE

DEPARTMENT
OF LABOUR

Certificate

This is to certify that

SAFETRAIN CC
TRADING AS T\A SAFETECH

has been approved as an

APPROVED INSPECTION AUTHORITY

in terms of the Occupational Health and Safety Act, 1993, for the monitoring of

Physical Stress Factors and Chemical Stress Factors (including Lead and Asbestos, Ergonomic hazards and Ventilation Installation) and Biological Factors

2009-08-27

DATE

CI 049 OH

CERTIFICATE NUMBER

CHIEF INSPECTOR

8.2 APPENDIX B – CALIBRATION CERTIFICATE

sanas
Calibration Laboratory
148
1302

M AND N ACOUSTIC SERVICES (Pty) Ltd
VAT NO: 4300255876 BEE Status: Level 4
P.O. Box
No. 15, Mustang
Pierre van Ryneveld
Tel: 012 689-2007 / 076 920 30
E-mail: admin@mnacoustics.co.za
Website: www.mnacoustics.co.za

CERTIFICATE OF CONFORMANCE

CERTIFICATE NUMBER	2017-AS-2098
ORGANISATION	SAFETRAIN T/A SAFETECH
ORGANISAION ADDRESS	P.O. BOX 27697, GREENACRES, PORT ELIZABETH, 6057
CALIBRATION OF	INTEGRATING SOUND LEVEL METER complete with ½" PRE-AMPLIFIER, ½" MICROPHONE and ⅓-OCTAVE/OCTAVE FILTER CARD
MANUFACTURERS	RION
MODEL NUMBERS	NL-32, NH-21, UC-53A and NX-22RT
SERIAL NUMBERS	00151075, 13814, 319366 and 00150957 V2.2
DATE OF CALIBRATION	07 NOVEMBER 2017
RECOMMENDED DUE DATE	------------------------
PAGE NUMBER	PAGE 1 OF 5

This certificate is issued in accordance with the conditions of approval granted by the South African National Accreditation System (SANAS). This Certificate may not be reproduced without the written approval of SANAS and M and N Acoustic Services.

The measurement results recorded in this certificate were correct at the time of calibration. The subsequent accuracy will depend on factors such as care, handling, frequency of use and the amount of different users. It is recommended that re-calibration should be performed at an interval, which will ensure that the instrument remains within the desired limits and/or manufacturer's specifications.

The South African National Accreditation System (SANAS) is member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This arrangement allows for mutual recognition of technical test and calibration data by member accreditation bodies worldwide. For more information on the arrangement please consult www.ilac.org

Calibrated by:	Authorized/Checked by:	Date of Issue:
W.S. SIBANYONI (CALIBRATION TECHNICIAN)	M. NAUDÉ (SANAS TECHNICAL SIGNATORY)	08 NOVEMBER 2017

Director: Marianka Naudé

Pages 2 to 4 available on request

8.3 APPENDIX C – TYPICAL SOUND POWER AND SOUND PRESSURE LEVELS

Acoustic Power	Degree		Pressure Level	Source
32 GW	Deafening		225 dB	12" Cannon @ 12ft in front and below
25 to 40 MW			195 dB	Saturn Rocket
100 Kw			170 dB	Turbojet engine with afterburner
10 Kw			160 dB	Turbojet engine, 7000lb thrust
1 kW			150 dB	4 Propeller Airliner
100 W			140 dB	Artillery Fire
10 W	Threshold of pain		130 dB	Pneumatic Rock Drill
				130 dB causes immediate ear damage
3 W			125 dB	Small aircraft engine
1.0 W			120 dB	Thunder
100 Mw			110 dB	Close to train
10 mW	Very Loud		100 dB	Home lawn mower
1 mW			90 dB	Symphony or a Band
				85 dB regularly can cause ear damage
100 uW	Loud		80 dB	Police whistle
10 uW			70 dB	Average radio
1 uW	Moderate		60 dB	Normal conversational voice
100 nW			50 dB	Quiet stream
10 nW	Faint		40 dB	Quiet conversation
1 nW			30 dB	Very soft whisper
100 pW	Very faint		20 dB	Ticking of a watch
10 pW	Threshold of hearing		10 dB	

1 pW			0 dB	Absolute silence

Sound Perception

Change in Sound Level	Perception
3 dB	Barely perceptible
5 dB	Clearly perceptible
10 dB	Twice as loud

8.4 APPENDIX D – ADJOINING WIND FARM WTG POSITIONS

Rietkloof			Brandvalley			Karreebosch		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°26'24.18"	33°04'57.38"	1198	20°23'36.20"	33°01'11.11"	1322	20°30'33.18"	32°47'27.95"	938
20°26'47.81"	33°04'48.70"	1200	20°23'37.82"	33°00'58.26"	1321	20°30'30.35"	32°47'39.93"	970
20°26'44.27"	33°04'27.49"	1180	20°23'45.84"	33°00'47.17"	1289	20°30'25.50"	32°46'06.06"	970
20°27'13.28"	33°04'47.13"	1240	20°23'50.44"	32°58'20.63"	1190	20°30'37.28"	32°45'58.37"	940
20°27'23.56"	33°04'38.07"	1211	20°24'00.40"	32°59'35.37"	1280	20°30'37.67"	32°47'08.43"	930
20°27'42.27"	33°04'52.59"	1210	20°24'11.92"	33°01'09.07"	1309	20°30'16.42"	32°48'01.50"	1026
20°28'06.39"	33°04'55.28"	1182	20°24'25.27"	32°58'16.83"	1210	20°30'18.08"	32°46'16.71"	998
20°26'12.35"	33°03'50.84"	1203	20°24'24.81"	33°01'01.27"	1300	20°30'30.19"	32°49'30.59"	1120
20°26'23.02"	33°03'41.61"	1230	20°24'33.36"	32°57'59.95"	1308	20°29'33.58"	32°48'06.46"	1010
20°26'31.96"	33°03'31.15"	1216	20°24'33.87"	32°57'47.06"	1320	20°30'21.79"	32°47'49.92"	989
20°27'16.77"	33°03'36.50"	1180	20°24'35.10"	32°57'21.60"	1369	20°30'14.51"	32°46'29.04"	990
20°30'05.02"	33°05'08.34"	1205	20°24'37.58"	32°57'34.56"	1320	20°32'33.58"	32°50'59.29"	1058
20°30'29.33"	33°05'02.09"	1219	20°24'42.25"	32°57'10.20"	1345	20°30'42.55"	32°49'08.53"	1060
20°30'38.06"	33°04'37.14"	1211	20°24'57.51"	32°55'29.35"	1420	20°30'36.72"	32°49'19.68"	1110
20°30'43.65"	33°04'50.27"	1258	20°24'59.69"	32°55'51.45"	1378	20°29'34.59"	32°47'53.21"	1030
20°31'30.21"	33°04'31.37"	1228	20°25'19.74"	33°01'12.67"	1220	20°32'41.00"	32°50'08.37"	1076
20°31'27.45"	33°03'35.42"	1226	20°25'23.79"	32°55'32.32"	1400	20°30'39.56"	32°49'47.42"	1110
20°31'19.84"	33°03'19.55"	1250	20°25'33.17"	33°01'04.80"	1210	20°32'35.96"	32°50'46.60"	1062
20°31'30.90"	33°03'02.63"	1220	20°25'44.10"	32°59'03.38"	1280	20°30'44.22"	32°50'01.99"	1128
20°31'38.99"	33°02'51.75"	1240	20°26'03.36"	32°56'43.86"	1340	20°30'40.19"	32°50'14.05"	1110
20°31'50.02"	33°02'42.32"	1210	20°26'17.05"	32°56'23.90"	1390	20°29'21.94"	32°48'13.97"	983
20°31'45.25"	33°02'25.62"	1210	20°26'43.07"	32°55'44.03"	1405	20°30'28.72"	32°50'36.44"	1187
20°31'41.31"	33°02'13.06"	1238	20°26'46.09"	32°56'11.32"	1410	20°30'30.87"	32°50'50.87"	1147
20°31'53.12"	33°02'04.89"	1250	20°27'06.33"	32°55'54.69"	1416	20°30'18.28"	32°51'13.52"	1200
20°32'03.71"	33°01'55.61"	1260	20°27'24.88"	32°59'06.20"	1290	20°30'23.77"	32°51'02.14"	1176
20°32'17.02"	33°01'49.29"	1290	20°27'50.99"	32°58'55.95"	1363	20°32'38.21"	32°50'20.89"	1070
20°32'25.08"	33°01'38.36"	1320	20°28'03.52"	32°58'48.59"	1386	20°32'40.22"	32°50'34.94"	1091
20°32'20.27"	33°01'21.93"	1320	20°28'24.33"	32°59'27.91"	1308	20°28'35.49"	32°49'52.89"	1020
20°32'19.90"	33°01'09.03"	1330	20°28'24.15"	32°59'49.80"	1288	20°28'39.78"	32°50'17.15"	1113
20°32'31.75"	33°01'00.93"	1318	20°28'39.12"	32°58'36.92"	1427	20°28'40.92"	32°50'40.74"	1040
20°31'58.05"	33°00'40.83"	1328	20°28'54.42"	32°58'01.90"	1510	20°28'45.91"	32°50'53.34"	1040
20°32'08.84"	33°00'31.66"	1316	20°29'05.61"	32°58'50.45"	1409	20°28'45.03"	32°51'06.00"	1058
20°31'11.16"	32°59'46.78"	1351	20°29'06.72"	32°57'54.29"	1478	20°28'30.52"	32°49'28.62"	980
20°30'45.54"	32°59'46.97"	1380	20°29'11.42"	32°58'17.90"	1455	20°29'39.51"	32°47'39.85"	980
20°30'20.05"	32°59'45.72"	1369	20°29'32.94"	32°57'53.95"	1409	20°25'45.28"	32°54'17.49"	1160
20°29'46.43"	32°59'42.49"	1350	20°30'20.44"	32°57'48.80"	1380	20°25'54.12"	32°54'07.72"	1160
20°30'08.70"	33°00'14.48"	1288	20°30'41.46"	32°58'10.73"	1394	20°25'56.55"	32°53'55.13"	1204
20°30'01.91"	33°00'26.02"	1297	20°30'54.18"	32°58'03.59"	1369	20°26'00.52"	32°53'43.07"	1239
20°29'55.99"	33°00'38.00"	1260	20°31'44.49"	32°57'55.13"	1355	20°25'59.73"	32°53'29.83"	1230
20°29'50.86"	33°00'50.12"	1260	20°31'56.28"	32°57'46.89"	1400	20°26'15.92"	32°52'41.15"	1140
20°29'53.20"	33°01'02.82"	1246	20°32'08.84"	32°57'39.50"	1366	20°26'18.04"	32°52'28.99"	1135
20°29'57.14"	33°01'15.29"	1221	20°24'24.73"	32°59'41.10"	1270	20°26'08.04"	32°51'44.25"	1051
20°30'04.93"	33°01'37.92"	1200	20°24'29.38"	32°59'28.86"	1280	20°26'09.70"	32°51'31.34"	1077
20°30'11.58"	33°02'15.16"	1170	20°24'41.92"	32°59'21.55"	1270	20°26'11.71"	32°51'18.42"	1110

Rietkloof		
Longitude	Latitude	Elevation [m]
20°30'11.14"	33°02'33.92"	1147
20°29'01.92"	33°02'22.86"	1156
20°28'23.90"	33°01'15.40"	1280
20°28'29.59"	33°01'03.43"	1231
20°28'23.60"	33°00'44.44"	1280
20°28'32.36"	33°00'33.88"	1260
20°29'00.01"	33°02'42.77"	1120
20°33'02.47"	33°03'28.28"	1205
20°33'05.59"	33°03'15.57"	1199
20°33'01.45"	33°03'01.41"	1209
20°32'59.88"	33°02'48.54"	1204
20°33'03.34"	33°02'35.90"	1215
20°27'57.12"	33°00'36.62"	1242
20°32'19.70"	33°00'21.35"	1290
20°31'28.69"	33°04'54.31"	1184
20°28'27.72"	33°01'27.87"	1226

Brandvalley		
Longitude	Latitude	Elevation [m]
20°24'53.56"	32°59'11.12"	1266
20°25'17.86"	32°59'04.74"	1286
20°28'30.60"	32°58'47.67"	1420
20°28'46.68"	32°58'13.03"	1453
20°28'51.75"	32°58'29.66"	1450
20°24'36.81"	33°00'53.24"	1243
20°23'48.07"	32°59'42.92"	1282
20°24'06.86"	32°59'23.72"	1240
20°25'19.90"	32°58'21.05"	1270
20°28'21.75"	32°58'17.34"	1394
20°29'27.48"	32°58'07.75"	1423
20°28'50.03"	32°59'24.72"	1336
20°28'36.43"	32°59'06.60"	1370
20°25'44.81"	33°00'55.98"	1184

Karreebosch		
Longitude	Latitude	Elevation [m]
20°26'20.20"	32°51'08.49"	1114
20°26'26.39"	32°50'57.28"	1081
20°26'52.78"	32°49'30.37"	940
20°26'59.04"	32°49'19.29"	950
20°27'03.74"	32°49'04.99"	943
20°27'00.48"	32°48'50.66"	960
20°27'03.92"	32°48'38.36"	979
20°27'12.12"	32°48'28.27"	966
20°30'57.15"	32°49'02.99"	1028
20°30'15.51"	32°49'36.06"	1081
20°32'42.30"	32°49'55.32"	1010
20°25'37.40"	32°54'27.75"	1145
20°26'17.47"	32°52'09.33"	1080
20°26'48.20"	32°49'42.23"	937
20°27'11.87"	32°48'13.14"	1000
20°28'34.86"	32°50'05.16"	1086
20°30'33.63"	32°50'24.87"	1147
20°26'10.75"	32°52'54.62"	1150
20°28'49.93"	32°49'43.05"	972
20°28'45.93"	32°51'19.95"	1053
20°26'00.02"	32°53'11.41"	1210

Witberg		
Longitude	Latitude	Elevation [m]
20°28'08.82"	33°16'59.07"	1442.7
20°28'09.84"	33°17'07.88"	1450
20°27'58.98"	33°17'09.71"	1450
20°27'48.42"	33°17'11.90"	1437.6
20°27'29.38"	33°17'22.74"	1412.8
20°27'16.41"	33°17'24.43"	1410
20°27'02.33"	33°17'21.48"	1400
20°26'49.53"	33°17'19.94"	1381.7
20°26'51.87"	33°17'30.93"	1400
20°26'39.57"	33°17'31.76"	1380.9
20°27'07.29"	33°17'36.05"	1380
20°26'28.02"	33°17'32.85"	1352.2
20°26'15.98"	33°17'45.06"	1346.2
20°26'31.76"	33°18'00.94"	1340
20°26'18.51"	33°17'58.18"	1353.5
20°26'05.34"	33°17'55.46"	1370
20°25'51.44"	33°17'57.28"	1343.1
20°27'28.41"	33°16'59.33"	1378.8
20°27'14.18"	33°17'00.46"	1387.1
20°26'59.96"	33°17'00.88"	1369.3

Esizayo		
Longitude	Latitude	Elevation [m]
20°33'40.64"	32°57'30.35"	1380
20°35'09.27"	32°57'22.54"	1335
20°33'59.92"	32°57'25.55"	1370
20°38'07.36"	33°01'29.88"	1200
20°37'22.97"	33°01'44.37"	1201
20°38'24.73"	33°01'23.44"	1180
20°34'50.00"	32°57'24.09"	1333
20°38'28.65"	33°01'07.22"	1140
20°38'47.93"	33°01'05.65"	1120
20°38'52.28"	32°59'00.64"	1218
20°35'28.53"	32°57'22.60"	1294
20°36'31.06"	33°01'13.36"	1222
20°37'48.06"	33°01'36.33"	1190
20°34'28.82"	32°57'22.40"	1328
20°38'34.92"	32°59'07.08"	1205
20°36'17.80"	33°00'21.36"	1170
20°35'08.37"	33°00'34.12"	1199
20°36'54.18"	33°01'16.68"	1199
20°38'07.45"	33°01'08.78"	1139
20°39'15.22"	32°59'47.79"	1120

Roggeveld		
Longitude	Latitude	Elevation [m]
20°29'48.80"	32°56'31.84"	1392
20°29'59.40"	32°56'24.35"	1423
20°30'12.40"	32°56'18.53"	1410
20°30'19.68"	32°56'08.68"	1383
20°30'26.37"	32°55'58.45"	1370
20°30'20.28"	32°55'44.74"	1401
20°30'25.43"	32°55'34.16"	1420
20°30'30.49"	32°55'23.53"	1418
20°30'34.79"	32°55'12.02"	1387
20°30'49.65"	32°55'24.78"	1375
20°31'00.62"	32°55'17.37"	1350
20°31'08.87"	32°55'08.31"	1310
20°30'31.77"	32°54'58.90"	1328
20°30'33.25"	32°54'45.24"	1340
20°30'47.32"	32°54'40.94"	1340
20°30'59.89"	32°54'34.73"	1320
20°31'07.55"	32°54'25.18"	1320
20°31'20.88"	32°54'19.25"	1301
20°31'29.89"	32°54'10.58"	1291
20°31'30.66"	32°53'56.88"	1260

Witberg			Esizayo			Roggeveld		
Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]	Longitude	Latitude	Elevation [m]
20°22'22.34"	33°17'49.96"	1230	20°35'41.12"	33°00'37.48"	1180	20°31'35.77"	32°53'45.18"	1230
20°21'59.66"	33°17'54.29"	1220	20°38'32.57"	33°00'50.99"	1077	20°31'41.21"	32°53'34.61"	1194
20°21'45.50"	33°17'54.78"	1220	20°35'58.51"	33°00'26.17"	1160	20°31'47.35"	32°53'24.44"	1200
20°21'31.88"	33°17'54.92"	1220	20°37'46.52"	33°00'03.77"	1100	20°31'55.36"	32°53'15.25"	1230
20°28'23.16"	33°17'04.97"	1424.4	20°37'03.75"	33°01'31.32"	1190	20°32'04.80"	32°53'06.84"	1218
20°25'38.42"	33°17'59.93"	1320.1	20°38'09.70"	32°59'49.23"	1120	20°32'14.43"	32°52'57.72"	1173
20°26'44.72"	33°17'59.29"	1340	20°39'11.54"	32°59'02.32"	1200	20°32'23.56"	32°52'49.13"	1180
			20°38'21.34"	32°59'29.78"	1128	20°32'29.26"	32°52'38.65"	1188
			20°37'05.80"	33°01'03.72"	1145	20°32'48.91"	32°52'22.79"	1230
			20°38'32.85"	32°59'42.80"	1119	20°32'57.06"	32°52'13.58"	1205
			20°39'48.11"	32°59'12.16"	1180	20°32'36.70"	32°52'27.87"	1240
			20°36'45.10"	32°59'08.38"	1165	20°30'05.26"	32°54'21.85"	1304
			20°40'51.63"	32°59'26.94"	1174	20°29'51.83"	32°54'06.01"	1298
			20°35'08.94"	32°58'32.35"	1196	20°30'03.85"	32°54'00.56"	1313
			20°38'15.65"	32°59'07.03"	1179	20°30'10.80"	32°53'50.33"	1286
			20°37'19.56"	32°59'58.82"	1105	20°30'13.89"	32°53'38.86"	1270
			20°35'05.32"	32°57'42.00"	1251	20°30'21.01"	32°53'26.18"	1270
			20°37'21.71"	32°59'06.87"	1158	20°30'25.68"	32°53'15.42"	1261
			20°36'35.18"	33°00'14.92"	1120	20°30'24.66"	32°53'04.04"	1236
			20°35'40.16"	32°57'06.40"	1197	20°30'18.27"	32°52'44.60"	1270
			20°35'24.40"	32°58'22.66"	1210	20°32'25.36"	32°51'34.69"	1100
			20°36'56.46"	32°59'53.88"	1111	20°32'28.27"	32°51'23.15"	1089
			20°35'07.17"	32°57'58.25"	1221	20°32'33.48"	32°51'12.61"	1087
			20°35'21.92"	33°00'22.80"	1161	20°30'34.11"	32°52'41.54"	1240
			20°36'40.63"	33°01'28.00"	1160	20°30'05.02"	32°52'46.81"	1230
			20°39'40.12"	33°00'25.20"	1060	20°29'29.70"	32°56'43.50"	1410
			20°39'28.85"	32°59'08.86"	1182	20°29'30.70"	32°56'58.59"	1419
			20°37'21.56"	32°59'42.59"	1118			
			20°36'58.31"	33°00'11.74"	1104			
			20°34'53.49"	32°58'42.04"	1171			
			20°38'11.37"	33°00'52.55"	1083			
			20°36'27.28"	33°00'57.11"	1142			
			20°35'34.50"	32°56'40.40"	1141			
			20°34'46.05"	32°57'45.19"	1246			
			20°35'31.94"	32°58'58.40"	1160			

Soetwater				Karusa		
Longitude	Latitude	Elevation [m]		Longitude	Latitude	Elevation [m]
20°42'02.34"	32°44'33.40"	1420		20°37'51.20"	32°46'50.73"	1310
20°41'15.97"	32°44'03.45"	1395		20°37'43.61"	32°46'58.09"	1310
20°40'51.47"	32°43'54.06"	1408		20°38'45.89"	32°47'29.63"	1315
20°40'28.05"	32°43'46.64"	1410		20°38'38.17"	32°47'36.42"	1340
20°40'25.19"	32°43'55.65"	1394		20°38'30.19"	32°47'42.67"	1333
20°40'10.60"	32°43'58.52"	1390		20°38'13.19"	32°47'44.41"	1309
20°40'05.60"	32°44'06.40"	1390		20°37'58.00"	32°47'49.47"	1231
20°39'54.17"	32°44'10.83"	1384		20°37'43.41"	32°47'52.40"	1241
20°39'38.74"	32°44'12.97"	1370		20°37'29.87"	32°47'55.90"	1260
20°39'23.12"	32°44'14.92"	1347		20°37'18.09"	32°48'00.65"	1256
20°39'05.72"	32°44'15.58"	1360		20°37'09.37"	32°48'17.43"	1250
20°38'58.76"	32°44'30.92"	1316		20°37'05.78"	32°48'29.30"	1250
20°38'53.65"	32°44'38.90"	1310		20°37'03.39"	32°48'38.68"	1263
20°38'44.38"	32°44'44.99"	1320		20°37'01.31"	32°48'48.00"	1286
20°38'34.41"	32°44'50.65"	1320		20°37'05.58"	32°49'00.08"	1280
20°38'24.65"	32°44'56.35"	1310		20°37'08.81"	32°49'11.83"	1238
20°38'13.37"	32°45'12.42"	1293		20°37'05.55"	32°49'39.38"	1212
20°37'59.92"	32°45'15.87"	1290		20°37'01.28"	32°49'47.88"	1244
20°37'43.52"	32°45'17.59"	1320		20°36'57.13"	32°49'56.41"	1270
20°37'32.83"	32°45'22.59"	1314		20°36'54.97"	32°50'05.91"	1260
20°37'36.62"	32°45'34.30"	1308		20°36'49.90"	32°50'14.04"	1260
20°37'40.40"	32°45'46.10"	1330		20°36'46.66"	32°50'23.60"	1264
20°44'16.41"	32°46'12.27"	1364		20°36'30.49"	32°50'48.94"	1240
20°43'52.03"	32°46'28.21"	1308		20°36'18.84"	32°50'53.80"	1206
20°42'34.39"	32°47'23.36"	1150		20°36'03.62"	32°51'32.40"	1226
20°41'47.31"	32°47'53.19"	1189		20°35'52.88"	32°51'37.49"	1246
20°41'50.47"	32°48'08.06"	1213		20°35'42.80"	32°51'43.27"	1227
20°41'40.83"	32°48'13.55"	1237		20°37'48.68"	32°52'51.08"	1230
20°41'54.15"	32°44'39.15"	1379		20°38'12.30"	32°52'52.82"	1211
20°38'48.16"	32°44'16.36"	1360		20°38'31.47"	32°52'50.99"	1210
20°38'21.03"	32°45'05.39"	1300		20°38'38.54"	32°52'43.53"	1213
20°37'50.74"	32°46'02.55"	1275		20°38'41.70"	32°52'33.65"	1180
20°43'50.02"	32°45'45.80"	1370		20°38'45.44"	32°52'24.46"	1160
20°43'37.55"	32°45'51.04"	1370		20°38'47.29"	32°52'14.22"	1150
20°44'18.42"	32°46'02.09"	1390		20°37'32.90"	32°46'24.23"	1301
20°43'56.76"	32°46'06.28"	1366		20°37'34.92"	32°46'36.21"	1304
20°42'26.69"	32°47'33.01"	1212		20°38'00.19"	32°47'11.17"	1339
20°42'19.71"	32°47'39.68"	1243		20°37'58.80"	32°47'21.36"	1347
20°42'11.23"	32°47'45.05"	1248		20°39'43.02"	32°47'33.21"	1285
20°41'58.19"	32°47'48.04"	1208		20°39'36.53"	32°47'40.47"	1326
20°41'33.74"	32°48'20.42"	1250		20°39'29.70"	32°47'47.63"	1333
20°41'21.77"	32°48'22.99"	1267		20°39'12.94"	32°47'45.63"	1321

Soetwater				Karusa		
Longitude	Latitude	Elevation [m]		Longitude	Latitude	Elevation [m]
20°41'15.33"	32°48'30.06"	1270		20°37'09.81"	32°48'06.67"	1240

Appendix 6G

Socio-Economic Assessment

Dr. Neville Bews & Associates

Social Impact Assessors

Committed to building high trust environments

P. O. Box 145412
Bracken Gardens
Alberton
South Africa
1452

Tel: +27 11 867-0462
Fax: +27 86 621-8345
Mobile: +27 82 557-3489
Skype: neville.bews
Email: bewsco@netactive.co.za

URL: http://www.socialassessment.co.za/

20 February, 2019

Liandra Scott-Shaw
SiVEST Environmental Division
PO Box 1899
Umhlanga Rocks
4320

Re: SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED 325 MW RONDEKOP WIND FARM PROJECT, (WEF) BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE PROVINCE.

Dear Liandra

The overall impact rating reflected in the report,

SOCIAL IMPACT ASSESSMENT FOR THE PROPOSED 325 MW RONDEKOP WIND FARM PROJECT, (WEF) BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE PROVINCE
Dated 17 October 2018,

will not be affected by the following proposed changes.

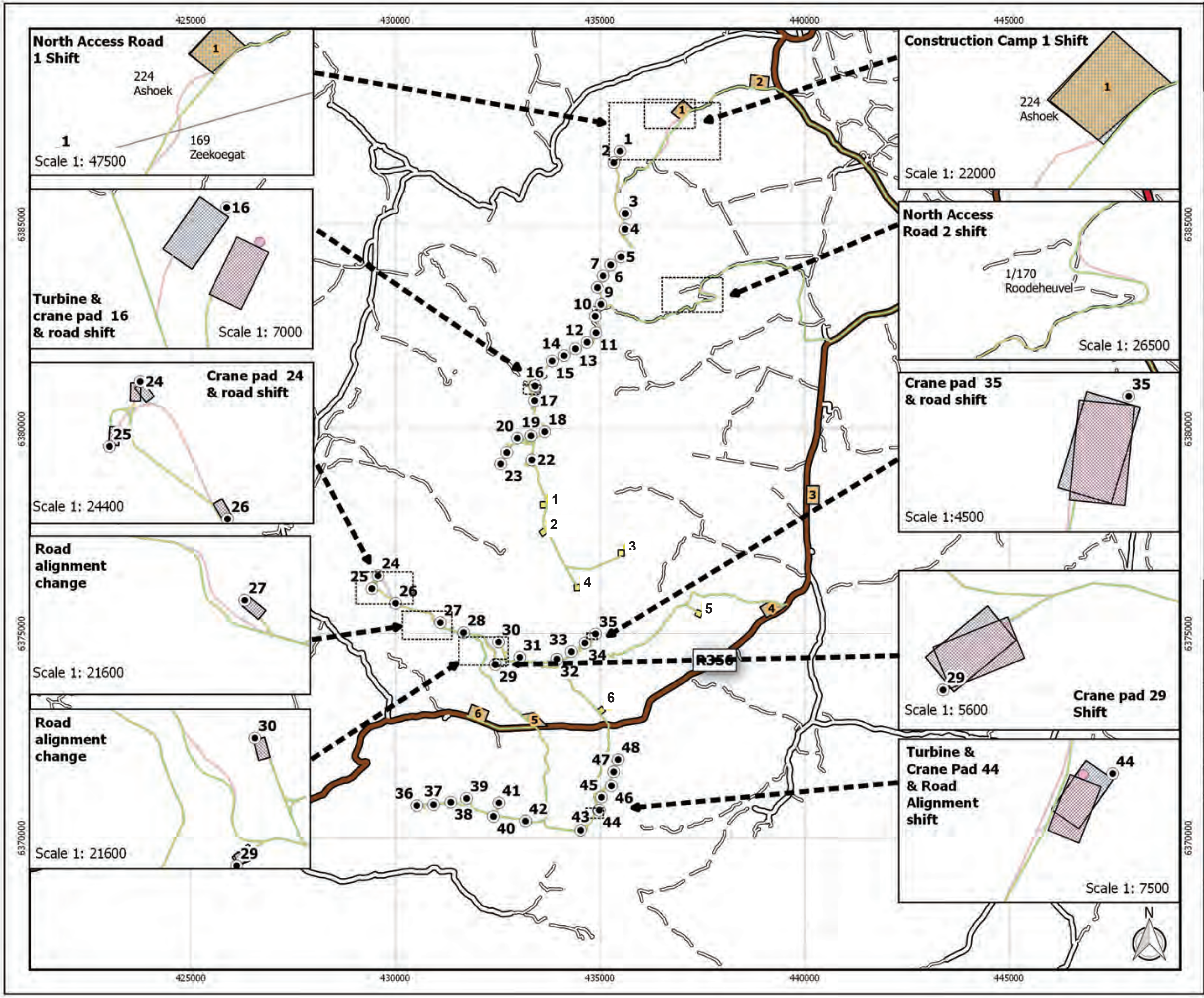
- A change in capacity from up to 6MW to up to 8MW.
- All turbines are still valid (slight alignment shifts mainly to turbine 16 [ecology changes] 44 [to avoid the 200 m bat and bird buffer surrounding the watercourse]).
- Turbine 25 access road to crane pad: minor alignment change as the current alignment was very close to the edge of the ridge and ecologist was concerned about downslope erosion).

- Turbine 27 access road: minor alignment shift to avoid crossing a rocky ridge / outcrop as per the ecology requirement.
- Road between turbine 28 & 29: minor alignment change to avoid rocky outcrop.
- Crane pad 29 & 35: minor alignment change to avoid the rocky outcrops.
- Access road north 1: shifted the alignment slightly away from the drainage line and then crossing it perpendicularly at a single point.
- Access road 2: shifted to only cross the drainage line at one point.
- Construction Camp 1: shift to follow road alignment

The revised layout changes referred to above are illustrated in the attached layout map.

Yours sincerely,

Neville Bews



Rondekop WEF Layout Changes: EIA Phase

Legend

- Property Boundaries
- Provincial Road
- Main Gravel Road
- Secondary Gravel Roads
- Farm Roads

Scoping Phase Layout

- Scoping Phase Road Alignment
- Construction Camp Alternatives
- Crane Pads (48)
- Substation Alternatives (6)
- Turbines (48)

EIA Phase Layout Changes

- EIA Phase Road Alignment
- Construction Camp Alternatives
- Crane Pads (48)
- Substation Alternatives (6)
- Turbines (48)

Scale:	1:121 200 (0 1 2 3 4 km)
Date: 14-2-2019	Project: Rondekop
Coordinate System: WG 21	
Drawn:	VF
Approved:	KdB
GM001.1	Revision: 1

125 Buitengracht Street
Cape Town 8001
Tel: 021 3000 610
Email: info@g7energies.com
Internet: www.g7energies.com

PROPOSED 325 MW RONDEKOP WIND FARM PROJECT, NEAR SUTHERLAND, NORTHERN CAPE PROVINCE

SOCIAL IMPACT ASSESSMENT REPORT
October 2018

Prepared by:	Submitted to:
Dr. Neville Bews & Associates	**SiVEST SA (Pty) Ltd**
Social Impact Assessors	4 Pencarrow Crescent,
PO Box 145412	La Lucia Ridge Office Estate,
Bracken Gardens	Umhlanga Rocks.
1452	4320

DETAILS OF PROJECT

Report Title	:	Social Impact Assessment for the Proposed 325 Mw Rondekop Wind Farm Project, Northern Cape Provinces
Author	:	Dr Neville Bews
DEA Reference Number	:	
Project Developer	:	Rondekop Wind Farm (Pty) Ltd
Environmental Consultant	:	SiVEST SA (Pty) Ltd
Review Period	:	06 September, 2018 – 17 October, 2018
Status of Report	:	Second Draft Report

EXECUTIVE SUMMARY

INTRODUCTION

Rondekop Wind Farm (Pty) Ltd has proposed the development of a Wind Energy Facility (WEF) referred to as the Rondekop Wind Energy Facility, 45 km south-west of Sutherland, in the Northern Cape Province, South Africa. As the proposed facility is located partially within and partly outside of the Komsberg Renewable Energy Development Zone (REDZ 2), SiVEST Environmental Division has been appointed by G7 on behalf of Rondekop Wind Farm (Pty) Ltd to undertake a full Environmental Impact Assessment (EIA) in order to apply for environments authorisation (EA) for this facility.

Towards this end SiVEST have contracted Dr Neville Bews & Associates (NBA) to undertake a desktop based social impact assessment in respect the proposed Rondekop Wind Farm as part of the Environmental Impact Assessment process.

APPROACH TO STUDY

Data was gathered through:

- The project description prepared by G7 Renewable Energies (Pty) Ltd.
- Statistics South Africa, Census 2011 and other relevant demographic data generated by Stats SA such as the Quarterly Labour Force Survey and Mid-year population estimates.
- Discussions with the project proponents and Environmental Impact Assessment Consultants.
- A literature review of various documents such as the relevant Municipal Integrated Development Plans (IDPs) and other specialist reports and documents.
- A broader literature scan.

The assessment technique used to evaluate the social impacts was provided by SiVEST Environmental Division.

PROJECT DESCRIPTION

The Rondekop Wind Farm will be up to 325 megawatt (MW) and will be comprised of the following major components, but not limited to:

- Forty eight wind turbines;
- Electrical transformers (690V/33kV) adjacent to each turbine;
- Underground 33 kV cabling between turbines buried along access roads, where feasible, with overhead 33 kV lines grouping turbines across valleys and ridges;
- Internal access roads of up to 12 m wide, including structures for storm water control;
- One 33/132 kV onsite substation and
- A temporary construction camp of ~13 ha.

Various location and technological alternatives were considered for the project as was the no-go alternative.

IMPACTS IDENTIFIED

The social impacts associated with the project were as follows;

Construction Phase

Health and social wellbeing

- Annoyance, dust noise and shadow flicker
- Increase in crime
- Increased risk of HIV infections
- Influx of construction workers and
- Hazard exposure.

Quality of the living environment

- Disruption of daily living patterns
- Disruptions to social and community infrastructure; and
- Transformation of the sense of place.

Economic

- Job creation and skills development; and
- Socio-economic stimulation.

Operational Phase

Quality of the living environment

- Transformation of the sense of place.

Economic

- Job creation and skills development and
- Socio-economic stimulation.

Cumulative impacts

Health and social wellbeing

- Risk of HIV and AIDS;

Quality of the living environment

- Sense of place and
- Service supplies and infrastructure.

Economic

- Job creation and skills development and
- Socio-economic stimulation.

FINDINGS

Most of the impacts associated with the construction phase of the project are moderate and can be mitigated. Over the operational phase the project will be highly visible and this is likely to change the sense of place of the area with mitigation likely to be difficult. This, however, is addressed by the visual specialist. On a more positive note the project fits well with the investment into renewable energy finding strong support in the National Development Plan and thus filtering down through other national, provincial and municipal legislation and documentation. The project is also quite likely to have a positive effect on the national and regional economy.

On a cumulative basis, there is clearly a conflict between the benefits of renewable energy and the changes that this will bring to the sense of place of the area. In this regard some effort will need to be made from all sides, on a collective basis, to find common ground on which to move forward as renewable energy is an integral part of South Africa’s low-emissions development strategy. This effort is beyond a project specific level and will need to be coordinated from a governmental, or at least on a regional basis.

A further issue of concern, on a cumulative basis, is the threat that all the developments in the region are creating in respect of an increased risk in HIV prevalence. The Namaqua District Municipality has the lowest level of HIV prevalence across the country at 2.3% followed by the Central Karoo District at 6.9%. Of the 52 districts surveyed the Cape Winelands, together with the Vhembe district, has the fifth lowest level of HIV prevalence at 15.0%. Consequently, it is quite clear that the prevalence of HIV is extremely low in the area in comparison with the rest of South Africa. With the influx of workers and truck drivers, both notorious spreaders of HIV, into the area the risk of the HIV prevalence is high. The authorities will need to take serious note of this and will need to develop and implement HIV/AIDS strategies that are effective if the area is to retain its current low HIV prevalence rate. A pre and post mitigation comparison of the impacts is presented below.

PRE AND POST MITIGATION COMPARISON OF THE IMPACTS

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Construction Phase					
Health & social wellbeing	Annoyance, dust and noise	-18		-9	
	Increase in crime	-30		-30	
	Increased risk of HIV infections	-60		-32	
	Influx of construction workers	-22		-22	
	Hazard exposure.	-028	**-31.6**	-24	**-23.4**
			Negative Medium Impact		Negative Low Impact
Quality of the living environment	Disruption of daily living patterns	-28		-26	
	Disruptions to social and community infrastructure	-30	**-29**	-30	**-28**
			Negative Medium Impact		Negative Low Impact
Economic	Job creation and skills development	30		30	
	Socio-economic stimulation	32	**31**	32	**31**
			Positive Medium Impact		Positive Medium Impact
Operational Phase					
Quality of the living environment	Transformation of the sense of place	-60	**-60**	-60	**-60**
			Negative High Impact		Negative High Impact
Economic	Job creation and skills development	30		30	
	Socio-economic stimulation	60	**45**	60	**45**
			Positive Medium Impact		Positive Medium Impact
No Project Alternative					
No project		-32	**-32**	No mitigation measures	
			Negative Medium Impact		
Cumulative Impacts					
Health & social wellbeing	Risk of HIV	-69	**-69**	-66	**-66**
			Negative High Impact		Negative High Impact
Quality of the living environment	Sense of place	-66		-66	
	Services, supplies & infrastructure	-32	**-49**	-30	**-48**
			Negative High Impact		Negative Medium Impact
Economic	Economic	84	**84**	84	**84**
			Positive Very High Impact		Positive Very High Impact

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LIST OF ABBREVIATIONS

AIDS	Acquired immunodeficiency syndrome
BID	Background Information Document
dB	Decibel
DBSA	Development Bank of South Africa
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DM	District Municipality
EIA	Environmental Impact Assessment
GPS	Global Positioning System
HIA	Heritage Impact Assessment
HIV	Human Immunodeficiency Virus
I&AP	Interested and Affected Party
IDP	Integrated Development Plan
IRP	Integrated Resource Plan
IRR	Issues Response Report
kV	Kilovolt
LM	Local Municipality
MW	Megawatt
NBA	Dr. Neville Bews & Associates
NEMA	National Environmental Management Act (No. 107 of 1998)
NERSA	The National Energy Regulator of South Africa
NGO	Non-Governmental Organisation
OHS	Occupational Health and Safety
PA	Per Annum (Yearly)
PGDS	Provincial Growth and Development Strategy
PPP	Public Participation Process
REIPPPP	Renewable Energy Independent Power Producer Procurement Program
SACPVP	South African Council for the Property Valuers Profession
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SDF	Spatial Development Framework
SIA	Social Impact Assessment

SIPs	Strategic Integrated Projects
SMME	Small Medium and Micro Enterprises
Stats SA	Statistics South Africa
STDs	Sexually Transmitted Diseases
ToR	Terms of Reference
UNESCO	United Nations Educational, Scientific and Cultural Organization
WEF	Wind Energy Facility
WHO	World Health Organisation
WWF	World Wild Fund for Nature

QUALIFICATIONS AND EXPERIENCE OF SPECIALIST

Qualifications:

University of South Africa: B.A. (Honours) – 1984

Henley Management College, United Kingdom: The Henley Post-Graduate Certificate in Management – 1997

Rand Afrikaans University: M.A. (cum laude) – 1999

Rand Afrikaans University: D. Litt. et Phil. – 2000

Projects:

The Social Impact Assessment (SIA) for the Gautrain Rapid Rail Link; The impact assessment for the Australian – South African sports development programme; SIA for Kumba Resources, Sishen South Project; Evaluation of a Centre for Violence Against Women for The United Nations Office on Drugs and Crime; SIAs for the following Exxaro Resources Ltd.'s mines, Leeuwpan Coal Mine Delmas, Glen Douglas Dolomite Mine Henley-on-Klip, Grootegeluk Open Cast Coal Mine Lephalale; SIA for the South African National Road Agency Limited (SANRAL) on Gauteng Freeway Improvement Project; SIA for SANRAL on the N2 Wild Coast Toll Highway; Research into research outputs of the University for the University of Johannesburg; SIA for Waterfall Wedge housing and business development in Midrand Gauteng; SIA for the Environmental Management Plan for Sedibeng District Municipality; Social and Labour Plan for the Belfast Project on behalf of Exxaro Resources Ltd; SIA for the Transnet New Multi-Product Pipeline (Commercial Farmers) on behalf of Golder Associates Africa (Pty) Ltd; SIA for the Proposed Vale Moatize Power Plant Project in Mozambique on behalf of Golder Associates Africa (Pty) Ltd; SIA for Kumba Resources Ltd.'s proposed Dingleton Resettlement Project at Sishen Iron Ore Mine on behalf of Water for Africa (Pty) Ltd; SIA for Gold Fields West Wits Project for EcoPartners; SIA for the Belfast Project for Exxaro Resources Ltd; SIA for Eskom Holdings Ltd.'s Proposed Ubertas 88/11kV Substation on behalf of KV3 Engineers (Pty) Ltd; SIA for the Mokolo and Crocodile River (West) Water Augmentation Project for the Department of Water and Sanitation on behalf of Nemai Consulting and the Trans Caledonian Water Authority; Assisted Octagon Consulting with the SIA for Eskom's Nuclear 1 Power Plant on behalf of Arcus GIBB Engineering & Science. SIA for the 150MW Photovoltaic Power Plant and Associated Infrastructure for Italgest Energy (Pty) Ltd, on behalf of Kalahari Survey Solutions cc. SIA for Eskom Holdings Limited, Transmission Division's Neptune-Poseidon 400kV Power Line on behalf of Nemai Consulting. Ncwabeni Off-Channel Storage Dam for security of water supply in Umzumbe, Mpumalanga.

Social Impact assessment for Eskom Holdings Limited, Transmission Division, Forskor-Merensky 275kV ±130km Powerline and Associated Substation Works in Limpopo Province. Social impact assessment for the proposed infilling of the Model Yacht Pond at Blue Lagoon, Stiebel Place, Durban.ABC Prieska Solar Project; Proposed 75 MWp Photovoltaic Power Plant and its associated infrastructure on a portion of the remaining extent of ERF 1 Prieska, Northern Cape.Sekoko Wayland Iron Ore, Molemole Local Municipalities in Limpopo Province.Langpan Chrome Mine, Thabazimbi, Limpopo; Jozini Nodal Expansion Implementation Project, Mpumalanga, on behalf of Nemai Consulting; SIA for Glen Douglas Dolomite Burning Project, Midvaal Gauteng, on behalf of Afrimat Limited; SIA for Lyttelton Dolomite mine Dolomite Burning Project, Marble Hall Limpopo on behalf of Afrimat Limited; Tubatse Strengthening Phase 1 – Senakangwedi B Integration for Eskom Transmission on behalf of Nsovo Environmental Consulting; Department of Water and Sanitation, South Africa (2014). Environmental Impact Assessment for the Mzimvubu Water Project: Social Impact Assessment DWS Report No: P WMA 12/T30/00/5314/7. Umkhomazi Water Project Phase 1 – Raw Water Component Smithfield Dam - 14/12/16/3/3/3/94; Water Conveyance Infrastructure - 14/12/16/3/3/3/94/1; Balancing Dam - 14/12/16/3/3/3/94/2. Umkhomazi Water Project Phase 1 – Potable Water Component: 14/12/16/3/3/3/95. Expansion of Railway Loops at Arthursview; Paul; Phokeng and Rooiheuwel Sidings in the Bojanala Platinum District Municipality in the North West Province for Transnet Soc Ltd; Basic Social Impact Assessment for the Cato Ridge Crematorium in Kwazulu-Natal Province; SIA for the Kennedy Road Housing Project, Ward 25 situated on 316 Kennedy Road, Clare Hills (Erf 301, Portion 5); Eskom's Mulalo Main Transmission Substation and Power Line Integration Project, Secunda;

Regularly lecture in the Department of Sociology at the University of Johannesburg and collaborated with Prof.Henk Becker of Utrecht University, the Netherlands, in a joint lecture to present the Social Impact Assessment Masters course via video link between the Netherlands and South Africa. Presented papers on Social Impact Assessments at both national and international seminars. Published on both a national and international level.

Affiliation:

The South African Affiliation of the International Association for Impact Assessment.

Registered on the database for scientific peer review of iSimangaliso GEF project outputs.

DECLARATION OF INDEPENDENCE

I, Neville Bews, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: 

Name of Specialist: Neville Bews

Date: 06 November, 2018

1. INTRODUCTION

Rondekop Wind Farm (Pty) Ltd has proposed the development of a Wind Energy Facility (WEF) referred to as the Rondekop Wind Energy Facility, 45 km south-west of Sutherland, in the Northern Cape Province, South Africa. As the proposed facility is located partially within and partly outside of the Komsberg Renewable Energy Development Zone (REDZ 2), SiVEST Environmental Division has been appointed on behalf of Rondekop Wind Farm (Pty) Ltd to undertake a full Environmental Impact Assessment in order to apply for environments authorisation for this facility.

Towards this end SiVEST have contracted Dr Neville Bews & Associates (NBA) to undertake a desktop based social impact assessment in respect the proposed Rondekop Wind Farm as part of the Environmental Impact Assessment process.

1.1. PURPOSE OF REPORT

The purpose of the report is to identify the social baseline conditions in which the proposed project will unfold and to acquire an understanding of the proposed project. Against this background, the primary objective was to identify the issues and concerns associated with the Rondekop Wind Energy Facility (WEF) and to identify, assess and propose mitigation for the likely social impacts that may occur as a result of the proposed project to inform the EIA undertaken in terms of the National Environmental Management Act (Act 107 of 1988) (as amended).

1.2. STRUCTURE OF REPORT

This specialist study is undertaken in compliance with Requirements of Appendix 6 – GN R326 EIA Regulations 2014, as amended on of 7 April 2017. Table 1 indicates how the requirements of Appendix 6 have been fulfilled in this report.

Table 1: Report content requirements in terms of EIA Regulations

Requirements of Appendix 6 – GN R326 EIA Regulations 2014, as amended on 7 April 2017	Section of Report
1. (1) A specialist report prepared in terms of these Regulations must contain- (a) details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page x
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page xii
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1 & 1.3
(cA) an indication of the quality and age of base data used for the specialist report;	Section: 1.4 & 1.4.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8 & 8.5
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 1.4 & 1.4.2
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 2 & 2.2
(g) an identification of any areas to be avoided, including buffers;	N/A
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 2.2 Figure 2
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.5
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, **[including identified alternatives on the environment]** or activities;	Section: Sections: 5, 6, 7 & 8 Pages 39-64 7 Page 69
(k) any mitigation measures for inclusion in the EMPr;	Section 6
(l) any conditions for inclusion in the environmental authorisation;	N/A
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section: 5, 6, & 8 Pages 39-55 & 58-64
(n) a reasoned opinion- (i) **[as to]** whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 10
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**N/A** -No feedback has yet been received from the public participation process regarding the visual environment
(q) any other information requested by the competent authority.	**N/A**. No information regarding the SIA has been requested from the competent authority to date.
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

1.3. Terms of reference

To undertake a SIA in respect of the proposed 325 MW Rondekop WEF, and on this basis to consider the extent of the proposed project and its likely effect on the social environment within which the project will be placed.

General requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;
- Provide a thorough overview of all applicable legislation, guidelines
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts). Potential impacts should be rated in terms of the direct, indirect and cumulative:
    - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
    - Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
    - Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Comparative assessment of impacts;
- Recommend mitigation measures in order to minimise the impact of the proposed development; and

- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).

Specific requirements:

- Describe the socio-economic context of the Matjiesfontein, Laingsburg and Sutherland areas, focusing on aspects that are potentially affected by a wind energy project, and taking into consideration the current situation as well as the trends, the local planning (IDPs and SDFs), other developments in the area. The study should look more broadly than the individual land parcels on which the proposed projects will developed, as most, if not all, of the anticipated social impacts may be experienced in the urban areas nearest to the proposed project.
- Apply a variety of appropriate options for sourcing information, such as review of analogous studies, available databases and social indicators, etc.
- The socio-economic study does not lend itself to providing a spatially based sensitivity map. Therefore, instead, the study could provide a simplified schematic mapping of the links between the project actions (i.e. interventions) and the receiving social environment (i.e. the socio-ecological system), which may occur at a local, provincial or national scale, and showing how these links can be optimized to enhance benefits and minimize negative impacts.
- Consider social issues such as potential in-migration of job seekers, opportunities offered by training and skills development, cumulative effects with other projects in the local area implications for local planning and resource use.
- Provide recommendations to enhance the socio-economic benefits of the proposed wind energy project and to avoid (or minimise) the potential negative impacts.
- Identify and assess potential social benefits and costs as a result of the proposed development, for all stages of the project, and including the estimated direct employment opportunities.
- Evaluate the implications of the social investment programme associated with REIPPPP projects on the local socio-economic context.

1.4. Approach to study

Data was gathered by means of the following techniques.

1.4.1. Collection of data

Data was gathered through:

- The project description prepared by G7 Renewable Energies (Pty) Ltd.
- Statistics South Africa, Census 2011 and other relevant demographic data generated by Stats SA such as the Quarterly Labour Force Survey and Mid-year population estimates.
- Discussions with the project proponents and Environmental Impact Assessment Consultants.
- A literature review of various documents such as the relevant Municipal Integrated Development Plans (IDPs) and other specialist reports and documents.
- A broader literature scan.

1.4.2. Impact assessment technique

The assessment technique used to evaluate the social impacts was provided by SiVEST Environmental Division and is attached in Appendix 1.

1.5. Assumptions and limitations

The following assumptions and limitations apply in respect of this report.

1.5.1. Assumptions

It is assumed that the technical information provided by the project proponent, G7 Renewable Energies (Pty) Ltd and the environmental consultants SiVEST, is credible and accurate at the time of compiling the report.

It is also assumed that the data provided by the various specialists as used in this report are credible and accurate.

1.5.2. LIMITATIONS

The demographic data used in this report was sourced from Statistics South Africa and is based on data gathered during Census 2011. This data is somewhat outdated but where possible is supplemented with the latest Stats SA's survey data such as the Mid-year population estimates and the Quarterly Labour Force Survey. The limitation of this is that this survey data is restricted to a provincial level and does not extend down to a municipal level.

It was also agreed with the project proponent and environmental consultant that contact with land owners would be treated with sensitivity. This, in an effort to retain the positive rapport that the project proponent, G7 Renewable Energies (Pty) Ltd, had painstakingly established with land owners, and to ensure that the information provided to land owners was of an accurate and consistent nature. Consequently, no site visit was undertaken as the region was sparsely populated and where necessary information could be obtained from the environmental consultants. It was also agreed that if any specific social issues arose that required a site visit and engagement with an affected party that this would be undertaken in a manner acceptable to that or those affected parties.

2. PROJECT DESCRIPTION

Rondekop Wind Farm (Pty) Ltd propose to develop a Wind Energy Facility (WEF) of up to 325 megawatt (MW), 45 km south-west of Sutherland, in the Northern Cape Province, South Africa. The proposed facility is located within the Karoo Hoogland Local Municipality, which fall within the Namakwa District Municipality.

The Rondekop WEF will have an energy generation capacity (at 132 kV point of utility connection) of up to 325 megawatt (MW), and will include the following:

- Up to 48 wind turbines, each between 3 MW and 6.5 MW in nameplate capacity each with a foundation of up to 30 m in diameter and up to 5 m in depth.
- The hub height of each turbine will be between 90 m and up to 140 m and its rotor diameter between 100 m and up to 180 m.
- Permanent compacted hardstanding laydown areas (also known as crane pads) for each wind turbine of 90 m x 50 m (total footprint 21.6 ha) during construction and for ongoing maintenance purposes for the lifetime of the project.
- Electrical transformers (690V/33kV) adjacent to each turbine (typical footprint of 2 m x 2 m, but can be up to 10 m x 10 m at certain locations) to step up the voltage to 33 kV.

- Underground 33 kV cabling between turbines buried along access roads, where feasible, with overhead 33 kV lines grouping turbines to across valleys and ridges outside of the road footprints to get to the onsite 33/132 kV substation.
- Internal access roads up to 12 m wide, including structures for storm water control would be required to access each turbine and the substation, with a total footprint of about 73 ha, of which 38.6 ha will be upgrades to existing roads. Turns will have a radius of up to 50 m in order for abnormal loads (especially turbine blades) to access the various turbine positions.
- Access roads to the site will be approximately 9 m wide while access roads to the substation will be approximately 6 m wide.
- One 33/132 kV onsite substation. The 33 kV footprint will need to be assessed as part of the WEF EIA and the 132 kV footprint will be assessed in a separate basic assessment (BA) process as the current applicant will remain in control of the low voltage components of the 33/132 kV substation, whereas the high voltage components of this substation will likely be ceded to Eskom shortly after the completion of construction. The total footprint of this onsite substation will be approximately 2.25 ha.
- Up to 4 (the height will be the same as the final wind turbine hub height) wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.
- Temporary infrastructure including a construction camp (~13 ha) which includes an on-site concrete batching plant for use during the construction phase and for offices, administration, operations and maintenance buildings during the operational phase.
- Fencing will be limited around the construction camp and batching plant. The entire facility would not be fenced off. The heights of fences around the construction camp are anticipated to be up to 6 m.
- Temporary infrastructure to obtain water from available local sources/ new or existing boreholes including a potential temporary above ground pipeline (approximately 35 cm diameter) to feed water to the on-site batching plant. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the DWS will be applied for separately.
- Application site is ~37 543.13 hectares (cadastral units). The total footprint of the wind farm will however be ~ 114 ha (of which ~38ha will be upgrading of existing roads).

2.1. LOCATION

The project is situated within the Northern Cape Province falling within the District Municipality of Namakwa and the Local Municipality of the Karoo Hooglands and bordering the Cape Windlands District and Witzenberg Local municipalities. The location of the project is illustrated in **Figure 1**.

2.2. EIA ALTERNATIVES

The alternatives assessed consist of the following:

- Location alternative
    - No further site locations are available.
- Technology alternative
    - At this stage no other technological alternatives are considered feasible.
- Layout alternatives
    - Turbine layout alternatives
    - Road layout alternatives
        - North ridge
        - Centre ridge
        - Southern ridge
    - Construction camp
        - Six alternatives
        - Batching plant area
    - Substations
        - Six onsite 33/132 kV substation locations.
    - No-Go alternative.

A detailed description of these alternatives is provided below.

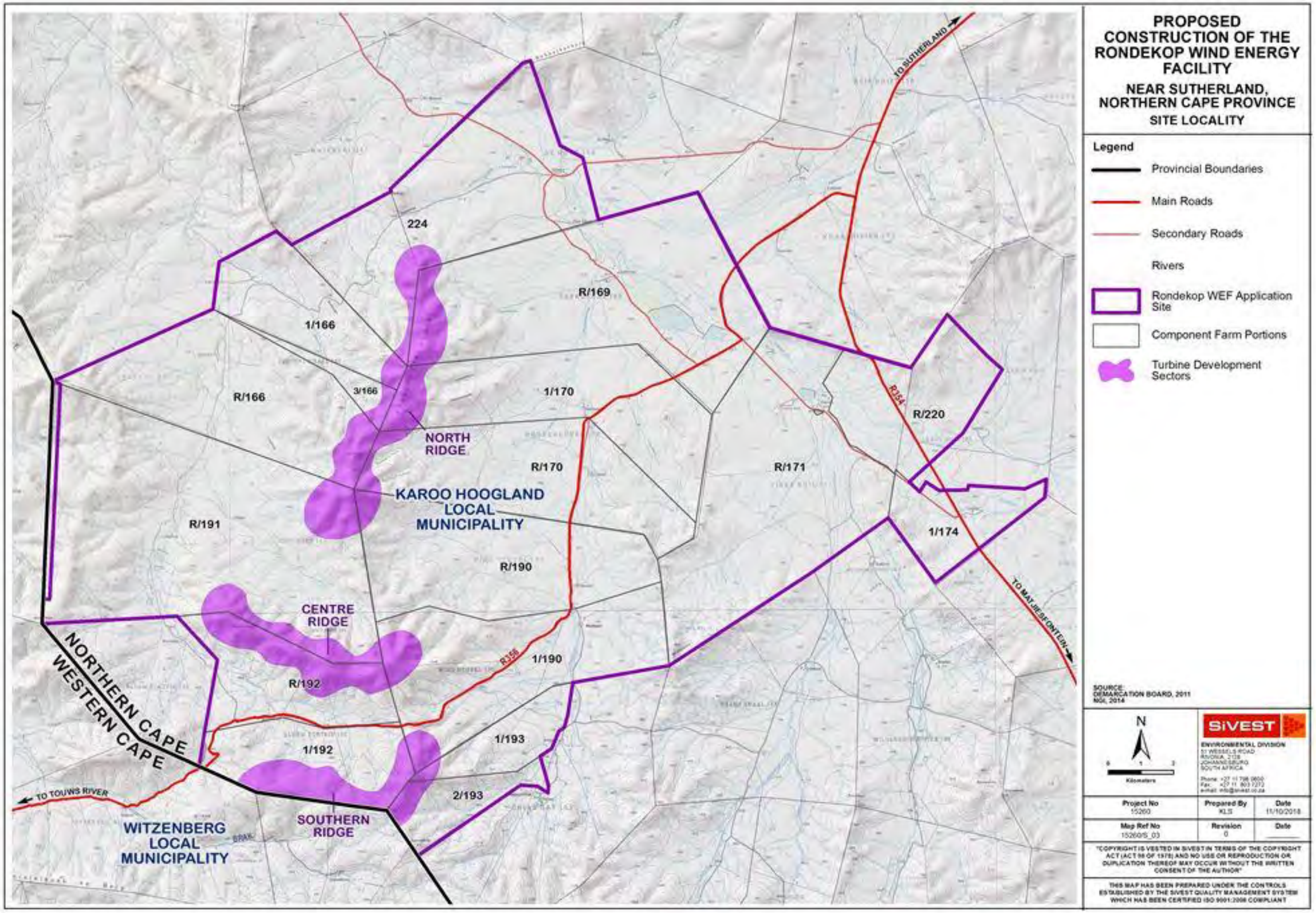


Figure 1: Project location

2.2.1. LOCATION ALTERNATIVE

The proposed site was selected through an environmental and social pre-feasibility assessment commissioned by the applicant for several sites within the Roggeveld area. This study was undertaken by CES in 2009 and included a high-level screening of potential environmental and socio-economic issues, as well as ‘fatal flaws’ to determine suitable areas for project development. The consideration of a number of criteria resulted in the selection of the site by the applicant. Therefore, no further site location alternatives other than Rondekop will be considered in this process.

2.2.2. TECHNOLOGICAL ALTERNATIVE

Based on the hilly to mountainous terrain, the climatic conditions and current land use being agricultural, it was determined that the Rondekop site would be best-suited for a WEF, instead of any other type of renewable energy technology. The terrain is not flat enough for a photovoltaic facility and there is not enough rainfall in the area to justify a hydro-electric plant. Therefore, no other renewable energy technology has been considered. Through the project development process, Rondekop Wind Farm (Pty) Ltd will continue to consider various wind turbine designs in order to maximise the capacity of the site. Therefore, no technology alternatives are feasible for assessment at this stage of the project other than a WEF.

2.2.3. LAYOUT ALTERNATIVES

Turbine layout alternatives

One layout alternative will be assessed for Rondekop WEF based on 48 wind turbines with associated crane pad areas and other associated infrastructure. The proposed layout is spread over three ridges namely northern ridge, centre ridge and southern ridge as illustrated in **Figure 2**. The proposed layout will be amended, as needed, based on specialist input and input from I&APs.

Road layout alternatives

Various access road alternatives are currently proposed to connect the R356 to the three ridges. The proposed access to the site is from the tarred R354 connecting Matjiesfontein and Sutherland, turning north-west onto the R356 provincial gravel road and heading west from where the access roads branches off. The six access road alternatives (two per ridge) branch off the R356.

Considering that the proposed Rondekop WEF is to be developed on three separate ridges, there are two proposed access roads to each ridge, therefore six access road alternatives in total.

Three access road alternatives would connect the public R356 road to the new wind farm road network between the turbines on the ridges namely:

North ridge

- Access road alternative North 1, route is approximately 11.8 km in length, almost all of which comprises an existing farm road that will need to be upgraded; or
- Access road alternative North 2 is approximately 12.8 km in length and branches off the R356 and follows an existing farm road that will need to be upgraded.
- Access road alternative Centre 1 is approximately 2.6 km in length and branches off the R356 to the north and connects between turbine 31 and 32; or
- Access road alternative Centre 2 is approximately 3.1 km in length and branches off the R356 and connects to the site near turbine 28.

Centre ridge

- Access road alternative Centre 1 is approximately 2.6 km in length and branches off the R356 to the north and connects between turbine 31 and 32; or
- Access road alternative Centre 2 is approximately 3.1 km in length and branches off the R356 and connects to the site near turbine 28.

Southern ridge

- Access road alternative South 1 is approximately 1.9 km in length and branches off the R356 to the south and connects near turbine 45; or
- Access road alternative South 2 is approximately 4.2 km in length and branches off the R356 to the south and connects near turbine 42.

All six alternatives are assessed with the road network and one access road per ridge would require environmental authorisation in order to enable access to all three ridges. The internal access roads are assessed as part of all access road alternatives.

Each road section will be buffered by approximately 200 m to allow for incremental alternatives i.e. reroute within the buffer in order to avoid any sensitive features identified during the detailed specialist assessments.

Construction camp alternatives

Six alternative construction camp layouts, including the area required for a batching plant, will be assessed namely construction camp:

- Construction Camp Alternative 1 is located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;
- Construction camp Alternative 2 is also located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;
- Construction Camp Alternative 3 is located adjacent to and east of the R356 public road on the Remainder of farm 190 Wind Heuvel;
- Construction Camp Alternative 4 is located at the intersection of an existing 4x4 track and the R356 on portion 1 of farm 190 Wind Heuvel;
- Construction Camp Alternative 5 is located at the intersection of the R356, access road alternative centre 2 and access road alternative south 1 extending to the north on the remainder of farm 192 Bloem Fontein; and
- Construction Camp Alternative 6 is located to the west of access road alternative centre 2 north of the R356 on the remainder of farm 192 Bloem Fontein.

Substations alternatives

Six onsite 33/132 kV substation location alternatives were identified based on technical studies which considered aspects such as topography, earth works and levelling, environmentally sensitive features, electrical losses, turbine locations and existing agricultural use. All six (6) positions are located relatively in the centre of the facility.

- Substation alternative 1 is located south of turbine 22 on the remainder of farm 191 Hout Hoek;
- Substation alternative 2 is located south of substation alternative 1 on the remainder of farm 191 Hout Hoek;
- Substation alternative 3 is located south east of substation alternative 2 on the remainder of farm 190 Wind Heuvel;

- Substation alternative 4 is located north east of substation alternative 3 on the remainder of farm 190 Wind Heuvel;
- Substation alternative 5 is located west of construction camp alternative 4 along an existing 4x4 jeep track; and
- Substation alternative 6 is located adjacent to access road alternative centre 1 to the east on portion 1 of farm 190 Wind Heuvel.

2.2.4. NO-GO ALTERNATIVE

It is mandatory to consider the "no-go" option in the EIA process. The no development alternative option assumes the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area and the status quo would proceed.

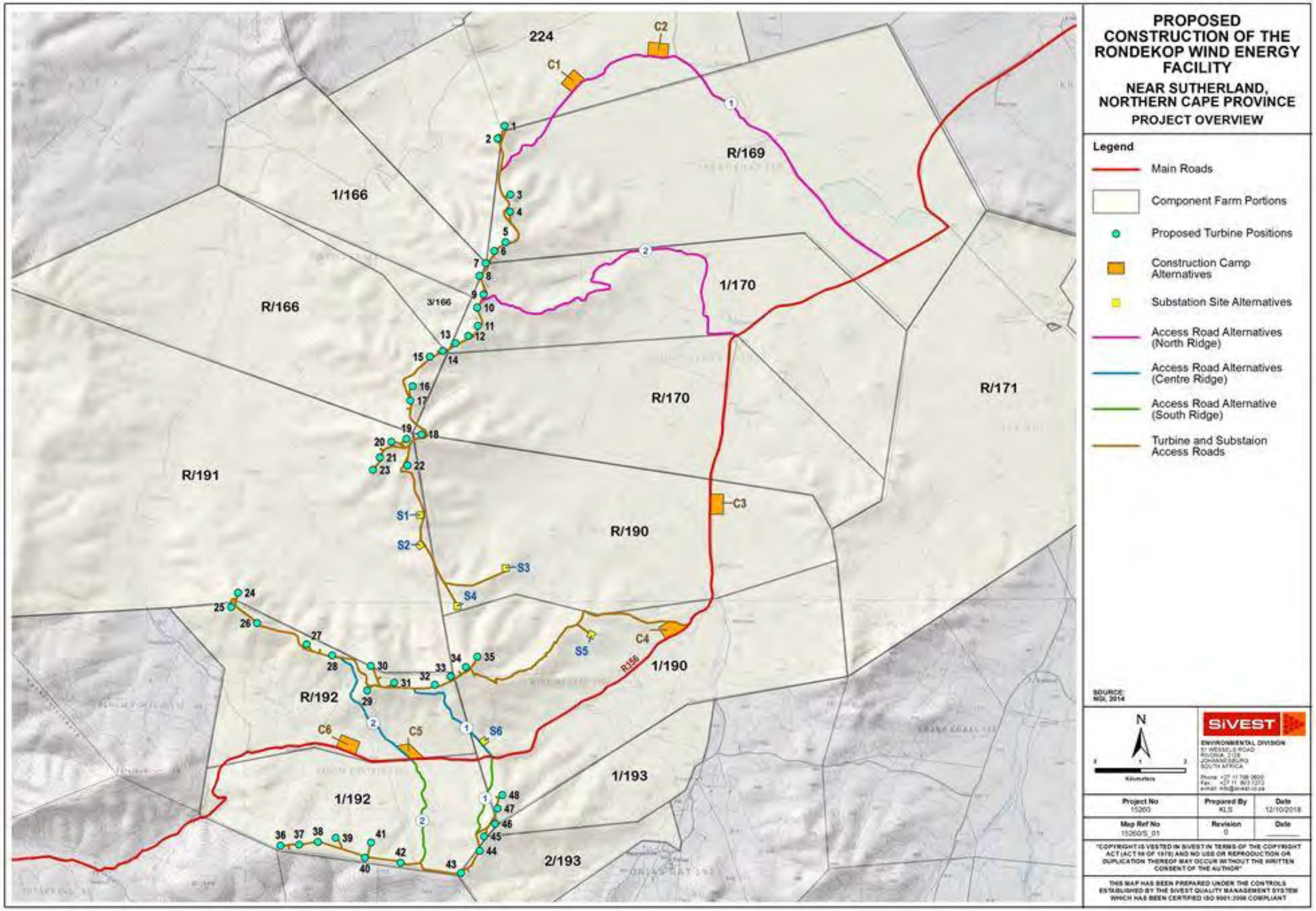


Figure 2: Rondekop layout map

3. APPLICABLE POLICY AND LEGISLATION

Legislation and policy serve to guide the authorities in undertaking and agreeing on projects that are in the interest of the country as a whole. Consequently, the fit of the project with the relevant national, provincial and municipal legislation and policy is an important consideration. In this respect the following legislation and policy is applicable to the project.

International

- Climate Change Action Plan, 2016-2020, World Bank Group (2016);
- Renewable Energy Vision 2030 – South Africa; World Wildlife Fund for Nature-SA (formerly World Wildlife Fund-SA) (2014);
- REthinking Energy 2017: Accelerating the global energy transformation. International Renewable Energy Agency, (2017);
- Renewable Energy Policies in a Time of Transition. International Renewable Energy Agency (2018).
- Global Warming of 1.5 °C. An IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Summary for Policymakers. Subject to copy edit: Intergovernmental Panel on Climate Change (2018).

National

- White Paper on the Energy Policy of the Republic of South Africa (1998);
- White Paper on Renewable Energy (2003);
- A National Climate Change Response Strategy for South Africa (2004);
- National Energy Act (2008);
- Integrated Resource Plan (IRP) for South Africa (2010-2030);
- The Environmental Impact Assessment and Management Strategy for South Africa (2014);
- Government Gazette Vol. 632; 16 February 2018 No. 41445. Department of Environmental Affairs, No. 114, Page No. 92 (2018);
- New Growth Path Framework (2010);
- The National Development Plan (2011);
- National Infrastructure Plan (2012).

Provincial

- Western Cape Green Economy Strategy Framework (2013);
- Western Cape Provincial Strategic Plan (2014 – 2019);
- Western Cape Climate Change Response Strategy (2014);
- Northern Cape Provincial Growth and Development Strategy (2004-2014);
- Northern Cape Province Twenty Year Review (2014);
- Northern Cape Climate Change Response Strategy;
- Northern Cape Spatial Development Framework;
- Northern Cape Department of Environment & Nature Conservation Annual Report (2016/17);
- Norther Cape Department of Economic Development & Tourism Annual Report (2017);
- Northern Cape State of the Province Address (2018).

District and local

- Namakwa District Municipality, Climate Change Vulnerability Assessment and Response Plan (Draft Version 4; 2017);
- Namakwa District Integrated Development Plan (Review 2018/19);
- Karoo Hoogland Municipality Integrated Development Plan (2017 – 2022);
- Karoo Hoogland and Spatial Development Framework (2010);
- Central Karoo District Municipality Local Economic Development (2009);
- Central Karoo District Municipality 3rd 2012-2017 IDP Review (2016);
- Laingsburg Local Municipality Integrated Development Plan (2018).

3.1. POLICY AND LEGISLATION FIT

Considering the nature and location of the project there is a clear fit with international, national, provincial and local, at both district and municipal levels, policy and legislation. For instance, the World Wild Life Fund for Nature (WWF)

> "…*calls for a more ambitious plan, suggesting that the IRP* [Integrated Resource Plan for Electricity] *should provide for an 11-19% share of electricity capacity by 2030, depending on the country's growth rate over the next fifteen years*" (Sager, 2014, p. 5).

The issue of climate change is high on the agenda of all levels of government in South Africa with the Department of Environmental Affairs and Tourism indicating that;

> "*The efforts of all stakeholders will be harnessed to achieve the objectives of the Government's White Paper on Renewable Energy (2003) and the Energy Efficiency Strategy, promoting a sustainable development path through coordinated government policy* (Department of Environmental Affairs and Tourism, 2004, p. 23) "

DEAT goes further in specifically listing renewable energy sources, including wind power, solar power and biomass, as a tool in promoting mitigation against climate change.

In terms of the capacity determinations of the Minister of Energy, in consultation with the National Energy Regulator (NERSA), it has been established that South Africa required;

> "*14 725 MW of renewable energy (comprising of solar PV: 6 225 MW, wind: 6 360 MW, CSP: 1 200 MW, small hydro: 195 MW, landfill gas: 25 MW, biomass: 210 MW, biogas: 110 MW and the small scale renewable energy programme: 400 MW)*" (Independent Power Producer Office, 2018a, p. 5).

With the Northern Cape contributing 2 048 GWh in respect of wind (Independent Power Producers Procurement Office, 2018b, p. 3) and the Western Cape contributing 3 518 GWh (Independent Power Producers Procurement Office, 2018c, p. 3).

On 16 February 2018 the boundaries of eight Renewable Energy Zones (REZs) that are of strategic importance for large scale wind and solar photovoltaic for the country were gazetted (Government Gazette No. 41445, 2018). In respect of these zones the project is located partly within the Renewable Energy Development Zone 2 which is located in the Komsberg region and falls across the borders of the Northern and Western Cape Provinces. The project, however, does not fall completely within this zone with a section falling outside the zone.

In the Western Cape's Provincial Strategic Plan 2014 – 2019 (Western Cape Government, 2014, pp. 49-50) it is indicated that in its response to climate change " …*the province focuses on key areas of potential impact namely renewable energy,*" amongst other areas.

The Northern Cape Department of Economic Development and Tourism identifies six economic development opportunities, one of which is renewable energy, and states that;

> "*During the financial year* [2017/18] *the intension* (sic) *is to focus on additional opportunities such as, Renewable Energy, a focus area of the 9-Point Plan*" (Northern Cape Province. Department of Economic Development & Tourism, 2017, p. 10 & 15).

The importance of renewable energy facilities within the Northern Cape has been recognised in the province's Twenty Year Review 2014 where it is indicated that;

> "*The New Growth Path that was adopted by national government in 2010 identified the green economy as a new economic sector that will be key to the creation of jobs. The focus of the green economy is on renewable energy and the Northern Cape was identified as the solar hub of the country with a number of solar plants being established across the province*" (Northern Cape Province, 2014, p. 153).

On a municipal level wide support is also evident across all affected municipalities. In the Namakwa District Municipality Integrated Development Plan Revision 2018/2019 (Namakwa District Municipality, 2018, p. 19) it is stated that;

> "*Renewable energy is recently one of the cornerstones of the economy of the District and there needs to be engagement on National level to ensure that the District benefit from this resource*".

The Central Karoo District Municipality also recognised the value of renewable energy projects listing one of its mission objectives as;

> "*Facilitating economic growth through improving infrastructure and green energy opportunities*" (Central Karoo District Municipality, 2016, p. 36) see also pages 38 and 39.

In its Project Priority Matrix[1] the Karoo Hoogland Local Municipality lists the promotion of renewable energy generation and policy on the development of wind energy facilities as one of its eight priorities. In a similar vein it is pointed out in the Laingsburg Integrated Development Plan (2017, p. 88) that renewable energy generation in the greater Karoo region "...*will add value to the GDP within certain economic sectors and, by implication, change the composition and character of the towns.*"

Considering the policy and legislation referred to above it seems that the project largely fits this framework as the majority of the project falls within one of the eight Renewable Energy Zones (REDZs 2 Komsberg) allocated by National Government. Notwithstanding this, however, the provision that the project also conforms to appropriate scale and form, particularly considering the cumulative impacts associated with similar such projects in the

[1]See the following link http://www.karoohoogland.gov.za/wp-content/uploads/2015/06/2010-12-03-Karoo-Hoogland-PROJECT-PRIORITISATION.pdf

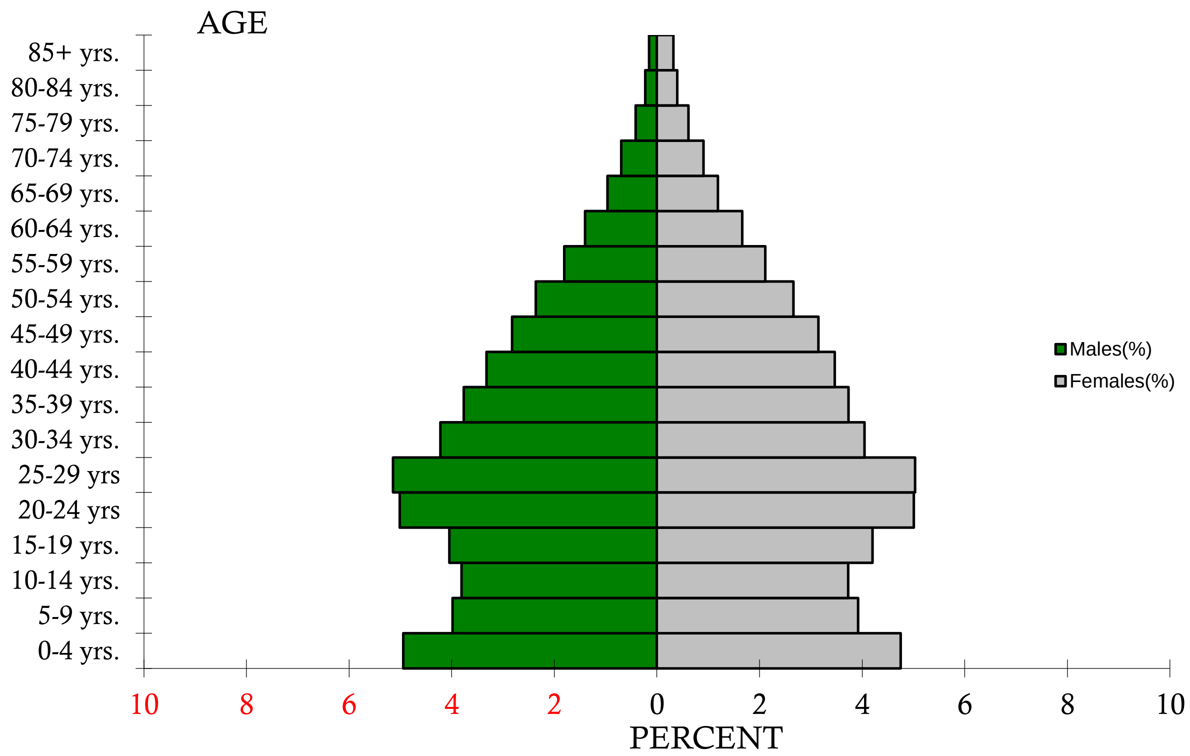
area, will need to be considered on a broader basis than can be done as far as this report is concerned. In this regard attention will need to be given to the cumulative impacts at a later point in this report in as far as they relate to the social environment. In the following section a description of the affected environment is provided.

4. Description of the Affected Environment

The project falls within the Northern Cape Province, within the Namakwa (DC6) district and Karoo Hooglands (NC066) local municipal areas. The closest towns to the project are Sutherland which is located within the Karoo Hoogland Local Municipality and the town of Laingsburg and village of Matjiesfontein both of which fall within the Central Karoo (DC5) and Laingsburg local municipal area. The demographics pertaining to these areas, as sourced from Statistics South Africa, are described below.

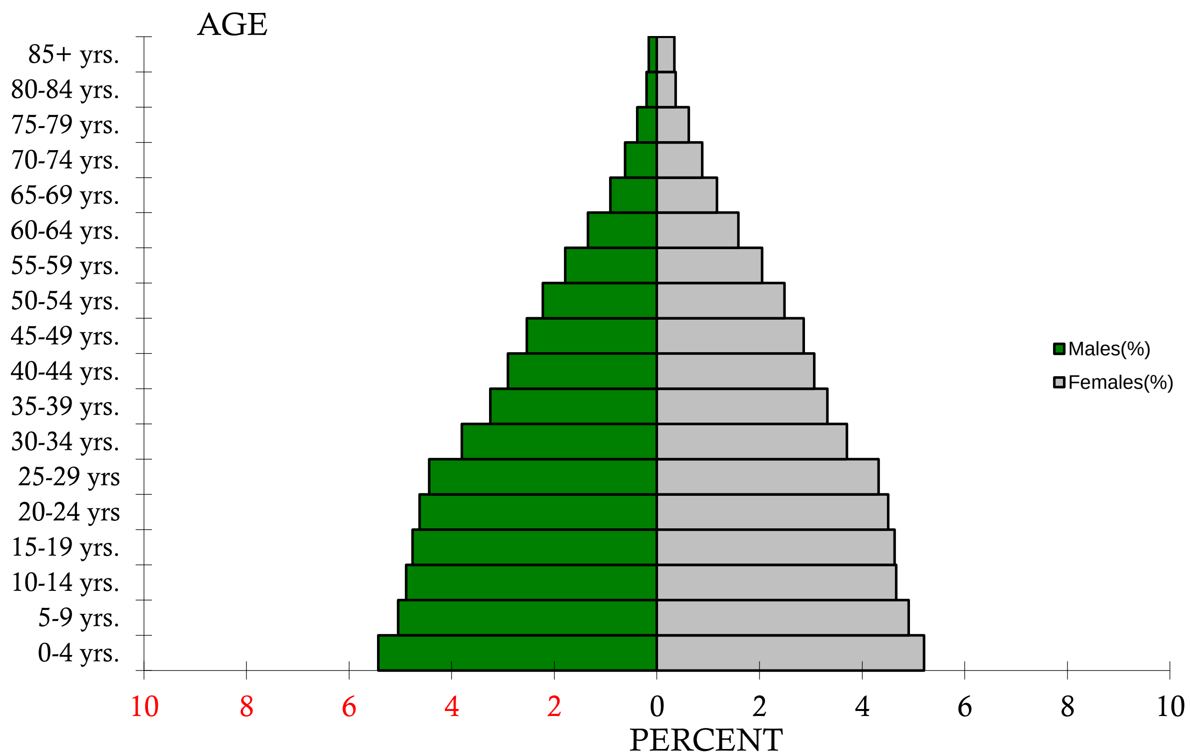
4.1. Provincial

The Western Cape Province covers an area of 129 462.21 km² and, with a population of 5 82 734, according to Census 2011 (Statistics South Africa, 2011), resulting in a population density of 44.98 people per km² in 2011. The Northern Cape Province covers an area of 372 889.36 km² and, over the same period, had a population of 1 145 861 giving it a population density of 3.07 people per km². In respect of age structure 25.1% of the population of the Western Cape are below 16 years while 69% are between 15 and 64 years of age and 5.9% are above 64 years. The corresponding figures pertaining to the Northern Cape are as follows; below 16 years = 30.1%, between 15 and 64 years = 64.2% and above 64 years = 5.7%. The population pyramids of the Western and Northern Cape provinces are illustrated in **Figure 3** and **Figure 4** respectively.



Source: (Statistics South Africa, 2011)

Figure 3: Population pyramid Western Cape Province



Source: (Statistics South Africa, 2011)

Figure 4: Population pyramid Northern Cape Province

According to the 2018 Mid-year population estimates (Statistics South Africa, 2018a), with a population of 6 621 100 in 2018, the Western Cape has the third highest population across the country below Gauteng (14 717 000) and KwaZulu-Natal (11 384 700). The Northern Cape Province has the smallest population with an estimated population of 1 225 600 in 2018. As the Mid-year population estimates remain at a provincial level and are not projected to the district and local municipal levels, for comparative purposes, data gathered during Census 2011, will be used where appropriate notwithstanding it being rather outdated.

On this basis and in respect of population grouping at 48.8%, the dominant population group in the Western Cape are coloured people while the dominant population of the Northern Cape, at 50.35%, are black African people. At 49.7% and 53.8% respectively Afrikaans is the dominant home language spoken across both provinces.

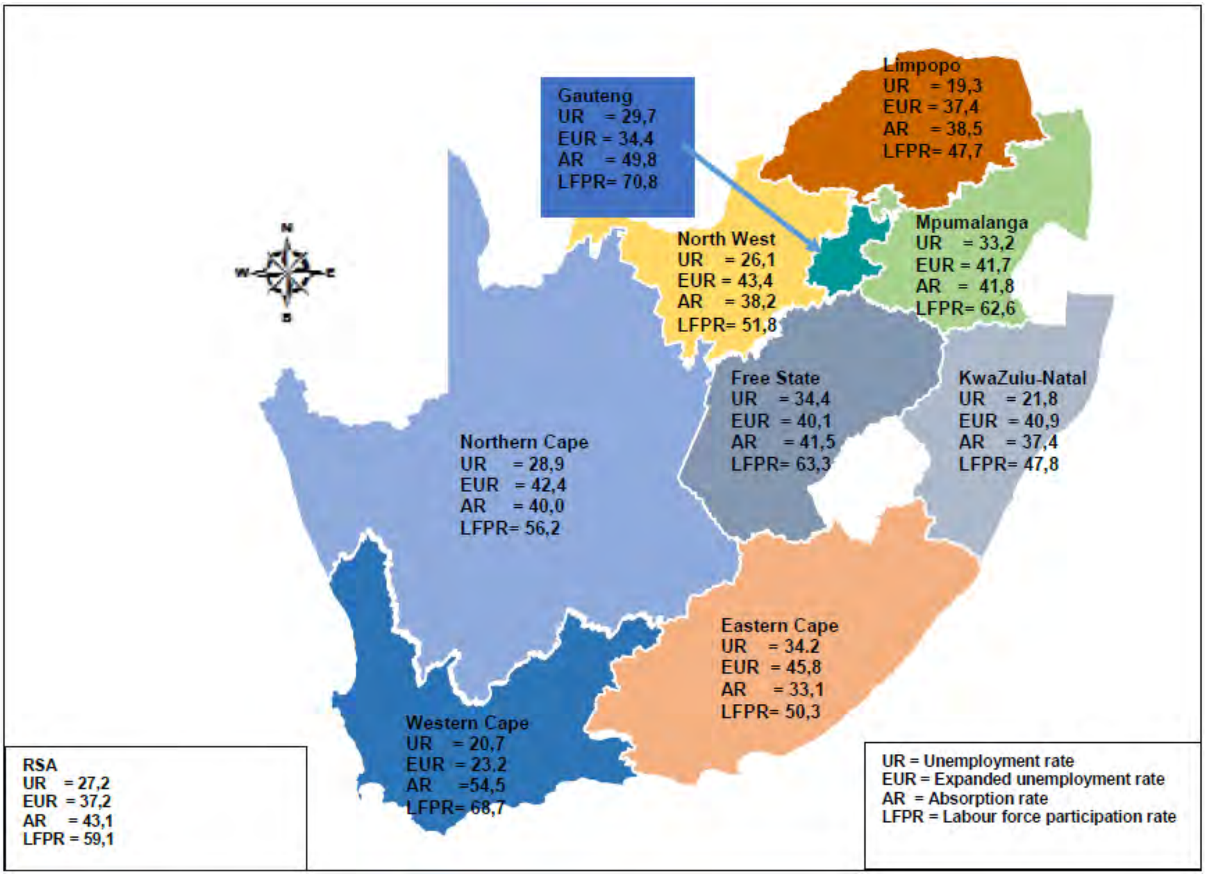
The dependency ratio of the Western Cape, which indicates the burden placed on the population of working age, between 15 and 64 years, who support children under 15 years and people over 65 years, is 45.0 while that of the Northern Cape is 55.7. The sex ratio, which measures the proportion of males to females, is 96.4 indicating a higher number of females in the province while that of the Northern Cape is 97.3 also indicating a higher female to male ratio across the province. Between 1996 and 2001 the population growth rate of the Western Cape was 2.68% p.a. while between 2001 and 2011 it was 2.52% p.a. The corresponding data for the Northern Cape was -0.40 between 1996 and 2001 and 1.44 between 2001 and 2011.

In 2011 the official unemployment rate in the Western Cape was 21.6% with the official unemployment rate amongst the youth, aged between 15 and 34 years, being 29%. The corresponding figures for the Northern Cape are 27.4% and 34.5% respectively. In the 2nd quarter of 2018 the official unemployment rate in the province had dropped to 20.7% while that in the Northern Cape had risen to 28.9%. These figures must, however, be considered with caution as the official unemployment rate is defined by Stats SA as follows;

> "*Unemployed persons are those (aged 15–64 years) who:*
>
> *a) Were not employed in the reference week and;*
>
> *b) Actively looked for work or tried to start a business in the four weeks preceding the survey interview and;*
>
> *c) Were available for work, i.e. would have been able to start work or a business in the reference week or;*

d) Had not actively looked for work in the past four weeks but had a job or business to start at a definite date in the future and were available." (Statistics South Africa, 2018b, p. 17).

Considering this in the 2nd Quarter of 2018, the unofficial employment rate in the Western Cape was 23.2% while that in the Northern Cape stood at 42.4%. During this period the labour absorption rate in the Western Cape was 54.5% while the labour force participation rate was 68.7%. In the Northern Cape the labour force absorption rate was 40% and the labour force participation rate was 56.2%. A summary of the labour market indicators illustrated on a comparative basis across South Africa is provided in **Figure 5**.



Source: (Statistics South Africa, 2018b, p. 9)

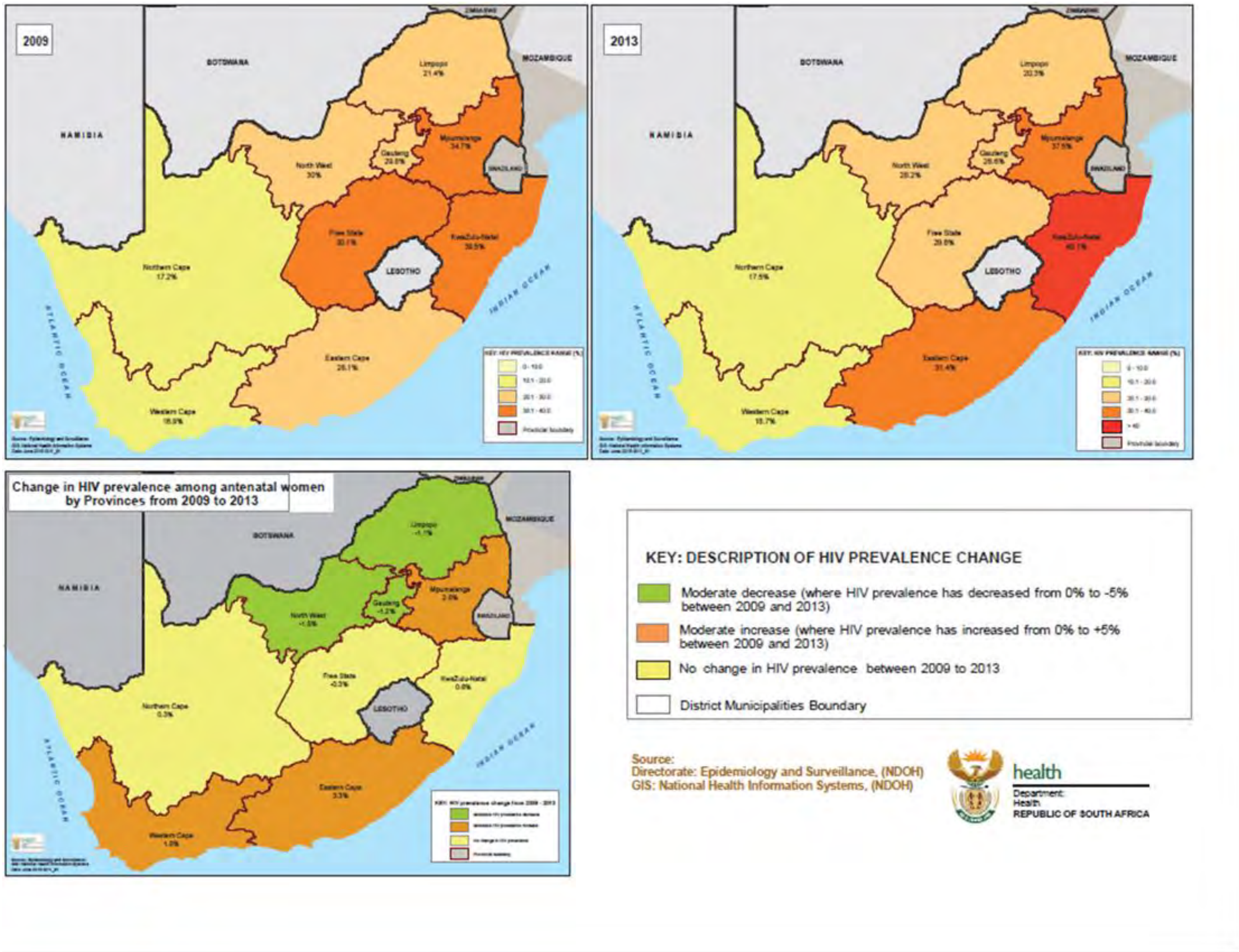
Figure 5: Labour market indicators 2nd Quarter 2018

In respect of households, the 2011 Census indicated that there were 1 634 000 households in the Western Cape with an average household size of 3.6 and 301 405 households in the Northern Cape with an average household size of 3.8. Of the households in the Western Cape, 36.6% were female headed, 80.4% lived in formal dwellings and 52.4% either owned or were paying off their dwelling. The corresponding figures for the Northern Cape are 38.8% female headed households with 82.4% living in formal dwellings and 55.1% having either owned or were paying off their dwelling.

Regarding household services in 2011, 85.6% of households in the Western Cape and 60.1% in the Northern Cape had flush toilets connected to the sewerage system. In respect of refuse removal 89.9% of households in the Western Cape and 64% in the Northern Cape had their refuse removed on a weekly basis. Piped water was delivered to 75.1% and 45.8% of households in the Western and Northern Cape respectively while 93.4% of households in the Western Cape and 85.4% in the Northern Cape used electricity as a means of energy for lighting.

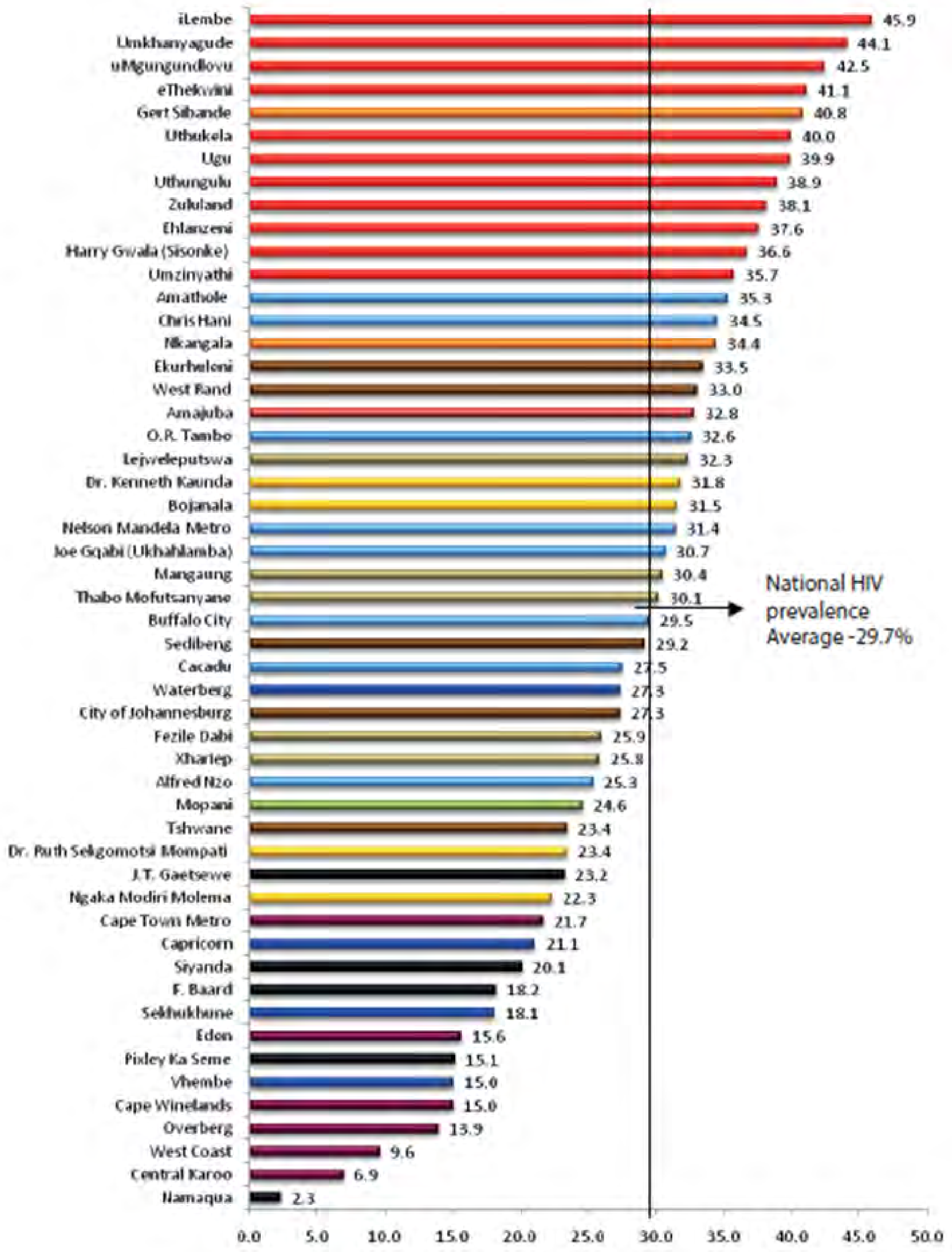
Concerning HIV prevalence amongst prenatal women in both the Western and Northern Cape provinces, in 2013 the Northern Cape had the lowest prevalence rate across South Africa at 17.5% followed by the Western Cape at 18.7%. At that point the highest level of HIV prevalence amongst antenatal women was in KwaZulu-Natal with a prevalence rate of 40.1% while the national rate was 29.7%. HIV prevalence amongst antenatal women across South Africa is illustrated in **Figure 6**.

The 2013 National Antenatal Sentinel HIV Prevalence Survey extended to the district level which indicated that the Namaqua District Municipality had the lowest level of HIV prevalence across the country at 2.3% followed by the Central Karoo District at 6.9%. Of the 52 districts surveyed the Cape Winelands, which boarders the proposed project, together with the Vhembe district had the fifth lowest level of HIV prevalence at 15.0%. Consequently, it is quite clear that the prevalence of HIV is extremely low in the area in comparison with the rest of South Africa as is clearly illustrated in **Figure 7**.



Source: (National Department of Health, 2015, p. 27)

Figure 6: HIV prevalence amongst antenatal women – South Africa 2009 – 2013



Source: (National Department of Health, 2015, p. 29)

Figure 7: HIV prevalence across the 52 districts – 2013

Attention is now turned towards the district and local municipalities which are compared together with both the provinces in **Table 2** to **Table 5**.

4.2. MUNICIPAL

The project impacts the two district municipalities of Namakwa and the Central Karoo as well as their respective local municipalities of the Karoo Hooglands and Laingsburg. On a district level Namakwa covers the greatest land area and has the lowest population density at 0.91/km^2, while at a local municipal level the Karoo Hoogland covers the greatest geographical area and has the lowest population resulting in a population density of 0.39/km^2. In respect of population grouping, Coloured people are the dominant population group across all districts and local municipalities and Afrikaans is the dominant home language spoken in the area, ranging between 87.18% in the Central Karoo and 96.3% in the Karoo Hoogland LM. In **Table 2** the data pertaining to the district and local municipalities is compared together with that applicable to the Western and Northern Cape Provinces.

The principal towns in the Karoo Hoogland are Williston, home of the municipal head office, Fraserburg and Sutherland. The low population density of the Karoo Hoogland's is as a result of a relatively high proportion of the population living in small, dispersed settlements. This population is relatively poor and, as of 1 July 2017, 818 households within the Karoo Hoogland were recipients of monthly indigent support.

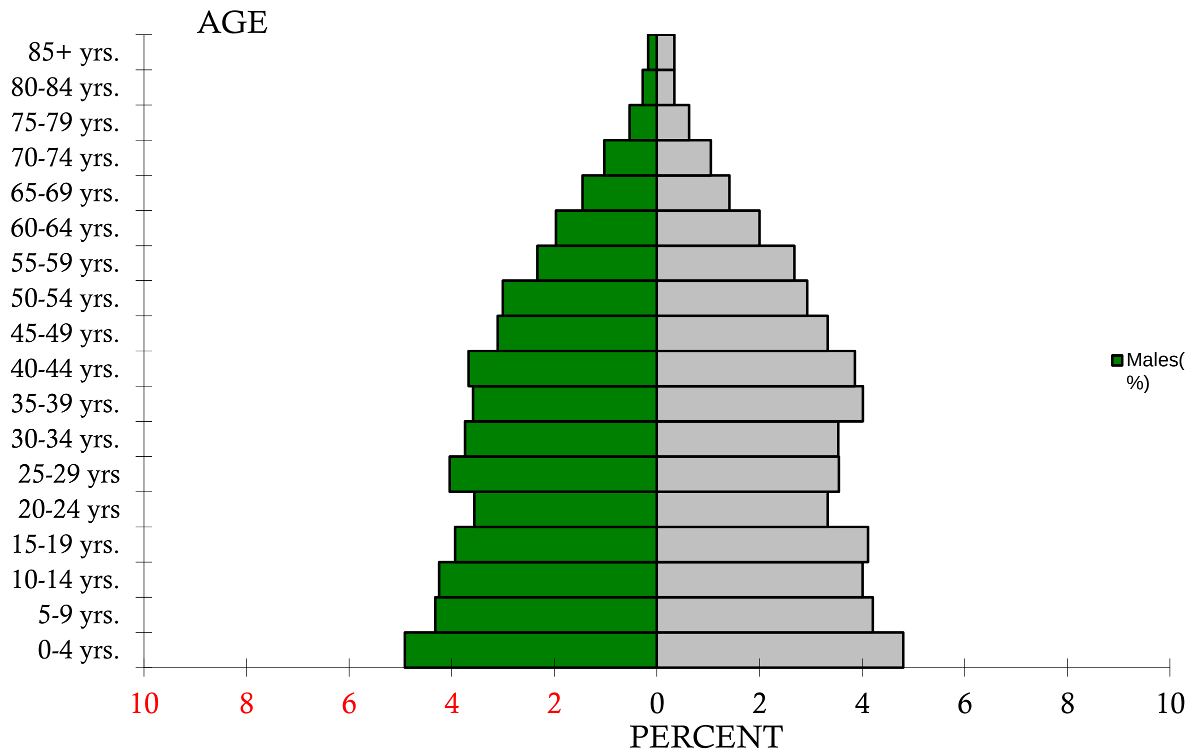
The main towns in the Laingsburg Local Municipality are Laingsburg and Matjiesfontein the latter of which is essentially a village. The economy of the area mainly consists of agriculture, tourism, finance, construction and community services.

Table 2: Geographic and demographic data

	WESTERN CAPE	DC5: Central Karoo	WC051: Laingsburg	NORTHERN CAPE	DC6: Namakwa	NC066: Karoo Hooglands
Geographical Area	129,462.21 km²	38,853.98 km²	8,784.48 km²	372,889.36 km²	126,836.34 km²	32,273.88 km²
Population	5,822,734	71,011	8,289	1,145,861	115,842	12,588
Households	1,634,000	19,076	2,408	301,405	33,856	3,842
Population Density	44.98/km²	1.38/km²	0.94/km²	3.07/km²	0.91/km²	0.39/km²
Household Density	12.62/km²	0.49/km²	0.27/km²	0.81/km²	0.27/km²	0.12/km²
Female	50.91%	51.04%	50.13%	50.69%	49.70%	50.33%
Male	49.09%	48.96%	49.87%	49.31%	50.30%	49.67%
Coloured	48.78%	76.15%	78.97%	40.31%	83.18%	78.92%
Black African	32.85%	12.74%	6.97%	50.35%	6.82%	5.51%
White	15.72%	10.14%	13.31%	7.09%	8.73%	14.55%
Other	1.61%	0.55%	0.51%	1.56%	0.74%	0.36%
Indian/Asian	1.04%	0.42%	0.24%	0.68%	0.53%	0.66%
Home Language	Afrikaans 49.70%	Afrikaans 87.18%	Afrikaans 94.33%	Afrikaans 53.76%	Afrikaans 93.90%	Afrikaans 96.33%
	isiXhosa 24.72%	isiXhosa 7.76%	English 1.69%	Setswana 33.08%	Setswana 1.71%	English 1.33%
	English 20.25%	English 2.60%	isiXhosa 1.21%	isiXhosa 5.34%	isiXhosa 1.55%	isiXhosa 0.90%
	Other 2.24%	Setswana 0.58%	Setswana 0.17%	English 3.36%	English 1.22%	Setswana 0.41%

Source: (Statistics South Africa, 2011)

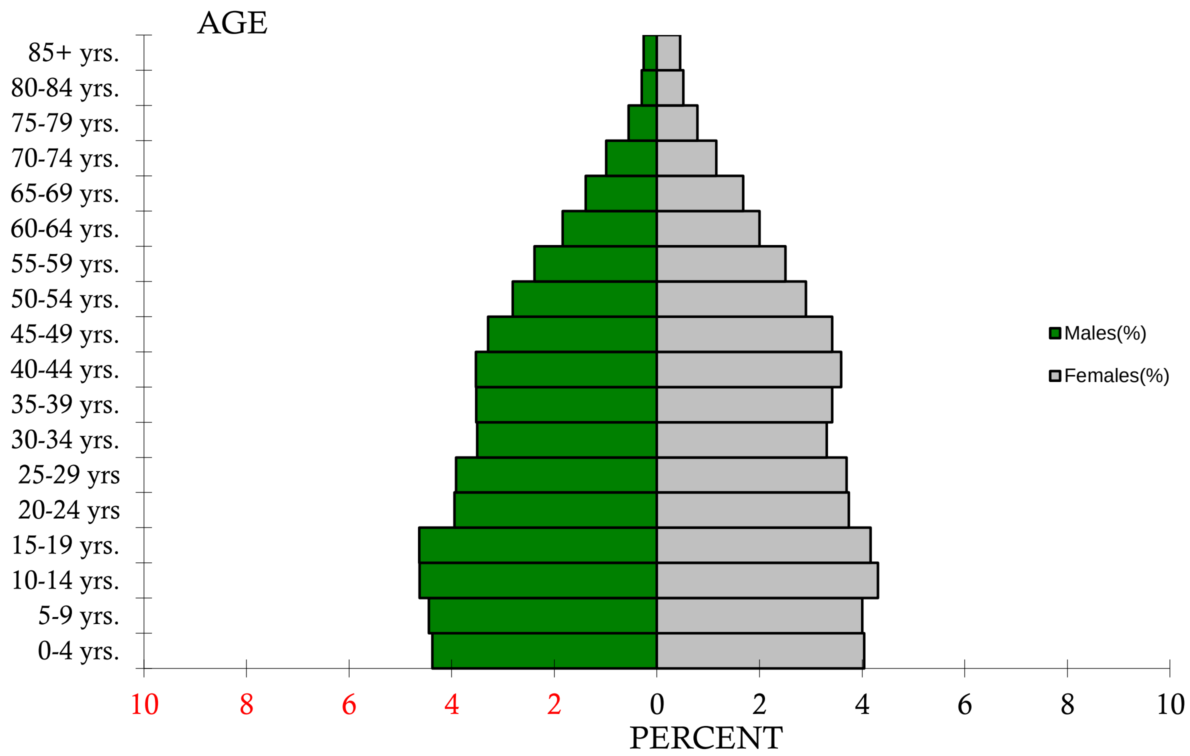
In the Central Karoo district 30.5% of the population, which amounted to 71 011 people in 2011, were under 16 years of age while 63.3% were between 15 and 64 years and 6.2% were over the age of 64. Based on this data the population pyramid of the Central Karoo is illustrated in **Figure 8**.



Source: (Statistics South Africa, 2011)

Figure 8: Population pyramid Central Karoo

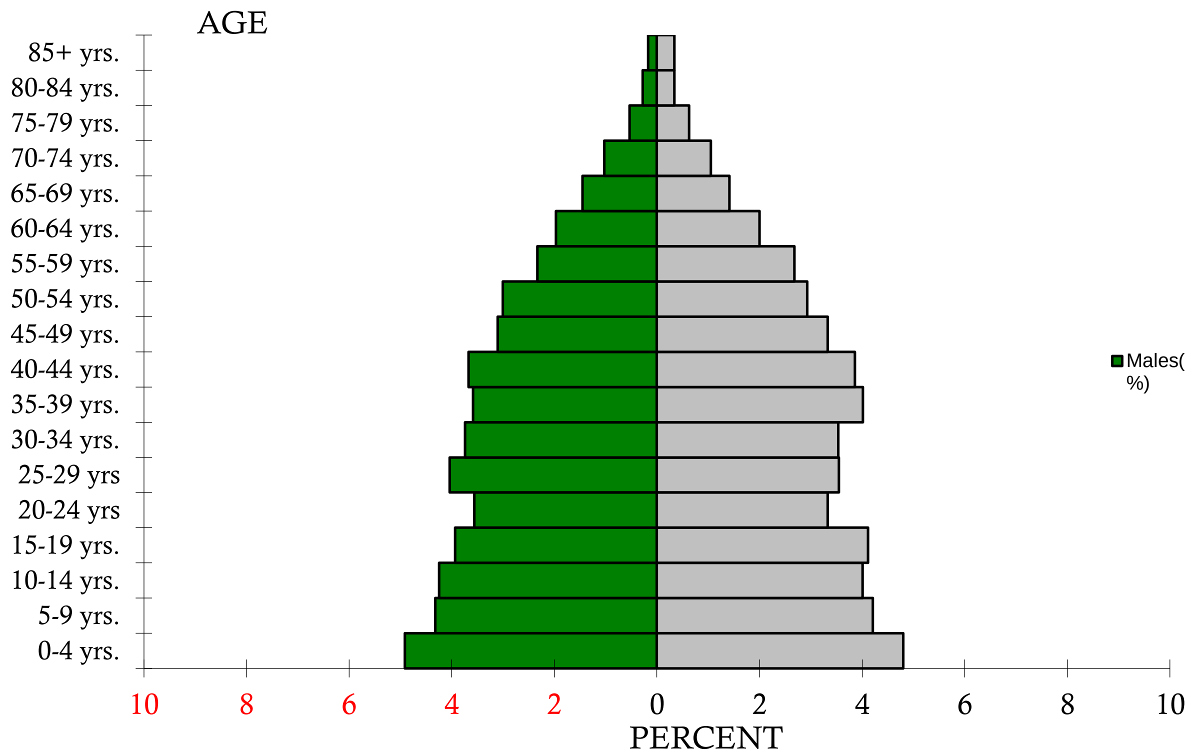
In the Namakwa district, which had a population of 115 842 people in 2011, 25.8% were under 16 years of age while 66.1% were between 15 and 64 years and 8.1% were over the age of 64. The population pyramid of Namakwa is represented in **Figure 9**



Source: (Statistics South Africa, 2011)

Figure 9: Population pyramid Namakwa

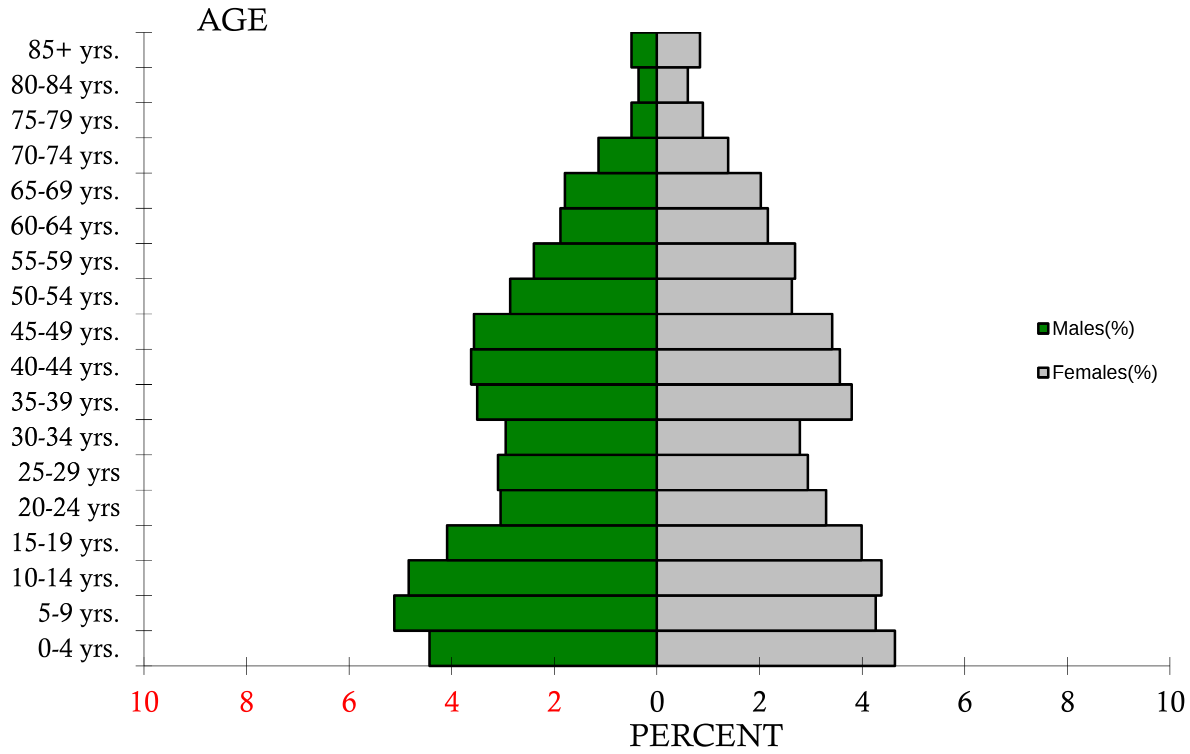
In the Laingsburg Local Municipality 26.5% of the population of 8 289 people were under 16 years of age, while 66.3% fell between 15 and 64 years and 7.2% were over the age of 64. The population pyramid of the Laingsburg is represented in **Figure 10**



Source: (Statistics South Africa, 2011)

Figure 10: Population pyramid Laingsburg

Of the population of 12 588 people in the Karoo Hoogland, 27.7% were under 16 years of age in 2011 while 62.3% were between 15 and 64 years and 10% were over the age of 64 years. The population pyramid of the Karoo Hoogland is represented in **Figure 11**



Source: (Statistics South Africa, 2011)

Figure 11: Population pyramid Karoo Hoogland

The dependency ratio, which indicates the burden of support for children under 16 years and people over 64 years placed on the working population aged between 15–64 years, is highest in the Karoo Hoogland at 60.5 and lowest in Laingsburg at 50.9. In respect of sex ratio Namakwa has a higher proportion of males to females in the population at 101.2 while, at 95.9, the Central Karoo has a higher proportion of females to males. Between 2001 and 2011 Laingsburg had a population growth of 2.16% with the Karoo Hoogland having a lower population growth of 1.8%. This data is compared across the region in **Table 3**.

Table 3: Age structure, dependency ratio, sex ratio and population growth

Municipality	Age Structure						Dependency Ratio		Sex Ratio		Population Growth (% p.a.)	
	<15		15-64		65+		Per 100 (15-64)		Males per 100 females			
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
WESTERN CAPE	27.3%	25.1%	67.5%	69.0%	5.2%	5.9%	48.2	45.0	94.0	96.4	2.68	2.52
DC5: Central Karoo	32.7%	30.5%	61.4%	63.3%	6.0%	6.2%	62.9	58.0	93.9	95.9	1.50	1.60
WC051: Laingsburg	29.3%	26.5%	63.0%	66.3%	7.7%	7.2%	58.7	50.9	93.4	99.5	2.44	2.16
NORTHERN CAPE	32.1%	30.1%	62.5%	64.2%	5.4%	5.7%	60.1	55.7	93.7	97.3	-0.40	1.44
DC6: Namakwa	29.3%	25.8%	64.0%	66.1%	6.7%	8.1%	56.4	51.2	97.8	101.2	-0.27	0.69
NC066: Karoo Hoogland	29.7%	27.7%	61.1%	62.3%	9.1%	10.0%	63.6	60.5	90.9	98.7	-3.28	1.80

Source: (Statistics South Africa, 2011)

The unemployment rate in the area is highest in the Central Karoo district and Laingsburg local municipalities at 23.7 and 17.9 percent respectively. The level of unemployment in the Namakwa District Municipality was 20.1% in 2011 while in the Karoo Hooglands it was 14.6%. In respect of education, at 6.6% Namakwa has the lowest percentage of the population that has no schooling with the Karoo Hoogland having the highest percentage having no schooling at 18.4%. The Karoo Hooglands has the highest percentage of the population having a matric level of education at 21.6% while the Laingsburg municipality has the highest percentage of the population with an education level higher than matric at 8.6% closely followed by the Karoo Hoogland at 8.5%. Data pertaining to education as discussed above is compared across the municipalities and at the provincial levels in **Table 4**.

In respect of the local municipalities associated with the project, Laingsburg has the fewest number of households at 2 408 compared to the 3 842 households in the Karoo Hoogland. The average household size is also marginally smaller, at 3.3 persons per household, in the Karoo Hooglands compared to 3,4 in Laingsburg. There is a slightly higher percentage of female headed households in Laingsburg at 30.6% compared to 30.6% in the Karoo Hoogland. Most households in the Karoo Hoogland, 96.9%, and in Laingsburg, 96.6%, live in formal dwellings. Compared across the entire region, both the Karoo Hoogland and the Laingsburg local municipalities have a relatively low number of households, at 47.36 and 36.2 respectively, who either own or who are paying off their dwellings. Data pertaining to household dynamics across the region is presented in **Table 5**.

Table 4: Labour market and education aged 20 +

Municipality	Labour Market				Education (age 20 +)					
	Unemployment Rate (official)		Youth Unemployment Rate (Official) 15-34 years		No Schooling		Matric		Higher Education	
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
WESTERN CAPE	26.1%	21.6%	33.2%	29.0%	5.7%	2.7%	23.4%	28.4%	11.2%	14.0%
DC5: Central Karoo	36.2%	23.1%	47.3%	30.9%	16.8%	10.1%	14.5%	21.6%	5.9%	7.0%
WC051: Laingsburg	26.3%	17.9%	37.0%	22.0%	19.5%	11.7%	12.1%	16.8%	5.7%	8.6%
NORTHERN CAPE	35.6%	27.4%	44.1%	34.5%	19.3%	11.3%	15.8%	22.9%	5.9%	7.2%
DC6: Namakwa	28.5%	20.1%	37.7%	25.4%	11.5%	6.6%	15.5%	19.1%	5.8%	7.1%
NC066: Karoo Hoogland	28.6%	14.6%	40.3%	20.0%	27.5%	18.4%	13.7%	17.1%	8.0%	8.5%

Source: (Statistics South Africa, 2011)

Table 5: Household dynamics

Municipality	Household dynamics									
	Households		Average household size		Female headed households		Formal dwellings		Housing owned/paying off	
	2001	2011	2001	2011	2001	2011	2001	2011	2001	2011
WESTERN CAPE	1,173,304	1,634,000	3.7	3.6	33.2%	36.3%	81.3%	80.4%	57.3%	52.4%
DC5: Central Karoo	15,009	19,076	3.9	3.7	35.1%	38.2%	95.7%	97.0%	58.4%	56.9%
WC051: Laingsburg	1,922	2,408	3.4	3.4	30.2%	31.0%	96.6%	96.6%	55.1%	36.2%
NORTHERN CAPE	245,086	301,405	3.9	3.8	37.7%	38.8%	81.0%	82.4%	60.8%	55.1%
DC6: Namakwa	27,776	33,856	3.6	3.4	35.8%	36.6%	89.4%	93.8%	65.7%	60.1%
NC066: Karoo Hoogland	2,942	3,842	3.4	3.3	29.0%	30.6%	94.5%	96.9%	55.3%	47.3%

Source: (Statistics South Africa, 2011)

4.3. PROJECT FOOT PRINT

At a more project foot print specific level the project is located within the Karoo Hoogland non-urban (NU) area which is sparsely populated with a population density of 0.10 people per square kilometre.

The demographic data in respect of the Karoo Hoogland NU listed as Sub Place 367002001 in respect of Census 2011 is as follows:

Geographic area = 3 2061.07 km²

Population = 3 356 people

Population density = 0.10/km²

Households = 1 450

Household density = 0.05/km²

Gender	**People**	**Percentage**
Male	1827	54.44%
Female	1528	45.53%
Population group	**People**	**Percentage**
Coloured	2333	69.52%
White	870	25.92%
Black African	136	4.05%
Indian or Asian	13	0.39%
Other	4	0.12%
First language	**People**	**Percentage**
Afrikaans	3210	97.21%
English	44	1.33%
Sign language	16	0.48%
Setswana	13	0.39%
isiXhosa	9	0.27%
Sesotho	5	0.15%
Sepedi	3	0.09%
isiNdebele	1	0.03%
Not applicable	*54*	

The project will be situated along various ridges and will affect the farm portions and land owners as illustrated in the map in **Figure 12**.

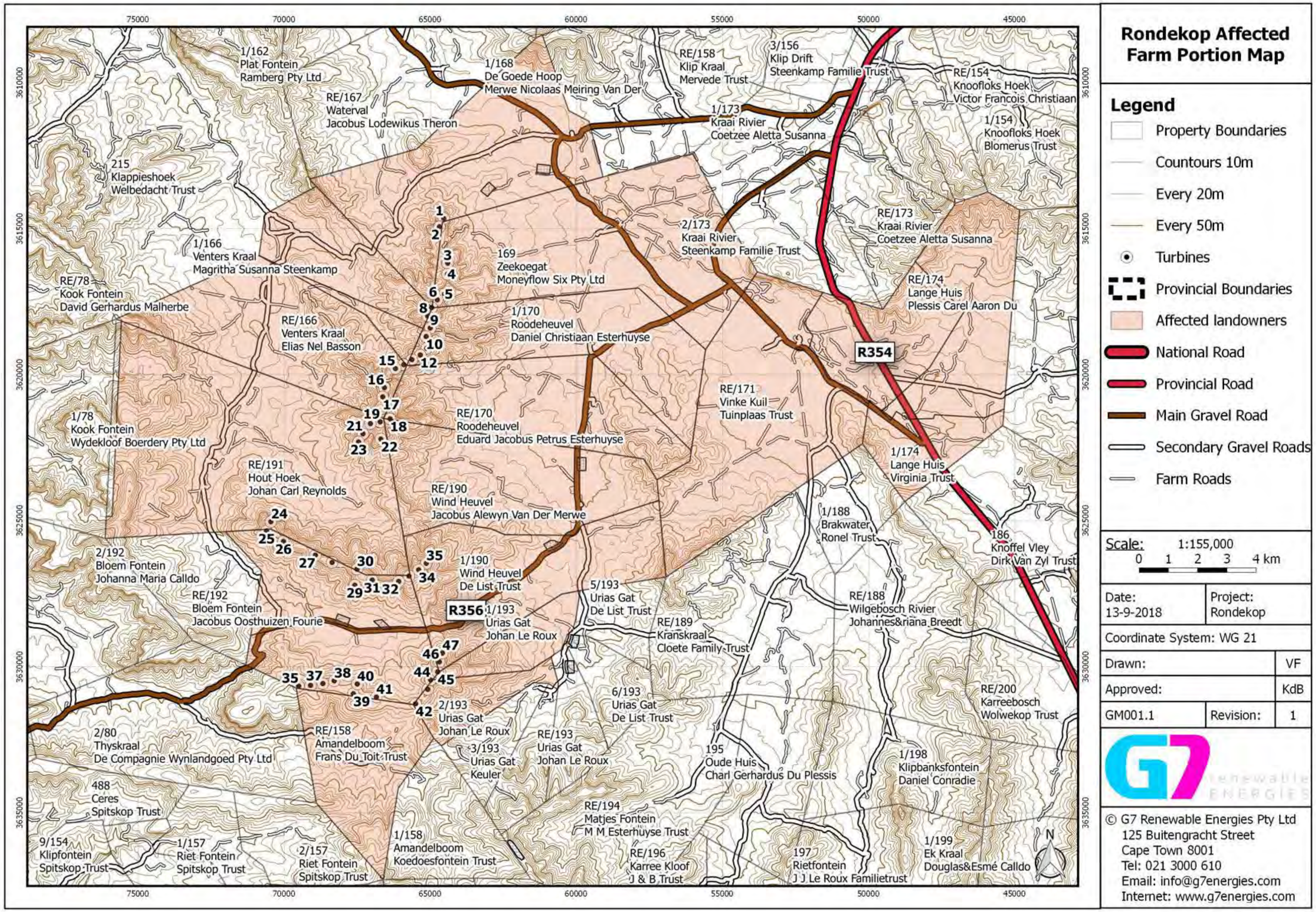


Figure 12 Rondekop affected farm portion map

The closest urban areas to the site of the Rondekop Wind Farm Project are the towns of;

- Sutherland;
- Matjiesfontein and:
- Laingsburg.

Sutherland

Sutherland falls within the Karoo Hoogland Local Municipality and lies some 45 km to the north-east of Rondekop. The town, founded in 1857, served as a centre for the sheep farming industry in the area. Recent economic activates in the town have been spurred on by the establishment of the South African Astronomical Observatory in the area. This has resulted in an increase in tourism to the region which in turn has driven up the demand for accommodation and eating establishments such as bars and restaurants. This greater interest being show towards the region has also driven up property values in and around the town.

The demographic data in respect of Sutherland, listed as Sub Place 367004001 in respect of Census 2011 is as follows:

Geographic area = 35.98 km²

Population = 2 836 people

Population density = 78.82/km²

Households = 718

Household density = 19.95/km²

Gender	**People**	**Percentage**
Female	1 513	53.35%
Male	1 323	46.65%
Population group	**People**	**Percentage**
Coloured	2 219	78.24%
White	360	12.69%
Black African	226	7.97%
Indian or Asian	23	0.81%
Other	8	0.28%

First language	People	Percentage
Afrikaans	2 360	95.90%
English	47	1.91%
isiXhosa	19	0.77%
Setswana	9	0.37%
Tshivenda	7	0.28%
isiNdebele	6	0.24%
Sesotho	4	0.16%
Sign language	3	0.12%
Sepedi	2	0.08%

Other data	
Young (0-14)	28,2%
Working Age (15-64)	57,6%
Elderly (65+)	14,2%
Dependency ratio	73,7
Sex ratio	87,4
Population density	79 persons/km^2
No schooling aged 20+	17,5%
Higher education aged 20+	8,2%
Matric aged 20+	15,1%
Average household size	3,4
Female headed households	45,3%
Formal dwellings	94,4%
Housing owned/paying off	52,1%
Flush toilet connected to sewerage	19,4%
Weekly refuse removal	98,1%
Piped water inside dwelling	43,2%
Electricity for lighting	95,4%

Matjiesfontein

The town of Matjiesfontein, which falls within the Laingsburg Local Municipality, lies some 52 km south-east of the project and, owing its origins to the railway, was established in the 1880s. Matjiesfontein's Victorian character was preserved and the town was declared a National Monument in 1975 with the railway station and cemetery subsequently being declared National Monuments in 1984 and 1994 respectively. On an economic basis, apart from serving as a centre for farmers in the area, the town also has a high tourist attraction associated with its preserved Victorian charm. This has resulted in the hospitality industry being relatively active in the area with such establishments as The Lord Milner Hotel regarded as attractive tourist destinations.

The demographic data in respect of Matjiesfontein, listed as Sub Place 181003001 in respect of Census 2011, is as follows:

Geographic area = 1.22 km²

Population = 422 people

Population density = 346.26/km²

Households = 94

Household density = 77.13km²

Gender	**People**	**Percentage**
Female	226	53.55%
Male	196	46.45%
Population group	**People**	**Percentage**
Coloured	412	97.63%
Black African	5	1.18%
White	3	0.71%
Other	2	0.47%
First language	**People**	**Percentage**
Afrikaans	409	97.38%
Setswana	5	1.19%
isiNdebele	4	0.95%
English	1	0.24%
Sesotho	1	0.24%
Not applicable	2	

Other data	
Young (0-14)	30,3%
Working Age (15-64)	66,4%
Elderly (65+)	3,3%
Dependency ratio	50,7
Sex ratio	86,7
Population density	346 persons/km^2
No schooling aged 20+	9,4%
Higher education aged 20+	1,6%
Matric aged 20+	19,3%
Average household size	4,3
Female headed households	48,9%
Formal dwellings	88,4%
Housing owned/paying off	35,1%
Flush toilet connected to sewerage	29,8%
Weekly refuse removal	98,9%
Piped water inside dwelling	37,9%
Electricity for lighting	93,7%

Laingsburg

The town of Laingsburg, which together with the towns of Matjiesfontein, Bergsig and Goldnerville makes up the Laingsburg Local Municipality, lies some 66 km south-east of the proposed Rondekop WEF. The town is located along the National Road 1 (N1) which runs the entire length of South Africa, between Cape Town and the Beit Bridge border post. On an economic level Laingsburg serves as an agricultural centre for farmers in the region with agricultural activities such as livestock farming (goats and sheep) crops (alfalfa or Lucerne) as well as fruit and vegetables.

The demographic data in respect of Laingsburg, listed as Sub Place 181002001 in respect of Census 2011, is as follows:

Geographic area = 723.72 km²

Population = 5 667 people

Population density = 7.83/km²

Households = 1 512

Household density = 2.09/km²

Gender	**People**	**Percentage**
Female	2 943	51.93%
Male	2 725	48.09%
Population group	**People**	**Percentage**
Coloured	4 665	82.32%
White	481	8.49%
Black African	466	8.22%
Other	39	0.69%
Indian or Asian	16	0.28%
First language	**People**	**Percentage**
Afrikaans	5 052	93.59%
English	90	1.67%
isiXhosa	86	1.59%
Setswana	42	0.78%
isiZulu	35	0.65%
Sesotho	27	0.50%
Other	17	0.31%
Sign language	15	0.28%
Tshivenda	9	0.17%
Xitsonga	9	0.17%
Sepedi	7	0.13%

SiSwati	5	0.09%
isiNdebele	4	0.07%
Not applicable	*269*	

Other data

Young (0-14)	29,6%
Working Age (15-64)	63%
Elderly (65+)	7,4%
Dependency ratio	58,8
Sex ratio	92,6
Population density	8 persons/km^2
No schooling aged 20+	10,4%
Higher education aged 20+	8,4%
Matric aged 20+	17,6%
Average household size	3,5
Female headed households	40,6%
Formal dwellings	97,9%
Housing owned/paying off	44%
Flush toilet connected to sewerage	95,2%
Weekly refuse removal	87,4%
Piped water inside dwelling	71,8%
Electricity for lighting	97,6%

5. IDENTIFICATION OF POTENTIAL IMPACTS

The social impact variables considered across the project are in accordance with Vanclay's list of social impact variables clustered under the following main categories as adapted by Wong (Vanclay, 2002; Wong, 2013) and include;

1. Health and social well-being
2. Quality of the living environment (Liveability)
3. Economic
4. Cultural

These categories are not exclusive and at times tend to overlap as certain processes may have an impact within more than one category.

5.1. HEALTH AND SOCIAL WELLBEING

The health and social wellbeing impacts related to the project include.

- Annoyance, dust noise and shadow flicker
- Increase in crime
- Increased risk of HIV infections
- Influx of construction workers
- Hazard exposure.

These impacts are addressed separately below.

5.1.1. ANNOYANCE, DUST NOISE AND SHADOW FLICKER

Annoyance, dust and noise will be more evident during the construction phase of the project, as construction activities will result in the generation of dust and noise from construction vehicles and equipment.

Shadow flicker will apply to the operational phase of the project; however, the turbines are to be constructed on ridges in a remote area and will not be above any residential buildings so the issue of shadow flicker should not arise[2]. Over the operational phase of the project noise should not be a factor provided that the mitigation measures suggested in the noise specialist's report are implemented effectively, noise levels should be limited to within a tolerable range of between 35 dB(A) and 45 dB(A) (Safetech, 2018) which is within an acceptable range as per 10103: 2008. It is therefore highly unlikely that noise and shadow flicker will be a significant health factors.

5.1.2. INCREASE IN CRIME

With the area being rather remote and sparsely populated, at 231 crimes committed to this point in 2018, the Sutherland Precinct[3] has a relatively low level of crime compared to the Laingsburg Precinct[4] which has a higher level at 1 525. The Laingsburg Precinct is however more densely populated which will result in a higher number of crimes being committed. It is

[2] For more information see the Visual Report (Schwartsz & Gibb, 2018).
[3] According to Crime Stats SA as at 08 October 2018 www.crimestatssa.com/precinct.php?id=871

[4] According to Crime Stats SA as at 08 October 2018 www.crimestatssa.com/precinct.php?id=937

often opportunistic crime, stock theft, the abuse of alcohol and relationship related crime that is associated with construction activities.
Considering the relative remoteness of the project it is unlikely that the project will lead to any significant increase in crime levels in the area, however, it would be pertinent for the developers to ensure that processes are put in place through which any suspected criminal activates associated with the project can be easily communicated and swiftly addressed. The construction phase carries with it a higher risk of associated criminal activates than would be associated with the operational phase.

5.1.3. INCREASED RISK OF HIV INFECTIONS

The area has the lowest HIV prevalence rate in the country with the Namaqua District Municipality having a prevalence rate of 2.3% followed by the Central Karoo District with a prevalence rate of 6.9%. The fact that sexually transmitted diseases tend to be spread by construction and transport workers, together with the high prevalence of HIV across the rest of South Africa, opens the area to a high risk of HIV infections (Singh & Malaviya, 1994; Ramjee & Gouws, 2002; Meintjes, Bowen, & Root, 2007; World Bank Group, 2016; Bowen, Dorrington, Distiller, Lake, & Besesar, 2008; Bowen P. , Govender, Edwards, & Cattell, 2016; Kikwasi & Lukwale, 2017; Bowen P. , Govender, Edwards, & Lake, 2018). This risk is likely to be at its highest during the construction phase of the project as the conduction workforce increases and material and equipment is delivered to site and is likely to subside during the operational phase.

Consequently, it is important that this issue be given serious attention and that the appropriate mitigation measures are implemented and the situation is closely monitored throughout the construction and operational phases of the project. The risk of the spread of HIV is most prevalent on a cumulative basis and is addressed as such under section 9: Cumulative Impacts below.

5.1.4. INFLUX OF CONSTRUCTION WORKERS

It is estimated that over the construction period, which will stretch over a 20 to 24 month period, the peak construction workforce will reach approximately 250 workers. Of these 211 (85%) will likely be recruited locally while 38 (15%) will come from outside of area and will be at a professional level. The influx of workers could lead to the disruption of social networks with the formation of temporary relationships and an increase in pregnancy which may place pressures on local family units. Apart from this the arrival of construction workers may result in the formation of a subculture that could manifest in antisocial behaviour which conflicts with the expectations of local communities. This may result in these local communities, who are accustomed to a quiet, rural environment, becoming dissatisfied with the neighbourhood. These disruptions are, however, more likely to occur in the nearby urban areas such as Sutherland, Matjiesfontein and Laingsburg, when workers seek recreational activities. Due to population sparsity the risk to the families of local farm workers in the vicinity of the site will be relatively low.

During the operational phase of the project the workforce will be comprised of 20 workers who will be accommodated off site. Consequently, the risks associated with disruptions to social networks will be minimal over the operation phase of the project.

5.1.5. HAZARD EXPOSURE

The use of heavy equipment and vehicles and an increase in vehicle traffic within the vicinity of all construction sites will result in and increased risk to the personal safety of people and animals. Of particular concern are increased hazards faced by pedestrians, cyclists and motorists with emphasis on vulnerable groups such as children and the elderly. Excavation work and trenches also pose a hazard to the safety of people, particularly children and animals, who may fall into these works and may have difficulty in getting out. However due to the low population numbers within the vicinity of the proposed development this risk is likely to be low and the appropriate mitigation measure can reduce the impact to very low. There will also be an increased risk of fires brought about through construction workers lighting fires for cooking and for warmth during cold periods. Nevertheless, with the recommended mitigation measures being successfully put in place this can be controlled.

5.2. QUALITY OF THE LIVING ENVIRONMENT

The following quality of the living environment impacts are related to the project.

- Disruption of daily living patterns
- Disruptions to social and community infrastructure
- Transformation of the sense of place.

5.2.1. DISRUPTION OF DAILY LIVING PATTERNS

If there are any disruptions to daily living patterns these are likely to be minimal and restricted to the construction phase of the project. This impact will be mainly associated with the site and the main access roads. These disruptions are only likely to be associated with the delivery of materials and machinery to site and the transportation of workers to and from site.

5.2.2. Disruption to social and community infrastructure

With the workforce associated with the construction phase peaking at 250 people, of which 211 are likely to be recruited locally, it is unlikely that in isolation the project will have any significant effect on social and community infrastructure in the area. However, on a cumulative basis, considering the activities taking place and planned for the area there is likely to be a significant impact in this regard. This impact is dealt with in greater depth under section 8.3: Cumulative Impacts below.

5.2.3. Transformation of the sense of place

The wind turbines will be highly visible from some distance and will result in the landscape being transformed from that of a rural setting to what would be considered by some to have more of an industrial aura. This issue remains controversial as a sense of place is personal and subjective with some accepting the visual changes to the landscape in support of renewable energy while others may reject it (Firestone, Bidwell, Gardner, & Knapp, 2018; Schneider, Mudra, & Kozumplíková, 2018). The subjectivity of the viewer/receptor toward a visual impact is also confirmed in the visual specialist report, the visual character and cultural values of the area as well as the visual sensitivity and visual absorption capacity of the area are described in this report (Schwartsz & Gibb, 2018, pp. 27 & 41-48).

The visual environment and noise are both important elements through which a sense of place is constructed, and both these criteria are subject to separate specialist studies in which they will be evaluated and mitigated. In addition, the significance of a sense of place is highest at a cumulative level and is addressed as such under section 9: Cumulative Impacts below.

5.3. Economic

The economic impacts related to the project include.

- Job creation and skills development
- Socio-economic stimulation

5.3.1. JOB CREATION AND SKILLS DEVELOPMENT

The project will lead to the creation of both direct and indirect job which will have a positive economic benefit within the region. In this regard there are 250 jobs associated with the construction phase of the project and 20 with the operational phase. Of these jobs approximately 136 (55%) of the employment opportunities will be available to low skilled workers (construction labourers, security staff etc.), 76 (30%) to semi-skilled workers (drivers, equipment operators etc.) and 38 (15%) for skilled personnel (engineers, land surveyors, project managers etc.). Many of the low and semi-skilled employment opportunities will likely be available to local residents in the area, specifically residents from Sutherland, Maitjiesfontein and Laingsburg. Many of the beneficiaries are likely to be historically disadvantaged members of the community and the project will provide opportunities to develop skills amongst these people. The operational phase will employ approximately 20 people full time for a period of up to 20 years. Of this approximately 4 are low skilled, 10 are semi-skilled and 6 are skilled.

5.3.2. SOCIO-ECONOMIC STIMULATION

Apart from these jobs the project is also likely to stimulate the local economy and again this is likely to be most significant at a cumulative level. Nevertheless, there will be a significant economic contribution attached to the Rondekop WEF. This contribution will be in the form of disposable salaries and the purchases of services and supplies from the local communities in and around the towns of Sutherland, Matjiesfontein and Laingsburg. The capital expenditure on completion of the project is anticipated to be in the region of R 2.5 billion.

Apart from job creation and procurement spend the project will also have broader positive socio-economic impacts as far as socio-economic development contributions are concerned. Although, at the point of writing, the project developer had not as yet put a corporate social responsibility plan in place the intention is to either, fall in line with the REIPPP BID guidelines or put an equivalent plan in place. This will create an opportunity to support the local community over the life span of the operational phase of the project which will stretch over a 20 year period. At a national level the project also has the potential to contribute towards the national grid requirements as part of the Government's vision to source 15.1% of the country's energy through wind power (Department of Energy Republic of South Africa, 2018, p. 41).

5.4. Cultural impacts

At a social level it is likely that any cultural impacts would be associated with sensitive archaeological and/or heritage sites that may be found. In this regard a Heritage and Palaeontology Impact Assessment was undertaken and it was found that;

> "*The overall impact of the WEF and its associated infrastructure, on the heritage resources identified during this report, is seen as low after the recommendations have been implemented and therefore, impacts can be mitigated to acceptable levels allowing for the development to be authorised. There are no preferences in terms of the proposed layout alternatives as none of them will affect known heritage resources thus no mitigation measures will be required, except for the implementation of a chance-finds protocol. However, if the development layout is altered, this position will need to be revaluated."* (PGS Heritage (Pty) Ltd, 2018, p. 84).

6. Impact Assessment

The impacts as they apply to both the construction and operational phase of the project will be assessed below and mitigation and optimisation measures will be suggested as is appropriate.

6.1. Planning and design phase

An investigation was undertaken to assess the viability of the choice of site and it was found that due to the nature of the terrain, the climatic conditions and current land use the site was best suited for a wind energy farm rather than any other type of renewable energy facility. In this regard see section 2.2.2 Technological alternative. Further to this it is evident that the project fits with legislation and key planning and policy documentation. In this regard renewable energy facilities are supported on a national, provincial and municipal level. In this regard see section 3.1: Policy and legislation fit.

However, provincial and municipal documentation also regards tourism as an important resource for the area. In addition to this there have been concerns raised regarding the cumulative effect of the proliferation of renewable energy in the region and the impact that this may have on the sense of place of the area. In this regard see section 8.2: Sense of place.

Mitigation measures

- Engage with a broad spectrum of the affected public in a transparent and constructive way to find solutions to this seeming conflict of interests as is being done in this EIA process where all relevant stakeholders are provided with opportunities to comment on the project;

Attention is now turned towards the assessment of the construction phase of the project.

6.2. CONSTRUCTION PHASE

Most of the impacts discussed above apply over the short-term to the construction phase of the project and include:

- Annoyance, dust and noise
- Increase in crime
- Increased risk of HIV infections
- Influx of construction workers
- Hazard exposure
- Disruption of daily living patterns
- Disruptions to social and community infrastructure
- Economic
  - Job creation and skills development

Each of these impacts is assessed below with mitigation and optimisation measures being suggested in **Table 6** to **Table 14**.

Table 6: Annoyance dust and noise

IMPACT TABLE		
Environmental Parameter	Health and social wellbeing	
Issue/Impact/Environmental Effect/Nature	Annoyance dust and noise	
Extent	Site	
Probability	Definite	
Reversibility	Completely reversible	
Irreplaceable loss of resources	No loss of resource	
Duration	Short term	
Cumulative effect	Negligible cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	Low negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-18 (low negative)	-9 (low negative)
Mitigation measures	Where necessary apply the appropriate dust suppression methods; Follow the mitigation measures suggested in the Noise Impact Assessment.	

Table 7: Increase in crime

IMPACT TABLE		
Environmental Parameter	Health and social wellbeing	
Issue/Impact/Environmental Effect/Nature	Increase in crime	
Extent	Local area	
Probability	Probable	
Reversibility	Barely reversible	
Irreplaceable loss of resources	No loss of resource	
Duration	Short term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	Medium negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	3	3
Reversibility	3	3
Irreplaceable loss	2	2
Duration	2	2
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-30 (medium negative)	-30 (medium negative)
Mitigation measures	Ensure that construction workers are clearly identifiable. All workers should carry identification cards and wear identifiable clothing; Fence off construction site and control access to these sites; Appoint an independent security company to monitor the site; Encourage local people to report any suspicious activity associated with the construction sites through the establishment of a community liaison forum; Prevent loitering within the vicinity of the construction camp as well as construction sites.	

Table 8: Increased risk of HIV infections

IMPACT TABLE		
Environmental Parameter	Health and social wellbeing	
Issue/Impact/Environmental Effect/Nature	Increased risk of HIV infections	
Extent	Entire province	
Probability	Definite	
Reversibility	Barely reversible	
Irreplaceable loss of resources	Significant loss of resource	
Duration	Long term	
Cumulative effect	High cumulative impact	
Intensity/magnitude	High	
Significance Rating	High negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	3	3
Probability	4	3
Reversibility	3	2
Irreplaceable loss	3	2
Duration	3	3
Cumulative effect	4	3
Intensity/magnitude	3	2
Significance rating	-60 (high negative)	-32 (medium negative)
Mitigation measures	Ensure that an onsite HIV infections policy is in place and that construction workers have easy access to condoms; Expose workers to a health and HIV/AIDS awareness educational program; Extend the HIV/AIDS program into the community with specific focus on schools and youth clubs.	

Table 9: Influx of construction workers

IMPACT TABLE		
Environmental Parameter	Health and social wellbeing	
Issue/Impact/Environmental Effect/Nature	Influx of construction workers	
Extent	Site	
Probability	Definite	
Reversibility	Completely reversible	
Irreplaceable loss of resources	No loss of resource	
Duration	Short term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	Low negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	1	1
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-22(low negative)	-22 (low negative)
Mitigation measures	Communicate the limitation of opportunities created by the project through Community leaders and Ward Councillors; Draw up a recruitment policy in conjunction with the Community Leaders and Ward Councillors of the area and ensure compliance with this policy.	

Table 10: Hazard exposure

IMPACT TABLE		
Environmental Parameter	Health and social wellbeing	
Issue/Impact/Environmental Effect/Nature	Hazard exposure	
Extent	Local	
Probability	Definite	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resource	
Duration	Short term	
Cumulative effect	Medium Cumulative Impact	
Intensity/magnitude	Medium negative	
Significance Rating	Low negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	4	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-24 (low negative)
Mitigation measures	Ensure all construction equipment and vehicles are properly maintained at all times; Ensure that operators and drivers are properly trained and make them aware, through regular toolbox talks, of any risk they may pose to the community. Place specific emphasis on the vulnerable sector of the population such as children and the elderly; Ensure that fires lit by construction staff are only ignited in designated areas and that the appropriate safety precautions, such as not lighting fires in strong wilds and completely extinguishing fires before leaving them unattended, are strictly adhered to; Make staff aware of the dangers of fire during regular tool box talks.	

Table 11: Disruption of daily living patterns

IMPACT TABLE		
Environmental Parameter	Quality of the living environment	
Issue/Impact/Environmental Effect/Nature	Disruption of daily living patterns	
Extent	Local	
Probability	Definite	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resource	
Duration	Short term	
Cumulative effect	Medium Cumulative Impact	
Intensity/magnitude	Medium	
Significance Rating	Low negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	-28 (low negative)	-26 (low negative)
Mitigation measures	Ensure that, at all times, people have access to their properties as well as to social facilities	

Table 12: Disruption to social and community infrastructure

IMPACT TABLE		
Environmental Parameter	Quality of the living environment	
Issue/Impact/Environmental Effect/Nature	Disruptions to social and community infrastructure	
Extent	District	
Probability	Definite	
Reversibility	Partly reversible	
Irreplaceable loss of resources	Marginal loss of resource	
Duration	Short term	
Cumulative effect	High cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	Medium negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	1	1
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	-30 (medium negative)	-30 (medium negative)
Mitigation measures	Regularly monitor the effect that construction is having on infrastructure and immediately report any damage to infrastructure to the appropriate authority; Ensure that where communities' access is obstructed that this access is restored to an acceptable state.	

Table 13: Job creation and skills development

IMPACT TABLE		
Environmental Parameter	Economic	
Issue/Impact/Environmental Effect/Nature	Job creation and skills development	
Extent	District	
Probability	Definite	
Reversibility	Partly reversible	
Gain of resources	Significant gain of resource	
Duration	Short term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	High positive	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	2	2
Irreplaceable loss	3	3
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	30 (medium positive)	30 (medium positive)
Mitigation measures	Wherever feasible, local residents should be recruited to fill semi and unskilled jobs; Women should be given equal employment opportunities and encouraged to apply for positions; A skills transfer plan should be put in place at an early stage and workers should be given the opportunity to develop skills which they can use to secure jobs elsewhere post-construction; A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	

Table 14: Socio-economic development

IMPACT TABLE		
Environmental Parameter	Economic	
Issue/Impact/Environmental Effect/Nature	Positive economic impacts	
Extent	Provincial	
Probability	Definite	
Reversibility	Partly reversible	
Gain of resources	Significant gain of resource	
Duration	Short term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	High positive	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	3	3
Probability	4	4
Reversibility	2	2
Irreplaceable loss	3	3
Duration	1	1
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	32 (medium positive)	32 (medium positive)
Mitigation measures	A procurement policy promoting the use of local business should, where possible, be put in place to be applied throughout the construction phase.	

6.3. OPERATIONAL PHASE

The social impacts that apply to the operational phase of the project are:

- Transformation of the sense of place and
- Economic
  - Job creation and skills development
  - Socio-economic stimulation

These impacts are assessed below in **Table 15** to **Table 17** and mitigation and optimization measure are suggested in each case.

Table 15: Transformation of the sense of place

IMPACT TABLE		
Environmental Parameter	Quality of the living environment	
Issue/Impact/Environmental Effect/Nature	Transformation of the sense of place	
Extent	Region	
Probability	Definite	
Reversibility	Barely reversible	
Irreplaceable loss of resources	Significant loss of resource	
Duration	Long term	
Cumulative effect	High Cumulative Impact	
Intensity/magnitude	High	
Significance Rating	High negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	3	3
Probability	4	4
Reversibility	3	3
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	-60 (high negative)	-60 (high negative)
Mitigation measures	Apply the mitigation measures suggested in the Visual Impact Assessment Report; Communicate the benefits associated with renewable energy to the broader community as is being done in this EIA process; Ensure that all affected land owners and tourist associations are regularly consulted; A Grievance Mechanism should be put in place and all grievances should be dealt with in a transparent manner; The mitigation measures recommended in the Heritage and Paleontology Impact Assessment should be followed.	

Table 16: Job creation and skills development

IMPACT TABLE		
Environmental Parameter	Economic	
Issue/Impact/Environmental Effect/Nature	Positive economic impacts	
Extent	District	
Probability	Definite	
Reversibility	Partly reversible	
Gain of resources	Marginal gain of resource	
Duration	Long term	
Cumulative effect	Low cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	Medium positive	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	30 (medium positive)	30 (medium positive)
Mitigation measures	Implement a training and skills development programme for locals; Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme;	

Table 17: Socio-economic stimulation

IMPACT TABLE		
Environmental Parameter	Economic	
Issue/Impact/Environmental Effect/Nature	Socio-economic stimulation	
Extent	National	
Probability	Definite	
Reversibility	Partly reversible	
Gain of resources	Significant gain of resource	
Duration	Long term	
Cumulative effect	High cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	High positive	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	4	4
Probability	4	4
Reversibility	2	2
Irreplaceable loss	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	2	2
Significance rating	60 (high positive)	60 (high positive)
Mitigation measures	Ensure that the procurement policy supports local enterprises; Establish a social responsibility programme either in line with the REIPPP BID guidelines or equivalent; Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme; Ensure that any trusts or funds are strictly managed in respect of outcomes and funds.	

Under the following section attention will be focused on the decommissioning phase of the project.

6.4. DECOMMISSIONING PHASE

If the project was to be completely decommissioned the major social impacts likely to be associated with this would be the loss of jobs and revenue stream that stimulated the local economy and flowed into the municipal coffers. It is estimated that the project has a lifespan of approximately 20 years and there is the possibility that after this period the wind turbines would be dismantled and could be replaced with more up-to-date technology that would extend the life of the WEF. Although the loss of a job is significant and can be devastating on an individual and family level, the total number of jobs under threat could be insignificant as the operational staff complement is estimated at 20 and many of these employees will be skilled and could find alternative employment.

Decommissioning will result in a limited number of jobs being created over a short period of time as components are dismantled and the site is cleared. Although positive, this will be a rather insignificant benefit considering the size of the WEF and the time period attached to decommissioning.

Considering the time period to decommissioning, the uncertainty of what would exactly occur, and the significance of the impact in isolation it would be rather meaningless to attach assessment criteria to decommissioning at this point. However, prior to decommissioning the following mitigation measures are suggested.

Decommissioning mitigation measures

- Ensure that a retrenchment package is in place;
- Ensure that staff have been trained in a manner that would provide them with saleable skills within the job market;
- Ensure that the site is cleared responsibly and left in a safe condition.

The no project option will be considered next.

7. Assessment of No Project Alternative

The no project option would mean that the social environment is not affected as the status quo remains. On a negative front it would also mean that all the positive aspects associated with the project would not materialise. Consequently, there would be no job creation, no revenue streams into the local economy and municipal coffers and a lost opportunity to enhance the national grid with a renewable source of energy. Considering that Eskom's coal fired power stations are a huge contributor to carbon emissions the loss of a chance to supplement the National Grid through renewable energy would be significant at a national, if not at a global level. The Intergovernmental Panel on Climate Change (6 October 2018, p. 15) has warned that that Co^2 emissions need to be reduce by 45% from 2010 levels by 2030 and to zero by 2050 which basically means that coal must go. The no-project alternative is assed in **Table 18**.

Table 18: No project alterative

IMPACT TABLE	
Environmental Parameter	No project alternative
Issue/Impact/Environmental Effect/Nature	No project
Extent	National
Probability	Possible
Reversibility	Completely reversible
Loss of resources	Significant loss of resource
Duration	Long term
Cumulative effect	Medium cumulative impact
Intensity/magnitude	Medium
Significance Rating	Medium negative
	Impact rating
Extent	4
Probability	4
Reversibility	2
Irreplaceable loss	3
Duration	3
Cumulative effect	4
Intensity/magnitude	2
Significance rating	-32 (medium negative)

8. CUMULATIVE IMPACTS

Over the last five years South Africa has experienced a proliferation in the number of renewable energy facilities being constructed across the country. Many of these facilities are being constructed in parts of the Western and Northern Cape Provinces, in particular in areas such as the Karoo that has the ideal climate, with long cloudless days that result in the area having high levels of solar irradiation and wind energy. Accordingly, the government has identified eight Renewable Energy Development Zones (REDZs) and embarked on an initiative, the Renewable Energy Independent Power Producer Procurement Program (REIPPPP), in an effort to channel private sector expertise and investment into grid-connected renewable energy in South Africa. This has resulted in many of these renewable energy facilities being clustered within or close to these REDZs, which in turn has resulted in a cumulative impact in and around these areas.

On a more project specific basis the following projects listed in **Table 19** have been identified within a 50 km radius of the Rondekop WEF and are illustrated in respect of this radius in the map in **Figure 13**.

Table 19: Renewable energy projects within a 50 km radius of Rondekop WEF

Name	Megawatt	Status
Brandvalley WEF	140	Approved
Esizayo WEF	140	Approved
Gunstfontein WEF	200	Approved
Hidden Valley (Karusa & Soetwater) WEF	140 each	Preferred bidders. Construction to commence 2019
Hidden Valley (Greater Karoo) WEF	140	Approved
Kareebosch WEF	140	Approved
Komsberg West and East WE	140 each	Approved
Kudusberg WEF	325	In process
Maralla WEF (East and West)	140 each	Approved
Perdekraal East WEF	110	Under Construction
Perdekraal West WEF	150	Approved
Rietkloof WEF	36	Approved
Roggeveld WEF	140	Preferred bidders. Construction to commence 2019
Sutherland WEF	140	Approved
Sutherland SEF	10	Approved
Tooverberg WEF	140	In process
Witberg WEF	120	Approved

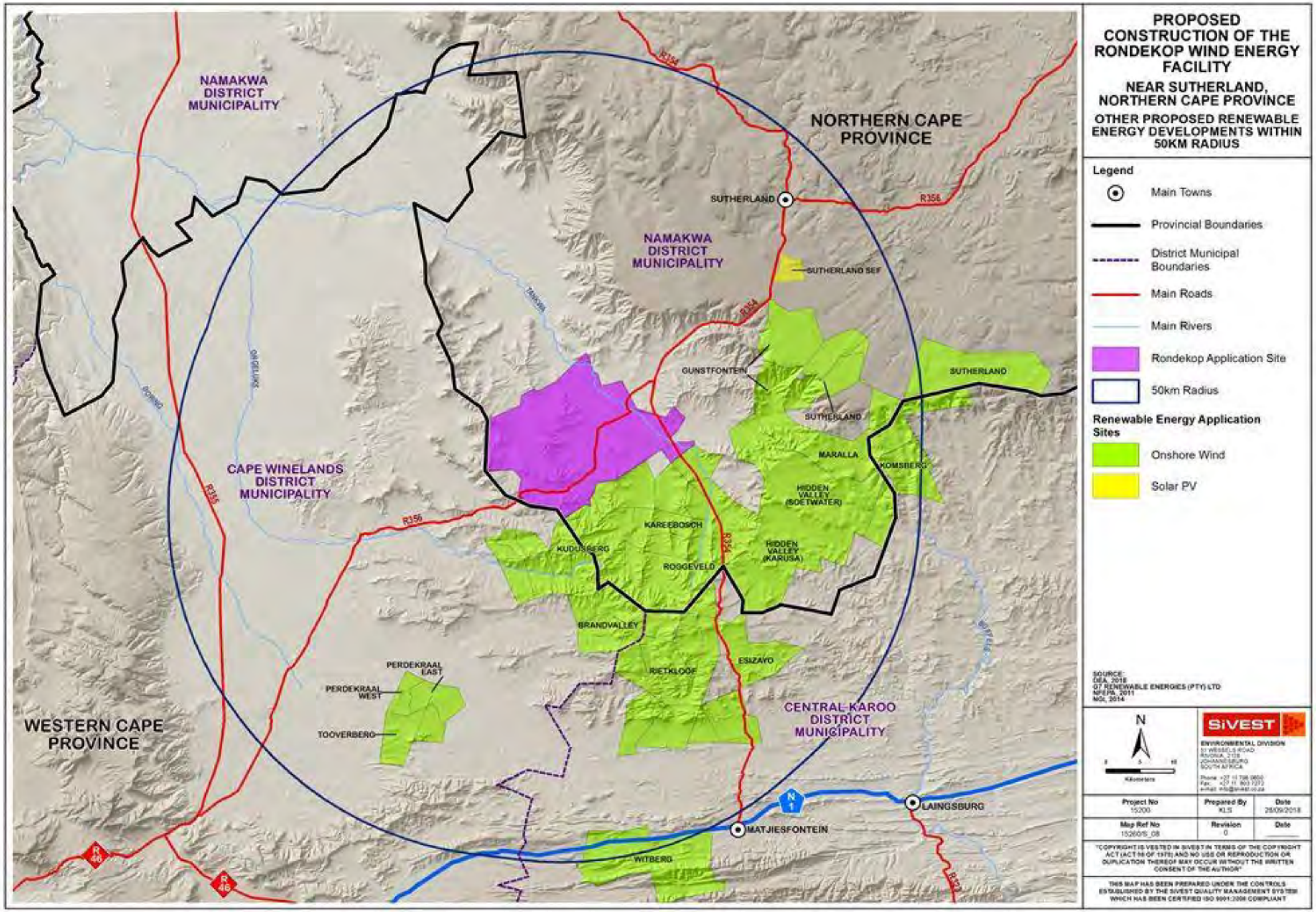


Figure 13: **Proposed renewable energy developments ~50 km radius from site**

In response to these developments in the Karoo there has been a counter reaction amongst some communities opposed to this relatively sudden change to what was previously an isolated, tranquil and pristine environment. In this vein the Heritage Association of South Africa published an undated appeal to the Minister of the Department Environmental Affairs to consider the need for a cumulative impact assessment with regard to the cumulative effect of mining and energy developments within the area[5]. Another article cited in the Karoo News Group appeal is a criticism of the cumulative effects of the renewable energy sector, highlighting environmental questions regarding wind farms[6]. Apart from the general reaction towards the cumulative effects of renewable energy projects the following more specific social issues need to be considered, these relate to the effects on;

- Risk of HIV;
- Sense of place;
- Service supplies and infrastructure and;
- The economy.

8.1. Risk of HIV infections[7]

With respective HIV prevalence rates of 18.7 and 17.5 percent, both the Western and Northern Cape provinces have the lowest HIV prevalence rates across the country. At a district level the Cape Winelands has the fifth lowest HIV prevalence across all districts in South Africa, with a prevalence rate of 15% and, most significantly, the Namaqua district has the lowest HIV prevalence rate in the country at 2.3%, followed by the Central Karoo which has the second lowest HIV prevalence rate in the country at 6.9%. Consequently, the district within which the project is located, and the neighbouring districts, have the lowest HIV prevalence rates across the country.

[5] Heritage Association of South Africa: Karoo News Group – Undated, Appeal to Minister. http://heritagesa.org/wp/2222-2/
[6] Tilting at windmills: Power politics and Wind farms in South Africa. http://reprobate.co.za/tilting-at-windmills-power-politics-and-wind-farms-in-south-africa/
[7] HIV prevalence rates are at 2013 figures based on The 2013 National Antenatal Sentinel HIV Prevalence Survey, South Africa.

These figures are significantly low compared to other areas of the country which range from a rate of 20.3% in Limpopo and 40.1% in KwaZulu-Natal with the iLembe District Municipality having an HIV prevalence rate of 45.9% in 2013. The provinces sharing common borders with the Western and Northern Cape Provinces all have relatively high HIV prevalence rates as indicated below;

North West = 28.2%
Free State = 29.8%;
Eastern Cape = 31.1%

With the influx of labour, particularly following the construction of the various renewable energy and mining projects within the region, the risk of HIV infections in the area is likely to rise significantly. It is well documented on both an international and local basis that the construction industry carries a high level of HIV (Meintjes, Bowen, & Root, 2007; Bowen, Dorrington, Distiller, Lake, & Besesar, 2008; Wasie, et al., 2015; Bowen P. , Govender, Edwards, & Cattell, 2016; Kikwasi & Lukwale, 2017; Bowen P. , Govender, Edwards, & Lake, 2018) which can be spread amongst the local communities, particularly through the spread of prostitution that follows the availability of disposable income. It is also well documented on both an international and local level that HIV is also spread by truck drivers (Singh & Malaviya, 1994; Ramjee & Gouws, 2002; Strauss, et al., 2018) and there is likely to be an increase in truck drivers in the area as equipment and material is delivered to the various construction sites.

These issues associated with the area being extremely poor and the associated disposable income that will follow the construction workers and truck drivers to the area will heighten the risk of the spread of HIV infections across what is a rather remote region. In this regard The World Bank (2009, pp. 367-368) had indicated a strong link between infrastructure projects and health as:

> "*Transport, mobility, and gender inequality increase the spread of HIV and AIDS, which along with other infectious diseases, follow transport and construction workers on transport networks and other infrastructure into rural areas, causing serious economic impacts.*"

8.2. Sense of place

There is also a concern amongst various interest groups that the proliferation of renewable energy facilities, particularly when considered in association with other industrial activities such as mining, will have a significant and negative cumulative social impact on the area[8]. In this regard issues such as the noise from blades; aesthetic associated with highly visible wind farms, solar parks and mines; the loss of bird and bat life and its effect on tourism; as well as the disruption of social networks have all been cited amongst these concerns. For more project specific cumulative impacts see section 6.4 Cumulative Impacts in the Visual Impact Assessment Report (Schwartsz & Gibb, 2018, pp. 65-67)

This is, however, a complex issue as there are varying opinions in respect of the aesthetic appearance of wind farms with some regarding them in a far more positive light than others may (Firestone, Bidwell, Gardner, & Knapp, 2018; Schneider, Mudra, & Kozumplíková, 2018). In a study of public attitudes towards onshore windfarms in south-west Scotland it was found that many regarded the visual impact of these developments in a positive light. It must, however, be noted that this was linked with community ownership having a positive impact on public attitudes towards windfarm developments in Scotland (Warren & McFadyen, 2010). A further and important consideration in this regard is of an ethical nature associated with community acceptance and energy justice and raises the question of the incorporation of public acceptance, particularly that of the underrepresented, into energy policy (Roddisa, Carvera, Dallimerb, Normana, & Ziva, 2018, pp. 362-363).

8.3. Services, supplies and infrastructure

With the proliferation of renewable energy facilities in the area it is quite likely that the local authorities, currently hard pressed to deliver services, will find it difficult to keep up with this development. The influx of construction workers is likely to place pressure on accommodation and the need for both services and supplies. Sutherland, Matjiesfontein and Laingsburg, being either within or just outside of the 70 km radius of these projects, are likely to bear the brunt of the demand for accommodation, services and supplies. On this basis market demands

[8] Amongst others see for instance:
1. Heritage South Africa's Karoo News Group http://heritagesa.org/wp/2222-2/
2. Alternative sources of energy for South Africa in various shades of green (Smit, 2011)
3. Social media sites such as the Facebook Karoo Energy Debate https://www.facebook.com/TheKarooEnergyDebate/
4. Why the Karoo. (Research Chair in the Sociology of Land, Environment and Sustainable Development. Department of Sociology and Social Anthropology, Stellenbosch University, 2016).

could inflate costs that may have a negative effect on local communities, particularly the poor, who may be forced to pay higher prices for essential supplies resulting in an escalation of the cost of living in the area. Social services such as medical and educational facilities could also be placed under pressure due to increased demand. Although this may reach its peak during the construction phase it should be mitigated somewhat by the fact that the construction of the various project will be spread across different timelines, with some project commencing while other reach completion. Where numerous projects are entering into construction phase simultaneously, the project companies should engage to align efforts. Employing local people across the various projects and project phases may also assist in reducing the stress placed on services, supplies and infrastructure in the area.

During the operational phases it is likely that these demands will continue as operational staff take up more long-term residency in the area and are supported by service and maintenance personnel who may spend some time on site on a contractual basis. An influx of temporary maintenance and service workers is likely to last over the operational phase of the projects but is likely to settle within the medium term as the economy adjusts and the municipal authorities are able to respond to this growth.

8.4. ECONOMIC

The cumulative economic impact of the project will be both positive and negative. The negative economic impacts, associated with a possible rise in living costs driven by market demand, are considered under the section above. Under this section the positive economic impacts will be addressed.

From a positive perspective the proliferation of renewable energy facilities within the region is likely to result in significant and positive cumulative impacts in the area in terms of both direct and indirect job creation, skills development, training opportunities, and the creation of business opportunities for local businesses. In this regard it is indicated in the IPPPP Quarterly Report, as at 31 March 2018, that in respect of South Africa as a whole and through the Independent Power Producers Procurement Programme, " ..*the REIPPPP is targeting broader economic and socio-economic developmental benefits*" and that "[t]*o date, a total of 35 702 job years have been created for South African citizens, of which 30 763 were in construction and 4 938 in operations*" (Independent Power Producer Office, 2018a, p. 36 & 40). In addition to this R 20.6 Billion has been committed to socio-economic development while the projected procurement spend is "…*R 147.6 billion of which R 55.5 billion has been spent to date.*" The district and local municipalities within the area have identified renewable energy as a strategic economic opportunity in a region that previously had few such opportunities. This is indicated in the various IDPs and LEDs pertaining to the affected municipalities.

8.5. ASSESSMENT OF CUMULATIVE IMPACTS

The cumulative impacts discussed above are assessed below in **Table 20** to **Table 23**. It must, however, be noted that this assessment is at a superficial level as any in-depth investigation of the cumulative effects of the various developments being planned for the region are beyond the scope of this study as they would require a broad based investigation on a far larger scale.

Table 20: Risk of HIV

IMPACT TABLE		
Environmental Parameter	Health	
Issue/Impact/Environmental Effect/Nature	Risk of HIV	
Extent	Province	
Probability	Definite	
Reversibility	Irreversible	
Loss of resources	Significant loss of resource	
Duration	Permanent	
Cumulative effect	High cumulative impact	
Intensity/magnitude	High	
Significance Rating	High negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	4	4
Probability	4	4
Reversibility	4	3
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	-69 (high negative)	-66 (high negative)
Mitigation measures	Mitigation can only be implemented at a regional level and will need to be driven on a provincial and municipal basis. In this sense the following mitigation measures would need to be considered. Ensure that all companies coming into the area have and are implementing an effective HIV/AIDS policy; Introduce HIV/ADS awareness programs to schools and youth institutions; Carefully monitor and report on the HIV status of citizens in the region and will need to be driven on a provincial and municipal basis; Be proactive in dealing with any increase in the HIV prevalence rate in the area.	

Table 21: Sense of place

IMPACT TABLE		
Environmental Parameter	Quality of the living environment	
Issue/Impact/Environmental Effect/Nature	Sense of place	
Extent	Regional	
Probability	Definite	
Reversibility	Irreversible	
Loss of resources	Significant loss of resource	
Duration	Permanent	
Cumulative effect	High cumulative impact	
Intensity/magnitude	High	
Significance Rating	High negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	3	3
Probability	4	4
Reversibility	4	4
Irreplaceable loss	3	3
Duration	4	4
Cumulative effect	4	4
Intensity/magnitude	3	3
Significance rating	-66 (high negative)	-66 (high negative)
Mitigation measures	Mitigation can only be implemented at a regional level and will need to be driven on a provincial and municipal basis. In this sense the following mitigation measures would need to be considered. Consider undertaking a cumulative impact assessment to evaluate the changes taking place across the area on a broader scale; Form a regional work group tasked with addressing the effect of changes to the sense of place of the region; Establish grievance mechanisms to deal with complaints associated with changes to the area; Enlighten the public about the need and benefits of wind power; Engage with the tourism businesses and authorities in the region to identify any areas of cooperation that could exist.	

Table 22: Service, supplies and infrastructure

IMPACT TABLE		
Environmental Parameter	Quality of the living environment	
Issue/Impact/Environmental Effect/Nature	Service supplies and infrastructure	
Extent	District	
Probability	Definite	
Reversibility	Partly reversible	
Loss of resources	Significant loss of resource	
Duration	Medium term	
Cumulative effect	Medium cumulative impact	
Intensity/magnitude	Medium	
Significance Rating	Medium negative	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	2	2
Probability	4	4
Reversibility	2	2
Irreplaceable loss	3	2
Duration	2	2
Cumulative effect	3	3
Intensity/magnitude	2	2
Significance rating	-32 (medium negative)	-30 (medium negative)
Mitigation measures	Mitigation can only be implemented at a regional level and will need to be driven on a provincial and municipal basis. In this sense the following mitigation measures would need to be considered. Engage with the municipal authorities to ensure that they are aware of the expansion planned for the area and the possible consequences of this expansion; Ensure that local labour is recruited in respect of these developments in the area.	

Table 23: Economy

IMPACT TABLE		
Environmental Parameter	Economic	
Issue/Impact/Environmental Effect/Nature	Positive economic impacts	
Extent	National	
Probability	Definite	
Reversibility	Barely reversible	
Gain of resources	Significant gain of resource	
Duration	Long term	
Cumulative effect	High cumulative impact	
Intensity/magnitude	Very high	
Significance Rating	Very high positive	
	Pre-mitigation impact rating	**Post mitigation impact rating**
Extent	4	4
Probability	4	4
Reversibility	3	3
Irreplaceable gain	3	3
Duration	3	3
Cumulative effect	4	4
Intensity/magnitude	4	4
Significance rating	84 (very high positive)	84 (very high positive)
Mitigation measures	Mitigation can only be implemented at a regional level and will need to be driven on a provincial and municipal basis. In this sense the following mitigation measures would need to be considered. Implement a training and skills development programme for locals; Ensure that the procurement policy supports local enterprises; Establish a social responsibility programme in line with the REIPPP; Work closely with the appropriate municipal structures in regard to establishing a social responsibility programme; Ensure that any trusts or funds are strictly managed in respect of outcomes and funds allocated.	

The assessment of the cumulative impacts takes into consideration the impacts associated with wind energy facilities in the area and on this basis no fatal flaws associated with the cumulative impacts are evident at a social level. The impacts assessed above are summarised and a pre and post mitigation comparison is presented in **Table 24**.

Table 24: Impact summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Construction Phase					
Health & social wellbeing	Annoyance, dust and noise	-18		-9	
	Increase in crime	-30		-30	
	Increased risk of HIV infections	-60		-32	
	Influx of construction workers	-22		-22	
	Hazard exposure.	-28	**-31.6**	-24	**-23.4**
			Negative Medium Impact		Negative Low Impact
Quality of the living environment	Disruption of daily living patterns	-28		-26	
	Disruptions to social and community infrastructure	-30	**-29**	-30	**-28**
			Negative Medium Impact		Negative Low Impact
Economic	Job creation and skills development	30		30	
	Socio-economic stimulation	32	**31**	32	**31**
			Positive Medium Impact		Positive Medium Impact
Operational Phase					
Quality of the living environment	Transformation of the sense of place	-60	**-60**	-60	**-60**
			Negative High Impact		Negative High Impact
Economic	Job creation and skills development	30		30	
	Socio-economic stimulation	60	**45**	60	**45**
			Positive Medium Impact		Positive Medium Impact
No Project Alternative					
No project		-32	**-32**	No mitigation measures	
			Negative Medium Impact		
Cumulative Impacts					
Health & social wellbeing	Risk of HIV	-69	**-69**	-66	**-66**
			Negative High Impact		Negative High Impact
Quality of the living environment	Sense of place	-66		-66	
	Services, supplies & infrastructure	-32	**-49**	-30	**-48**
			Negative High Impact		Negative Medium Impact
Economic	Economic	84	**84**	84	**84**
			Positive Very High Impact		Positive Very High Impact

9. Comparative Assessment of Layout Alternatives

The area is isolated and not populated and currently is being used as grazing facilities for sheep farmers. A cross reference with other specialist studies such as the Noise (Safetech, 2018), Heritage (PGS Heritage (Pty) Ltd, 2018) and Visual specialists highlighted no issues such as burial grounds or visual and noise receptors that would have social relevance and consequently no social preferences have arisen in respect of the various alternatives.

Table 25: Comparative Assessment of Layout Alternative

Key	
PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)
ACCESS ROADS		
NORTH RIDGE		
Access Road Alternative North 1	Preferred	In accordance with the Visual Impact
Access Road Alternative North 2	Least Preferred	In accordance with the Visual Impact
CENTRE RIDGE		
Access Road Alternative Centre 1	Preferred	In accordance with the Visual Impact
Access Road Alternative Centre 2	Favourable	In accordance with the Visual Impact
SOUTHERN RIDGE		
Access Road Alternative South 1	Favourable	In accordance with the Visual Impact
Access Road Alternative South 2	Preferred	In accordance with the Visual Impact
CONSTRUCTION CAMPS		
Construction Camp Alternative 1	Favourable	In accordance with the Visual Impact
Construction Camp Alternative 2	Favourable	In accordance with the Visual Impact
Construction Camp Alternative 3	Preferred	In accordance with the Visual Impact
Construction Camp Alternative 4	Favourable	In accordance with the Visual Impact
Construction Camp Alternative 5	Favourable	In accordance with the Visual Impact
Construction Camp Alternative 6	Favourable	In accordance with the Visual Impact
SUBSTATIONS		
Substation Alternative 1	Favourable	In accordance with the Visual Impact
Substation Alternative 2	Favourable	In accordance with the Visual Impact
Substation Alternative 3	Favourable	In accordance with the Visual Impact
Substation Alternative 4	Favourable	In accordance with the Visual Impact
Substation Alternative 5	Favourable	In accordance with the Visual Impact
Substation Alternative 6	Preferred	In accordance with the Visual Impact

10. CONCLUSION AND RECOMMENDATIONS

Although highly visible the project is located within a remote area situated on top of three ridges. Apart from the 48 wind turbines to be constructed the project will also include access roads to these ridges and there will be a substation and construction camp associated with the project. In assessing the social impact of this proposed development, it was found that in respect of the energy needs of the country and South Africa's need to reduce its carbon emissions that the project fits with national, provincial and municipal policy.

Regarding the impacts associated with the project it was found that most apply over the short term to the construction phase of the project. Of these impacts all can be mitigated to within acceptable ranges and there are no fatal flaws associated with the construction of the project.

Although the project will be highly visible and is likely to change the sense of place of the area over the operational phase, it will also have significant benefits in respect of the supply of renewable energy into a grid system heavily reliant on coal powered systems. In this sense the project forms part of a national effort to reduce South Africa's carbon emissions and thus carries with it a significant benefit.

Considering the impacts discussed above it is evident that the cumulative impacts associated with changes to the social environment of the region are more significant than those attached to the project. On a negative front there are two issues associated with developments in the region that are of most concern. The first of these issues is the change to the sense of place of an area that was once considered a pristine region of South Africa. The second is the potential, through an influx of labour and an increase in transportation to constructions sites, of the risk for the prevalence of HIV to rise in an area that has the lowest HIV prevalence rate in South Africa. It is important that the relevant authorities recognise these issues and find ways of mitigating them to ensure that they do not undermine the benefit that renewable energy projects bring, both to the region as well as to the country as a whole.

From a Socio-Economic perspective the impacts associated with the proposed wind energy facility are considered to be overall of medium significance with the negative impacts being able to be mitigated to acceptable levels with the implementation of the recommended mitigation measures. There are no obvious fatal flaws associated with the proposed development at a social level. All the proposed layout alternatives appear to be acceptable, and there should be no problem with the proposed development proceeding with environmental authorisation. It is unlikely that any further assessment will be required from a Socio-economic perspective.

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Appendix 1 – Environmental impact assessment methodology

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.

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 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.

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:

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.

Appendix 6H

Terrestrial Ecology Assessment

Ecology EIA Study

Rondekop 325 MW Wind Energy Facility between Matjiesfontein and Sutherland, Northern Cape Province

David Hoare Consulting (Pty) Ltd

Ecological Impact Assessment study on the potential impacts of the proposed Rondekop 325MW Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape Province.

David Hoare
Consulting (Pty) Ltd

Address:
Postnet Suite #116
Private Bag X025
Lynnwood Ridge
0040

41 Soetdoring Avenue
Lynnwood Manor
Pretoria

Telephone: 012 804 2281
Cell: 083 284 5111
Fax: 086 550 2053
Email: dhoare@lantic.net

Location:
Karoo Hoogland Local Municipality within the Namakwa District Municipality

for

SiVEST SA (Pty) Ltd
P O Box 2921,
Rivonia. 2128

on behalf of

Rondekop Wind Farm (Pty) Ltd

28 February 2019

Report version: 2nd draft

Details of specialist consultant

Company name	David Hoare Consulting (Pty) Ltd
Registration no.:	CK2017/308639/07
Address	Postnet Suite #116 Private Bag X025 Lynnwood Ridge 0040
Contact person	Dr David Hoare
Contact details	Cell: 083 284 5111 Email: dhoare@lantic.net
Qualifications	PhD Botany (Nelson Mandela Metropolitan University) MSc Botany (University of Pretoria) BSc (Hons) Botany (Rhodes University) BSc Botany, Zoology (Rhodes University)

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EXECUTIVE SUMMARY

Rondekop Wind Farm (Pty) Ltd appointed SiVEST SA (Pty) Ltd as the Environmental Assessment Practitioners (EAP) to undertake the required Environmental Impact Assessment (EIA) process for the proposed 325MW Rondekop Wind Energy project. Dr David Hoare of David Hoare Consulting (Pty) Ltd was commissioned by SiVEST Environmental Division to provide specialist biodiversity consulting services for the EIA for the proposed WEF. The consulting services comprise an assessment of the potential impacts on the general ecology in the study area by the proposed project. The study excludes Bats, Avifauna and Invertebrates. This report provides details of the results of the ecology EIA study, based on a desktop assessment of the study area, mapping from aerial imagery, a reconnaissance site visit, and a detailed walk-through survey of the entire footprint of the proposed project. The study area is located on several farms that are situated between Matjiesfontein and Sutherland, located entirely in the Northern Cape Province, near the border of the Western Cape Province, straddling the R356 road that runs south-west of Sutherland towards Ceres.

The first section of the report provides an outline of the Terms of Reference for the study, Limitations, Assumptions and Uncertainties, a list of acronyms, abbreviations and a short glossary, and a table indicating compliance with Appendix 6 of the EIA Regulations, 2014 as amended. This is followed by an introduction to the project and a description of layout alternatives.

The following section provides an outline of the methodology used to undertake the ecology assessment. This includes the approach taken to assess the sensitivity of the site and a summary of the background information used to undertake the assessment. Background information includes electronic databases with species information, Red Data Lists, published field guides and National and Provincial legislation, specifically regulations with published lists of species and/or ecosystems.

The next section of the report provides details on legislation that applies to development of the site with respect to the ecological receiving environment. There are various acts that limit development or require permits before development can proceed. The most important of these are permits required in terms of protected species that could potentially occur on site, including the National Environmental Management: Biodiversity Act, the Northern Cape Nature Conservation Act and the National Forests Act.

The next section provides a description of the ecological receiving environment, including details on the location of the site, the regional vegetation patterns, local habitat patterns occurring on site, lists of plant and animal species of concern that are likely to occur there and a list of species that were observed on site during the site visits. Details of this section are summarised as follows:

1. The study area is situated in an area with moderately to steeply sloping topography. Habitat on site is in a largely natural state and is in a remote and rural environment. There is very little transformation or degradation on site.
2. There are two regional vegetation types occurring in the project study area, Koedoesberge-Moordenaars Karoo (most of the area), and Central Mountain Shale Renosterveld (small patches in the southern side on ridge summits). Both vegetation types are listed in the scientific literature as Least Threatened with less than 1% transformed overall and neither is listed in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011).
3. All habitat in the southern half of the study area is mapped as “Critical Biodiversity Area 2” (CBA2) in the Provincial Conservation Plan and most of the northern half is mapped as “Ecological Support Area” (ESA). There are two small areas of “Critical Biodiversity Area 1” (CBA1) in the southern part of the site. The remaining natural vegetation on site therefore has high value for conservation of vegetation in the Province, according to the broadscale CBA maps.
4. Habitats on site were divided into various units, namely “Summits”, “Crests” and Plateaus” in the mountains, “Rocky Outcrops”, “Midslopes”, “Scarp Valleys”, “Lowland Plains” and “Riparian Vegetation” and “Floodplains”, the latter two associated with dry stream beds. The vegetation on site was found to be a succulent dwarf shrubland that resembles the description for Koedoesberg-Moordenaars Karoo, but with a trend of increasing diversity and structural variation with increased elevation and increased surface rockiness. This means that mountain vegetation, especially the highest peaks, have the highest local diversity and

greatest variation in species composition. A map of natural habitats of the study area was produced by mapping from aerial imagery and verifying in the field.

5. There is one plant species protected according to the National Environmental Management: Biodiversity Act (Act No 10. Of 2004) (NEM:BA) that was found on site. This is *Hoodia gordonii*, which was found at two localities on site, neither of which are within the proposed footprint of the project. This is a widespread species that is not restricted to the site but found throughout dryer parts of South Africa.
6. There are a number of plant species occurring on site that are protected according to the Northern Cape Nature Conservation Act (Act 9 of 2009). None of these are of conservation concern, but a permit is required from the Provincial authorities to destroy them. These are listed in the text in the body of this report.
7. There are no protected tree species that are likely to occur in the study area.
8. A total of 56 mammal species have a geographical distribution that includes the general study area in which the site is found. Of the species currently listed as threatened or protected (see Appendix 5 for list of protected species), the following are considered to have a medium probability of occurring on site, based on habitat suitability: Honey Badger (Near Threatened), Black-footed Cat, Leopard, Cape Fox and Grey Rhebok (Near Threatened). Given the nature of the proposed project and the fact that many of the species of concern are relatively mobile, few threatened, near threatened or protected mammal species are likely to be significantly negatively impacted by activities on the site. The species that could potentially be affected by habitat disturbance or degradation, due to its specific habitat requirements, is the Riverine Rabbit, however when considering that Riverine Rabbits require vast extents of plains to thrive and the wind farm infrastructure is located on the mountainous areas, the concern / impact is very low.
9. The site contains habitat that is suitable for a small number of frog species, although none are listed or protected species.
10. A total of 74 reptile species have a geographical distribution that includes the general study area in which the site is found. Two reptile species of conservation concern could potentially occur in the study area, as follows: the Karoo Dwarf Tortoise (NT), and the Armadillo Girdled Lizard (protected).
11. A sensitivity map of the site was produced that identifies areas of high sensitivity based on the detailed site walk through that should be taken into account in the layout amendment and during activities on site. This includes watercourses and their associated riparian vegetation, Rocky Outcrops, Scarp Valleys, and areas mapped as Critical Biodiversity Areas, especially CBA1 areas. Other areas that were not mapped but considered to be sensitive are any steep slopes.

The section of the report following the above identifies a number of potential impacts for the proposed project, including direct and indirect impacts for the construction, operation and decommissioning phases of the project, as well as cumulative impacts taken together with similar projects in the region. These are described and discussed. For each potential impact, possible mitigation measures are provided for managing potential impacts related to this project.

The report concludes that there are some sensitivities on site related to natural habitat and to individual species, but that these can be minimised or avoided with the application of appropriate mitigation or management measures. There will be residual impacts, primarily on natural habitat, but the amount of habitat that will be lost to the project is insignificant compared to the area in hectares of the regional vegetation type that occurs on site and therefore the residual impacts are considered acceptable, on condition local sensitivities of biodiversity importance are avoided. On this basis it is recommended that the project be authorised.

The report includes a comprehensive list of Appendices containing lists of species and species of concern with a geographical distribution that includes the site as well as lists of species protected according to National legislation.

SPECIALISTS DECLARATION

I, David Hoare as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- act as the independent specialist in this application;
- perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- will comply with the Act, Regulations and all other applicable legislation;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- have no vested interest in the proposed activity proceeding;
- undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of specialist: D Hoare

Name of specialist: Dr D B Hoare

Date: 21 February 2019

TERMS OF REFERENCE

The study was to adhere to the following:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements.
- Provide a thorough overview of all applicable legislation, guidelines.
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered).
- Identification of sensitive areas to be avoided (including providing shapefiles/kmls).
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative.
    - Direct impacts: are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
    - Indirect impacts: of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
    - Cumulative impacts: are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Comparative assessment of alternatives (according to infrastructure alternatives provided).
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).
- Specify if any further assessment will be required. Include an Impact Statement, concluding whether project can be authorised or not.
- Recommend mitigation measures in order to minimise the impact of the proposed development.

Specific issues to be addressed in the Terrestrial Ecology assessment were as follows:

- Describe the terrestrial ecology features of the project area, with focus on features that are potentially impacted by the proposed project. The description should include the major habitat forms within the study site, giving due consideration to terrestrial ecology (flora), terrestrial ecology (fauna) and Species of Special Concern (SSC).
- Consider seasonal changes and long-term trends, such as due to climate change;
- Identify any SSC or protected species on site and clearly map exact no-go zones with a high level of confidence;
- Map the sensitive ecological features within the proposed project area, showing any “no-go” areas (i.e. “very high” sensitivity). Specify set-backs or buffers and provide clear reasons for these recommendations. Also map the extent of disturbance and transformation of the site;
- Identify and assess the potential impacts of the project on the terrestrial environment and provide mitigation measures to include in the environmental management plan; and
- The assessment should be based on existing information, national and provincial databases, SANBI mapping, professional experience and field work conducted.
- Undertake a detailed site walkthrough of the entire WEF during the flowering season.

LIMITATIONS, ASSUMPTIONS & UNCERTAINTIES

The following assumptions, limitations, uncertainties are listed regarding the ecological assessment of the Rondekop site:

- Compiling the list of species that could potentially occur on site is limited by the paucity of collection records for the area. The list of plant species that could potentially occur on site was therefore taken from a wider area and from literature sources that may include species that do not occur on site and may miss species that do occur on site. In order to compile a comprehensive site-specific list of the biota on site, studies would be required that would include different seasons, be undertaken over a number of years and include extensive sampling. Due to time constraints, this was not possible for this study.
- Rare and threatened plant and animal species are, by their nature, usually very difficult to locate and can be easily missed.
- The study excludes Bats, Avifauna, Aquatic Ecology and Invertebrates.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments of a similar nature that are within a 50 km radius of the site. However, many of the specialist reports are not in the public domain and were not accessible, with the exception of those provided by the EAP and proponent for this project.

ACRONYMS

AIS	Alien and Invasive species
CBA	Critical Biodiversity Area
CBD	Convention on Biological Diversity
CEPF	Critical Ecosystem Partnership Fund
CFR	Cape Floristic Region
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
ESA	Ecological Support Area
GIS	Geographical Information System
I&AP	Interested and Affected Party
IEM	Integrated Environmental Management
IUCN	International Union for the Conservation of Nature
NBA	National Biodiversity Assessment
NBSAP	National Biodiversity Strategy Action Plan
NC	Northern Cape province
NCNCA	Northern Cape Nature Conservation Act
NDP	National Development Plan
NEM:BA	National Environmental Management: Biodiversity Act
NEMA	National Environmental Management Act
NPAES	National Protected Area Expansion Strategy
ONA	Other Natural Areas
PA	Protected Area
REDZ	Renewable Energy Development Zone
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SCC	Species of conservation concern
SEA	Strategic Environmental Assessment
SKEP	Succulent Karoo Ecosystem Plan
ToPS	Threatened and Protected Species
ToR	Terms of Reference
WEF	Wind Energy Facility

ABBREVIATIONS

%	Percentage
MW	Megawatt
kV	Kilovolt
cm	Centimetres
m	Metres
km	Kilometres

GLOSSARY

Definitions	
Alternative	Alternatives can refer to any of the following but are not limited to: alternative sites for development, alternative projects for a particular site, alternative site layouts, alternative designs, alternative processes and alternative materials.
Biodiversity	The diversity of genes, species and ecosystems, and the ecological and evolutionary processes that maintain that diversity.
Biodiversity offset	Conservation measures designed to remedy the residual negative impacts of development on biodiversity and ecological infrastructure, once the first three levels of the mitigation hierarchy have been explicitly considered (i.e. to avoid, minimize and rehabilitate / restore impacts). Offsets are the last resort form of mitigation, only to be implemented if nothing else can mitigate the impact.
Biodiversity priority areas	Features in the landscape that are important for conserving a representative sample of ecosystems and species, for maintaining ecological processes, or for the provision of ecosystem services. These are identified using a systematic spatial biodiversity planning process and include the following categories: Protected Areas, Critically Endangered and Endangered ecosystems, Critical Biodiversity Areas, Ecological Support Areas, and Focus Areas for land-based Protected Area expansion.
Category 1a Listed Invasive Species	Species listed by notice in terms of section 70(1)(a) of the act, as a species that must be combatted or eradicated. These species are contained in Notice 3 of the AIS list, which is referred to as the National List of Invasive Species. Landowners are obliged to take immediate steps to control Category 1a species.
Category 1b Listed Invasive Species	Species listed by notice in terms of section 70(1)(a) of the act, as species that must be controlled or ‘contained’. These species are contained in Notice 3 of the AIS list, which is referred to as the National List of Invasive Species. However, where an Invasive Species Management Programme has been developed for a Category 1b species, then landowners are obliged to “control” the species in accordance with the requirements of that programme.
Category 2 Listed Invasive Species	Species which require a permit to carry out a restricted activity e.g. cultivation within an area specified in the Notice or an area specified in the permit, as the case may be. Category 2 includes plant species that have economic, recreational, aesthetic or other valued properties, notwithstanding their invasiveness. It is important to note that a Category 2 species that falls outside the demarcated area specified in the permit, becomes a Category 1b invasive species. Permit-holders must take all the necessary steps to prevent the escape and spread of the species.
Category 3 Listed Invasive Species	A species listed by notice in terms of section 70(1)(a) of the act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of the act, as specified in the notice. Category 3 species are less-transforming invasive species which are regulated by activity. The principal focus with these species is to ensure that they are not introduced, sold or transported. However, Category 3 plant species are automatically Category 1b species within riparian and wetland areas.
CBA Maps	A map of Critical Biodiversity Areas and Ecological Support Areas based on a systematic biodiversity plan.
Connectivity	The spatial continuity of a habitat or land cover type across a landscape.
Corridor	A relatively narrow strip of a particular type that differs from the areas adjacent on both sides.
Critical Biodiversity Areas	Areas required to meet biodiversity targets of representivity and persistence for ecosystems, species and ecological processes, determined by a systematic conservation plan. They may be terrestrial or aquatic, and are mostly in a good ecological state. These areas need to be maintained in a natural or near-natural state, and a loss or degradation must be avoided. If these areas were to be modified, biodiversity targets could not be met.
Cumulative impact	Past, current and reasonably foreseeable future impacts of an activity, considered together with the impact of the proposed activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

Definitions	
Ecological consition	An assessment of the extent to which the composition, structure and function of an area or biodiversity feature has been modified from a reference consition of natural.
Ecological infrastructure	Naturally functioning ecosystems that generate or deliver valuable ecosystem services, e.g. mountain catchment areas, wetlands, and soils.
Ecological process	The functions and processes that operate to maintain and generate biodiversity.
Ecological Support Areas	An area that must be maintained in at least fair ecological condition in order to support the ecological functioning of a CBA or protected area, or to generate or deliver ecosystem services, or to meet remaining biodiversity targets for ecosystem types or species when it is not possible or necessary to meet them in natural or near natural areas. It is one of five broad categories on a CBA map, and a subset of biodiversity priority areas.
Ecosystem resilience	The ability of an ecosystem to maintain its functions (biological, chemical, and physical) in the face of disturbance or to recover from external pressures.
Ecosystem threshold	The tipping point where ongoing disturbance or change results in an irreversible change in its composition, structure and functioning. Surpassing ecosystem thresholds diminishes the quality and quantity of ecosystem services provided, rapidly reduces the ability of the ecosystem to sustain life, and results in less resilient ecosystems.
Ecosystem services	The benefits that people obtain from ecosystems, including provisioning services (such as food and water), regulating services (such as flood control), cultural services (such as recreational benefits), and supporting services (such as nutrient cycling, carbon storage) that maintain the conditions for life on Earth.
Edge	The portion of an ecosystem or cover type near its perimeter, and within which environmental conditions may differ from interior locations in the ecosystem.
Endemic	Restricted or exclusive to a particular geographic area and occurring nowhere else. Endemism refers to the occurrence of endemic species.
Exempted Alien Species	An alien species that is not regulated in terms of this statutory framework - as defined in Notice 2 of the AIS List.
Forbs	Herbaceous plants with soft leaves and non-woody stems.
Fragmentation	The breaking up of a habitat or cover type into smaller, disconnected parcels, often associated with, but not equivalent to, habitat loss.
Geophyte	Perennial plants having underground perennating organs, such as bulbs, corms or tubers.
Global Hotspot	An area characterised by high levels of biodiversity and endemism, and that faces significant threats to that biodiversity.
Habitat	The area of an environment occupied by a species or group of species, due to the particular set of environmental conditions that prevail there.
Habitat loss	Conversion of natural habitat in an ecosystem to a land use or land cover class that results in irreversible change to the composition, structure and functional characteristics of the ecosystem concerned.
Keystone species	A species that has a disproportionately large effect on its environment relative to its abundance.
Prohibited Alien Species	An alien species listed by notice by the Minister, in respect of which a permit may not be issued as contemplated in section 67(1) of the act. These species are contained in Notice 4 of the AIS List, which is referred to as the List of Prohibited Alien Species.
Mitigate	The implementation of practical measures to reduce adverse impacts or enhance beneficial impacts of an action.
"No-Go" option	The “no-go” development alternative option assumes the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area.
Patch	A surface area that differs from its surroundings in nature or appearance.
Red List	A publication that provides information on the conservation and threat status of species, based on scientific conservation assessments.
Rehabilitation	Less than full restoration of an ecosystem to its predisturbance condition.
Restoration	To return a site to an approximation of its condition before alteration.
Riparian	The land adjacent to a river or stream that is, at least periodically, influenced by flooding.
Runoff	Non-channelized surface water flow.

Definitions	
Succulent	Plants that have some parts that are more than normally thickened and fleshy, usually to retain water in arid climates or soil conditions.
Species of special / conservation concern	Species that have particular ecological, economic or cultural significance, including but not limited to threatened species.
Systematic biodiversity conservation planning	Scientific methodology for determining areas of biodiversity importance involving: mapping biodiversity features (such as ecosystems, species, spatial components of ecological processes); mapping a range of information related to these biodiversity features and their condition (such as patterns of land and resource use, existing protected areas); setting quantitative targets for biodiversity features, analysing the information using GIS; and developing maps that show spatial biodiversity priorities. Systematic biodiversity planning is often called 'systematic conservation planning' in the scientific literature.
Threatened ecosystems	An ecosystem that has been classified as Critically Endangered, Endangered or Vulnerable, based on analysis of ecosystem threat status. A threatened ecosystem has lost, or is losing, vital aspects of its structure, composition or function. The Biodiversity Act makes provision for the Minister or Environmental Affairs, or a provincial MEC of Environmental Affairs, to publish a list of threatened ecosystems.
Threatened species	A species that has been classified as Critically Endangered, Endangered or Vulnerable, based on a conservation assessment using a standard set of criteria developed by the IUCN for determining the likelihood of a species becoming extinct. A threatened species faces a high risk of extinction in the near future.

COMPLIANCE WITH APPENDIX 6 OF THE EIA REGULATIONS AND AMENDMENTS

Requirements of Appendix 6 – GN326 EIA Regulations of April 2017	Section of specialist report addressing requirement
1) A specialist report prepared in terms of these Regulations must contain— a. details of— i. the specialist who prepared the report; ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	See Page(ii) and Appendix 8
b. a declaration that the specialist is independent in a form as may be specified by the competent authority;	See Specailist Declaration (page viii)
c. an indication of the scope of, and the purpose for which, the report was prepared;	"Terms of Reference" in "Introduction" on page 10
A. an indication of the quality and age of base data used for the specialist report;	"Methodology" pages 12-22
B. a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	"Site conditions" on page 23, "Cumulative impacts" on page 55, "Habitat sensitivity" on page 32
d. the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	"Field surveys" on page 17
e. a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	"Methodology" pages 12-22
f. details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	"Habitat sensitivity" page 32 "Proposed infrastructure" page 41
g. an identification of any areas to be avoided, including buffers;	"Habitat sensitivity" page 32
h. a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 18, page 68
i. a description of any assumptions made and any uncertainties or gaps in knowledge;	Page (xiii)
j. a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Page 64 onwards
k. any mitigation measures for inclusion in the EMPr;	Page 71 onwards
l. any conditions for inclusion in the environmental authorisation;	None proposed
m. any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Page 71 onwards
n. a reasoned opinion— i) as to whether the proposed activity, activities or portions thereof should be authorised; A. regarding the acceptability of the proposed activity or activities; and ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation	Page 113

Requirements of Appendix 6 – GN326 EIA Regulations of April 2017	Section of specialist report addressing requirement
measures that should be included in the EMPr, and where applicable, the closure plan;	
o. a description of any consultation process that was undertaken during the course of preparing the specialist report;	Consultation will be undertaken by the EAP. The Ecology Scoping Report went out for 30 day PPP. And has been submitted to the DEA. This report will go out for a further 30 day comment period during the DEIAr phase
p. a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Consultation will be undertaken by the EAP
q. any other information requested by the competent authority.	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

LIST OF FIGURES

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INTRODUCTION

Background

Rondekop Wind Farm (Pty) Ltd appointed SiVEST SA (Pty) Ltd as the Environmental Assessment Practitioners (EAP) to undertake the required Environmental Impact Assessment (EIA) process for the proposed 325MW Rondekop Wind Energy Facility (WEF). On 5 September 2018 David Hoare Consulting (Pty) Ltd was commissioned by SiVEST Environmental Division to provide specialist Terrestrial Ecology consulting services for the EIA for the proposed project. The proposed facility is situated between Matjiesfontein and Sutherland, located in the Northern Cape Province on the border to the Western Cape Province. The consulting services comprise an assessment of potential impacts on the general ecology in the study area by the proposed project. The study excludes Bats, Avifauna, Aquatic Ecology and Invertebrates.

The proposed facility is located partially within the Komsberg Renewable Energy Development Zone (REDZ 2), one of the eight REDZ formally gazetted in South Africa for development of solar and wind energy generation facilities. In line with the gazetted process for projects located within REDZ, a project would be subject to a Basic Assessment (BA) process instead of a full Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA, 1998), EIA Regulations (NEMA, 2014; NEMA, 2017). However, the current project falls partially outside the REDZ and is therefore subject to a full EIA process.

Project description

The Rondekop WEF will have an energy generation capacity (at 132kV point of utility connection) of up to 325 megawatt (MW), and will include the following:

- Up to 48 wind turbines, each between 3MW and 8MW in nameplate capacity each with a foundation of up to 30 m in diameter and up to 5 m in depth.
- The hub height of each turbine will be between 90 m and up to 140 m and its rotor diameter between 100 m and up to 180 m.
- Permanent compacted hardstanding laydown areas (also known as crane pads) for each wind turbine of 90 m x 50 m (total footprint 21.6ha) during construction and for ongoing maintenance purposes for the lifetime of the project.
- Electrical transformers (690V/33kV) adjacent to each turbine (typical footprint of 2 m x 2 m, but can be up to 10 m x 10 m at certain locations) to step up the voltage to 33kV.
- Underground 33kV cabling between turbines buried along access roads, where feasible, with overhead 33kV lines grouping turbines to crossing valleys and ridges outside of the road footprints to get to the onsite 33/132kV substation.
- Internal access roads up to 12 m wide, including structures for stormwater control would be required to access each turbine and the substation, with a total footprint of about 73 ha, of which 38,6 ha are roads that are to be upgraded. Turns will have a radius of up to 50 m in order for abnormal loads (especially turbine blades) to access the various turbine positions.
- Access roads to the site will be approximately 9 m wide while access roads to the substation will be approximately 6 m wide.
- One 33/132kV onsite substation. The 33kV footprint will need to be assessed as part of the WEF EIA and the 132kV footprint will be assessed in a separate basic assessment (BA) process as the current applicant will remain in control of the low voltage components of the 33/132kV substation, whereas the high voltage components of this substation will likely be ceded to Eskom shortly after the completion of construction. The total footprint of this onsite substation will be approximately 2.25 ha.

- Up to 4 (the height will be the same as the final wind turbine hub height) wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.
- Temporary infrastructure including a construction camp (~13ha) which includes an on-site concrete batching plant for use during the construction phase and for offices, administration, operations and maintenance buildings during the operational phase.
- Fencing will be limited around the construction camp and batching plant. The entire facility would not be fenced off. The height of fences around the construction camp are anticipated to be up to 6 m.
- Temporary infrastructure to obtain water from available local sources/ new or existing boreholes including a potential temporary above ground pipeline (approximately 35cm diameter) to feed water to the on-site batching plant. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the DWS will be applied for separately.
- Application site is ~37 543.13 hectares (cadastral units). The total footprint of the wind farm will however be ~ 114 ha (of which ~38ha will be upgrading of existing roads).

Location alternatives

The proposed site was selected through an environmental and social pre-feasibility assessment commissioned by the applicant for several sites within the Roggeveld area. This study was undertaken by CES in 2009 and included a high-level screening of potential environmental and socio-economic issues, as well as 'fatal flaws' to determine suitable areas for project development. The consideration of a number of criteria resulted in the selection of the site by the applicant. Therefore, no further site location alternatives other than Rondekop will be considered in this process.

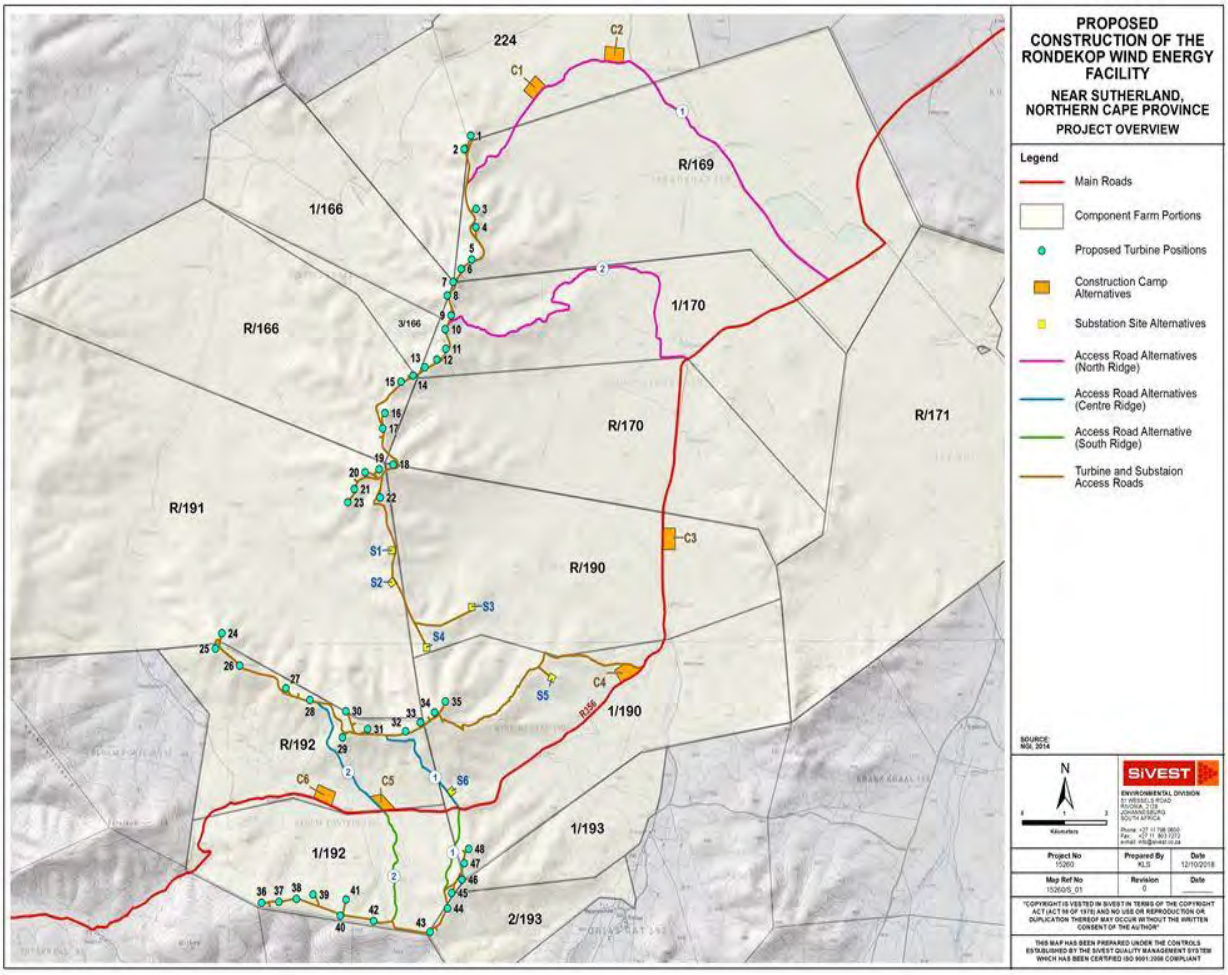

Figure 1: Proposed layout and alternatives.

Technology alternatives

Based on the hilly to mountainous terrain, the climatic conditions and current land use being agricultural, it was determined that the Rondekop site would be best-suited for a WEF, instead of any other type of renewable energy technology. The terrain is not flat enough for a photovoltaic facility and there is not enough rainfall in the area to justify a hydro-electric plant. Therefore, no other renewable energy technology has been considered. Through the project development process, Rondekop Wind Farm (Pty) Ltd will continue to consider various wind turbine designs in order to maximise the capacity of the site. Therefore, no technology alternatives are feasible for assessment at this stage of the project other than a WEF.

Layout alternatives

Turbine layout alternatives
One layout alternative will be assessed for Rondekop WEF based on 48 wind turbines with associated crane pad areas and other associated infrastructure. The proposed layout is spread over three (3) ridges namely northern ridge, centre ridge and southern ridge. The proposed layout will be amended, as needed, based on specialist input and input from I&APs. A turbine layout map is shown in Figure 1.

Road layout alternatives

Various access road alternatives are currently proposed to connect the R356 to the three ridges. The proposed access to the site is from the tarred R354 connecting Matjiesfontein and Sutherland, turning north-west onto R356 provincial gravel road and heading west from where the access roads branches off. The six (6) access road alternatives (two (2) per ridge) branch off the R356.. Three access road alternatives would connect the public R356 road to the new wind farm road network between the turbines on the ridges namely:

North ridge

- Access road alternative North 1, route is approximately 11.8 km in length, almost all of which comprises an existing farm road that will need to be upgraded; or
- Access road alternative North 2 is approximately 12.8 km in length and branches off the R356 and follows an existing farm road that will need to be upgraded.

Centre ridge

- Access road alternative Centre 1 is approximately 2.6 km in length and branches off the R356 to the north and connects between turbine 31 and 32; or
- Access road alternative Centre 2 is approximately 3.1 km in length and branches off the R356 and connects to the site near turbine 28.

Southern ridge

- Access road alternative South 1 is approximately 1.9 km in length and branches off the R356 to the south and connects near turbine 45; or
- Access road alternative South 2 is approximately 4.2 km in length and branches off the R356 to the south and connects near turbine 42.

Each road section will be buffered by approximately 200 m to allow for incremental alternatives i.e. reroute within the buffer in order to avoid any sensitive features identified during the detailed specialist assessments.

Construction camps

Six (6) alternative construction camp layouts, including the area required for a batching plant, will be assessed namely:

- Construction Camp Alternative 1 is located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;

- Construction camp Alternative 2 is also located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road;
- Construction Camp Alternative 3 is located adjacent to and east of the R356 public road on the Remainder of farm 190 Wind Heuvel;
- Construction Camp Alternative 4 is located at the intersection of an existing 4x4 track and the R356 on portion 1 of farm 190 Wind Heuvel;
- Construction Camp Alternative 5, is located at the intersection of the R356, access road alternative centre 2 and access road alternative south 1 extending to the north on the remainder of farm 192 Bloem Fontein; and
- Construction Camp Alternative 6 is located to the west of access road alternative centre 2 north of the R356 on the remainder of farm 192 Bloem Fontein.

Substations

Six (6) onsite 33/132kV substation location alternatives were identified based on technical studies which considered aspects such as topography, earth works and levelling, environmentally sensitive features, electrical losses, turbine locations and existing agricultural use. All six (6) positions are located relatively in the centre of the facility.

- Substation alternative 1 is located south of turbine 22 on the remainder of farm 191 Hout Hoek;
- Substation alternative 2 is located south of substation alternative 1 on the remainder of farm 191 Hout Hoek;
- Substation alternative 3 is located south east of substation alternative 2 on the remainder of farm 190 Wind Heuvel;
- Substation alternative 4 is located north east of substation alternative 3 on the remainder of farm 190 Wind Heuvel;
- Substation alternative 5 is located west of construction camp alternative 4 along an existing 4x4 jeep track; and
- Substation alternative 6 is located adjacent to access road alternative center 1 to the east on portion 1 of farm 190 Wind Heuvel.

No-Go alternative

The no development alternative option assumes the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area and the status quo would prevail.

APPROACH & METHODOLOGY

This report provides an EIA level description of the site and assessment of the proposed project from and ecology perspective. The detailed methodology followed as well as the sources of data and information used as part of this assessment is described below.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on the site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically <u>focus on red flags and/or potential fatal flaws</u>. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species;
2. protected trees; and
3. threatened animal species.

Ecosystems

1. threatened ecosystems;
2. protected ecosystems;
3. critical biodiversity areas;
4. areas of high biodiversity; and
5. centres of endemism.

Processes

1. corridors;
2. mega-conservancy networks;
3. rivers and wetlands; and
4. important topographical features.

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998); and
2. National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004).

Approach

The study commenced as a desktop-study followed by a site-specific field study from the 5th – 7th October 2018 and a detailed survey of the site from the 5th – 16th November 2018. The focus of the first site visit was a reconnaissance of the site and a search for any Species of Special Concern (SCC). The second detailed site survey was to undertake a detailed assessment of the proposed footprint and a search for any SCC. During the second survey, all the planned roads, including alternative road alignments (where applicable), all turbine locations, crane pads, alternative construction camp sites and all alternative substation sites were traversed on foot.

Aerial imagery from Google Earth was used to identify and map habitats on site. Patterns identified from satellite imagery were verified on the ground. During the walk-through survey of proposed infrastructure, vegetation survey sites were located at turbine locations, substation sites and construction camp sites. At each site a checklist of plant species was compiled as well as an estimate of cover/abundance. From this vegetation survey, as well as ad hoc observations on site, a checklist of plant species occurring on site was compiled. Digital photographs were taken at all survey sites, as well as at other locations where features of interest were observed.

Field surveys

The study area was visited and assessed to confirm patterns identified from the desktop assessment. One reconnaissance site visit was undertaken on 5th – 7th October 2018 and a detailed field survey was undertaken on 5th – 16th November 2018. The first site visit was undertaken very soon after good rains and after the last cold spell of the winter. Vegetation was in a good state, many plant species were flowering and / or could be identified, geophytic species were not dormant and habitats were generally in an ideal state to assess. This means that botanical diversity and species composition were relatively easy to assess, and any species of concervation concern (SCC) were likely to be visible. The conditions were similar during the detailed site survey undertaken in November, with the exception that the hot summer had commenced, and the initial flowering of plants was already drawing to an end. However, most plants were identifiable and this did not impose a limitation on the assessment of the site nor the collection of floristic information on site.

Specific features of potential concern were investigated in the field, including the following:

- General vegetation status, i.e. whether the vegetation was natural, disturbed/secondary or transformed;
- Presence of habitats of conservation concern in terms of high biodiversity, presence of SCC, specific sensitivities, e.g. wetlands, and any other factors that would indicate an elevated biodiversity or functional value that could not be determined from the desktop assessment;
- Presence of protected trees; and
- Potential presence of SCC, including observation of individual plants found on site or habitats that are suitable for any of the species identified from the desktop assessment.

Key parts of the development site were visited during the reconnaissance site visit in such a way as to ensure all major variation was covered and that any unusual habitats or features were observed. A preliminary checklist of species occurring on site was collected during the reconnaissance survey (Appendix 3, highlighted in green). Plant names follow Germishuizen *et al.* (2005). The season of the survey was favourable, and it there is high confidence that many of species present on site were identifiable at the time of the survey. The survey was of adequate duration and intensity to characterise the flora of the development site as per the regulations.

A second visit was undertaken to undertake a detailed site walkthrough of all infrastructure early November 2018 to inform the EIA phase. During this survey, a walk-through survey was undertaken of **ALL** infrastructure, including alternatives. Floristic survey data was collected at **ALL** turbine positions, **ALL** alternative Substation sites and **ALL** alternative Construction Camp sites. A detailed checklist of plant species was compiled to supplement the preliminary checklist (Appendix 3).

Species of conservation concern

There are two types of species of concern for the site under investigation, (i) those listed by conservation authorities as being on a Red List and are therefore considered to be at risk of extinction, and (ii) those listed as protected according to National and/or Provincial legislation.

Red List plant species

Determining the conservation status of a species is required to identify those species that are at greatest risk of extinction and, therefore, in most need of conservation action. South Africa has adopted the International Union for Conservation of Nature (IUCN) Red List Categories and Criteria to provide an objective, rigorous, scientifically founded system to identify Red List species. A published list of the Red List species of South African plants (Raimondo *et al.*, 2009) contains a list of all species that are considered to be at risk of extinction. This list is updated regularly to take new information into account, but these are not published in book/paper format. Updated assessments are provided on the SANBI website (http://redlist.sanbi.org/). According to the website of the Red List of Southern African Plants (http://redlist.sanbi.org/), *the conservation status of plants indicated on the Red List of South African Plants Online represents the status of the species within South Africa's borders. This means that when a species is not endemic to South Africa, only the portion of the species population occurring within South Africa has been assessed. The global conservation status, which is a result of the assessment of the entire global range of a species, can be found on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species: http://www.iucnredlist.org*. The South African assessment is used in this study.

The purpose of listing Red List species is to provide information on the potential occurrence of species at risk of extinction in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species at risk of extinction (Red List species) previously recorded in the area. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute (http://posa.sanbi.org) for the quarter degree square/s within which the study area is situated. Habitat information for each species was obtained from various published sources. The probability of finding any of these species was then assessed by comparing the habitat requirements with those habitats that were found, during the field survey of the site, to occur there.

Protected trees

Regulations published for the National Forests Act (Act 84 of 1998) (NFA) as amended, provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area. The distribution of species on this list were obtained from published sources (e.g. van Wyk & van Wyk 1997) and from the SANBI Biodiversity Information System website (http://sibis.sanbi.org/) for quarter degree grids in which species have been previously recorded. Species that have been recorded anywhere in proximity to the site (within 100 km), or where it is considered possible that they could occur there, were listed and were considered as being at risk of occurring there.

Other protected species

National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following:

- National Environmental Management: Biodiversity Act (Act No 10 of 2004); and
- Northern Cape Nature Conservation Act (Act No. 9 of 2009).

This legislation contains lists of species that are protected. These lists were used to identify any species that have a geographical range that includes the study area and habitat requirements that are met by those found on site. These species were searched for within suitable habitats on site or, where relevant, if it is possible that they could occur on site, this was stated.

Red List animal species

Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997). The likelihood of any of them occurring was evaluated based on habitat preference and habitats available within the study area. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

Mammal threat status is according to Child *et al.* (2016), reptile threat status is according to Bates *et al.* 2014, and amphibian threat status is according to Minter *et al.* (2004).

Species probability of occurrence

Some species of plants may be cryptic, difficult to find, rare, ephemeral or generally not easy to identify while undertaking a survey of a large area. An assessment of the possibility of these species occurring there was therefore provided. For all threatened or protected flora that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. karoo shrubland), but detailed microhabitat requirements (e.g. mountain shrubland on shallow soils overlying sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain shrubland on shallow soils overlying sandstone);
- DEFINITE: species found in habitats on site.

Sources of information

Vegetation and plant species

- Broad vegetation types occurring on site were obtained from Mucina and Rutherford (2006), with updates according to the SANBI BGIS website (http://bgis.sanbi.org).
- The conservation status of the vegetation types was obtained from Mucina and Rutherford (2006) and the National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004).
- More detailed vegetation mapping was done by Van der Merwe *et al.* (2008a, 2008b), from which information was obtained for providing a more detailed description of the expected vegetation on site.
- Information on endemic and near-endemic plant species was obtained from Clark *et al.* (2011) for the Roggeveld Centre of Endemism, which is located close to the site.
- The plant species checklist compiled by Ekotrust CC for the adjacent site (Kudusberg WEF) was used for the current site. According to the authors of that report, this was compiled from a plant species checklist extracted from the NewPosa database of the South African National biodiversity Institute (SANBI) for the quarter degree grids 3220CA, CB, CC and CD.
- The IUCN Red List Category for plant species, as well as supplementary information on habitats and distribution, was obtained from the SANBI Threatened Species Programme (Red List of South African Plants, http://redlist.sanbi.org).

Fauna

- Lists of animal species that have a geographical range that includes the study area were obtained from literature sources (Bates *et al.*, 2014 for reptiles, du Preez & Carruthers 2009 for frogs, Mills & Hes 1997 and Friedmann and Daly, 2004 for mammals). This was supplemented with information from the Animal Demography Unit website (adu.uct.ac.za) and literature searches for specific animals, where necessary.

Regional plans

- Information from the National Protected Areas Expansion Strategy (NPAES) was consulted for possible inclusion of the site into a protected area in future (available on http://bgis.sanbi.org).).
- The Northern and Western Cape Biodiversity Area Maps were consulted for inclusion of the site into a Critical Biodiversity Area or Ecological Support Area (biodiversityadvisor.sanbi.org).

Habitat sensitivity

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks *et al.*, 2000) using available satellite imagery and aerial photography. From this, it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

An explanation of the different sensitivity classes is given in Table 1. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 1: Explanation of sensitivity ratings.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for <u>any</u> of the following: • presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • <u>High</u> conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • <u>Protected</u> habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • <u>High</u> intrinsic biodiversity value (<u>high</u> species richness and/or turnover, unique ecosystems) • <u>High</u> value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon	• Remaining areas of vegetation type listed in National Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of populations of threatened species.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). • presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	• CBA "critical biodiversity areas". • Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• CBA 2 "corridor areas". • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	• Natural habitat with no specific sensitivities.
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.	• Highly degraded areas or highly disturbed areas in which the original species composition has been lost.
LOW	No natural habitat remaining.	• Transformed areas.

Any natural vegetation within which there are features of conservation concern will be classified into one of the high sensitivity classes (MEDIUM-HIGH, HIGH or VERY HIGH. The difference between these three high classes is based on a combination of factors and can be summarised as follows:

1. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
2. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services. CBA2 "irreplaceable biodiversity areas" would qualify for inclusion into this class, if there were no other factors that would put them into the highest class.
3. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories. CBA2 "corridor areas" would qualify for inclusion into this class.

Impact assessment methodology

The Impact Assessment 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. The impact rating methodology used was provided by SiVEST.

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 2.

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.

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.

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 2: Description of impact assessment terms

NATURE		
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.		
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 3: Impact table format.

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 of the area over which the impact will be expressed	
Probability	A brief description indicating the chances of the impact occurring	
Reversibility	A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity	
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
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.	

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

Convention on Biodiversity (CBD)

South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimize these effects and, where appropriate, to allow for public participation in such procedures.

National Environmental Management Act, Act No. 107 of 1998 (NEMA)

NEMA is the framework environmental management legislation, enacted as part of the government's mandate to ensure every person's constitutional right to an environment that is not harmful to his or her health or wellbeing. It is administered by DEA but several functions have been delegated to the provincial environment departments. One of the purposes of NEMA is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. The Act further aims to provide for institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for the administration and enforcement of other environmental management laws.

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied",
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

This report considers the Environmental Impact Assessment (EIA) Regulations of 2014 (NEMA, 2014) as amended in 2017 (NEMA, 2017), under the National Environmental Management Act, (Act No. 107 of 1998). According to these Regulations under Listing Notice 1 (GRN No. 327), Listing Notice 2 (GRN No 325) and Listing Notice 3 (GRN No 324), the activities listed are identified as activities that may require Environmental Authorisation prior to commencement of that activity and to identify competent authorities in terms of sections 24(2) and 24D of the Act.

The EIA Regulations (2014, as amended) include three lists of activities that require environmental authorisation:

- Listing Notice 1: activities that require a basic assessment (GNR. 327 of 2014, as amended),
- Listing Notice 2: activities that require a full environmental impact assessment report (EIR) (GNR. 325 of 2014, as amended),
- Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (GNR. 324 of 2014, as amended).

The proposed WEF is located partially within the Komsberg Renewable Energy Development Zone (REDZ 2), one of the eight REDZ formally gazetted[1] in South Africa indicating the procedure to be followed in applying for environmental authorisation (EA) for large scale solar and wind energy generation facilities. Considering that a portion of the proposed facility is located partially outside of the Komsberg REDZ, the Rondekop WEF will be subject to a full Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) as amended and EIA Regulations, 2014 (as amended).

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

As the principal national act regulating biodiversity protection, NEM:BA, which is administered by DEA, is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. The term biodiversity according to the Convention on Biodiversity (CBD) refers to the variability among living organisms from all sources including, inter alia terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity in genes, species and ecosystems.

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- (1) A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species".

Alien and Invasive Species

Chapter 5 of NEM:BA relates to species and organisms posing a potential threat to biodiversity. The Act defines alien species and provides lists of invasive species in regulations. The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEM:BA, was published in Government Notice R598 in Government Gazette 37885 in 2014 (NEM:BA, 2014). The Alien and Invasive Species (AIS) lists were subsequently published in Government Notice R 864 of 29 July 2016 (NEM:BA, 2016).

According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

The National Environmental Management: Biodiversity Act (NEMBA) regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. The purpose of Chapter 5 is:

a) to prevent the unauthorized introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur;

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[1] Formally gazetted on 16 February 2018 (government notice 114).

b) to manage and control alien species and invasive species to prevent or minimize harm to the environment and to biodiversity in particular;
c) to eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats;

According to Section 65 of the Act, "Restricted activities involving alien species":

1) A person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7. Restricted activities include the following:
    a. Importing into the Republic, including introducing from the sea, any specimen of a listed invasive species.
    b. Having in possession or exercising physical control over any specimen of a listed invasive species.
    c. Growing, breeding or in any other way propagating any specimen of a listed invasive species, or causing it to multiply.
    d. Conveying, moving or otherwise translocating any specimen of a listed invasive species.
    e. Selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any other way acquiring or disposing of any specimen of a listed invasive species.
    f. Spreading or allowing the spread of any specimen of a listed invasive species.
    g. Releasing any specimen of a listed invasive species.
    h. Additional activities that apply to aquatic species.
2) A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

An "**alien species**" is defined in the Act as:

a) a species that is not an indigenous species; or
b) an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by means of migration or dispersal without human intervention.

According to Section 71 of the Act, "Restricted activities involving listed invasive species":

1) A person may not carry out a restricted activity involving a specimen of a listed invasive species without a permit issued in terms of Chapter 7.
2) A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

An "**invasive species**" is defined in the Act as any species whose establishment and spread outside of its natural distribution range:

a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and
b) may result in economic or environmental harm or harm to human health.

A "**listed invasive species**" is defined in the Act as any invasive species listed in terms of section 70(1).

According to Section 73 of the Act, "Duty of care relating to listed invasive species":

2) A person who is the owner of land on which a listed invasive species occurs must-
    a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
    b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
    c) take all the required steps to prevent or minimize harm to biodiversity.

According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

Government Notice No. 1002 of 2011: National List of Ecosystems that are Threatened and in need of protection
Published under Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). This Act provides for the listing of threatened or protected ecosystems based on national criteria. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the National Spatial Biodiversity Assessment (2004).

GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List
Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List
Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

Government Notice No. 40733 of 2017: Draft National Biodiversity Offset Policy
Published under the National Environmental Management Act (Act No. 107 of 1998). The aim of the Policy is to ensure that significant residual impacts of developments are remedied as required by NEMA, thereby ensuring sustainable development as required by section 24 of the Constitution of the Republic of South Africa, 1996. This policy should be taken into consideration with every development application that still has significant residual impact after the Mitigation Sequence has been followed. The mitigation sequence entails the consecutive application of avoiding or preventing loss, then at minimizing or mitigating what cannot be avoided, rehabilitating where possible and, as a last resort, offsetting the residual impact. The Policy specifies that one impact that has come across consistently as unmitigatable is the rapid and consistent transformation of certain ecosystems and vegetation types, leading to the loss of ecosystems and extinction of species. The Policy specifically targets ecosystems where the ability to reach protected area targets is lost or close to being lost. However, the Policy states that "*[w]here ecosystems remain largely untransformed, intact and functional, an offset would not be required for developments that lead to transformation, provided they have not been identified as a biodiversity priority*". Biodivesity offsets should be considered to remedy residual negative impacts on biodiversity of 'medium' to 'high' significance. Residual impacts of 'very high' significance are a fatal flaw for development and residual biodiversity impacts of 'low' significance would usually not require offsets. The Policy indicates that impacts should preferably be avoided in protected areas, CBAs, verified wetland and river features and areas earmarked for protected area expansion.

National Forests Act (Act no 84 of 1998)

Protected trees
According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

Forests
Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Water Act (Act 36 of 1998)

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (Act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks. However, this has been dealt with in more detail by the Wetland Specialist.

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

The impact on agricultural resources is assessed in a separate assessment.

National Veld and Forest Fire Act (Act No. 101 of 1998)

Provides requirements for veldfire prevention through firebreaks and required measures for fire-fighting. Chapter 4 of the Act places a duty on landowners to prepare and maintain firebreaks. Chapter 5 of the Act places a duty on all landowners to acquire equipment and have available personnel to fight fires.

Northern Cape Nature Conservation Act, No. 9 of 2009

This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project:

- Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off a property;
- Aquatic habitats may not be destroyed or damaged;
- The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species.

The Act provides lists of protected species for the Province. According to Northern Cape Nature Conservation officials, a permit is required for the removal of any species on this list.

Other Acts

Other Acts that may apply to biodiversity issues, but which are considered to not apply to the current site are as follows:

- National Environmental Management Protected Areas Act (Act No. 57 of 2003)
- Mountain Catchment Areas Act (Act No. 63 of 1970)

DESCRIPTION OF STUDY AREA

Location

The project is located 45 km south-west of Sutherland, in the Northern Cape Province, South Africa (Figure 1). The proposed facility is located within the Karoo Hoogland Local Municipality, which fall within the Namakwa District Municipality. The R354 road from Matjiesfontein to Sutherland passes some distance to the east of the site. An off-shoot of this road, travelling from the Sutherland road towards Ceres passes through the southern part of the site (Figure 1). The site is in the quarter degree grids 3220CA, CB, CC and CD, between 32°38'31.3" S and 32°49'20.0 S latitude, and between 20°13'58.0 E and 20°24'10.0 E longitude.

Site conditions

The entire site is largely in a natural state, with the exception of some scattered farm buildings, narrow gravel roads, jeep tracks and fences. The vegetation is used primarily for livestock grazing and is affected to some degree by this useage, but not to the extent that any obvious degradation was noted on site. No alien plants were seen anywhere during the field survey, although areas around farm infrastructure were not inspected as no infrastructure associated with the proposed WEF is located next to farm infrastructure. The vegetation and habitats on site appear to be largely in a natural state and reflecting what would be expected according to the natural relationship between the physical environment and the vegetation. This natural pattern extends beyond the site in all directions and gives the general area a sense of being relatively unspoilt, remote and natural.

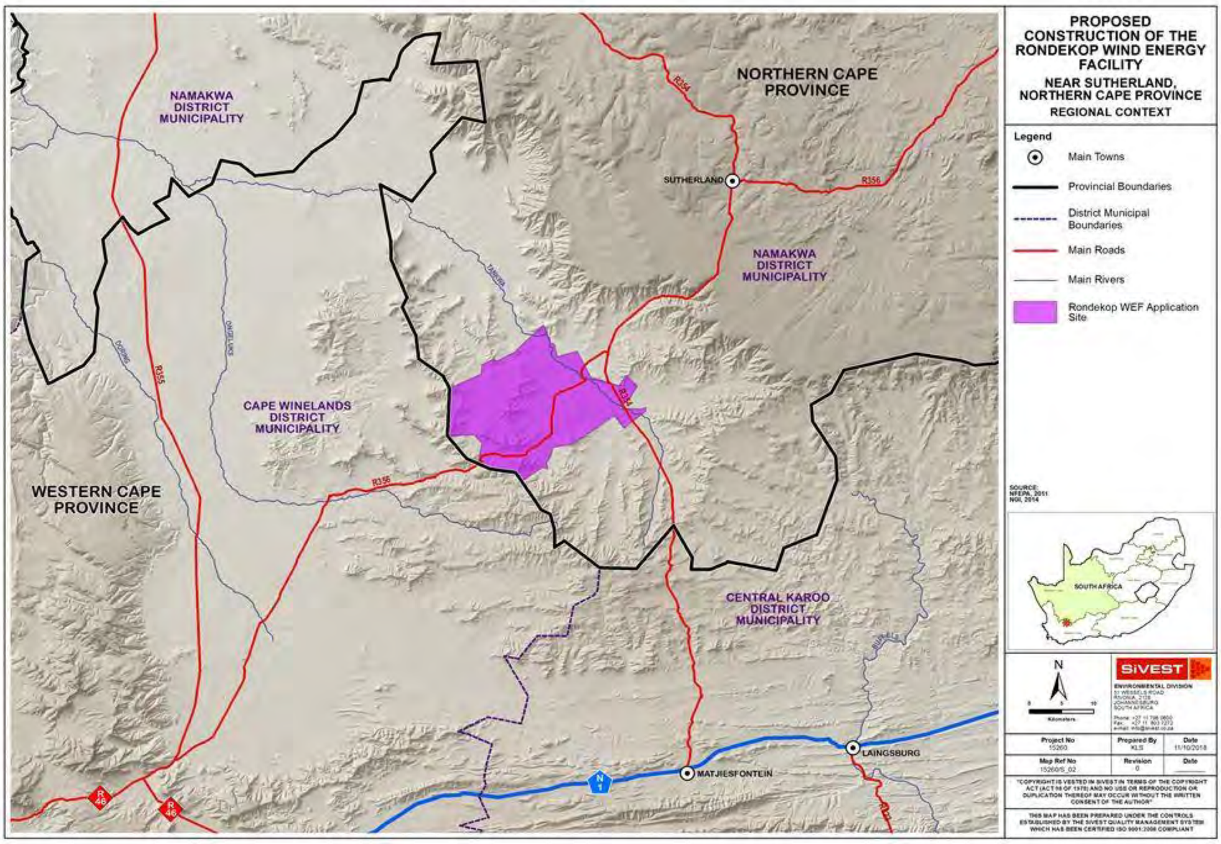

Figure 2: Location of the study area.

Topography and drainage

The study area is situated in an area with moderately to steeply sloping topography, occurring on the broad ridges of the low mountain ranges that border the southern Tanqua Karoo. A broad indication of slope inclination categories is shown in Figure 2, derived from a landscape level model of topography. This shows that the landscape on site varies from level to steep (Figure 3).

The elevation on site varies from 675 to 1207 m above sea level, an elevation difference of approximately 500 m across a distance of around 5,0 km. The mountains form north-south and east-west running ridges, the northern half called the Kareefonteinsberg and local peaks called Rondekop, Windheuwel, Vaalberg, Aasvoelkop and Gifkop. The ridges drop quite steeply into valleys that fall into the surrounding plains.

The site is drained by several dry rivers, most of which drain eventually towards the north-west. The dry stream beds on site coalesce into the Uriasgatrivier, Houthoek and Brak, all joining up to run into the Tankwarivier that runs north-westwards out of the study area.

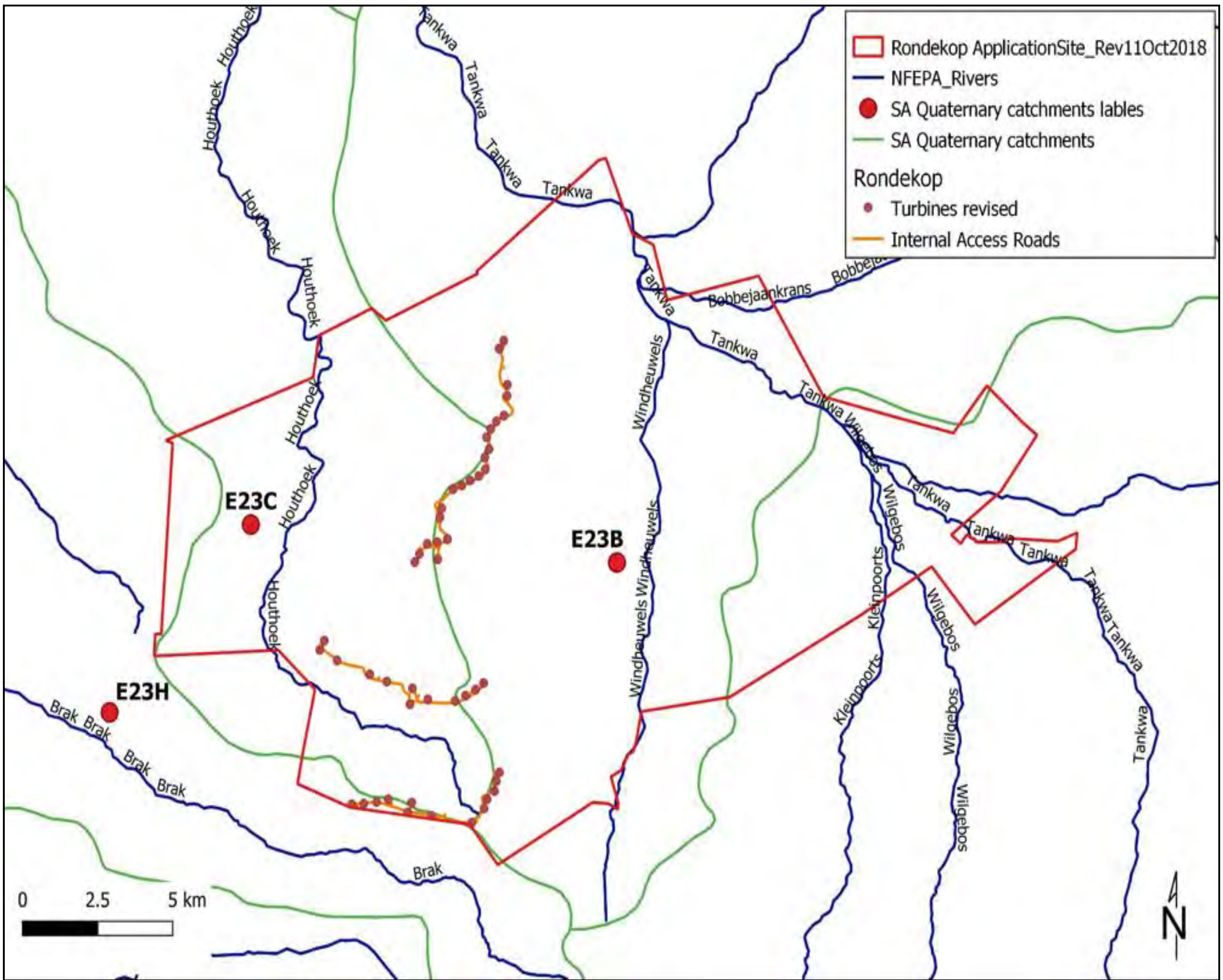

Figure 3: Main non-perennial rivers draining the study area.

Soils

Detailed soil information for the site is available from a separate specialist study for the site. Landtype data was used here to provide a general description of substrate conditions in the study area (land types are areas with largely uniform soils, topography and climate). The land types described below provide a generalized description of soils on site that may differ in detail from site-specific patterns, but not in overall trends. There are two land types in the study area. These are the Fc landtype in most of the study area and the Ag landtype in and around the valley on the western side of the mountain ridges (Land Type Survey Staff, 1987).

The F-group of land types accommodates pedologically young landscapes that are not predominantly rock and not predominantly alluvial or aeolian, and in which the dominant soil-forming processes include rock weathering, the formation of orthic topsoil horizons and commonly, clay illuviation, giving rise typically to lithocutanic horizons. The Fc landtype refers to land where the soils are shallow and/or rocky, often on steep slopes. The soils are slightly leached and lime occurs regularly. This is the typical pattern across most of the study area.

The A-group of land types refers to lands where red and yellow, freely drained soils are dominant (MacVicar *et al.*, 1974). Unit Ag refers to land in which red, slightly leached soils of less than 300 mm occur.

Figure 4: Aerial image of the study area with the site boundary in red.

Climate

The study area is within an arid environment with an annual rainfall of just over 200 mm per annum (Mucina & Rutherford 2006). Rainfall can potentially occur at any time of the year, but is more likely in mid to late winter, most often from May to August (Mucina & Rutherford 2006). Winter frost is common and occurs on average 30 days per year (Mucina & Rutherford 2006). In contrast, summers can be very hot (Mucina & Rutherford 2006).

Broad vegetation patterns

There are two regional vegetation types occurring in the study area, namely Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld (Figure 5). The vegetation types that occur on site and nearby areas are briefly described below.

Koedoesberge-Moordenaars Karoo

<u>*Distribution*</u>

Found in the Western Cape and Northern Cape Provinces in the Koedoesberge and Pienaar se Berg low mountain ranges bordering on southern Tanqua Karoo and separated by the Klein Roggeveld Mountains from the Moordenaars Karoo in the broad area of Laingsburg and Merweville. The unit also includes the Doesberg region east of Laingsburg and

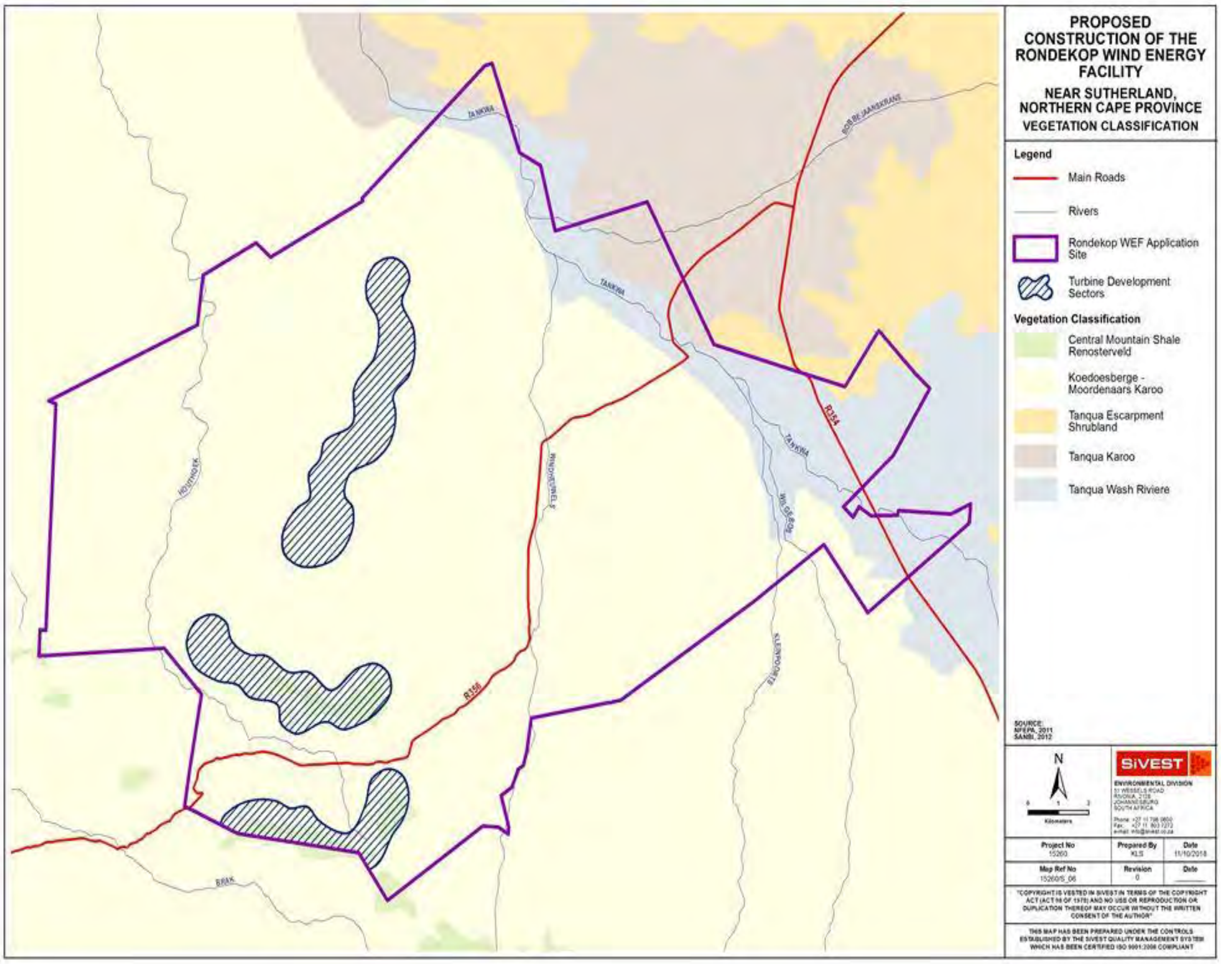

Figure 5: Broad vegetation types of the study area.

piedmonts of the Elandsberg as far as beyond the Gamkapoort Dam at Excelsior (west of Prince Albert). The vegetation type occurs at an altitude of 500–1 250 m (most of the area is at 680–1 120 m).

Vegetation & Landscape Features

The vegetation occurs on slightly undulating to hilly landscape covered by low succulent scrub and dotted by scattered tall shrubs, patches of 'white' grass visible on plains, the most conspicuous dominants being dwarf shrubs of *Pteronia*, *Drosanthemum* and *Galenia*.

Geology & Soils

Mudstone (mainly), shale and sandstone of the Adelaide Subgroup (Beaufort Group), accompanied by sandstone, shale and mudstone of the Permian Waterford Formation (Ecca Group) and sandstone and shale of other Ecca Group Formations as well as Dwyka Group diamictites (all of the Karoo Supergroup). This geology gives rise to shallow, skeletal soils. Region is classified as Fc land type (to a large extent), with Ib land type playing a subordinate role.

Climate

Probability of rain is given for the entire year, but it is higher in winter. MAP slightly above 200 mm. There are two slight rainfall optima: one in March and another spread from May to August. MAT close to 16°C and incidence of frost relatively high (30 days).

Important Taxa

Succulent Shrubs	*Hereroa odorata (d), Antimima fergusoniae, Antimima maxwellii, Antimima wittebergensis, Aridaria noctiflora* subsp. *straminea, Crassula nudicaulis, Crassula rupestris* subsp. *commutata, Cylindrophyllum comptonii, Drosanthemum framesii, Drosanthemum karrooense, Drosanthemum lique, Euphorbia decussata, Euphorbia eustacei, Euphorbia mauritanica, Hoodia gordonii, Hoodia grandis, Lycium oxycarpum, Manochlamys albicans, Peersia macradenia, Pelargonium crithmifolium, Ruschia grisea, Ruschia intricata, Salsola aphylla, Sarcocaulon crassicaule, Sceletium rigidum, Tetragonia robusta* var. *psiloptera, Trichodiadema barbatum, Tylecodon reticulatus, Tylecodon wallichii* subsp. *wallichii, Zygophyllum flexuosum*
Tall Shrub	*Diospyros pallens*
Low Shrubs	*Pteronia incana (d), Amphiglossa tomentosa, Aptosimum indivisum, Aptosimum spinescens, Asparagus burchellii, Asparagus capensis* var. *capensis, Athanasia minuta* subsp. *inermis, Barleria stimulans, Berkheya spinosa, Chrysocoma ciliata, Eriocephalus africanus, Eriocephalus ericoides, Eriocephalus pauperrimus, Eriocephalus spinescens, Euryops lateriflorus, Felicia filifolia, Felicia macrorrhiza, Felicia muricata, Felicia scabrida, Galenia africana, Galenia fruticosa, Garuleum bipinnatum, Helichrysum lucilioides, Hermannia grandiflora, Hermannia multiflora, Lessertia fruticosa, Limeum aethiopicum, Melolobium candicans, Menodora juncea, Microloma armatum, Monechma spartioides, Muraltia scoparia, Pelargonium hirtum, Pentzia incana, Polygala seminuda, Pteronia adenocarpa, Pteronia ambrariifolia, Pteronia empetrifolia, Pteronia glauca, Pteronia glomerata, Pteronia pallens, Pteronia scariosa, Pteronia sordida, Rhigozum obovatum, Senecio haworthii, Tripteris sinuata, Zygophyllum microphyllum, Zygophyllum retrofractum, Zygophyllum spinosum*
Semiparasitic Shrub	*Thesium lineatum*
Woody Climbers	*Asparagus fasciculatus, Asparagus racemosus, Asparagus retrofractus, Microloma sagittatum*
Herbaceous Climber	*Fockea sinuata*
Semiparasitic Epiphytic Shrub	*Viscum capense*
Herbs	*Atriplex suberecta, Felicia bergeriana, Gazania jurineifolia* subsp. *scabra, Hermannia althaeifolia, H. pulverata, Lepidium africanum, L. desertorum, Leysera tenella, Pelargonium minimum, Pelargonium nervifolium, Syncarpha dregeana, Ursinia nana, Zaluzianskya inflata, Zaluzianskya peduncularis*
Geophytic Herbs	*Drimia intricata, Geissorhiza karooica, Ixia marginifolia, Ixia rapunculoides, Ornithogalum adseptentrionesvergentulum, Oxalis obtusa, Romulea austinii, Romulea tortuosa* subsp. *tortuosa, Strumaria karooica, Strumaria pubescens, Trachyandra thyrsoidea*
Succulent Herbs	*Astroloba foliolosa, Astroloba spiralis, Brownanthus vaginatus, Crassula deceptor, Crassula muscosa, Crassula tomentosa, Deilanthe thudichumii, Haworthia marumiana* var. *archeri, Mesembryanthemum stenandrum, Pectinaria articulata, Piaranthus parvulus, Psilocaulon coriarium, Psilocaulon junceum, Quaqua arenicola* subsp. *arenicola, Quaqua arida, Quaqua*

	ramosa, Stapelia pillansii, Stapelia rufa, Stapeliopsis exasperata, Tetragonia microptera, Tripteris aghillana var. *integrifolia*
Parasitic Herb	*Hyobanche glabrata*
Graminoids	*Aristida adscensionis, A. diffusa, Ehrharta calycina, Ehrharta delicatula, Enneapogon scaber, Fingerhuthia africana, Karroochloa tenella, Pentaschistis airoides, Stipagrostis ciliata, S. obtusa*

Biogeographically Important Taxa
([GKB]Great Karoo basin endemic, [RH]Roggeveld-Hantam endemic,[S]Southern distribution limit,[W]Western distribution limit)

Succulent Shrubs	*Deilanthe peersii*[W], *Hereroa crassa*[GKB], *Pleiospilos nelii*[GKB], *Rhinephyllum graniforme*[GKB], *Ruschia crassa*[GKB], *R. perfoliata*
Low Shrubs	*Felicia lasiocarpa*[GKB], *Sericocoma pungens*[S]
Herbs	*Helichrysum cerastioides* var. *aurosicum*[W], *Ifloga molluginoides*[S]
Geophytic Herbs	*Brunsvigia comptonii*[S], *Drimia karooica*[W]
Succulent Herbs	*Aloe longistyla*[W], *Crassula hemisphaerica*[W], *Pectinaria longipes* subsp. *longipes*[RH], *Piaranthus comptus*[GKB], *Quaqua parviflora* subsp. *gracilis*[RH], *Tridentea parvipuncta* subsp. *parvipuncta*[GKB]

Endemic Taxa

Succulent Shrubs	*Antimima karroidea, A. loganii, Calamophyllum teretiusculum, Cerochlamys gemina, Drosanthemum comptonii, Ruschia karrooica, Tanquana archeri, Trichodiadema hallii, Tylecodon faucium*
Low Shrub	*Pelargonium stipulaceum* subsp. *ovato-stipulatum*
Semiparasitic Shrub	*Thesium marlothii*
Geophytic Herbs	*Lachenalia comptonii, Strumaria undulata*
Succulent Herbs	*Haworthia nortieri* var. *pehlemanniae*

Remarks
Koedoesberge-Moordenaars Karoo remains poorly researched from the vegetation-ecological point of view. This means that information on plant species occurring there, including those of conservation importance, is relatively poor.

Central Mountain Shale Renosterveld
Distribution
Northern and Western Cape Provinces: Southern and southeastern slopes of the Klein-Roggeveldberge and Komsberg below the Roggeveld section of the Great Escarpment (facing the Moordenaars Karoo) as well as farther east below Besemgoedberg and Suurkop west of Merweville and in the west in the Karookop area between Losper se Berg and high points around Thyshoogte. Altitude 1 050–1 500 m.
Vegetation & Landscape Features
Slopes and broad ridges of low mountains and escarpments, with tall shrubland dominated by renosterbos and large suites of mainly nonsucculent karoo shrubs and with a rich geophytic flora in the undergrowth or in more open, wetter or rocky habitats.
Geology & Soils
Clayey soils overlying Adelaide Subgroup (Beaufort Group of the Karoo Supergroup) mudstones and subordinate sandstones. Glenrosa and Mispah forms are prominent. Land types mainly Ib and Fc.
Climate
Arid to semi-arid climate. MAP 180–410 mm (mean: 290 mm), with relatively even rainfall, but still showing a slight high in autumn-winter. Mean daily maximum and minimum temperatures 29.9°C and 0.9°C for January and July, respectively. Frost incidence 20–50 days per year.
Important Taxa

Low Shrubs	*Elytropappus rhinocerotis (d), Amphiglossa tomentosa, Asparagus capensis* var. *capensis, Chrysocoma ciliata, C. oblongifolia, Diospyros austro-africana, Eriocephalus africanus* var. *africanus, E. ericoides* subsp. *ericoides, E. eximius, E. grandiflorus, E. microphyllus* var. *pubescens, E. pauperrimus, E. purpureus, Euryops imbricatus, Exomis microphylla, Felicia filifolia* subsp. *filifolia, F. muricata* subsp. *muricata, F. ovata, Galenia africana, Helichrysum dregeanum, H. lucilioides, Hermannia multiflora, Lessertia fruticosa, Lycium cinereum, Nenax microphylla, Pelargonium abrotanifolium, Pentzia incana, Pteronia ambrariifolia, P. glauca, P. glomerata, P. incana, P.*

	sordida, Rosenia glandulosa, R. humilis, R. oppositifolia, Selago albida, Tripteris sinuata, Zygophyllum spinosum
Succulent Shrubs	*Delosperma subincanum, Drosanthemum lique, Euphorbia stolonifera, Trichodiadema barbatum, Tylecodon reticulatus* subsp. *reticulatus, T. wallichii* subsp. *wallichii*
Woody Climber	*Asparagus aethiopicus*
Herbs	*Dianthus caespitosus* subsp. *caespitosus, Heliophila pendula, Lepidium desertorum, Osteospermum acanthospermum, Senecio hastatu*
Geophytic Herbs	*Bulbine asphodeloides, Drimia intricata, Othonna auriculifolia, Oxalis obtusa*
Succulent Herbs	*Crassula deceptor, C. muscosa, C. tomentosa* var. *glabrifolia, Senecio radicans*
Graminoids	*Ehrharta calycina, Karroochloa purpurea, Merxmuellera stricta*

<u>Remarks</u>

This is a very poorly known renosterveld type despite its interesting biogeographical borderline position—the unit straddles the Fynbos, Succulent Karoo and marginally the Nama-Karoo Biomes. It does not appear to have any endemic species.

Conservation status of broad vegetation types

On the basis of a scientific approach used at national level by SANBI (Driver *et al.*, 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 4 below, as determined by best available scientific approaches (Driver *et al.*, 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al.*, 2005).

Determining ecosystem status (Driver *et al.*, 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

Table 4: Conservation status of different vegetation types occurring in the study area.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver *et al.* 2005; Mucina *et al.* 2006	National Ecosystem List (NEM:BA)
Koedoesberge-Moordenaars Karoo	19	0.3	1	Least threatened	Not listed
Central Mountain Shale Renosterveld	27	0	1	Least threatened	Not listed

According to scientific literature (Driver *et al.*, 2005; Mucina *et al.*, 2006), as shown in Table 4, both vegetation types are listed as Least Threatened. The total extent of the Koedoesberge-Moordenaars Karoo vegetation type is 47,145,009 hectares, very little of which has been transformed. It extends from near Tankwa Karoo towards Laingsburg and slightly beyond.

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature.

Neither vegetation type is listed in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011).

Vegetation communities

The vegetation of the Hantam – Tanqua – Roggeveld subregion was scientifically described by Van der Merwe *et al.* (2008a, 2008b) as part of a contribution towards the Succulent Karoo Ecosystem Plan, a project initiated to develop a better understanding of the Succulent Karoo, recognized as one of the global hotspots of diversity (Myers *et al.* (2000). The Succulent Karoo Ecosystem Plan (SKEP) initiative was launched (with the sponsorship of the Critical Ecosystem Partnership Fund (CEPF) to identify and generate consensus for a 20-year conservation and sustainable land-use strategy for the Succulent Karoo hotspot of biodiversity (Conservation International – website 2006). The objective of the study by Van der Merwe (2009) was partly to gather botanical information on a regional scale by identifying, classifying and describing plant associations and subassociations present in the Hantam-Tanqua-Roggeveld Subregion. The site of the proposed Rondekop WEF falls within this region, which is useful because the described plant communities provide more detailed information for understanding vegetation patterns within the site.

The vegetation of Hantam – Tanqua – Roggeveld subregion occurs at the transition between the Fynbos Biome and the Succulent Karoo Biome and elements of both biomes are represented in the subregion. There are several vegetation units in the general area that includes the site of the proposed Rondekop WEF, including those related to the Fynbos Biome and those related to the Succulent Karoo Biome. These are shown in Figure 4.

The Fynbos Biome related vegetation units that are found in the study area are as follows:

a. *Galenia africana – Dicerothamnus rhinocerotis* Mountain Renosterveld (Variant 2.1.1)
b. *Merxmuellera stricta – Dicerothamnus rhinocerotis* Mountain Renosterveld (Subassociation 2.3)

The Succulent Karoo Biome related vegetation units that are found in the study area are as follows:

c. *Montinia caryophyllacea – Pteronia glauca* Roggeveld Escarpment Karoo (Subassociation 4.1)
d. *Galenia africana – Pteronia glauca* Escarpment Karoo (Subassociation 4.2)
e. Leipoldtia schultzei – *Eriocephalus purpureus* Hantam Karoo (Subassociation 5.3)
f. Windheuwel / Rooiheuwel mosaic
g. Tankwa drainage system

The Windheuwel/Rooiheuwel mosaic (W/R) is spatially diverse and consists of vegetation units 4.1, 4.2 on the rocky ridges and 7.3 on the brackish plains.

A brief description of the vegetation units, according to Van der Merwe *et al.* (2008a; 2008b), in the study area is presented below:

1. *Galenia africana – Dicerothamnus rhinocerotis* Mountain Renosterveld
(Variant 2.1.1 of Van der Merwe *et al.* 2008a)
This vegetation unit is floristically very diverse and occurs on the mudstones of the Beaufort Group and the shales of the Ecca Group. It occurs on undulating terrain at an altitude ranging from 600 m to 1300 m above sea level on light brown to brown sandy soils with low rock cover on undulating terrain. A high shrub cover is present, resulting primarily from the presence of *Dicerothamnus rhinocerotis* as well as the diagnostic species *Galenia africana*. Various annual species such as *Cotula nudicaulis*, *Polycarena aurea*, *Erodium cicutarium*, *Leysera tenella* and the annual grass *Bromus pectinatus* are present. This species composition was interpreted by Van der Merwe *et al.* (2008a) as being a result of disturbance. **The unit appears as only a small sliver in the south-eastern part of the study area and is not affected by any proposed infrastructure**.

2. *Tenaxia (=Merxmuellera) stricta – Dicerothamnus rhinocerotis* Mountain Renosterveld
(Subassociation 2.3 of Van der Merwe *et al.* 2008a)
This vegetation unit is located in the Roggeveld Mountains and includes the higher-lying vegetation of the Koedoesberg and Basterberg Mountains and according to Figure 4 covers most of the site, including the majority of the proposed infrastructure. It occurs on the mudstones of the Beaufort Group and the shales of the Ecca Group, and occasionally on dolerites. The high-lying gentle to moderately steep slopes are covered with stones and boulders. The altitude ranges from 900 to 1600 m above sea level. The renosterbos, *Dicerothamnus rhinocerotis*, the grass, *Tenaxia stricta*, and the dwarf shrub, *Chrysocoma ciliata*, are the dominant species. Other species present include *Asparagus capensis*, *Euryops lateriflorus* and *Eriocephalus ericoides*.

3. *Montinia caryophyllacea – Pteronia glauca* Roggeveld Escarpment Karoo
(Subassociation 4.1 of Van der Merwe *et al.* 2008b)
This vegetation unit characterizes the rocky west-facing slopes of the Roggeveld Mountains and occurs at intermediate altitudes of 700 to 1100 m above sea level. It occurs on gentle to moderate, and sometimes steep slopes with a high rock cover, generally more than 90%. The vegetation is characterised by a high shrub cover, while grasses and annuals are usually absent. The vegetation is dominated by *Pteronia glauca*, with *Montinia caryophyllacea* and *Tylecodon wallichii* the other prominent species. Other species with rarer occurrence include *Pentzia incana*, *Pteronia pallens*, *Asparagus capensis*, *Galenia africana* and *Crassula alpestris*.

4. *Galenia africana – Pteronia glauca* Escarpment Karoo
(Subassociation 4.2 of Van der Merwe *et al.* 2008b)
This vegetation unit is located on the rocky slopes of the Hantam Mountain, the Platberg escarpment and the slopes where the Roggeveld and Klein Roggeveld Mountains meet. It is also found between the Roggeveld and Koedoesberg Mountains in the vicinity of the farms Windheuwel and Rooiheuwel at altitudes ranging from 700 to 1200 m above sea level. It is located on the eastern side of the study area and is not affected by the proposed infrastructure. Ecca shales and dolerite intrusions predominate in this vegetation unit. The shrub cover is high while the grass and annual forb components are not well represented. *Pteronia glauca*, *Pentzia incana*, *Eriocephalus ericoides*, *Osteospermum sinuatum* and *Galenia africana* are the prominent species in this unit.

5. *Leipoldtia schultzei – Eriocephalus purpureus* Hantam Karoo (Subassociation 5.3)
This vegetation unit (part of the W/R mosaic occurring in the north and northeast of the site) is found predominantly on brackish plains at the southern extreme of the Tanqua Basin, i.e. Ceres Karoo, and between the Roggeveld and Koedoesberg Mountains. Shales of the Ecca Group and Dwyka tillites are found in these areas. The altitude ranges from 200 to 1000 m above sea level. The shrub cover is moderate while grasses and annual forbs are mostly absent. Prominent species include Malephora crassa, Atriplex lindleyi, Ruschia intricata, Mesembryanthemum noctiflorum, Salsola tuberculata and Pteronia pallens.

6. *Windheuwel / Rooiheuwel* mosaic
This vegetation unit (part of the W/R mosaic occurring in the north and northeast of the site) is found predominantly on brackish plains at the southern extreme of the Tanqua Basin, i.e. Ceres Karoo, and between the Roggeveld and Koedoesberg Mountains. Shales of the Ecca Group and Dwyka tillites are found in these areas. The altitude ranges from 200 to 1000 m above sea level. The shrub cover is moderate while grasses and annual forbs are mostly absent. Prominent species include Malephora crassa, Atriplex lindleyi, Ruschia intricata, Mesembryanthemum noctiflorum, Salsola tuberculata and Pteronia pallens.

7. Tankwa drainage system
This vegetation unit (part of the W/R mosaic occurring in the north and northeast of the site) is found predominantly on brackish plains at the southern extreme of the Tanqua Basin, i.e. Ceres Karoo, and between the Roggeveld and Koedoesberg Mountains. Shales of the Ecca Group and Dwyka tillites are found in these areas. The altitude ranges from 200 to 1000 m above sea level. The shrub cover is moderate while grasses and annual forbs are mostly absent. Prominent species include Malephora crassa, Atriplex lindleyi, Ruschia intricata, Mesembryanthemum noctiflorum, Salsola tuberculata and Pteronia pallens.

Biodiversity Conservation Plans

The Northern Cape Critical Biodiversity Area (CBA) Map (Figure 7) was published in 2016 (Holness & Oosthuysen 2016) and "updates, revises and replaces all older systematic biodiversity plans and associated products for the province". The Northern Cape Critical Biodiversity Area Map, published in 2016 (Holness & Oosthuysen 2016) derives CBAs from the earlier Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008). On the basis that there was limited biodiversity information for some parts of the province, including the current site, general correlations between biophysical parameters and known biodiversity patterns were used to define the CBAs. This included the fact that there is a perceived general increase in local diversity, as well as increased likelihood of encountering plant species of special concern, as elevation increases. This means that higher elevation areas generally have higher biodiversity value, although the specific location of such areas of high value were not known with great confidence. To accommodate this pattern and the low certainty, a proportion of all higher elevation areas were allocated by regional planners to CBA2 areas according to an algorithm that seeks a least-cost outcome for preserving biodiversity, i.e. the least amount of land space for preserving the greatest amount of area of biodiversity importance, as well as meeting specific conservation targets. The net result is that CBA2 areas on site may be identical in character to other natural areas on site that are not included in a CBA based on limited biodiversity information available for the site. Data collected in the field for this project (at the location of all turbines, substation options, and construction camp options) support the observation that there is no significant floristic difference on site between areas included within CBA2 areas and those outside of these designated areas.

The rationale for defining the recent (2016) CBA areas is derived from the earlier (2008) product. CBA1 and CBA2 areas in the 2016 map include the following areas:

1. Important Bird Areas;
2. SKEP expert identified areas;
3. Threatened species locations;
4. Features from previous conservation plans (including CBA1 and CBA2 areas from the Namakwa District Biodiversity Sector Plan);
5. Areas supporting climate change resilience, e.g. areas of high diversity, topographic diversity, strong biophysical gradients, climate refugia, including kloofs, south-facing slopes and river corridors;
6. Conservation Plans from adjacent provinces; and
7. Landscape structural elements, e.g. rocky outcrops, koppies, dolerite dykes, boulder fields, woody vegetation on outwash plains.

It is important to understand the basis for defining CBAs in the study area, because it identifies the features that are considered important for biodiversity and are, therefore, sensitive in the landscape. The Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008) identifies the following features that are specifically of relevance in the study area and that are important for conserving biodiversity:

1. South-facing Mountain Slopes >25ha in extent (= climate change refugia);
2. Kloofs >50ha in extent (= keystone biodiversity resource and climate change refugia);
3. Riverine Rabbit habitat;
4. Areas identified by experts as being important for biodiversity;
5. Critical sites for species;
6. Corridors;
7. Rivers.

The Northern Cape CBA map classifies the natural vegetation of the province according to conservation value in decreasing value, as follows:

1. Protected
2. Critical Biodiversity Area One (Irreplaceable Areas)
3. Critical Biodiversity Area Two (Important Areas)
4. Ecological Support Area
5. Other Natural Area

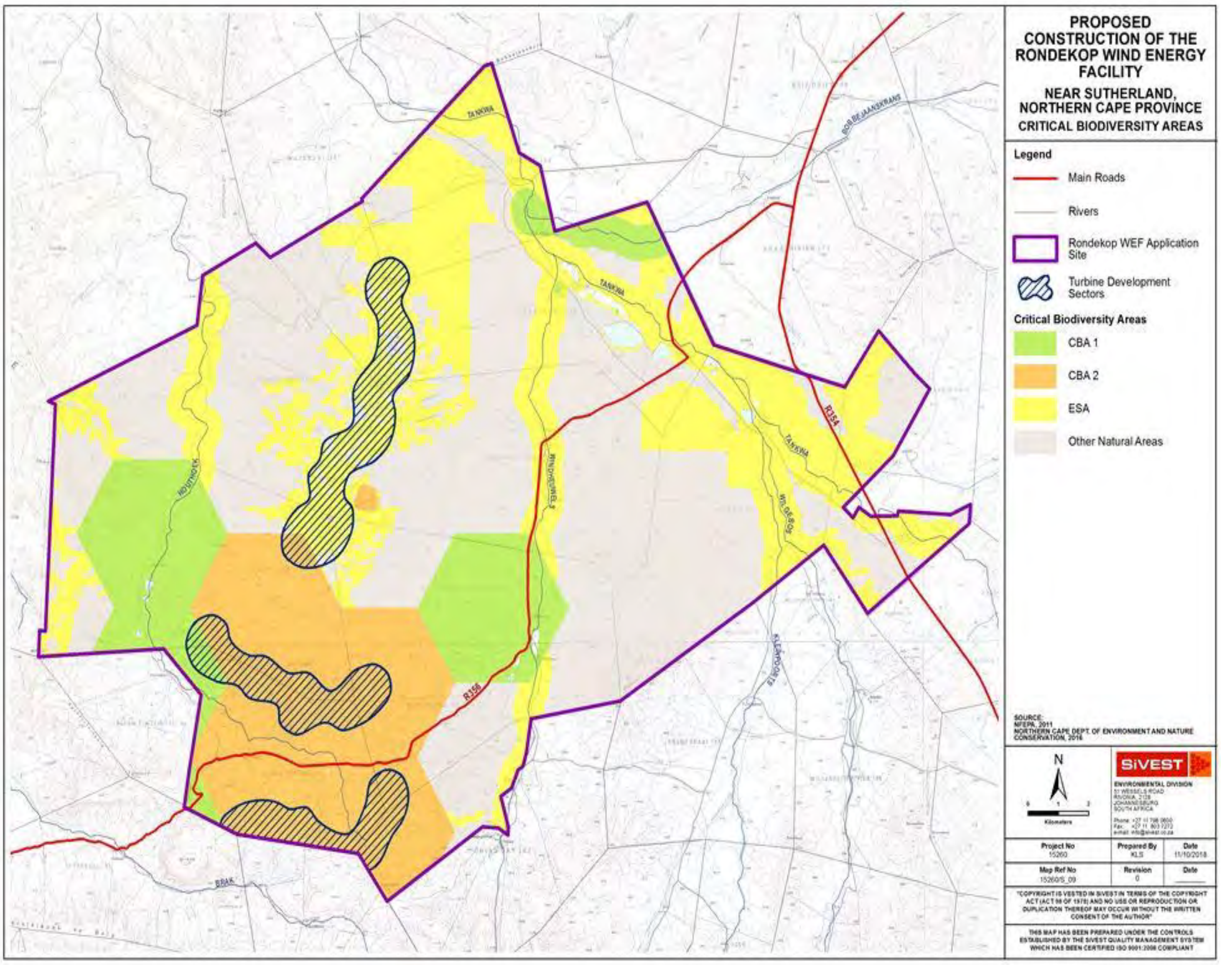

Figure 7: Northern Cape CBA map for the study area.

This shows features within the study area within three of these classes, as shown in Figure 7 below:

1. Critical Biodiversity Areas: The southern half of the site is mostly within a CBA2 area with two patches of CBA1 areas (see Figure 7 on previous page). For the current project, one turbine (turbine 25 and crane pad 25 and small section of an internal road – approximately 300 m) is located in the CBA1. There is also a small localised patch of CBA2 in the northern half that most likely is linked to the local occurrence of a species of concern, but no infrastructure affects this small area. All of the proposed infrastructure in the southern half of the site (the central ridge and the southern ridge) is within a CBA2 area.
2. Ecological Support Areas: All the higher-lying areas of the northern half of the study area are within ECAs**.** The dry river running along the eastern side of the study area (outside the study area) is also an ECA. This is relevant because some of the the proposed infrastructure, for example access roads, are within this general area.
3. Other Natural Areas: All remaining parts of the northern half of the site are indicated as being in a natural state.

The presence of CBA areas 1 and 2 in the southern half of the site indicate that these areas are considered important for biodiversity conservation at a regional level. Additionally, the ESAs in the northern half and to the east of the site indicate that the site has importance in a wider ecological context for supporting biodiversity patterns.

The Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008) provides recommended guidelines for land-use activities within different CBA categories and these provide the best indication of the type of development that may or may not be acceptable within these defined units. Those that are relevant to the current project are as follows:

Land use	CBA1	CBA2	ESA	ONA
Major/extensive development projects	N	N	R	R
Linear engineering structures	R	R	R	R

N=No, not permitted, R=Restricted, only when unavoidable, not usually permitted.

According to the Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008), the desired land management objective in CBA1 areas is to maintain the area in a natural state with no biodiversity loss. The Plan does not support developments that result in the **significant transformation** of natural habitat within CBA1 areas.

According to the Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008), the desired land management objective in CBA2 areas is to maintain the landscape in a near natural state, possibly allowing some loss in ecosystem integrity and functioning. Biodiversity compatible land uses are strongly encouraged, and industries encouraged to adopt and implement acceptable biodiversity management plans (Desmet & Marsh 2008). It is further recommended in the Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008) to restrict expansion of any activity that would cause loss of natural habitat and where possible utilise existing transformation or degraded areas for hard development.

Proposed protected areas

According to the National Parks Area Expansion Strategy (NPAES), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**. There are many areas outside of the study site, to the north, south, east and west that are included as being part of future protected areas, but not within or adjacent to the site itself.

Red List plant species of the study area

Lists of plant species previously recorded in the study area were obtained from the South African National Biodiversity Institute (SANBI) website (http://newposa.sanbi.org/). These are listed in Appendix 3. This list has been supplemented from information obtained from two published sources (Van der Merwe *et al.* 2008 a, b; Clark *et al.* 2011; Steyn *et al.* 2013) as well as a published specialist report for the neighbouring project (Ekotrust 2018). This list was refined for the study area after the suitability of the site had been assessed for the species on this list during a detailed field survey of the site.

Table 5: Explanation of IUCN Version 3.1 categories (IUCN 2001) and Orange List categories (Victor & Keith 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

The list contains 28 species listed in an IUCN threat category (Critically Endangered, Endangered or Vulnerable (see Table 5 above) of which **5 have a possibility of occurring in the general area** and in the type of habitats available in the study area. This does not mean that they will occur there, only that a literature review has identified that these are species that should be assessed as possibly occurring in the area. These species are as follows: ***Cliffortia arborea***, ***Helictotrichon barbatum***, ***Lachenalia longituba***, ***Lotononis venosa***, **and** ***Octopoma nanum***. **None of these species were encountered on the Rondekop site or on the neighbouring project** (Ekotrust 2018).

There are an additional five (5) species that are listed as Near Threatened that were assessed as having a possibility of occurring on site, two (2) of which have been recorded on the neighbouring project (Ekotrust 2018), namely *Geissorhiza karooica* (Iridaceae) and *Lachenalia whitehillensis* (Hyacinthaceae). Both of these are spring-flowering geophytes, and **neither was seen on the current site**. The other three (3) species are as follows: *Ehrharta eburnean*, *Pauridia alticola*, and *Romulea unifolia*. **None of these three species were found on the Rondekop site.**

There are an additional 24 species listed by SANBI as either Rare or Critically Rare, five (5) of which have been recorded on the neighbouring project (Ekotrust 2018), namely *Bulbine torta* (Asphodolaceae), *Cleretum lyratifolium* (Aizoaceae), *Eriocephalus grandiflorus* (Asteraceae), *Moraea contorta* (Iridaceae), and *Pectinaria articulata* (Apocynaceae). These are all late-winter to early spring-flowering plants, **none of which were seen on the current site.**

For all the species discussed here, it must be kept in mind that species are listed in a threat category or in a rarity category often due to being extremely rare as well as being threatened by some factor. They could also be highly cryptic or seasonal and therefore difficult to spot. It is usually very difficult to locate such species, even when it is known that they occur in a particular locality. One way of addressing this uncertainty is to attempt to identify habitats in which they are most likely to occur and then to treat these habitats as being potentially sensitive on the basis of being possible habitat for species of concern. This is somewhat circular, but of value in the absence of confirmed sitings. Logically, it is also only possible to prove the presence of a species, not its absence.

Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in Appendix 6. One (1) species on this list was found on site, namely *Hoodia gordonii* (see Figure 8 for plants found on site). This species is also protected according to the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009). There are no other plant species protected according to this legislation that have a geographical distribution that includes the study area.

Figure 8: Clump of *Hoodia gordonii* found on site, a protected species according to NEM:BA and NCNCA.

Hoodia gordonii

This species is widespread in the arid parts of South Africa and also occurs in Namibia, Botswana and Angola. It occurs in a wide variety of arid habitats from coastal to mountainous, on gentle to steep ridges and from dry, rocky places to sandy spots in riverbeds. It is harvested indiscriminately for its high economic value nationally and internationally. It can be locally common, but its status is unknown due to high levels of recent decline. It is currently listed as Data Deficient on the Red List of South African Plants (http://redlist.sanbi.org/species.php?species=2705-13, accessed on 10 October 2018). Two clumps were found on site (see Figure 8), but it is probable that a greater number occur there. Any impacts on this species will require a permit from the relevant authorities (DENC). This is the standard TOPS permit for which an application is made from the relevant department to remove / relocate / destroy individuals of this species. A walk-down survey is required to determine whether any plants are affected by the proposed WEF infrastructure and/or to obtain a count of how many plants are affected.

Protected plants (Northern Cape Nature Conservation Act)

Plant species protected under the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) are listed in Appendix 5. One (1) species on this list, *Hoodia gordonii*, is also protected according to the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) and has been discussed above. A number of species were found on site that are protected according to the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009). From the field surveys of the site, this includes the following species:

- *Aridaria noctiflora* (Family Aizoaceae) - common
- *Cheiridopsis namaquensis* (Family Aizoaceae) - common
- *Drosanthemum* species (Family Aizoaceae) - common
- *Galenia africana* (Family Aizoaceae) - common
- *Hammeria gracilis* (Family Aizoaceae)
- *Lampranthus* species (Family Aizoaceae)
- *Leipoldtia schultzei* (Family Aizoaceae) - common
- *Mesembryanthemum guerichianum* (Family Aizoaceae)
- *Psilocaulon junceum* (Family Aizoaceae)
- *Ruschia cradockensis* (Family Aizoaceae) – very common
- *Ruschia intricata* (Family Aizoaceae) – very common
- *Ruschia* sp. (Family Aizoaceae)
- *Boophone disticha* (Family Amaryllidaceae)
- *Hoodia gordonii* (Family Apocynaceae)
- *Aloe comosa* (Family Asphodolaceae)
- *Aloe microstigma* (Family Asphodolaceae) - common
- *Astroloba bullata* (Family Asphodolaceae) – locally common
- *Cotyledon papillaris* (Family Crassulaceae)
- *Cotyledon orbiculata* (Family Crassulaceae)
- *Crassula columnaris* subsp. *columnaris* (Family Crassulaceae)
- *Crassula cotyledonis* (Family Crassulaceae)
- *Crassula deltoidea* (Family Crassulaceae) - common
- *Crassula dependens* (Family Crassulaceae)
- *Crassula muscosa* L. var. *muscosa* (Family Crassulaceae)
- *Crassula rupestris* (Family Crassulaceae)
- *Crassula subaphylla* subsp. *subaphylla* (Family Crassulaceae) - common
- *Crassula tomentosa* subsp. *glabrifolia* (Family Crassulaceae)
- *Tylecodon paniculatus* (Family Crassulaceae) – locally common
- *Tylecodon reticulatus* subsp. *reticulatus* (Family Crassulaceae)
- *Tylecodon wallichii* subsp. *wallichii* (Family Crassulaceae) - common
- *Euphorbia decussata*
- *Euphorbia loricata* - common
- *Euphorbia multiceps*
- *Euphorbia rhombifolia* - common

- *Pelargonium abrotanifolium*
- *Pelargonium crithmifolium*
- *Pelargonium magenteum*
- *Moraea miniata* (Family Iridaceae)
- *Moraea* species (Family Iridaceae)
- *Albuca setosa*
- *Lachenalia alba*

Despite not being threatened, any impacts on these species (and other additional species that may be found that are listed as protected) will require a permit from the relevant authorities. Given the fact that the vegetation has a high proportion of succulent species and that plant families containing succulent species are protected, there is a possibility that additional protected species occur on site that were not detected during the field surveys. Note that many of these species are widespread and not of any conservation concern, but protected due to the fact that the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) protects entire families of flowering plants irrespective of whether some members are rare or common. The implication is that a comprehensive list of species occurring within the footprint of the proposed infrastructure is required and a permit application submitted for any of those listed as protected. The identity, location and numbers of protected plants will need to be established during a walk-down survey of the final infrastructure footprint, and the measures to manage these described in a Plant Rescue/Management Plan.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 2. There are none with a geographical distribution that includes the region in which the proposed project is located. There is one (1) species that has a geographical distribution that ends south of the study area, namely *Podocarpus latifolius*, but this species does not occur near to the site.

In summary, no species of protected trees were found or are likely to occur in the geographical area that includes the site.

Vertebrate animal species of the study area

Vertebrate species (mammals, reptiles, amphibians) with a geographical distribution that includes the study area are listed in Appendix 4. All threatened (Critically Endangered, Endangered or Vulnerable) or near threatened vertebrate animals that could occur in the study area and have habitat preference that includes habitats available in the study area, are discussed further below.

Mammals
There are 56 mammal species that have a geographical distribution that includes the study area, of which three (3) are listed in a conservation category of some level (see Appendix 3). This is a relatively moderate to low diversity of mammals compared to other parts of South Africa. Based on the natural state of the study area and surrounding areas, it is considered likely that many of these species could occur on site, especially the smaller species, such as various rodents, insectivores and small predators. Listed species with a geographical range that includes the site are discussed in more detail below to evaluate the potential for them to ocur on site.

Riverine Rabbit
The Riverine Rabbit (*Bunolagus monticularis*), listed as Critically Endangered, has not been previously recorded in the grid in which the site is located. Known records include grids further to the north, east and south of the current site (see Figure 7), most of which are on the highlands above the escarpment slopes. Although not previously recorded in the grid in which the site is located nor any immediately adjacent grids, the relatively wide distribution and scattered records, including a number of recent new sightings in widely-separated locations, suggest that there is a very small possibility of individuals occurring on site or migrating through the site, if suitable habitat occurs there. The species has narrowly defined habitat requirements and is found only in dense riverine vegetation on alluvial soils adjacent to seasonal rivers. Within the study area are a number of non-perennial watercourses, but none of these are significant in

Figure 9: Riverine Rabbit, listed as Critically Endangered.
(Picture obtained from http://karoospace.co.za/the-rarest-rabbit/)

terms of having both extensive and deep alluvial soils as well as dense riverine vegetation. **It is considered that there is a very low possibility of the species being found on site.** Nevertheless, any suitable habitat should be treated as sensitive and appropriately managed during this project.

Black Rhinoceros

The Black Rhinoceros (*Diceros bicornis bicornis*), listed as Critically Endangered, has a geographical distribution that includes the study area. The species is confined to formal conservation areas as well as a few individuals held on private land. **Although the habitat on site is suitable for this species, it does not occur there and would not be found there unless deliberately introduced.**

Grey Rhebok

The Grey Rhebok (*Pelea capreolus*), listed as Near Threatened, is endemic to South Africa, Lesotho and parts of Swaziland. In the south and southwest, their distribution is associated with the rocky hills of mountain Fynbos and the Little Karoo (Taylor *et al.* 2016). They are predominantly browsers, feeding on ground-hugging forbs, and largely water independent, obtaining most of their water requirements from their food (Taylor *et al.* 2016). Local declines in their population have been attributed to increased densities of natural predators, such as Black-backed Jackal, Caracals and Leopards. It has been recorded in both grids in which the site is located and a small number were seen on site. However, it is a relatively mobile species and not necessarily dependent on habitat at any particular location. Also, it is more likely to be found lower down in the topography of the study area, on the lowland plains and footslopes rather than high up on the ridge where the project is proposed to take place. It is likely to move away from the path of any construction

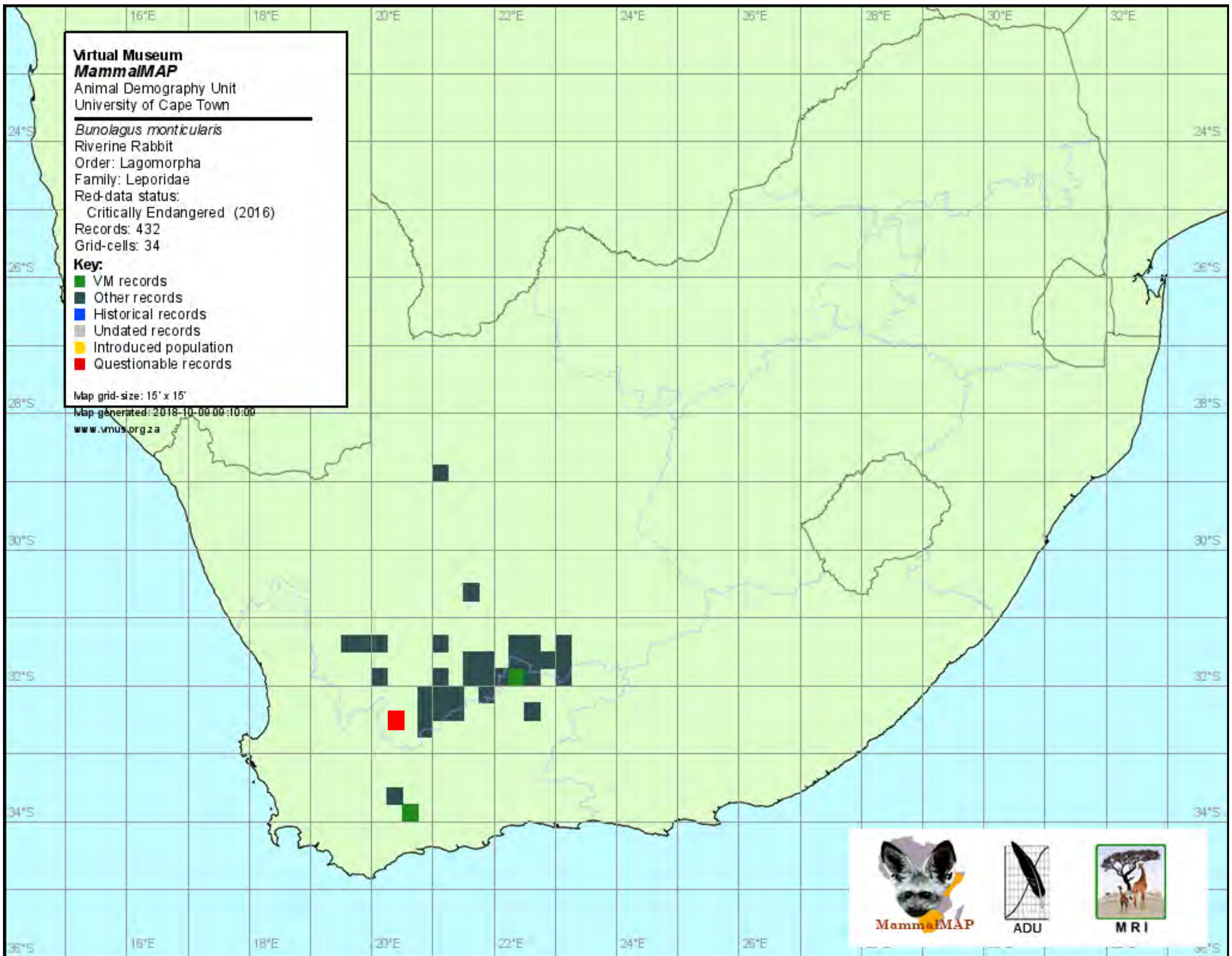

Figure 10: Known distribution of the Riverine Rabbit in South Africa.
(Obtained from the Virtual Museum of the animal Demography Unit (vmus.adu.org.za, downloaded on 9 October 2018). The study site grid square is shown in red.)

and development of parts of the study area. **The proposed development is therefore highly unlikely to have any negative effect on the species, even though it occurs there.**

Black-footed Cat

The Black-footed Cat (*Felis nigripes*), listed as Vulnerable, has been previously recorded in the grid to the north of the study area, but not in the grid in which the project is located. It's known distribution is on the inland part of most of South Africa, but seemingly not within the winter-rainfall part of the country. It also occurs in Botswana and Namibia. The current site is therefore on the western limit of its general distribution, although there is undoubtably a possibility of it occurring in the area. The species is nocturnal and carnivorous, favouring any vegetation cover that is low and not too dense. They make use of dens in the daytime, which can be abandoned termite mounds, or dens dug by other animals, such as aardvark, springhares or cape ground squirrels. Local declines in their population have been attributed to increased densities of natural predators, such as Black-backed Jackal, Caracals and Leopards. They are highly vulnerable to domestic carnivores. The study area is definitely suited to this species and it could occur there, although not likely in high densities. **The proposed development is therefore unlikely to have significant negative effect on the species, even though it is likely to occur there.**

Leopard

The Leopard (*Panthera pardus*), listed as Vulnerable, has a wide habitat tolerance, but with a preference for densely wooded areas and rocky areas. In montane and rocky areas of the Western and Northern Cape, they prey on dassies and klipspringers. They have large home ranges, but do not migrate easily, males having ranges of about 100 km^2 and females 20 km^2. It has been recorded in two adjacent grids, as well as throughout most of the Fynbos Biome. It has been confirmed by landowners to occur in the area, so there is a high probability of this species occurring on site, in which case it would be at very low densities. **The proposed project could displace individuals but is unlikely to have a significant effect on overall population densities.**

Spectacled Dormouse

The Spectacled Dormouse (*Graphiurus ocularis*), listed as Near Threatened, is endemic to South Africa, where it is found in the Northern, Eastern and Western Cape Provinces. It is associated with rock piles, crevices, outcrops and stone kraals. They may be territorial. The site is well-within the known distribution of this species and there are historical records for two adjacent grids to the east, although not from the current grid. There is therefore a high probability of the site being suitable for this species. **It is considered likely that it could occur on site and individuals could be affected by construction activities, if suitable habitat is damaged.**

African Striped Weasel

The African Striped Weasel (*Poecilogale albinucha*), listed as Near Threatened, is found throughout most of South Africa, except for the arid interior, and into central Africa (excluding Namibia). It has not been recorded in the grid in which the site is located or any surrounding grid, but the site is within the overall distribution range for the species. It is found primarily in moist grasslands and fynbos, where adequate numbers of prey may be found. **It is considered unlikely to occur in the study area and the proposed development will therefore not affect this species**.

Of the species currently listed as threatened or protected (see Appendix 5 for list of protected species), those listed in Table 6 are considered to have a low - medium probability of occurring on site and being potentially negatively affected by proposed activities on site.

Table 6: Mammal species of conservation concern with a likelihood of occurring on site.

Scientific name	Common name	Status	Likelihood of occurrence
Panthera pardus	Leopard	Vulnerable, protected	High
Graphiurus ocularis	Spectacled dormouse	Near Threatened	High
Mellivora capensis	Honey Badger	Protected	Medium
Felis nigripes	Black-footed Cat	Vulnerable	Medium
Pelea capreolus	Grey Rhebok	Near Threatened	Definite
Bunolagus monticularis	Riverine Rabbit	Critically Endangered, protected	Low

Reptiles
A total of 74 reptile species have a geographical distribution that includes the general study area in which the site is found (Alexander & Marais 2007, Bates *et al.* 2014, Branch 1988, Marais 2004, Tolley & Burger 2007). This is a fairly high potential diversity compared to average diversity in other parts of the country. Of the reptile species that could potentially occur in the study area, the Karoo Dwarf Tortoise, listed as Near Threatened, has been listed in a threat category.

<u>*Karoo Dwarf Tortoise*</u>
The Karoo Dwarf Tortoise (*Homopus boulengeri*), listed as Near Threatened, is associated with dolerite ridges and rocky outcrops of the southern Succulent Karoo and Nama-Karoo Biomes, and Albany Thicket in the southeast, at altitudes of approximately 800 m to 1 500 m. It occurs within dwarf shrubland that often contains succulent and grassy elements (Bates *et al.* 2014). It usually takes shelter under rocks in vegetated areas or in rock crevices. It has been previously recorded in the grid in which the site is located and, based on habitat requirements, **there is a high probability that the species could occur on site.**

<u>*Armadillo Girdled Lizard*</u>
The Armadillo Girdled Lizard (*Ouroborus cataphractus*), protected according to the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004), is endemic to the Succulent Karoo Biome in the winter rainfall zone of the Northern and Western Cape, South Africa (Mouton 2014).It occurs from the southern Richtersveld to the southern Tankwa Karoo and Matjiesfontein. It is group-living and found in rock crevices, especially of sandstone. It is particularly abundant on rock outcrops on the western coastal lowlands, but also found on lower mountain slopes

Figure 11: Armadillo Girdled Lizard, protected and CITES II listed.
(Picture obtained from http://biodiversityadvisor.sanbi.org/wp-content/uploads/sanbi-identify-it/reptiles/armadillo_girdled_lizard__cordylus_cataphractus.htm)

(Mouton 2014). It has been previously recorded in the grid in which the site is located as well as all the surrounding grids and, based on habitat requirements, **there is a high probability that the species occurs on site.**

There is therefore one (1) reptile species of conservation concern and one (1) protected reptile species that could potentially occur in the study area and that may therefore be affected by the proposed project, shown in Table 7.

Table 7: Reptile species of conservation concern with a likelihood of occurring on site.

Scientific name	Common name	Status	Likel;ihood of occurrence
Homopus boulengeri	Karoo Dwarf Tortoise	Near Threatened	High
Ouroborus cataphractus	Armadillo Girdled Lizard	Protected	High

Amphibians

A total of only seven (7) frog species have a geographical distribution that includes the general study area in which the site is found (Du Preez & Carruthers 2009). Some of these species are only marginally present in the study area due to the fact that their distribution range ends close to the study area. Of the frog species that could potentially occur in the study area, none are listed in a threat category.

It is concluded that the site contains habitat that is suitable for various frog species, although **no species of conservation concern are likely to occur in the study area**.

Table 8: Amphibian species of conservation concern with a likelihood of occurring on site.

Scientific name	Common name	Status	Likelihood of occurrence
None	None	N/A	N/A

Protected animals

There are a number of animal species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). According to this Act, "*a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7*". Such activities include any that are "*of a nature that may negatively impact on the survival of a listed threatened or protected species*". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

Those species protected according to the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) that have a geographical distribution that includes the site are listed in Appendix 6, marked with the letter "N". This includes the following species: Black Rhinoceros (does not occur on site), Honey Badger, Black-footed Cat, Leopard, Cape Fox, Riverine Rabbit (unlikely to occur on site) and Armadillo Lizard.

Due to habitat and forage requirements, and the fact that some species are restricted to game farms and/or conservation areas, only the Honey Badger, Black-footed Cat, Leopard, Cape Fox, Riverine Rabbit and Armadillo Lizard have any likelihood of occurring on site. Some of these species are mobile animals (Honey Badger, Black-footed Cat, Leopard, Cape Fox, Riverine Rabbit) that are likely to move away in the event of any activities on site disturbing them. However, there are some (Riverine Rabbit and Armadillo Lizard) that may be dependent on a small patch of habitat within their range to exist there. They could therefore be affected by the proposed development of the project.

Habitats on site

A map of habitats within the study area and adjacent areas is provided in Figure 16. Transformed areas where no vegetation occurs were insignificant in area and were not mapped. This included roads, farm buildings and similar existing disturbances. The broad natural habitat units on site are as follows:

1. Lowland plains vegetation (succulent karoo);
2. Mountain vegetation (more diverse succulent karoo), consisting of:
    a. Midslopes;
    b. Plateaus;
    c. Crests;
    d. Summits;
    e. Rock outcrops;
    f. Scarp valleys; and
3. Dry stream beds and associated riparian vegetation;
4. Wetland.

These are described in more detail below and the distribution of each is shown in Figure 16.

Figure 12: View showing succulent karoo vegetation on plains with steeper topography in background.

Lowland plains vegetation
The general study area is characterised by a low succulent, dwarf shrubland, typical of the regional vegetation type, **Koedoesberge-Moordenaars Karoo**, which is described as “low succulent scrub and… scattered tall shrubs, patches of ‘white’ grass visible on plains, the most conspicuous dominants being dwarf shrubs of *Pteronia*, *Drosanthemum* and *Galenia*” (Mucina & Rutherford 2006). A typical view of this vegetation on site is shown in Figure 12 below.

The general floristic character of this vegetation on site is fairly uniform across wide areas, often dominated by the same suite of species, including *Ruschia intricata*, *Drosanthemum karrooense, Pteronia incana, Galenia africana* and *Eriocephalus ericoides*. However, any local variation in topography can lead to localized increase in richness associated with a more diverse species composition. There is a high degree of succulence in the flora of this vegetation, a function largely of the aridity of the area, the mostly winter rainfall and the skeletal soils. The vegetation is drought-hardy and tolerant of a low level of grazing / browsing, but it has a low ability to recover from disturbance where the vegetation cover is removed. This is a typical pattern in arid areas where slow growth rates and water-scarcity do not allow rapid recovery from vegetation loss. In this vegetation, there are low rates of recruitment and existing plants are relatively old. The vegetation is an important cover for the landscape and, although not necessarily floristically sensitive, is sensitive to disturbance.

Mountain vegetation
This is essentially a variation on the plains vegetation with the exception of two important patterns related to local diversity and floristic composition:

1. The greater the local surface rockiness, the higher the diversity and the more likely it is that unusual species will be encountered; and

Figure 13: Vegetation in steeper parts of the landscape.

2. The higher the elevation the higher the local diversity and, once again, the higher the likelihood of finding unusual or rare plant species.

This habitat also falls primarily within **Koedoesberge-Moordenaars Karoo**, but in the southern half of the study area it also includes patches on the higher peaks of **Central Mountain Shale Renosterveld**. There is no regional difference in the sensitivity of these two vegetation types, but the pattern gives an indication of floristic variability on site.

There are several ecological differences between the mountainous areas and the flatter plains. The first is the increased steepness of the landscape (see Figure 13). The steeper areas sometimes have less stable substrates with looser soils, associated with the development of loose scree slopes. The vegetation is critical in stabilizing these areas. Areas lower down on slopes are vulnerable to any instability on areas higher up. The topography also introduces variation in slope and aspect, with some slopes facing hotter northern or western directions and others facing cooler southern and eastern directions, all of which introduces ecological variation into the landscape, providing new habitats for different species. Due to the sedimentary origin of the substrates, there are often bands of more resistant rock layers at specific heights on the mountain slopes. These substraits manifest themselves as small cliffs and rocky outcrops. There is a known diversity relationship between increased surface rockiness and increased local floristic species richness, which is true for the current study area, and many of the rarer floristic sitings on site were within rocky areas.

Riparian and floodplain vegetation

There is a network of dry stream beds throughout the lower-lying areas of the study area, with smaller streams eventually joining together to form larger systems further downstream. In the mountain areas these start as dry drainage lines, but these are not mapped as part of this unit since they reflect the characteritstics of the surrounding vegetation rather than that of being a unique habitat. Where the dry streams occur as a unique habitat, they consist of

Figure 14: Typical habitat on the banks of a small stream bed.

a sandy or rocky bed, often unvegetatated or sparsely vegetated, bordered by a line of shrubs or small thorn trees. A typical example is shown in Figure 14 below. As the stream beds get larger, the riparian fringe becomes more pronounced, often developing an almost impenetrable margin of thorn trees, as shown in Figure 15 below. There is a continuum from the smallest streams to the larger “rivers”.

The riparian areas have a species composition and structure that is almost completely different to the surrounding landscape. The habitat contains a combination of bare rock and deeper sands, so it is able to support a flora that is adapted to these substrate conditions, in addition to the sporadic flooding and scouring that takes place in these habitats as a result of rare large rainfall events. The thorn trees (and other shrubs) occur here because they are able to root deeply to access underground water, a source that is not available to other terrestrial habitats. Although not necessarily floristically sensitive, the habitat that is derived under these ecological conditions is critically important for fauna, providing food and shelter as well as corridors for undetected movement. In times of drought, riparian areas may offer the only slightly green vegetation as a source of food. The deeper sands are important for burrowing animals and the shrubs and low trees offer shelter and browse.

Riparian habitats are disproportionately important in terms of the proportion of the area that they occupy in the landscape – they probably occupy 5-10% of the landscape in total, but provide a unique and important habitat for both flora and fauna. The plant species occurring within these habitats are not necessarily rare in a global sense, but degradation of this interconnected system can cause floristic loss and change in areas far removed from any impact. Maintenace of regional vegetation patterns therefore is dependent on maintaining the health and functionality of this component of the landscape. For this reason, and for the utilitarian importance to fauna, the riparian vegetation is

Figure 15: Typical vegetation within a larger stream, characterised by thorn trees, *Vachellia karroo*.

considered to be ecologically sensitive. In addition, if there is any likelihood of the Riverine Rabbit occurring on site then this is the habitat in which it would be found.

Wetland

A single location was found on site where the plant species composition was interpreted as being a wetland. This included stands of *Phragmites australis* as well as *Tenaxia stricta*. The site was limited in extent (less than one hectare) and was located on the southern slopes of the central ridge on a relatively steep slope above a rocky ridge. It is unknown whether similar habitat occurs in other parts of the mountain outside the development footprint, but there are no further occurrences within the footprint of proposed infrastructure. Due to the limited occurrence of this habitat and the arid region in which the site is located, it is assumed that it is a rare habitat on site and therefore treated as sensitive.

Habitat sensitivity

To determine sensitivity on site, local and regional factors were taken into account. There are some habitats on site that have been described as sensitive in their own right, irrespective of regional assessments. This includes primarily the dry stream beds and associated riparian zones and adjacent floodplains however a detailed assessment of these areas has been undertaken by an aquatic specialist. Rocky outcrops and steep slopes, especially at higher elevations are more sensitive than surrounding areas, mainly due to higher floristic diversity and the likelihood of plant species with low local abundance occurring there.

In terms of other species of concern, including both plants and animals (with the exception of the Riverine Rabbit that has already been discussed), there are no specific locations where conservation of habitat would benefit a specific species based on the exsisitng data available. Both reptile species of concern, all mammal species of concern and all protected plant species described previously could occur on any part of the site, whether in the mountains or on the lowlands.

A summary of sensitivities that occur on site and that may be vulnerable to damage from the proposed project are as follows:

1. Dry stream beds, including the associated riparian habitats and adjacent floodplains;
2. Rock outcrops;
3. Very steep slopes (mapped as scarp valleys in Figure 16);
4. High-lying areas within mountain vegetation (plateaus, crests and mountain summits in Figure 16).

Based on this information, a map of habitat sensitivity on site is provided in Figure 17. This shows main habitat sensitivity classes on site, namely HIGH for rock outcrops and riparian habitats, MEDIUM-HIGH for plateaus, crests and mountain summits and MEDIUM for midslopes and lowland vegetation.

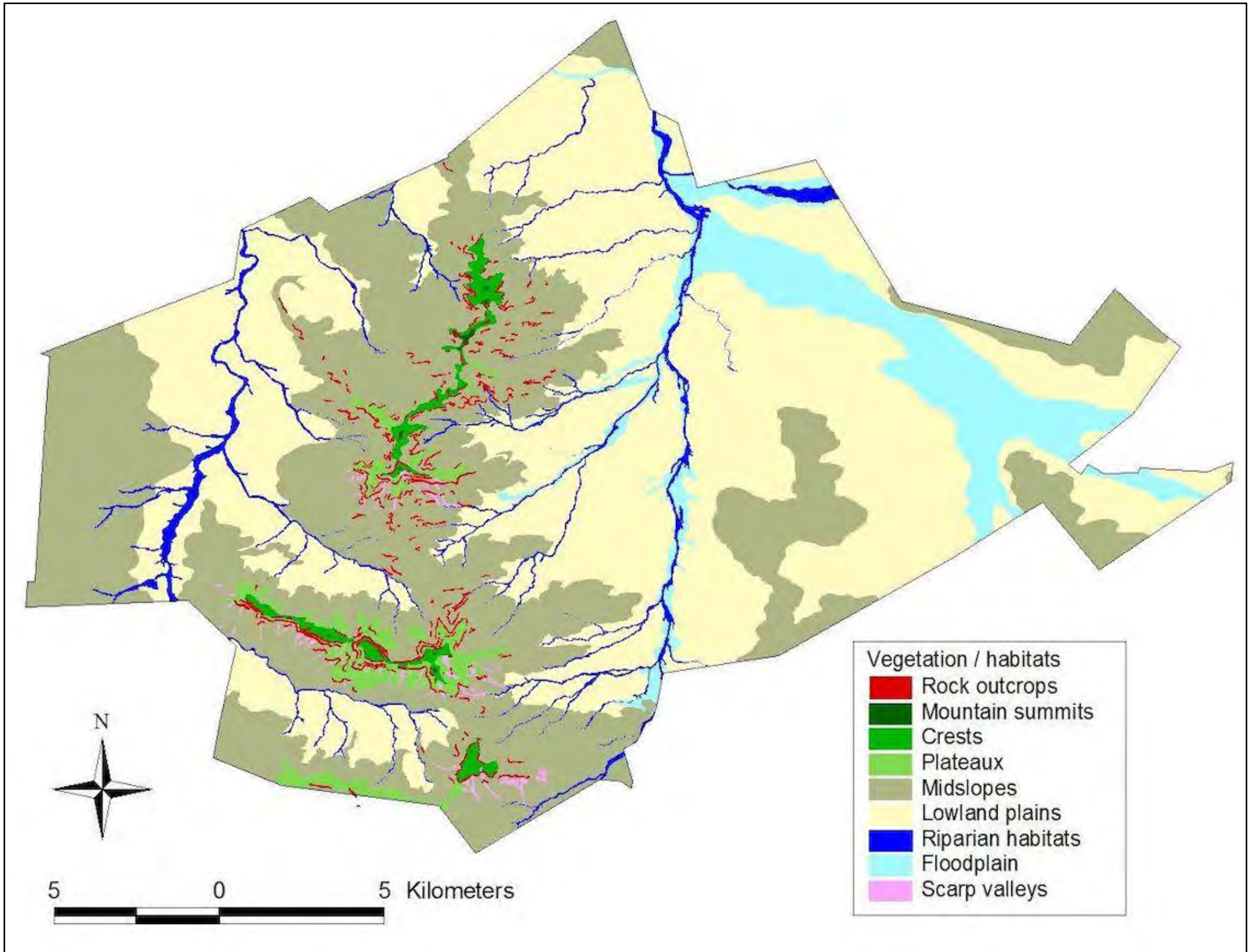

Figure 16: Main habitats of the study area.

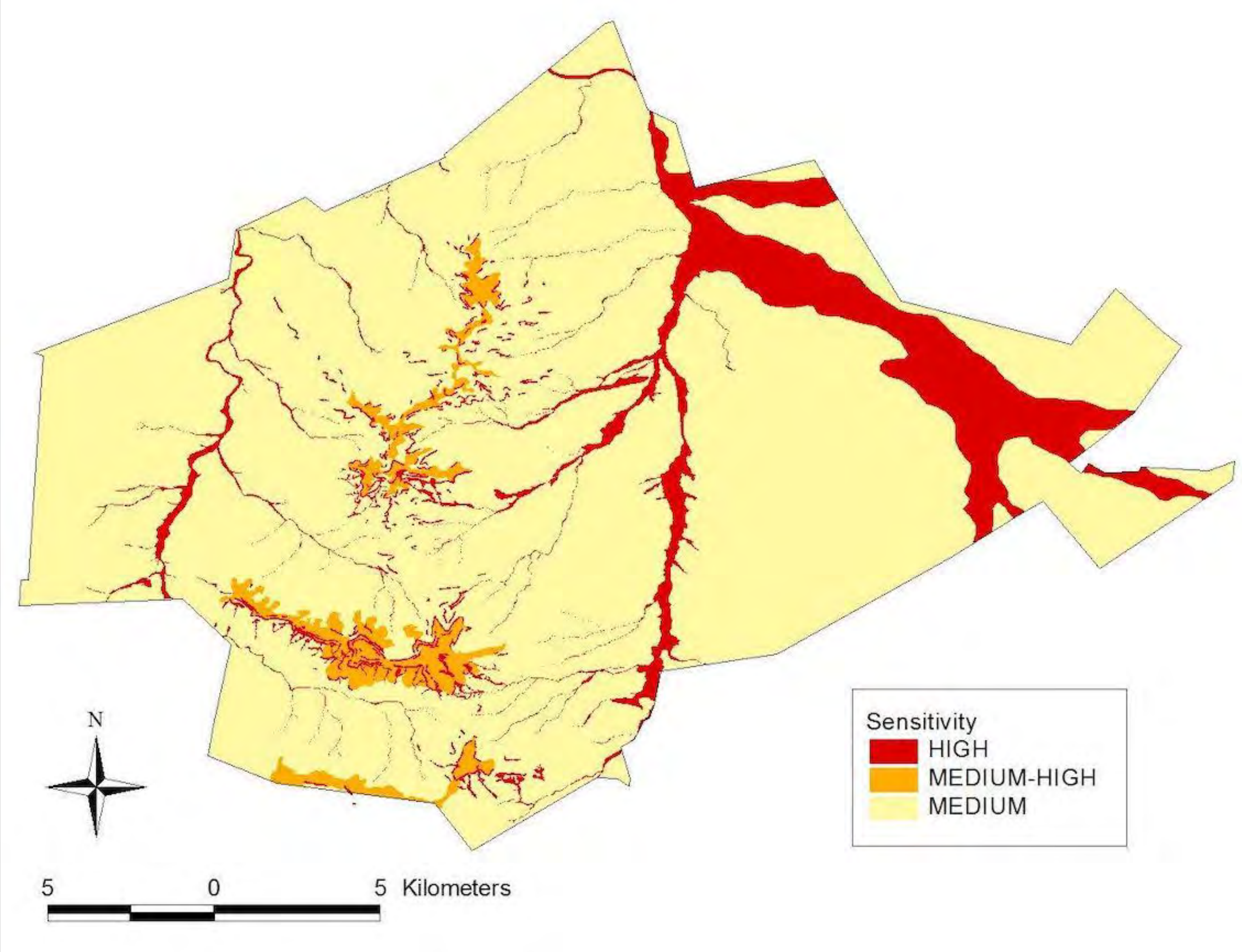

Figure 17: Habitat sensitivity of the study area.

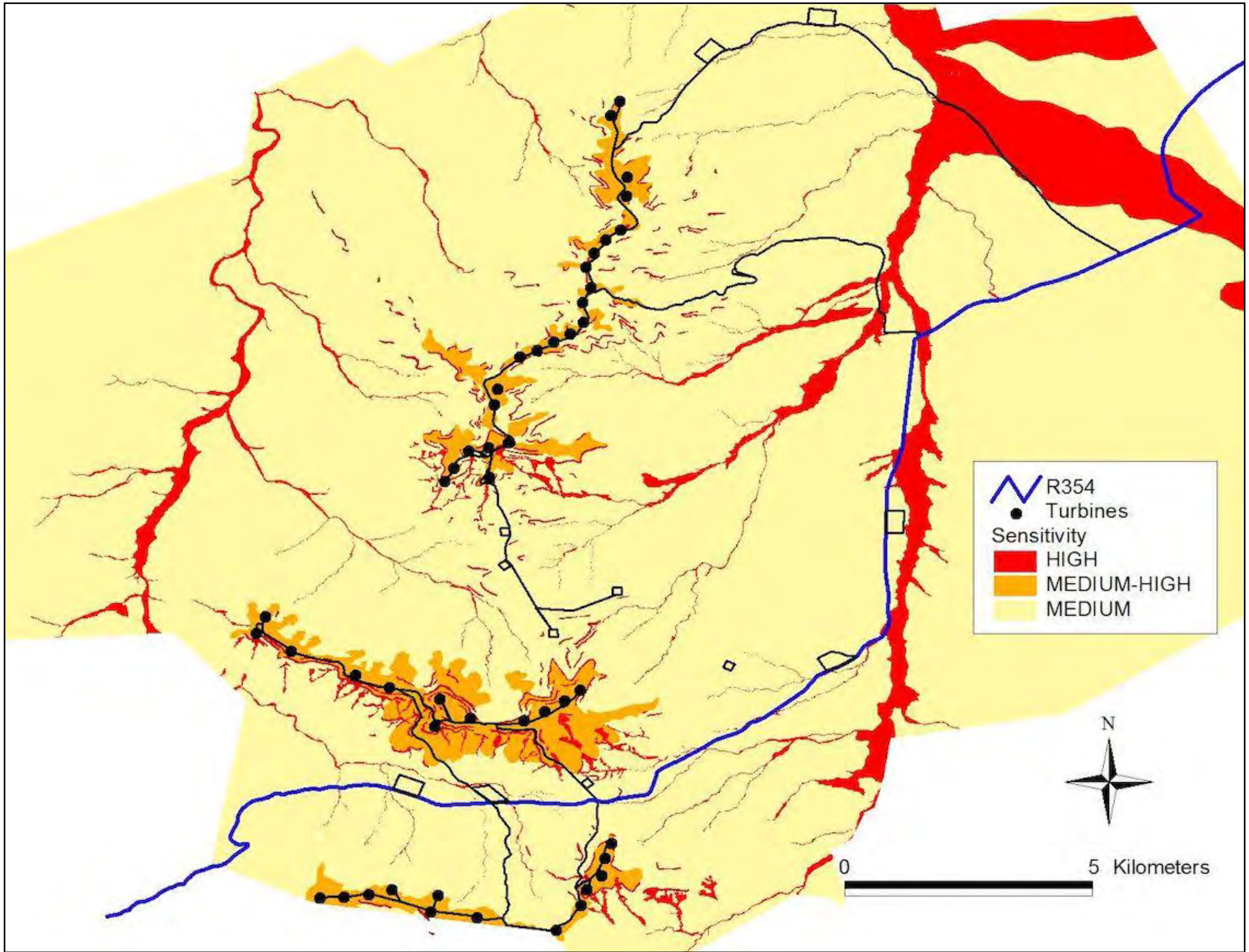

Figure 18: Proposed infrastructure in relation to habitat sensitivity.

DESCRIPTION OF POTENTIAL IMPACTS

Potential issues relevant to impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous grassland and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - disruption to nutrient-flow dynamics;
    - impedance of movement of material or water;
    - habitat fragmentation;
    - changes to abiotic environmental conditions;
    - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
    - changes to successional processes;
    - effects on pollinators; and
    - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

Potential sensitive receptors in the general study area

A summary of the potential ecological issues for the study area is as follows (issues assessed by other specialists, e.g. on birds and on freshwater function, are not included here as this has been dealt with by the revelent specialist in those fields):

- Presence of natural vegetation on site, some of which is within Critical Biodiversity Areas. All-natural vegetation on site is vulnerable to disturbance, especially direct habitat loss and habitat fragmentation.
- Presence of dry stream beds and associated riparian vegetation on site, assessed as being sensitive to impacts associated with development as well as being important habitat for various plant and animal species.
- Presence of protected plant species, namely *Hoodia gordonii*, protected according to the National Environmental Management: Biodiversity Act (Act 10 of 2004).
- Potential presence of plant species of conservation concern (SCC). The identity of these species is difficult to determine due to the lack of scientific information of the vegetation and flora of the study area. There have been some general vegetation studies, but knowledge of which species of concern could potentially occur on site is poorly known.
- Presence of various plant species protected according to the Northern Cape Nature Conservation Act (Act 9 of 2009). Most of the species that are likely to be affected have been identified during the field surveys, but the exact number and location of affected plants needs to be determined during a detailed walk-down survey of the final infrastructure footprint.

- Potential presence of two (2) reptile species of concern, namely the Karoo Dwarf Tortoise, listed as Near Threatened, and the Armadillo Girdled Lizard, protected according to the National Environmental Management: Biodiversity Act (Act 10 of 2004).
- Potential presence of various mammal species of concern, including Honey Badger, Black-footed Cat, Leopard and Cape Fox, protected according to the National Environmental Management: Biodiversity Act (Act 10 of 2004). In addition, the Honey Badher is listed as Near Threatened.
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Design Phase Impacts

Direct impacts

Direct impacts include the following:

1. Loss and/or fragmentation of indigenous natural vegetation due to clearing.

Construction Phase Impacts

Direct impacts

Direct impacts include the following:

1. Loss and/or fragmentation of indigenous natural vegetation due to clearing;
2. Loss of individuals of plant species of conservation concern and/or protected plants;
3. Loss of faunal habitat and refugia;
4. Direct mortality of fauna due to machinery, construction and increased traffic;
5. Displacement and/or disturbance of fauna due to increased activity and noise levels;
6. Increased poaching and/or illegal collecting due to improved access to area;
7. Effects on physiological functioning of vegetation due to dust deposition; and
8. Impact on integrity of Critical Biodiversity Areas.

Indirect impacts

Indirect impacts during the construction phase include the following:

1. Establishment and spread of alien invasive plants due to the clearing and disturbance of indigenous vegetation;
2. Changes to behavioural patterns of animals, including possible migration away or towards the project area; and
3. Increased runoff and erosion due to clearing of vegetation, construction of hard surfaces and compaction of surfaces, leading to changes in downslope areas.

Operational Phase Impacts

Direct impacts

Ongoing direct impacts will include the following:

1. Continued disturbance to natural habitats due to general operational activities and maintenance; and
2. Direct mortality of fauna through traffic, illegal collecting, poaching and collisions and/or entanglement with infrastructure.

Indirect impacts

These will include the following:

1. Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors;
2. Continued runoff and erosion due to the presence of hard surfaces that change the infiltration and runoff properties of the landscape; and
3. Changes to behavioural patterns of animals, including possible migration away or towards the project area.

Decommissioning Phase Impacts

Direct impacts

These will include the following:

1. Loss and disturbance of natural vegetation due to the removal of infrastructure and need for working sites;
2. Direct mortality of fauna due to machinery, construction and increased traffic;
3. Displacement and/or disturbance of fauna due to increased activity and noise levels; and
4. Effects on physiological functioning of vegetation due to dust deposition.

Indirect impacts

These will occur due to renewed disturbance due to decommissioning activities, as follows:

1. Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors;
2. Changes to behavioural patterns of animals, including possible migration away or towards the project area.

Cumulative impacts

These include the following:

1. Cumulative impacts on indigenous natural vegetation due to clearing;
2. Cumulative impacts on individuals of plant species of conservation concern and/or protected plants;
3. Cumulative impacts on ecological processes;
4. Cumulative impacts on fauna;
5. Cumulative impacts due to establishment and spread of alien invasive plant species;
6. Cumulative impacts due to loss of protected animals; and
7. Cumulative impacts on Critical Biodiversity Areas and conservation planning.

Cumulative impacts

The projects listed in Table 9 have been identified within a 50 km radius of the Rondekop WEF (shown in Figure 19 below) and are included in the Cumulative Impact Assessment. There are 17 projects listed that cover a fairly broad area, mostly to the east, south-east and south of the current project. The combination of all projects together also includes most of the natural environment in this quadrant relative to the current project (see Figure 19).

Table 9: Projects within a 50 km radius of the Rondekop WEF.

NAME	MEGAWATT	STATUS
Brandvalley WEF	140	Approved
Esizayo WEF	140	Approved
Gunstfontein WEF	200	Approved
Hidden Valley (Karusa & Soetwater) WEF	140 each	Preferred bidders. Construction to commence in 2019
Hidden Valley (Greater Karoo) WEF	140	Approved
Kareebosch WEF	140	Approved
Komsberg West and East WEF	140 each	Approved
Kudusberg WEF	325	In process
Maralla WEF (East and West)	140 each	Approved
Perdekraal East WEF	110	Under construction
Perdekraal West WEF	150	Approved
Rietkloof WEF	36	Approved
Roggeveld WEF	140	Preferred bidders. Construction to commence in 2019
Sutherland WEF	140	Approved
Sutherland SEF	10	Approved
Tooverberg WEF	140	In process
Witberg WEF	120	Approved

There are various cumulative impacts that may occur as a result of the combined impact of a number of similar projects in the area, as follows:

1. Loss and/or fragmentation of indigenous natural vegetation due to clearing;
2. Loss of individuals of plant species of conservation concern and/or protected plants;
3. Changes to ecological processes at a landscape level;
4. Mortality, displacement and/or disturbance of fauna;
5. General increase in the spread and invasion of new habitats by alien invasive plant species;
6. Impacts on protected fauna;
7. Effects on the landscape in such a way as to negatively affect Critical Biodiversity Areas.

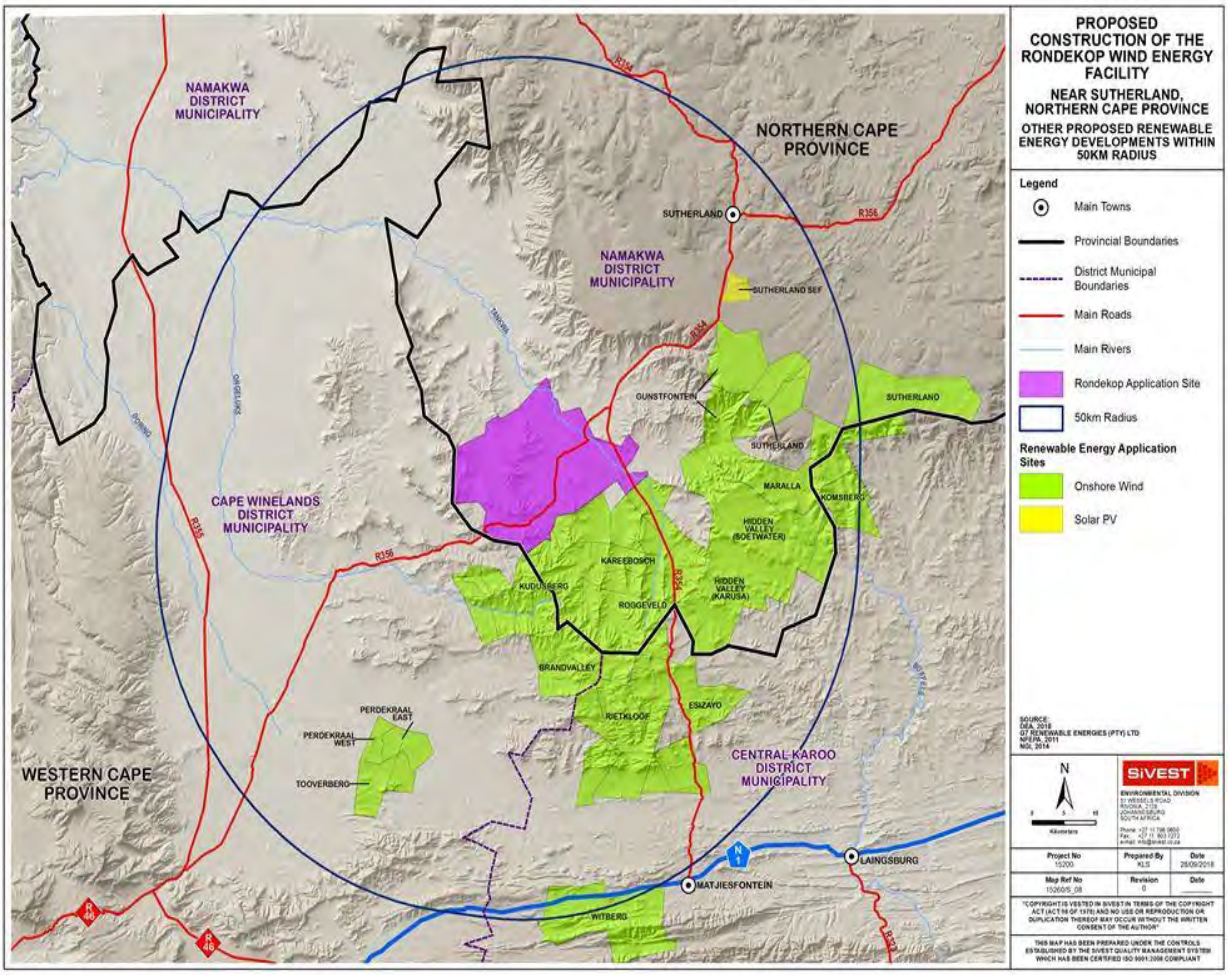

Figure 19: Other proposed renewable energy developments within 50 km radius.

ASSESSMENT OF SIGNIFICANCE OF ECOLOGICAL IMPACTS

Design Phase Impacts

A full assessment of Construction Phase impacts is provided in the next section. Since no impact occurs during the Design Phase of the project, the impact cannot be scored because there is no on-the-ground effect, until construction takes place. Nevertheless, measures taken during the Design Phase of the project can potentially have a significant effect on the nature, extent and intensity of impacts experienced during the Construction Phase.

Impact 1: Loss and/or fragmentation of indigenous natural vegetation due to clearing

Only measures that are implementable at the design phase of the project are discussed and assessed here. Note that the design is an iterative process that takes into account input from various specialists, including those from the study presented in this report. Some proposed modifications to infrastructure locations presented in this report (Proposed layout amendments chapter)have already been implemented. Please refer to the appropriate section for more detail on the proposed amnedments.

Table 10: Impact table for Impact 1: Loss and/or fragmentation of indigenous natural vegetation.

Loss and/or fragmentation of indigenous natural vegetation		
Environmental parameter	Indigenous natural vegetation	
Issue/Impact/Environmental Effect/Nature	Loss, degradation or fragmentation of vegetation.	
Extent	The impact will affect natural vegetation on **site**. Poor design could conceivably affect off-site areas, but this is considered unlikely. Design improvements can reduce the extent of areas that will be affected.	
Probability	If the project is authorized then the impact will **definitely** happen, although designing the project will not in itself cause any impacts whatsoever.	
Reversibility	Any design decision is fully reversible.	
Irreplaceable loss of resources	Improved design could concievabley reduce the degree to which biodiversity resources are affected.	
Duration	Construction impacts are assessed in the next section as being **Permanent**. Proposed mitigation measures at the Design Phase will not affect this assessment.	
Cumulative effect	Small design changes are unlikely to reduce the cumulative effect of the current project in combination with similar RE projects in nearby areas.	
Intensity/magnitude	Improved design can possibly reduce the intensity of impacts, although the categorical nature of the impact assessment methodology may be insensitive to incremental improvements in project design.	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	N/A	N/A
Probability	N/A	N/A
Reversibility	N/A	N/A
Irreplaceable loss	N/A	N/A
Duration	N/A	N/A

Cumulative effect	N/A	N/A
Intensity/magnitude	N/A	N/A
Significance rating	**N/A**	**N/A**
Mitigation measures	It is not possible to completely avoid impacts on indigenous vegetation for this project, although these will be restricted to a footprint of relatively limited extent. The following mitigation measures implementable at the Design Phase would help to ensure more extensive impacts are avoided and/or minimised: 1. Keep footprint as small as possible by selecting options that affect a smaller overall area of habitat. This measure has already been implemented through interaction between the design team and specialists. 2. Where possible, cluster infrastructure, rather than dispersing it widely. 3. As far as possible, locate infrastructure within areas that have been previously disturbed or in areas with lower sensitivity scores, taking the ecological sensitivity map into account. This measure has already been implemented through interaction between the design team and specialists. 4. Wherever technically possible, avoid sensitive features and habitats when locating infrastructure. This has already been implemented. 5. Cross streams and other linear features at right angles, where possible, and also near their end-points or where there are natural breaks in the feature. This has been taken into account with the road layouts. 6. Where possible, access roads should be located along existing farm, access and district roads, even if these require upgrading.	

Construction Phase Impacts

Impact 2: Loss and/or fragmentation of indigenous natural vegetation due to clearing

The regional vegetation type in the broad study area is primarily Koedoesberge-Moordenaars Karoo, classified in the scientific literature as Least Threatened (Mucina *et al.*, 2008) and not listed in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011). Any areas of natural habitat within this regional vegetation type are therefore considered to have moderate conservation value. Some infrastructure is located within Critical Biodiversity Areas for the Northern Cape, but the effect of this is assessed separately below.

Vegetation on site is within a very arid region and consists of slow-growing dwarf shrubs, many of which are partially succulent. These species are slow to grow, and individuals are probably much older than they appear from their size. Disturbed areas are not likely to recover to any natural state and clearing must therefore be kept to an absolute minimum to avoid habitat degradation issues.

Habitat loss refers to physical disturbance of habitats through clearing, grading and other permanent to semi-permanent loss or degradation. Loss of habitat on site could lead to loss of biodiversity as well as habitat important for the survival of populations of various species. Habitat fragmentation will occur primarily through the construction of roads. Edge effects related to roads are difficult to quantify or predict, but anything within 50 m of a road is almost certain to be affected by the changed physical conditions.

All infrastructure components will require clearing of vegetation prior to construction. However, the access roads, internal access roads, construction camps and crane pads will cause the greatest extent of vegetation loss. The substations and wind turbines will also require vegetation clearing, but this will be much smaller areas in comparison to the other components. **For all infrastructure components, loss of habitat will occur, but this will be relatively insignificant in comparison to the total area of the vegetation types concerned.**

Table 11: Impact table for Impact 2: Loss and/or fragmentation of indigenous natural vegetation.

Loss and/or fragmentation of indigenous natural vegetation		
Environmental parameter	Indigenous natural vegetation	
Issue/Impact/Environmental Effect/Nature	Loss, degradation or fragmentation of vegetation.	
Extent	The impact will affect natural vegetation on **site**.	
Probability	If the project is authorized then the impact will **definitely** happen.	
Reversibility	Within the immediate footprint of the infrastructure (turbine foundations, roads, and substation infrastructure), the impact is effectively **Irreversible** in human timeframes, since construction of roads and other hard surfaces completely remove vegetation and modify the substrate upon which it grows. In other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact is partially reversible in the sense that secondary vegetation in disturbed areas will probably never resemble the original vegetation found on site.	
Irreplaceable loss of resources	In the context of the vegetation type concerned, which is fairly widespread and has undergone little overall transformation to date, **marginal** loss of resources will occur and this will be within the footprint of the proposed infrastructure.	
Duration	Within the immediate footprint of the permanent infrastructure (turbine foundations, roads and substation) the impact will be **Permanent** (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). In other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact will be of long-term duration. The assessment here is for the permanently affected areas.	
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat from activities in the general region as well as the nearby similar RE projects, the current project will cause additional loss of vegetation, the cumulative effect of which will be **medium** (it will not be negligible, nor insignificant, therefore assessed as medium).	
Intensity/magnitude	Assessing the magnitude of the impact depends on the scale at which it is assessed – if considered at the scale of the constructed infrastructure, then the impact appears to be highly destructive (High intensity), but at the scale of the entire vegetation type, it is virtually insignificant (Low intensity). Taking local vegetation patterns into account, the intensity of the impact is assessed here as being of **Medium** intensity – the functional integrity of vegetation on site will be compromised to some degree, which can be limited to some extent by implementation of mitigation measures. Proposed mitigation measures will limit the extent of destruction in the sense that areas not permanently altered (crane pads, construction camp and disturbed areas adjacent to construction activities) will be expected to recover to a stable ecological state with time.[2]	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating

[2] Note that the impact assessment methodology requires placing a potential impact within a category of extent, probability, duration, etc. There are many cases where mitigation measures will have a clear effect on reducing an impact, but not to the degree that it would result in an assessed impact being placed in a lower category. The impact assessment methodology is categorical in nature and incremental improvements in design and implementation may possibly not lead to a change in the category in which a potential impact is placed. In the current case, mitigation measures can potentially reduce by approximately half the extent of the potential impact (loss of vegetation), which is a significant reduction, but the extent remains "Site", because there is no lower category. This does not reduce the value of proposed measures, even if it gives the appearance in the assessment that no improvement is realized.

Extent	1 (Site)	1 (Site)
Probability	4 (Definite)	4 (Definite)
Reversibility	4 (Irreversible)	3 (Partly reversible)
Irreplaceable loss	2 (Marginal loss of resources)	2 (Marginal loss of resources)
Duration	4 (Permanent)	3 (Long-term)
Cumulative effect	3 (Medium)	3 (Medium)
Intensity/magnitude	2 (Medium)	1 (low)
Significance rating	**-36 (medium negative)**	**-16 (low negative)**
Mitigation measures	It is not possible to completely avoid impacts on indigenous vegetation for this project, although these will be restricted to a footprint of relatively limited extent. The following mitigation measures would help to ensure more extensive impacts are avoided and/or minimised: 1. Restrict impact to development footprint only and limit disturbance spreading into surrounding areas. 2. Footprints of turbines, crane pads, construction sites and substation sites should be clearly demarcated. 3. Construct adequate structures at points where roads cross watercourses, either proper stabilized dips in the road or culverts that do not limit the width of natural channels or the natural hydrological function. 4. Ensure all possible steps are taken to limit erosion of surfaces, including proper management of storm-water runoff. 5. Compile a Rehabilitation Plan prior to the commencement of construction. 6. Compile an Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas. 7. Access to sensitive areas outside of development footprint should be strictly limited during construction.	

Impact 3: Impacts on listed or protected plant species

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat within which metapopulation dynamics occur (dispersal, recruitment, pollination, etc.).

There is one (1) species protected according to the National Environmental Management: Biodiversity Act, *Hoodia gordonii*, two (2) clumps of which were found on site during the field survey. No additional clumps or individuals were found on site during the detailed walk-through survey of all infrastructure. Neither clump is directly affected by the proposed project.

There are a number of species protected according to the Northern Cape Nature Conservation Act that were recorded on site during the walk-through survey. None of these are threatened species, but are protected according to Provincial legislation. These are listed in a section above in this report (Protected Plants [Northern Cape Nature Conservation Act] on pages 53 – 54).

Table 12: Impact table for impact 3: Loss of individuals of protected plants.

Loss of individuals of protected plants	
Environmental parameter	Protected plants, as per NEM:BA or NCNCA or listed plants
Issue/Impact/Environmental Effect/Nature	Loss of individuals occurring within the footprint of construction.
Extent	The impact will affect local populations or individuals of the affected species, which is at the **site** scale.
Probability	Based on the list of species that are protected or listed, the impact will **definitely** happen.

Reversibility	**Partly reversible**. Where necessary, individuals can be rescued or else cultivated to replace lost specimens, but in many cases the plants are from widespread and/or common species.	
Irreplaceable loss of resources	**Marginal** loss of resources could occur. The species that are likely to occur on site are likely to be relatively common throughout their range and they have very wide geographical ranges.	
Duration	The impact will be **medium-term**.	
Cumulative effect	**Low** cumulative impact. Cumulative effects will not be significant.	
Intensity/magnitude	Low. Loss of a small number of individuals will be insignificant compared to the number that probably occur in nearby natural areas as well as across the entire geographical range of the species.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	4 (Definite)	4 (Definite)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Marginal loss of resources)	1 (No loss of resources)
Duration	2 (Medium-term)	2 (Medium-term)
Cumulative effect	2 (Low)	1 (Negligible)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-13 (low negative)**	**-11 (low negative)**
Mitigation measures	A number of protected species were found on site. The following mitigation measures would help to avoid and limit impacts: **1. It is a legal requirement to obtain permits for specimens that will be lost.** 2. A detailed pre-construction walk-through survey will be required during a favourable season to locate any additional individuals of protected plants. This survey must cover the footprint of all approved infrastructure, including internal access roads (final infrastructure layout). 3. It is possible that some plants lost to the development can be rescued and planted in appropriate places in rehabilitation areas, but the description and appropriateness of such measures must be included in a Plant Rescue Plan. Any such measures will reduce the irreplaceable loss of resources as well as the cumulative effect. Note that Search and Rescue is only appropriate for some species. 4. A Plant Rescue Plan must be compiled to be approved by the appropriate authorities.	

Impact 4: Loss of faunal habitat and refugia

Construction activities will lead to direct loss of habitat favourable for various faunal species, including sites where mobile fauna would obtain refuge and sedentary fauna would have permanent homes. The total loss of habitat will be a relatively small proportion of the available habitat on site. Loss of habitat could potentially affect all animal species occurring on site, although threatened and protected species are of greater concern. There are two (2) animal species of particular concern for this project, namely the Karoo Dwarf Tortoise and the Armadillo Girdled Lizard, neither of which were seen on site, although they have been assessed as having a probability of occurring there. There are also other more mobile species that are protected by legislation, including the Honey Badger, Black-footed Cat, Leopard and Cape Fox.

Table 13: Impact table for Impact 4: Loss of faunal habitat and refugia.

Loss of faunal habitat and refugia		
Environmental parameter	Mobile fauna of conservation concern (Honey Badger, Black-footed Cat, Leopard, Riverine Rabbit and Cape Fox)	
Issue/Impact/Environmental Effect/Nature	Displacement of individuals.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	No or low loss of resources will occur.	
Duration	The impact will be short-term (construction phase).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Low. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable)	3 (Probable)
Reversibility	3 (Barely reversible)	3 (Barely reversible)
Irreplaceable loss	2 (Marginal)	2 (Marginal)
Duration	4 (Permanent)	3 (Long-term)
Cumulative effect	2 (Low)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-30 (medium negative)**	**-14 (low negative)**
Mitigation measures	1. Restrict impact to development footprint only and limit disturbance spreading into surrounding areas. 2. Limit clearing of natural habitat designated as sensitive, especially rocky outcrops, cliffs and riparian habitats, where possible. This has already been applied during the Design phase of the project where attempts have been made to avoid sensitive habitats. 3. All mitigation measures that apply to “Loss and/or fragmentation of indigenous natural vegetation” also apply here.	

Impact 5: Direct mortality of fauna due to machinery, construction and increased traffic

There is a possibility that animals will be killed by machinery during construction, especially sedentary or relatively sedentary species, and those that move too slowly to move out of the path of construction. This will inevitably lead to mortality of individuals of such animals. There is also a possibility of collisions with vehicles due to increased traffic along roads and within the project area. Faunal mortalities may also be caused by electric fences, ingestion of waste material and/or accidental ensnarement.

Table 14: Impact table for Impact 5: Mortality of fauna.

Mortality of individuals of fauna due to machinery, construction or increased traffic	
Environmental parameter	Fauna
Issue/Impact/Environmental Effect/Nature	Loss of individuals.
Extent	The impact will affect individuals on site.
Probability	The impact will probably happen to some extent.
Reversibility	Completely reversible. Impact is reversible with mitigation measures.
Irreplaceable loss of resources	Marginal loss of resources will occur.
Duration	The impact will be short-term (during construction phase only).
Cumulative effect	Negligible cumulative impact.
Intensity/magnitude	Low. Barely perceptible impact on population processes.

Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable))	2 (Possible))
Reversibility	1 (Completely reversible)	1 (Completely reversible)
Irreplaceable loss	2 (Marginal)	2 (Marginal)
Duration	1 (Short-term)	1 (Short-term)
Cumulative effect	1 (Negligible)	1 (Negligible)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-9 (low negative)**	**-8 (low negative)**
Mitigation measures	The following mitigation measures would help to avoid or limit impacts: 1. Access to sensitive areas outside of development footprint should not be permitted during construction. 2. Speed limits should be set for all roads on site, as well as access roads to the site. Strict enforcement of speed limits should occur – install speed control measures, such as speed humps, if necessary. 3. Night driving should be strictly limited and, where absolutely required, lower speed limits should apply for night driving. 4. Pre-construction walk-through in front of construction must be undertaken to move any individual animals, such as tortoises, prior to construction. 5. No dogs or other pets should be allowed on site, except those confined to landowners' dwellings. 6. Personnel on site should undergo environmental induction training, including the need to abide by speed limits, the increased risk of collisions with wild animals on roads in rural areas. 7. If electric fences are to be constructed at construction camp sites, these should be erected according to the standards of Nature Conservation authorities. 8. Proper waste management must be implemented, ensuring no toxic or dangerous substances are accessible to wildlife. This should also apply to stockpiles of new and used materials to ensure that they do not become a hazard.	

Impact 6: Displacement of mobile terrestrial fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the site. Mobile species of conservation concern that could potentially be affected by the proposed project are as follows:

1. Honey Badger,
2. Black-footed Cat,
3. Leopard,
4. Cape Fox, and
5. Grey Rhebok.

All these species are mobile terrestrial species with a large home range and the ability to travel long distances in short periods of time. Individuals may be locally displaced, but this will have little effect on the overall range of the species nor is it expected that any overall impacts will result from local displacement.

Table 15: Impact table for Impact 6: Displacement of terrestrial fauna.

Displacement of individuals of mobile terrestrial fauna

Environmental parameter	Mobile fauna of conservation concern (Honey Badger, Black-footed Cat, Leopard, Cape Fox and Grey Rhebok)	
Issue/Impact/Environmental Effect/Nature	Displacement of individuals.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	No or low loss of resources will occur.	
Duration	The impact will be short-term (construction phase).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Low. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	1 (None)	1 (None)
Duration	1 (Short-term)	1 (Short-term)
Cumulative effect	1 (Low)	1 (Low)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-8 (low negative)**	**-8 (low negative)**
Mitigation measures	1. Restrict impact to development footprint only and limit disturbance spreading into surrounding areas. 2. Access to sensitive areas outside of development footprint should not be permitted during construction. 3. Adhere to speed limits – install speed control measures, such as speed humps, if necessary 4. No hunting of protected species. 5. Personnel to be undergo induction and be educated about protection status of species, including distinguishing features to be able to identify protected species. 6. Report any mortality of protected species to conservation authorities (Northern Cape Nature Conservation, Tel.: 053 807 7300)	

Impact 7: Increased poaching and/or illegal collecting due to increased access to the area

The site is in a relatively remote area with moderately low access to the public. More importantly, access to mountainous areas is limited due to it being on private land. There is therefore a relatively low risk of opportunistic or targeted poaching of plants or animals. The construction of roads into the project area and the increased amount of traffic from outside areas will increase the opportunity for poaching or illegal collecting.

From a botanical perspective, there are a number of plants in succulent or geophyte groups that are attractive to collectors. There are also animals, such as lizards and tortoises that may be attractive to collectors or vulnerable to opportunistic collection. Many of these groups are protected under national and/or provincial legislation, but this does not necessarily prevent ill-informed or determined collectors.

Poaching of animals or plants for meat or medicinal purposes is a separate risk that is also more likely to occur where physical access is created.

Table 16: Impact table for Impact 7: Increased poaching and illegal collecting.

Increased poaching and/or illegal collection of plants and animals

Environmental parameter	Any plants and/or animals that are attractive to collectors and/or poachers	
Issue/Impact/Environmental Effect/Nature	Loss of individuals / populations.	
Extent	The impact will affect individuals on site.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	Low to marginal loss of resources will occur.	
Duration	The impact will be permanent (duration of the life of the roads).	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Low)	2 (Low)
Duration	4 (Permanent)	4 (Permanent)
Cumulative effect	2 (Low)	1 (Low)
Intensity/magnitude	2 (Low)	1 (Low)
Significance rating	**-26 (low negative)**	**-12 (low negative)**
Mitigation measures	1. Personnel to be educated about protection status of species, including distinguishing features, to be able to identify protected species. 2. Implement strict access control for the site. 3. No hunting / collecting of protected species. 4. Report any illegal collection to conservation authorities (Northern Cape Nature Conservation, Tel.: 053 807 7300).	

Impact 8: Effects on physiological functioning of vegetation due to dust deposition

There is a high probability during construction that dust will be created that will settle on surrounding vegetation. This will be due to earth-moving equipment as well as vehicles moving around on site as well as into and out of the site. There will be a definite increase in the amount of traffic on access roads to the site that will also affect surrounding areas.

Dust deposited on vegetation directly screens incoming radiation as well as affects stomatal gas-exchange. The combined effect is a reduction in fitness of affected vegetation which will lead to reduced potential growth rates, damage to leaves, and possibly reduced ability to resist pathogens.

In addition to direct effects on the vegetation, there is also a possibility that grazing animals will be affected through a reduction in palatability of plants, and increased silica on surfaces of edible plants that will possibly affect dental wear-and-tear.

Table 17: Impact table for Impact 8: Vegetation damage due to dust deposition.

Impaired physiologivcal functioning of vegetation due to increased dust deposition.	
Environmental parameter	Vegetation
Issue/Impact/Environmental Effect/Nature	Dust deposition, resulting in reduced physiological fitness of plants / vegetation.
Extent	The impact will affect vegetation on site and in all areas with access roads leading to site.
Probability	The impact will almost certainly happen.
Reversibility	Partly reversible with time.
Irreplaceable loss of resources	Low to marginal loss of resources will occur.

Duration	The impact will be permanent (duration of the life of the roads) for access roads (although only subject to high traffic volumes during construction, and short-term for construction areas.	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (Local)	2 (Local)
Probability	4 (Definite)	3 (Probable)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Low)	2 (Low)
Duration	1 (Short-term)	1 (Short-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-28 (low negative)**	**-12 (low negative)**
Mitigation measures	1. No speeding on access roads – install speed control measures, such as speed humps, if necessary, and penalties for non-compliance. 2. Excessive dust can be controlled by using appropriate dust-control measures.	

Impact 9: Impact on integrity of Critical Biodiversity Areas

Significant proportions of the site are included in Critical Biodiversity Areas for the Northern Cape. This includes two small areas within CBA1 (Irreplaceable) areas that, according to the layout plan, will be minimally affected by the project, and a significant part of the site that is within a CBA2 (Important) area. Currently, a single turbine (Turbine 25) and less than 300 m of road is proposed on the very edge of one CBA1 area – this is not excessive and will have no discernible effect on the functioning of the CBA1 area. There are also some infrastructure options within another CBA1 area, namely Substation 5 (on very edge), Construction Camp 3 and Construction Camp 4 (both next to existing gravel road). These options have all been considered on the basis of local ecological patterns and recommendations made on that basis.

The Northern Cape Critical Biodiversity Area Map, published in 2016 (Holness & Oosthuysen 2016) derives CBAs from the earlier Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008). On the basis that there was limited biodiversity information for some parts of the province, including the current site, general correlations between biophysical parameters and known biodiversity patterns were used to define the CBAs. This included the fact that there is a perceived general increase in local diversity, as well as increased likelihood of encountering plant species of special concern, as elevation increases. This means that higher elevation areas generally have higher biodiversity value, although the specific location of such areas of high value were not known with great confidence. To accommodate this pattern and the low certainty, a proportion of all higher elevation areas were allocated by regional planners to CBA2 areas according to an algorithm that seeks a least-cost outcome for preserving biodiversity, i.e. the least amount of land space for preserving the greatest amount of area of biodiversity importance, as well as meeting specific conservation targets. The net result is that CBA2 areas on site may be identical in character to other natural areas on site that are not included in a CBA based on limited biodiversity information available for the site. Data collected in the field for this project (at the location of all turbines, substation options, and construction camp options) support the observation that there is no significant floristic difference on site between areas included within CBA2 areas and those outside of these designated areas. Since no particular unique features have been targeted for protection, rather a general pattern in the landscape, complete exclusion of the project from CBA2 areas is not justified. If necessary, similar habitat on other ridges within the general area could be targeted for conservation purposes.

All infrastructure components will require clearing of vegetation prior to construction. However, the access roads, internal access roads, substation and turbine bases (foundations) will cause local permanent loss of vegetation, although not of significant extent in comparison to the entire extent of affected regional vegetation.

Table 18: Impact table for Impact 9: Reduction of integrity of CBAs.

Impact on integrity of CBAs		
Environmental parameter	Critical Biodiversity Area	
Issue/Impact/Environmental Effect/Nature	Loss, degradation or fragmentation of vegetation.	
Extent	The impact will affect natural vegetation on site, but affects defined CBAs that extend regionally.	
Probability	If the project is authorised then the impact will definitely happen.	
Reversibility	As discussed for "Loss of natural vegetation", irreversible in human timeframes against the currently mapped target areas. If it is assumed that adequate areas of similar habitat will remain after construction of the project (which has been suggested for this project from the data that has been collected in the field) then there is a possibility that CBAs could be redefined to include new areas that are not currently included within CBAs. On the basis of this assumption, it is possible (but difficult) to reverse some of the loss of areas within CBAs. It should also be taken into account that the absolute area (in hectares) is very small compared to the overall amount of area included within CBAs.	
Irreplaceable loss of resources	**Marginal** loss of resources will occur within the footprint of the proposed infrastructure since vegetation clearing is required prior to installation of infrastructure, but the overall loss of resources relative to the entire CBA is less significant.	
Duration	Within the immediate footprint of the permanent infrastructure (turbine foundations, roads and substation) the impact will be **Permanent** (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). In other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact will be of long-term duration. The assessment here is for the permanently affected areas.	
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat from activities in the general region as well as the nearby similar RE projects, the current project will cause additional loss of vegetation, the cumulative effect of which will be medium.	
Intensity/magnitude	Medium. Taking local vegetation patterns into account, the intensity of the impact is assessed here as being of **Medium** intensity – the functional integrity of vegetation on site will be compromised to some degree, which can be limited to some extent by implementation of mitigation measures. (See more detailed commentary under Impact 2).	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Local)	1 (Local)
Probability	4 (Definite)	4 (Definite)
Reversibility	3 (Barely reversible)	3 (Barely reversible)
Irreplaceable loss	2 (Marginal)	2 (Marginal)
Duration	4 (Permanent)	4 (Permanent)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	2 (Medium)
Significance rating	**-34 (medium negative)**	**-32 (medium negative)**
Mitigation measures	The following mitigation measures are proposed to reduce the potential impact on areas of conservation value on site (CBAs): 1. Minimise area of construction within CBA1 areas (this has already been done as much as possible as part of the project design process). 2. All mitigation measures suggested for Impact 1 (Loss and/or fragmentation of indigenous natural vegetation apply to this potential impact.	

Impact 10: Establishment and spread of declared weeds and alien invader plants due to the clearing and disturbance of indigenous vegetation

Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activities) and negative grazing practices (Zachariades *et al.* 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al.*, 2003). Consequences of this may include:

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

No existing populations of alien plants were see on site, but areas of farm infrastructure were not investigated during the field survey. There is a high possibility that alien plants could be introduced to areas within the footprint of the proposed activities from surrounding areas in the absence of control measures. The potential consequences may be of moderate seriousness for affected natural habitats. Control measures could prevent the impact from occurring. These control measures are relatively standard and well-known.

Table 19: Impact table for Impact 10: Establishment and spread of declared weeds.

Establishment and spread of declared weeds		
Environmental parameter	Vegetation and habitat	
Issue/Impact/Environmental Effect/Nature	Loss of habitat due to invasion by alien plants	
Extent	The impact will affect habitat on site and possibly in immediately surrounding areas.	
Probability	The impact will probably happen in the absence of control measures.	
Reversibility	Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.	
Irreplaceable loss of resources	Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.	
Duration	The impact will be long-term.	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. Severe invasion can alter the functioning of natural ecosystems.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable)	2 (Possible)
Reversibility	2 (Partly)	2 (Partly)
Irreplaceable loss	3 (Significant)	2 (Marginal)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-30 (medium negative)**	**-12 (low negative)**
Mitigation measures	It is possible to avoid impacts due to alien plant invasions by undertaking the following mitigation measures:	

	1. Compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control. 2. Undertake regular monitoring to detect alien invasions early so that they can be controlled, as per the Alien Management Plan. 3. Implement control measures, as per the Alien Management Plan.

Impact 11: Changes to behavioural patterns of animals, including possible migration away or towards the project area

The increased human presence and/or construction operations will increase noise levels as well as light levels at night. The increased human presence, elevated noise and light levels, loss of animal habitat and compaction of soils may alter the behavioural patterns of some animals. Some of these changes may favour certain species and negatively affect others and consequently change the composition of the animal communities. Some of these changes could possibly increase levels of predation. Territorial species such as steenbok, grey duiker and klipspringer will be negatively affected as well as species that live or move in the soil. These species might undergo a local reduction in their population size.

Table 20: Impact table for impact 11: Changes in behavioural patterns of animals.

Changes in behavioural patterns of fauna		
Environmental parameter	Mobile fauna	
Issue/Impact/Environmental Effect/Nature	Displacement of individuals or changes to community structure.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	No or low loss of resources will occur.	
Duration	The initial impact will be short-term (construction phase).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Low. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	1 (None)	1 (None)
Duration	1 (Long-term)	1 (Short-term)
Cumulative effect	1 (Low)	1 (Low)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-8 (low negative)**	**-8 (low negative)**
Mitigation measures	1. Access to sensitive areas outside of development footprint should not be permitted during construction. 2. Personnel to be educated about environmental sensitivities and issues on site. 3. Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per visual specialist assessment. 4. Construction activities should not be undertaken at night. 5. Noise and light pollution should be managed according to guidelines from the noise specialist study and SANS noise standards.	

Impact 12: Increased runoff and erosion due to clearing of vegetation, construction of hard surfaces and compaction of surfaces, leading to changes in downslope areas

Increased erosion (water and wind) and water run-off will be caused by the clearing of indigenous vegetation, creation of new hard surfaces and compaction of soil. The internal access roads will be the main source of disturbance and erosion if not properly constructed and provided with water run-off structures. The construction site, substation site and crane pads will furthermore be levelled and compacted causing additional run-off and erosion. Increased run-off and erosion could affect hydrological processes in the area and will change water and silt discharge into drainage lines and streams.

Table 21: Impact table for Impact 12: Increased runoff and erosion.

Increased runoff and erosion		
Environmental parameter	Vegetation and habitat	
Issue/Impact/Environmental Effect/Nature	Runoff and erosion	
Extent	The impact will affect habitat on site.	
Probability	The impact will probably happen in the absence of control measures.	
Reversibility	Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.	
Irreplaceable loss of resources	Marginal to significant loss of resources will occur. Uncontrolled erosion can affect all downslope natural habitats.	
Duration	The impact will be long-term.	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. Severe erosion can locally alter the functioning of natural ecosystems and cause additional loss of vegetation.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable)	2 (Possible)
Reversibility	2 (Partly)	2 (Partly)
Irreplaceable loss	3 (Significant)	2 (Marginal)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-30 (medium negative)**	**-12 (low negative)**
Mitigation measures	It is possible to avoid impacts due to erosion by undertaking the following mitigation measures: 1. Compile and implement a stormwater management plan, which highlights control priorities and areas and provides a programme for long-term control. 2. Undertake regular monitoring to detect erosion features early so that they can be controlled. 3. Implement control measures. 4. Construct proper culverts, bridges and/or crossings at drainage-line crossings, and other attenuation devices to limit overland flow, where necessary.	

Operational Phase impacts

Impact 13: Continued disturbance to natural habitats due to general operational activities and maintenance

During the operational phase of the project, there will be continuous activity on site, including normal operational activities, maintenance and monitoring. There may also be minor additional construction. Rehabilitation of various sites, such as the construction camps, will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation.

Table 22: Impact table for Impact 13: Continued disturbance of indigenous natural vegetation.

Loss and/or fragmentation of indigenous natural vegetation		
Environmental parameter	Indigenous natural vegetation	
Issue/Impact/Environmental Effect/Nature	Loss or degradation of vegetation.	
Extent	The impact will affect natural vegetation on site.	
Probability	Continued disturbance will probably happen.	
Reversibility	Partly reversible, on condition no additional vegetation clearing takes place unless for maintenance purposes.	
Irreplaceable loss of resources	Marginal loss of resources will occur adjacent to the footprint of the proposed infrastructure since this is the most likely location of operational activities.	
Duration	The impact will be long-term (will continue or last for the entire operational life of the project)	
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat from activities on site, will cause additional loss of vegetation, the cumulative effect of which will be medium.	
Intensity/magnitude	Medium. The quality, use and integrity of vegetation on site will be compromised to some degree, which can be limited to some extent by implementation of mitigation measures.	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable)	3 (Probable)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Marginal loss of resources)	2 (Marginal loss of resources)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	3 (Medium)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-28 (low negative)**	**-14 (low negative)**
Mitigation measures	The following mitigation measures would help to limit impacts: 1. No additional clearing of vegetation should take place without a proper assessment of the environmental impacts and authorization from relevant authorities, unless for maintenance purposes, in which case all reasonable steps should be taken to limit damage to natural areas. 2. No driving of vehicles off-road. 3. Implement Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas. 4. Access to sensitive areas outside of development footprint should not be permitted during operation. 5. Surface runoff and erosion must be properly controlled and any issues addressed as quickly as possible.	

Impact 14: Direct mortality of fauna through traffic, illegal collecting, poaching and collisions and/or entanglement with infrastructure

There are various animal species of particular concern for this project, including the Karoo Dwarf Tortoise and the Armadillo Girdled Lizard. There are also other more mobile species that are protected by legislation, including the Honey Badger, Black-footed Cat, Leopard and Cape Fox. It is possible that individuals of these species may suffer mortality or removal of individuals through road kills, encounters with infrastructure, illegal hunting, illegal collecting (especially for the tortoise and lizard) and possible damage to habitats.

Table 23: Impact table for Impact 14: Mortality of fauna during operation.

Loss of individuals of animal species of concern		
Environmental parameter	Fauna, including those of conservation concern (Honey Badger, Black-footed Cat, Leopard, and Cape Fox)	
Issue/Impact/Environmental Effect/Nature	Mortaility of individuals due to secondary effects.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	Low loss of resources will occur.	
Duration	The impact will be long-term (operation phase).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Marginal)	1 (None)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	2 (Low)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-24 (low negative)**	**-11 (low negative)**
Mitigation measures	1. Personnel and vehicles should be restricted to access, internal roads and no off-road driving should occur. 2. No speeding on access roads – install speed control measures, such as speed humps, if necessary 3. No illegal collecting of any individuals, particularly the Armadillo Girdled Lizard. 4. No hunting of protected species or hunting of any other species without a valid permit. 5. Personnel to be educated about protection status of species, including distinguishing features to be able to identify protected species. 6. Prevent unauthorised access to the site – project roads provide access to remote areas that were not previously easily accessible for illegal collecting or hunting.	

Impact 15: Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established.

Table 24: Impact table for Impact 15: Continued establishment and spread of declared weeds.

Continued establishment and spread of declared weeds	
Environmental parameter	Vegetation and habitat
Issue/Impact/Environmental Effect/Nature	Loss of habitat due to invasion by alien plants

Extent	The impact will affect habitat on site and possibly in immediately surrounding areas.	
Probability	The impact will probably happen in the absence of control measures.	
Reversibility	Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.	
Irreplaceable loss of resources	Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.	
Duration	The impact will be long-term.	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. Severe invasion can alter the functioning of natural ecosystems.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable)	2 (Possible)
Reversibility	2 (Partly)	1 (Completely)
Irreplaceable loss	3 (Significant)	2 (Marginal)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-30 (medium negative)**	**-11 (low negative)**
Mitigation measures	It is possible to avoid impacts due to alien plant invasions by undertaking the following mitigation measures: 1. Compile and implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control. 2. Undertake regular monitoring to detect alien invasions early so that they can be controlled. 3. Implement control measures. 4. Do NOT use any alien plants during rehabilitation.	

Impact 16: Continued runoff and erosion due to the presence of hard surfaces that change the infiltration and runoff properties of the landscape

Increased erosion (water and wind) and water run-off will be caused by the clearing of indigenous vegetation, creation of new hard surfaces and compaction of soil. The internal access roads will be the main source of disturbance and erosion if not properly constructed and provided with water run-off structures. The construction site, substation site and crane pads will furthermore be levelled and compacted causing additional run-off and erosion. Increased run-off and erosion could affect hydrological processes in the area and will change water and silt discharge into drainage lines and streams.

Table 25: Impact table for Impact 16: Increased runoff and erosion.

Increased runoff and erosion	
Environmental parameter	Vegetation and habitat
Issue/Impact/Environmental Effect/Nature	Runoff and erosion
Extent	The impact will affect habitat on site.
Probability	The impact will probably happen in the absence of control measures.
Reversibility	Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.
Irreplaceable loss of resources	Marginal to significant loss of resources will occur. Uncontrolled erosion can affect all downslope natural habitats.

Duration	The impact will be long-term.	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. Severe erosion can locally alter the functioning of natural ecosystems and cause additional loss of vegetation.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable)	2 (Possible)
Reversibility	2 (Partly)	2 (Completely)
Irreplaceable loss	3 (Significant)	2 (Marginal)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-30 (medium negative)**	**-12 (low negative)**
Mitigation measures	It is possible to avoid impacts due to erosion by undertaking the following mitigation measures: 1. Compile and implement a stormwater management plan, which highlights control priorities and areas and provides a programme for long-term control. 2. Undertake regular monitoring to detect erosion features early so that they can be controlled. 3. Implement control measures. 4. Construct proper culverts, bridges and/or crossings at drainage-line crossings, and other attenuation devices to limit overland flow.	

Impact 17: Changes to behavioural patterns of animals, including possible migration away or towards the project area

The increased human presence and/or construction operations will increase noise levels as well as light levels at night. The increased human presence, elevated noise and light levels, loss of animal habitat and compaction of soils may alter the behavioural patterns of some animals. Some of these changes may favour certain species and negatively affect others and consequently change the composition of the animal communities. Some of these changes could possibly increase levels of predation. Territorial species such as steenbok, grey duiker and klipspringer will be negatively affected as well as species that live or move in the soil. These species might undergo a local reduction in their population size.

Table 26: Impact table for Impact 17: Changes in behavioural patterns of animals.

Changes in behavioural patterns of fauna		
Environmental parameter	Mobile fauna	
Issue/Impact/Environmental Effect/Nature	Displacement of individuals or changes to community structure.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	No or low loss of resources will occur.	
Duration	The impact will be long-term (duration of the project).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Low. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)

Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	1 (None)	1 (None)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	1 (Low)	1 (Low)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-10 (low negative)**	**-10 (low negative)**
Mitigation measures	1. Personnel to be educated about environmental sensitivities and issues on site. 2. Appropriate lighting should be installed to minimize impacts on nocturnal animals, as per assessment by visual specialist. 3. Routine maintenance activities should not be undertaken at night. 4. Noise and light pollution should be managed according to guidelines from the noise specialist study and visual specialist assessment respectively.	

Decommissioning Phase impacts

It is expected that the project will operate for a minimum of twenty to twenty-five years or more (a typical planned life-span for a project of this nature). Decommissioning will probably require a series of steps resulting in the removal of equipment from the site and rehabilitation of footprint areas. It is possible that the site could be returned to a rural nature, but it is unlikely that natural vegetation would become established at disturbed locations on site for a very long time thereafter. The reality is that it is not possible to determine at this stage whether rehabilitation measures will be implemented or not or what the future plans for the site would be nor is it possible at this stage to determine what surrounding land pressures would be. These uncertainties make it difficult to undertake any assessment to determine possible impacts of decommissioning. It is recommended that a closure and rehabilitation plan be compiled near to the stage but in advance of when decommissioning is planned, and that this would be required to be implemented prior to closure of the project. Possible impacts are described below.

Impact 18: Loss and disturbance of natural vegetation due to the removal of infrastructure and need for working sites
During the decommissioning phase of the project, there will be a flurry of activity on site over a period of time, similar to during the construction phase, including dismantling and removal of equipment and rehabilitation. There may also be minor additional construction. Rehabilitation of various sites will also take place. These activities all have the potential to cause additional direct and/or indirect damage to natural habitat and vegetation.

Table 27: Impact table for Impact 18: Disturbance of indigenous natural vegetation.

Loss and/or fragmentation of indigenous natural vegetation	
Environmental parameter	Indigenous natural vegetation
Issue/Impact/Environmental Effect/Nature	Loss or degradation of vegetation.
Extent	The impact will affect natural vegetation on site.
Probability	Continued disturbance will probably happen.
Reversibility	Partly reversible, on condition no additional vegetation clearing takes place.
Irreplaceable loss of resources	Marginal loss of resources will occur adjacent to the footprint of the proposed infrastructure since this is the most likely location of operational activities.
Duration	The impact will be medium-term (until rehabilitation has succeeded in establishing perennial vegetation cover)
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat from activities on site, will cause additional loss of vegetation, the cumulative effect of which will be medium.

Intensity/magnitude	Medium. The quality, use and integrity of vegetation on site will be compromised to some degree, which can be limited to some extent by implementation of mitigation measures.	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	3 (Probable)	3 (Probable)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Marginal loss of resources)	2 (Marginal loss of resources)
Duration	2 (Medium-term)	2 (Medium-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-26 (low negative)**	**-12 (low negative)**
Mitigation measures	The following mitigation measures would help to limit impacts: 1. No additional clearing of vegetation should take place without a proper assessment of the environmental impacts and authorization from relevant authorities. 2. No driving of vehicles off-road. 3. Implement Alien Plant Management Plan, including monitoring, to ensure minimal impacts on surrounding areas. 4. Access to sensitive areas outside of development footprint should not be permitted during operation. 5. Surface runoff and erosion must be properly controlled and any issues addressed as quickly as possible.	

Impact 19: Direct mortality of fauna due to machinery, decomissioning and increased traffic

It is possible that individuals of species of concern, as well as other species, may suffer mortality or removal of individuals through road kills, encounters with infrastructure, illegal hunting, illegal collecting (especially for the tortoise and lizard) and possible damage to habitats. The animal species of particular concern for this project include the Karoo Dwarf Tortoise and the Armadillo Girdled Lizard. There are also other more mobile species that are protected by legislation, including the Honey Badger, Black-footed Cat, Leopard and Cape Fox.

Table 28: Impact table for Impact 19: Mortality of fauna during decomissioning.

Loss of individuals of animal species of concern		
Environmental parameter	Fauna, including those of conservation concern (Honey Badger, Black-footed Cat, Leopard, and Cape Fox)	
Issue/Impact/Environmental Effect/Nature	Mortaility of individuals due to secondary effects.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	Low loss of resources will occur.	
Duration	The impact will be short-term (decommissioning phase).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Low. May impact on population processes, but is likely to be barely perceptible.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)

Irreplaceable loss	2 (Marginal)	1 (None)
Duration	1 (short-term)	1 (short-term)
Cumulative effect	2 (Low)	2 (Low)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-10 (low negative)**	**-9 (low negative)**
Mitigation measures	1. Personnel and vehicles to avoid sensitive habitats. 2. No speeding on access roads – install speed control measures, such as speed humps, if necessary 3. No illegal collecting of any individuals, particularly the Armadillo Girdled Lizard. 4. No hunting of protected species or hunting of any other species without a valid permit. 5. Personnel to be educated about protection status of species, including distinguishing features to be able to identify protected species. 6. Report any sitings to conservation authorities. 7. Prevent unauthorised access to the site – project roads provide access to remote areas that were not previously easily accessible for illegal collecting or hunting.	

Impact 20: Displacement and/or disturbance of fauna due to increased activity and noise levels

Decommissioning and rehabilitation activities may lead to loss of habitat, noise, dust and general activity that are likely to cause all mobile species to move away from the site. Mobile species of conservation concern that could potentially be affected by the proposed project are as follows:

1. Honey Badger,
2. Black-footed Cat,
3. Leopard,
4. Cape Fox,
5. Grey Rhebok.

All these species are mobile terrestrial species with a large home range and the ability to travel long distances in short periods of time. Individuals may be locally displaced, but this will have little effect on the overall range of the species nor is it expected that any overall impacts will result from local displacement.

Table 29: Impact table for Impact 20: Displacement of terrestrial fauna.

Displacement of individuals of mobile terrestrial fauna		
Environmental parameter	Mobile fauna of conservation concern (Honey Badger, Black-footed Cat, Leopard, Cape Fox and Grey Rhebok)	
Issue/Impact/Environmental Effect/Nature	Displacement of individuals.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	No or low loss of resources will occur.	
Duration	The impact will be short-term (decommissioning phase).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Low. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)

Irreplaceable loss	1 (None)	1 (None)
Duration	1 (Short-term)	1 (Short-term)
Cumulative effect	1 (Low)	1 (Low)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-8 (low negative)**	**-8 (low negative)**
Mitigation measures	1. Restrict impact to development footprint only and limit disturbance spreading into surrounding areas. 2. No speeding on access roads – install speed control measures, such as speed humps, if necessary 3. No hunting of protected species. 4. Personnel to be educated about protection status of species, including distinguishing features to be able to identify protected species. 5. Report any sitings to conservation authorities.	

Impact 21: Effects on physiological functioning of vegetation due to dust deposition
There is a moderate risk during decommissioning that dust will be created that will settle on surrounding vegetation. This will be due to earth-moving equipment as well as vehicles moving around on site as well as into and out of the site. There will be a definite increase in the amount of traffic on access roads to the site that will also affect surrounding areas.

Table 30: Impact table for Impact 21: Vegetation damage due to dust deposition.

Impaired physiologivcal functioning of vegetation due to increased dust deposition.		
Environmental parameter	Vegetation	
Issue/Impact/Environmental Effect/Nature	Dust deposition, resulting in reduced physiological fitness of plants / vegetation.	
Extent	The impact will affect vegetation on site and in all areas with access roads leading to site.	
Probability	The impact will almost certainly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	Low to marginal loss of resources will occur.	
Duration	The impact will be of short-term duration for access roads (only subject to high traffic volumes during decommissioning).	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (Local)	2 (Local)
Probability	4 (Definite)	3 (Probable)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Low)	2 (Low)
Duration	1 (Short-term)	1 (Short-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-28 (low negative)**	**-12 (low negative)**
Mitigation measures	1. No speeding on access roads – install speed control measures, such as speed humps, if necessary, and penalties for non-compliance. 2. Excessive dust can be controlled by using appropriate dust-control measures.	

Impact 22: Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors

The presence of disturbed surfaces on site creates ecological edges and corridors along which alien species can travel and become established.

Table 31: Impact table for Impact 22: Continued establishment and spread of declared weeds.

<table>
<tr><th colspan="3">Continued establishment and spread of declared weeds</th></tr>
<tr><td>Environmental parameter</td><td colspan="2">Vegetation and habitat</td></tr>
<tr><td>Issue/Impact/Environmental Effect/Nature</td><td colspan="2">Loss of habitat due to invasion by alien plants</td></tr>
<tr><td>Extent</td><td colspan="2">The impact will affect habitat on site and possibly in immediately surrounding areas.</td></tr>
<tr><td>Probability</td><td colspan="2">The impact will probably happen in the absence of control measures.</td></tr>
<tr><td>Reversibility</td><td colspan="2">Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.</td></tr>
<tr><td>Irreplaceable loss of resources</td><td colspan="2">Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.</td></tr>
<tr><td>Duration</td><td colspan="2">The impact will be short-term.</td></tr>
<tr><td>Cumulative effect</td><td colspan="2">Medium cumulative impact. Cumulative effects will be minor.</td></tr>
<tr><td>Intensity/magnitude</td><td colspan="2">Medium. Severe invasion can alter the functioning of natural ecosystems.</td></tr>
<tr><td>Significance rating</td><td colspan="2">Low negative impact expected.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td></td><td>Pre-mitigation impact rating</td><td>Post-mitigation impact rating</td></tr>
<tr><td>Extent</td><td>1 (Site)</td><td>1 (Site)</td></tr>
<tr><td>Probability</td><td>3 (Probable)</td><td>2 (Possible)</td></tr>
<tr><td>Reversibility</td><td>2 (Partly)</td><td>2 (Partly)</td></tr>
<tr><td>Irreplaceable loss</td><td>3 (Significant)</td><td>2 (Marginal)</td></tr>
<tr><td>Duration</td><td>3 (Long-term)</td><td>1 (Short-term)</td></tr>
<tr><td>Cumulative effect</td><td>3 (Medium)</td><td>2 (Low)</td></tr>
<tr><td>Intensity/magnitude</td><td>2 (Medium)</td><td>1 (Low)</td></tr>
<tr><td>Significance rating</td><td>-30 (medium negative)</td><td>-9 (low negative)</td></tr>
<tr><td>Mitigation measures</td><td colspan="2">It is possible to avoid impacts due to alien plant invasions by undertaking the following mitigation measures:
1. Implement an alien management plan, which highlights control priorities and areas and provides a programme for long-term control.
2. Undertake regular monitoring to detect alien invasions early so that they can be controlled. Post-decommissioning monitoring should continue for an appropriate length of time to ensure that future problems are avoided. The required time-period should be indicated in the Alien Invasive Management Plan.
3. Do NOT use any alien plants during any rehabilitation that may be required.</td></tr>
</table>

Impact 23: Changes to behavioural patterns of animals, including possible migration away or towards the project area

The increased human presence and/or decommissioning operations will increase noise levels as well as light levels at night. The increased human presence, elevated noise and light levels, loss of animal habitat and compaction of soils may alter the behavioural patterns of some animals. Some of these changes may favour certain species and negatively affect others and consequently change the composition of the animal communities. Some of these changes could possibly increase levels of predation. Territorial species such as steenbok, grey duiker and klipspringer will be negatively affected as well as species that live or move in the soil. These species might undergo a local reduction in their population size.

Table 32: Impact table for Impact 23: Changes in behavioural patterns of animals.

Changes in behavioural patterns of fauna		
Environmental parameter	Mobile fauna	
Issue/Impact/Environmental Effect/Nature	Displacement of individuals or changes to community structure.	
Extent	The impact will affect individuals on site and possibly in immediately surrounding areas.	
Probability	The impact may possibly happen.	
Reversibility	Partly reversible with time.	
Irreplaceable loss of resources	No or low loss of resources will occur.	
Duration	The initial impact will be short-term (decommissioning phase).	
Cumulative effect	Low cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Low. May impact on population processes.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	1 (Site)	1 (Site)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	1 (None)	1 (None)
Duration	1 (Long-term)	1 (Short-term)
Cumulative effect	1 (Low)	1 (Low)
Intensity/magnitude	1 (Low)	1 (Low)
Significance rating	**-8 (low negative)**	**-8 (low negative)**
Mitigation measures	1. Access to sensitive areas outside of infrastructure footprint should not be permitted during decommissioning. 2. Personnel to be educated about environmental sensitivities and issues on site. 3. Appropriate lighting should be installed to minimize impacts on nocturnal animals. 4. Project decommissioning activities should not be undertaken at night. 5. Noise and light pollution should be managed according to guidelines from the noise specialist study and visual specialist respectively. 6. No dangerous pits, trenches, etc. should remain on site after rehabilitation.	

Cumulative impacts

It must be noted that the cumulative assessment is based on a worst case scenario and the assumption that all projects will be developed. However, it is unlikely that all the projects in the area will be developed due to the competitive nature of the REIPPPP.

Impact 24: Cumulative impacts on indigenous natural vegetation

The regional terrestrial vegetation types in the broad study area are listed as Least Threatened and generally have large areas. Loss of habitat will definitely occur for each project, each of which will be a small area in comparison to the total area of the vegetation type. The total loss of habitat due to a number of projects together will be greater than for any single project, so a cumulative effect will occur. However, the area lost in total will be small compared to the total area of the vegetation type concerned. Of more concern is the total degree of fragmentation and/or edge effects due to the combination of all projects, which will be much more significant than gross loss of habitat, measured in hectares. Direct loss of habitat will not result in a change in the conservation status of the vegetation types, but overall degradation due to fragmentation effects may be a greater cause for concern. The cumulative effect will therefore be low for vegetation loss, but possibly significant for fragmentation. In addition, the current project is located in a rural area with the no existing infrastructure nearby, as is the case with all the other proposed projects. This will fundamentally change the character of this area in terms of its remoteness and natural state. However, this has been discussed and assessed as part of the Visual Impact Assessment as well as the proposed developments location in a the Komsberg REDZ.

Table 33: Impact table for Impact 24: Cumulative impacts on natural vegetation.

Loss and/or fragmentation of indigenous natural vegetation	
Environmental parameter	Indigenous natural vegetation
Issue/Impact/Environmental Effect/Nature	Loss, degradation and/or fragmentation of indigenous natural vegetation.
Extent	The impact will affect natural vegetation in a broad area (within 50 km of the site) and is rated as **local/district**.
Probability	Loss and/or disturbance of vegetation will **definitely** happen for all of the projects if all are developed.
Reversibility	In all projects, loss of vegetation is effectively **irreversible** within the immediate footprint of permanent infrastructure, since construction of roads and other hard surfaces completely removes vegetation and modifies the substrate upon which it grows. For all the projects, in other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact is partially reversible in the sense that secondary vegetation in disturbed areas will probably never resemble the original vegetation found on site.
Irreplaceable loss of resources	For each project, there will locally be marginal to significant loss of resources. Assessed over a wider area (the combined footprint of all projects), there will probably only be marginal loss of resources (in relation to all biodiversity resources within the area).
Duration	Within the immediate footprint of the permanent infrastructure (turbine foundations, roads and substation) the impact will be **Permanent** (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). In other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact will be of long-term duration. The assessment here is for the permanently affected areas.
Cumulative effect	**Medium** cumulative impact. Added to existing impacts on natural habitat from activities on site, will cause additional loss of vegetation, the cumulative effect of which will be medium.
Intensity/magnitude	**Medium**. At the very minimum, the projects together will alter the quality, use and integrity of vegetation in the area, but the system (vegetation) will continue to function in a moderately modified way and maintain general integrity.

Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (District)	2 (District)
Probability	4 (Definite)	4 (Definite)
Reversibility	4 (Irreversible)	4 (Irreversible)
Irreplaceable loss	2 (Marginal loss of resources)	2 (Marginal loss of resources)
Duration	4 (Permanent)	4 (Permanent)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	2 (Medium)
Significance rating	**-38 (medium negative)**	**-36 (medium negative)**
Mitigation measures	All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Rondekop WEF is to adhere to the mitigation measures proposed in this report.	

Impact 25: Cumulative impacts on plant species of concern and protected plant species

There are various plant species of conservation concern and protected plant species that may occur in the study area, all of which are relatively widespread. A distinction is made here between protected species, which are often widespread, and threatened species, which are often rare. Constructing the current project as well as all other renewable energy projects increases the likelihood of individuals being affected, but unless large numbers of individuals are directly affected, there will only be small to moderate cumulative effects. In principle, no development should allow loss of populations of threatened species, so the assessment undertaken below is for protected species (although effects on threatened species are also discussed).

Table 34: Impact table for Impact 25: Loss of individuals of threatened and protected plants.

Loss of individuals of protected plants	
Environmental parameter	Protected plants, as per NEM:BA or NCNCA or listed plants
Issue/Impact/Environmental Effect/Nature	Loss of individuals occurring within the footprint of construction.
Extent	The impact will affect local populations or individuals of the affected species. The large number of projects taken together make this a regional effect.
Probability	Based on the list of species that are protected or listed, the impact is certain to happen to protected plants and probable for threatened plants.
Reversibility	Partly reversible. Where necessary, individuals can be rescued or else cultivated to replace lost specimens. Unfortunately, this is probably not feasible for threatened plants, which means the impact is barely reversible / irreversible for such species.
Irreplaceable loss of resources	Marginal loss of resources could occur for protected plants and significant loss of resources for threatened plants. The protected species that are likely to occur on site (for all sites) are mostly relatively common throughout their range and they have very wide geographical ranges. With a number of projects, however, the chances of threatened species being affected increases.
Duration	The impact will be long-term for protected plants (for the life of the project) and possibly permanent for threatened plants.
Cumulative effect	Medium cumulative impact. Based on the species that will be affected, which mostly have wide geographical ranges, the cumulative effects will be minor.
Intensity/magnitude	Possibly medium for protected plants and very high for threatened plants. Loss of some individuals will be insignificant compared to the number that probably occur in nearby natural areas.
Significance rating	Low negative impact expected.

	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (District)	2 (District)
Probability	4 (Definite)	4 (Definite)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Marginal loss of resources)	2 (Marginal loss of resources)
Duration	3 (Long-term)	2 (Medium-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	2 (Medium)
Significance rating	**-32 (medium negative)**	**-28 (low negative)**
Mitigation measures	The following mitigation measures would help to avoid and limit impacts: 1. It is a legal requirement to obtain permits for specimens that will be lost. 2. Undertake a detailed pre-construction walk-through survey will be required during a favourable season to locate any additional individuals of protected plants. This survey must cover the footprint of all approved infrastructure, including internal access roads. 3. A Plant Rescue Plan must be compiled to be approved by the appropriate authorities. 4. Where large populations of affected species of high value are encountered, consideration should be given to shifting infrastructure to avoid such areas. 5. All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Rondekop WEF is to adhere to the mitigation measures proposed in this report.	

Impact 26: Cumulative impacts on ecological processes

There are various ecological processes that may be affected at a landscape level by the presence of multiple projects. This includes obvious processes, such as migration, pollination and dispersal, but also more difficult to interpret factors, such as spatial heterogeneity, community composition and environmental gradients, that can become disrupted when landscapes are disturbed at a high level. Disturbance can alter the pattern of variation in the structure or function of ecosystems. Fragmentation is the breaking up of a habitat, ecosystem, or land-use type into smaller parcels. An important consequence of repeated, random clearing is that contiguous cover can break down into isolated patches. This happens when the area cleared exceed a critical level and landscapes start to become disconnected. Spatially heterogenous patterns can be interpreted as individualistic responses to environmental gradients and lead to natural patterns in the landscape. Disrupting gradients and creating disturbance edges across wide areas is very disruptive of natural processes and will lead to fundamental changes in ecosystem function.

Table 35: Impact table for Impact 26: Cumulative impacts on ecological processes.

Disruption of landscape-level ecological processes	
Environmental parameter	Landscape-level ecological processes
Issue/Impact/Environmental Effect/Nature	Disruption, disturbance or alteration of ecological processes
Extent	The large number of projects taken together make this a regional effect.
Probability	Based on the number and the nature of the projects (mostly wind-energy projects), the impact may possibly happen.
Reversibility	Partly reversible, where disruptions to specific processes can be identified and rectified.
Irreplaceable loss of resources	Significant loss of resources could potentially occur, but it is more likely that marginal loss of resources will happen.

Duration	The impact will be long-term to permanent, depending on the process and the specific impact.	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Based on the nature and number of projects and the ecological process affected, the impact is most likely to be of medium intensity.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (District)	2 (District)
Probability	2 (Possible)	2 (Possible)
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	3 (Significant loss of resources)	2 (Marginal loss of resources)
Duration	3 (Long-term)	2 (Medium-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	2 (Medium)
Significance rating	**-30 (medium negative)**	**-24 (low negative)**
Mitigation measures	The following mitigation measures would help to understand impacts: 1. All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Rondekop WEF is to adhere to the mitigation measures proposed in this report.	

Impact 27: Cumulative impacts on fauna

Construction activities, loss of habitat, noise, dust and general activity associated with the construction phase of the project are likely to cause all mobile species to move away from the area. This effect will be increased if there are a number of projects being constructed at the same time or in quick succession, so the effect is likely to be cumulative. However, the geographical ranges of the species of concern is wide and it is considered that the significance of the effect will be low in the long-term, although probably significant during the combined construction phase of the projects. It is possible that some species will be more significantly negatively affected than others, especially shy species, territorial species that get displaced, or those with large territories that get shrunk. It is also possible that some species will benefit from the increased presence of humans and will migrate into the area. This will possibly cause additional shifts in other species that are affected by the increase in numbers or new species.

Table 36: Impact table for Impact 27: Cumulative impacts on fauna.

Cumulative impacts on fauna		
Environmental parameter	Fauna	
Issue/Impact/Environmental Effect/Nature	Loss of individuals and habitats due to various factors, changes in behaviour, migration away from disturbance.	
Extent	Fauna in the general area of all RE projects being considered will be affected, rated as **district**.	
Probability	The impact will probably happen to some extent.	
Reversibility	Impact is partly reversible with mitigation measures.	
Irreplaceable loss of resources	Marginal loss of resources will occur.	
Duration	The impact will be long-term (for the duration of the projects).	
Cumulative effect	Medium cumulative impact.	
Intensity/magnitude	Potentially medium intensity. Population processes likely to continue to function in a moderately modified way with general integrity maintained.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (District)	2 (District)
Probability	3 (Probable))	3 (Probable))
Reversibility	2 (Partly reversible)	2 (Partly reversible)

Irreplaceable loss	2 (Marginal)	2 (Marginal)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	2 (Medium)
Significance rating	**-30 (medium negative)**	**-28 (low negative)**
Mitigation measures	All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Rondekop WEF is to adhere to the mitigation measures proposed in this report.	

Impact 28: Cumulative impacts due to spread of declared weeds and alien invader plants

There is a moderate possibility that alien plants could be introduced to areas within the footprint of the proposed infrastructure from surrounding areas in the absence of control measures. The greater the number of projects, the more likely this effect will happen; therefore, the effect is cumulative. For the current site, the impact is predicted to be low due to the current absence of invasive species on site and the high ability to control any additional impact. The significance will therefore be low, especially if control measures are implemented. However, the increased overall disturbance of the landscape will create opportunities and, if new invasions are not controlled, can create nodes that spread to new locations due to the heightened disturbance levels.

Table 37: Impact table for Impact 28: Cumulative impacts due to the establishment and spread of declared weeds.

Establishment and spread of declared weeds		
Environmental parameter	Vegetation and habitat	
Issue/Impact/Environmental Effect/Nature	Loss or degradation of habitat due to invasion by alien plants	
Extent	Habitat in the general area of all RE projects being considered will be affected, rated as **district**.	
Probability	The impact will probably happen in the absence of control measures.	
Reversibility	Partly reversible in the absence of control measures. Completely reversible if mitigation measures applied. Preventative measures will stop the impact from occurring.	
Irreplaceable loss of resources	Marginal to significant loss of resources will occur. Uncontrolled invasion can affect all nearby natural habitats.	
Duration	The impact will be long-term.	
Cumulative effect	Medium cumulative impact. Cumulative effects will be minor.	
Intensity/magnitude	Medium. Severe invasion can alter the functioning of natural ecosystems.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (District)	2 (District)
Probability	3 (Probable))	2 (Possible))
Reversibility	2 (Partly)	1 (Completely)
Irreplaceable loss	3 (Significant)	2 (Marginal)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	1 (Low)
Significance rating	**-32 (medium negative)**	**-12 (low negative)**
Mitigation measures	All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Rondekop WEF is to adhere to the mitigation measures proposed in this report.	

Impact 29: Cumulative impacts due to loss of protected animals

There are various animal species protected according to National legislation that occur in the geographical area covered by the combined projects. Some of these animals may be vulnerable to secondary impacts, such as hunting, road kill and illegal collecting (the Armadillo Girdled Lizard may be particularly vulnerable to this). The greater the number of projects, the more likely this effect will happen; therefore, the effect is cumulative. However, in all cases, the geographical distribution of each species is much wider than the combined project areas. The significance will therefore be low, especially if control measures are implemented.

Table 38: Impact table for Impact 29: Cumulative impacts on protected fauna.

Mortality of protected fauna		
Environmental parameter	Protected fauna	
Issue/Impact/Environmental Effect/Nature	Loss of individuals and habitats due to various factors, changes in behaviour, migration away from disturbance.	
Extent	Fauna in the general area of all RE projects being considered will be affected, rated as **district**.	
Probability	The impact will probably happen to some extent.	
Reversibility	Impact is partly reversible with mitigation measures.	
Irreplaceable loss of resources	Marginal loss of resources will occur.	
Duration	The impact will be long-term (for the duration of the projects).	
Cumulative effect	Medium cumulative impact.	
Intensity/magnitude	Potentially medium intensity. Population processes likely to continue to function in a moderately modified way with general integrity maintained.	
Significance rating	Low negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	2 (District)	2 (District)
Probability	3 (Probable))	3 (Probable))
Reversibility	2 (Partly reversible)	2 (Partly reversible)
Irreplaceable loss	2 (Marginal)	2 (Marginal)
Duration	3 (Long-term)	3 (Long-term)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	2 (Medium)
Significance rating	**-30 (medium negative)**	**-28 (low negative)**
Mitigation measures	All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Rondekop WEF is to adhere to the mitigation measures proposed in this report.	

Impact 30: Cumulative impacts on CBAs and conservation planning

Significant proportions of the site and surrounding sites are included in Critical Biodiversity Areas for the Northern Cape. Disruption of these areas means that conservation planners have to find alternative sites to include in future CBAs according to an algorithm that seeks a least-cost outcome for preserving biodiversity, i.e. the least amount of land space for preserving the greatest amount of area of biodiversity importance, as well as meeting specific conservation targets. At some point, the loss of suitable sites leads to a situation where it is no longer possible to plan effective conservation networks or the cost of doing so increases due to a lack of choice. The higher the density of similar projects in a uniform area, the less chance there is of finding sites suitable for conservation that contain all the attributes that are desired to be conserved, including both ecological processes and ecological patterns. However, at the current stage there is sufficient CBA that can protect these ecological processes while still allowing development to occur as a result this cumulative impact is low.

Table 39: Impact table for Impact 30: Reduction of integrity of CBAs.

Impact on integrity of CBAs	
Environmental parameter	Critical Biodiversity Area

Issue/Impact/Environmental Effect/Nature	Loss, degradation or fragmentation of areas of vegetation that have been categorised as falling within CBA1, CBA2 or ESA areas.	
Extent	The impact will affect natural vegetation on site, but affects defined CBAs that extend regionally, effectively affecting conservation planning for the entire Province.	
Probability	Based on the location of other Renewable Energy Projects as well as the Northern Cape CBA map, it is definite that areas within CBAs will be affected.	
Reversibility	In all projects, loss of vegetation is effectively **irreversible** within the immediate footprint of permanent infrastructure, since construction of roads and other hard surfaces completely removes vegetation and modifies the substrate upon which it grows. For all the projects, in other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact is partially reversible in the sense that secondary vegetation in disturbed areas will probably never resemble the original vegetation found on site.	
Irreplaceable loss of resources	For each individual project, **marginal** loss of resources will occur within the footprint of the proposed infrastructure since vegetation clearing is required prior to installation of infrastructure, but the overall loss of resources relative to the entire CBA is less significant.	
Duration	Within the immediate footprint of the permanent infrastructure (turbine foundations, roads and substation) the impact will be **Permanent** (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). In other areas (crane pads, construction camp and disturbed areas adjacent to construction activities) the impact will be of long-term duration. The assessment here is for the permanently affected areas.	
Cumulative effect	Medium cumulative impact. Added to existing impacts on natural habitat from activities in the general region as well as the nearby similar RE projects, the current project will cause additional loss of vegetation, the cumulative effect of which will be medium.	
Intensity/magnitude	Medium. The functional integrity of vegetation on site will be compromised to some degree (especially in the sense that the quality, integrity and functionality of CBA areas will be affected, which can be limited to some extent by implementation of mitigation measures.	
Significance rating	Medium negative impact expected.	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	3 (Province)	3 (Province)
Probability	4 (Definite)	4 (Definite)
Reversibility	3 (Barely reversible)	3 (Barely reversible)
Irreplaceable loss	2 (Marginal)	2 (Marginal)
Duration	4 (Permanent)	4 (Permanent)
Cumulative effect	3 (Medium)	2 (Low)
Intensity/magnitude	2 (Medium)	2 (Medium)
Significance rating	**-42 (medium negative)**	**-40 (medium negative)**
Mitigation measures	All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Rondekop WEF is to adhere to the mitigation measures proposed in this report.	

COMPARATIVE SENSITIVITY OF ALTERNATIVES

Road layout alternatives

Access road alternative North 1

This route is approximately 11.8 km in length, almost all of which comprises an existing farm road. There is approximately 5.3 km that will need to be built between the existing gravel road and the end point in the mountains (see Figure 20). Most of this built length is parallel to a small dry stream bed, very close for approximately 2 km, including a number of crossings. Impacts on this watercourse are unavoidable with this alignment. An option to avoid impacts on the watercourse is to shift the road alignment slightly within the 200 m buffer zone to avoid multiple river crossing. This can be undertaken during micro-siting.

There are no other identified sensitivities associated with this alternative and is therefore the preferred alternative to access the north ridge.

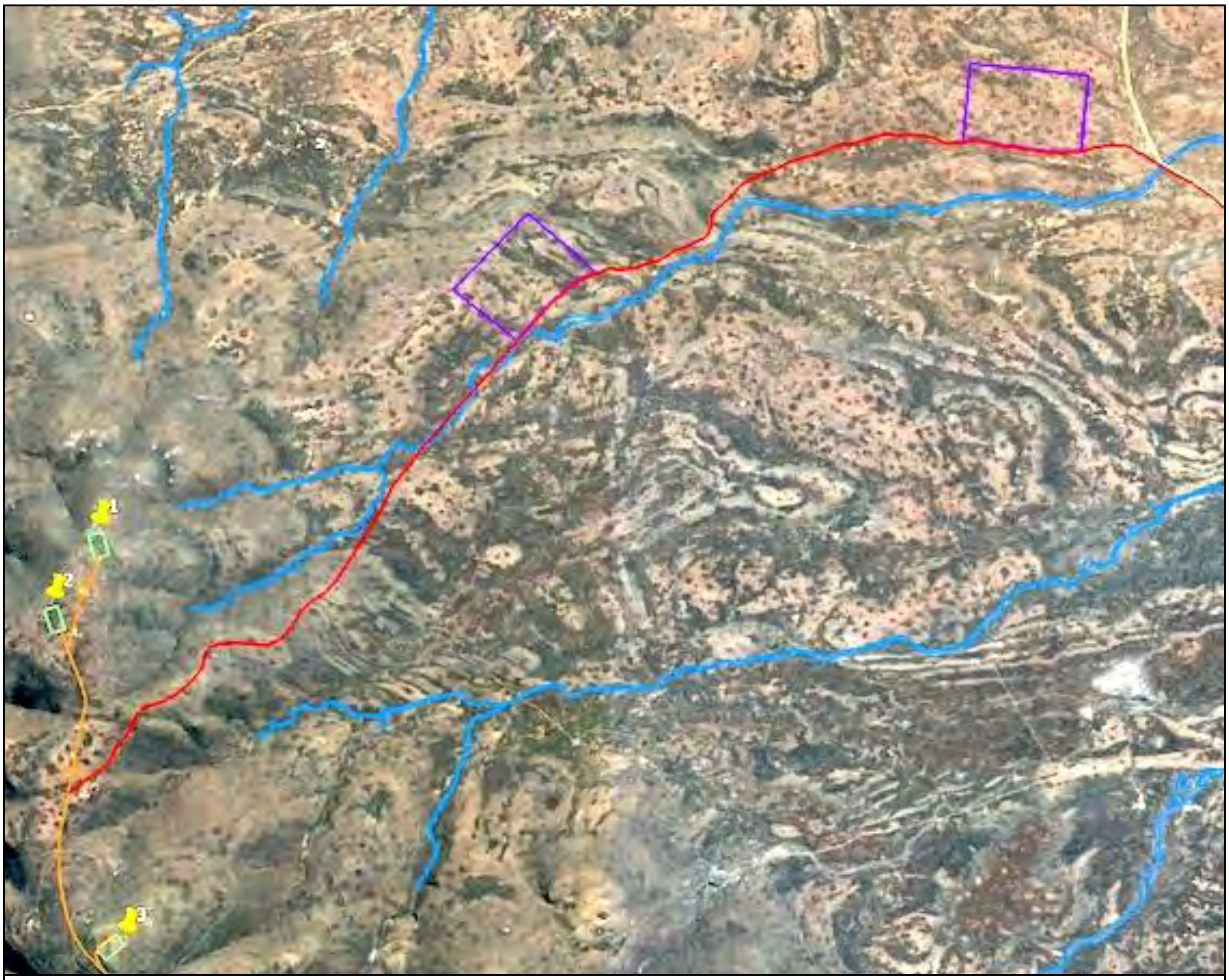

Figure 20: Access Road North Alternative 1.
(Access road = red line, internal roads = orange line, construction camps = purple line, dry stream = blue line, crane pads = green line, turbines = yellow pins)

Access road alternative North 2

This route is approximately 12.8 km in length. There is approximately 9.2 km that will need to be built between the existing gravel road and the end point in the mountains (see Figure 21). This built length will need to cross or pass through a significant dry stream bed for approximately 1.4 km, including a number of crossings. Impacts on this watercourse are unavoidable with this alignment. An option to avoid impacts on the watercourse is to shift the road alignment so that it starts out further east along the R356 so that there is only one crossing of this watercourse system.

After entering the study site this route option has a more complex climb to the high point, including running a significant length along a ridge line. Other than the access road, this ridge line would not be affected by any other infrastructure component options. In principle, the project design should minimise the footprint as much as possible, which would not be achieved with this alignment.

There are no other identified sensitivities associated with this alternative, although this alternative is still considered favourable in its current state.

Figure 21: Access Road North Alternative 2.

(Access road = red line, dry stream = blue line, orange area = CBA2, internal roads = orange line, crane pads = green line, turbines = yellow pins)

Access road alternative Centre 1

This route is approximately 2.6 km in length and branches off the R356 to the north and connects between turbine 31 and 32. It does not directly affect any watercourses, but does cross various drainage lines in the mountains.

A large proportion of the route is along the side of a steep slope, which has been identified as a potentially sensitive habitat on site. There are risks of downslope impacts due to construction on a steep slope and this entire section of the mountain slope falls within this category. In addition, this route crosses a wetland (with the reed, *Phragmites australis*, which suggests permanent wetness). This is located at the following co-ordinates: 32°46'27.59"S, 20°18'3.24"E. This is the only location found during the entire walk-through survey where there is a permanent wetland. It is strongly recommended that this is preserved as a unique habitat within the study area. As such this alternative is considered the least preferred alternative to access the centre ridge.

Figure 22: Access Road Centre Alternative 1.
(Access road = red line, internal roads = orange line, construction camps = purple line, dry stream = blue line, crane pads = green line, turbines = yellow pins, substation = yellow line)

Access road alternative Centre 2

This route is approximately 3.1 km in length and branches off the R356 and connects to the site near turbine 28. It does not directly affect any watercourses, but does cross various drainage lines in the mountains.

A large proportion of the route is along the side of a steep slope, which has been identified as a potentially sensitive habitat on site. There are risks of downslope impacts due to construction on a steep slope and this entire section of the mountain slope falls within this category. However, field investigation indicated that the steepness of this route was less extreme than the other alternative.

Figure 23: Access Road North Centre 2.

(Access road = red line, internal roads = orange line, construction camps = purple line, dry stream = blue line, crane pads = green line, turbines = yellow pins, substation = yellow line)

Access road alternative South 1

This route is shown in Figure 23 as the red line on the western (left) side of the figure. It is approximately 1.9 km in length and branches off the R356 to the south and connects near turbine 45. It does not directly affect any watercourses, but does cross various drainage lines in the mountains.

A large proportion of the route is along the side of a steep slope, which has been identified as a potentially sensitive habitat on site. There are risks of downslope impacts due to construction on a steep slope and this entire section of the mountain slope falls within this category.

Figure 24: Access Road South 1 (western side) and 2 (eastern side).

(Access road = red line, internal roads = orange line, construction camps = purple line, dry stream = blue line, crane pads = green line, turbines = yellow pins, substation = yellow line)

Access road alternative South 2

This route is shown in Figure 23 as the red line on the eastern (right) side of the figure. It is approximately 2.5 km in length and branches off the R356 to the south and connects near turbine 42. It does not directly affect any watercourses, but does cross various drainage lines in the mountains. It runs along the summit of the ridge and therefore does not affect steep side slopes of the mountain. As a result, this alternative is the preferred access road to the South ridge.

Construction camp alternatives

Construction Camp Alternative 1

This site is located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road. It is adjacent to Access Road Alternative North 1, which is the ecologically preferred option. However in its current state the one corner of this construction camp alternative intrudes within 32m of a watercourse. If this can be shifted to avoid the watercourse then there are no sensitivities associated with this location, as such this alternative is considered favourable.

Figure 25: Construction camp Alternative 1.
(Road = red line, dry stream = blue line, construction camp boundary = purple line)

Construction camp Alternative 2

This site is located adjacent to Access Road Alternative North 1 on the Farm 224 Ashoek at the end of an existing farm road. It is adjacent to Access Road Alternative 1, which is the ecologically preferred option, if it can be re-aligned north-westwards to avoid the watercourse. There are no sensitivities associated with this location, as such this alternative is preferred.

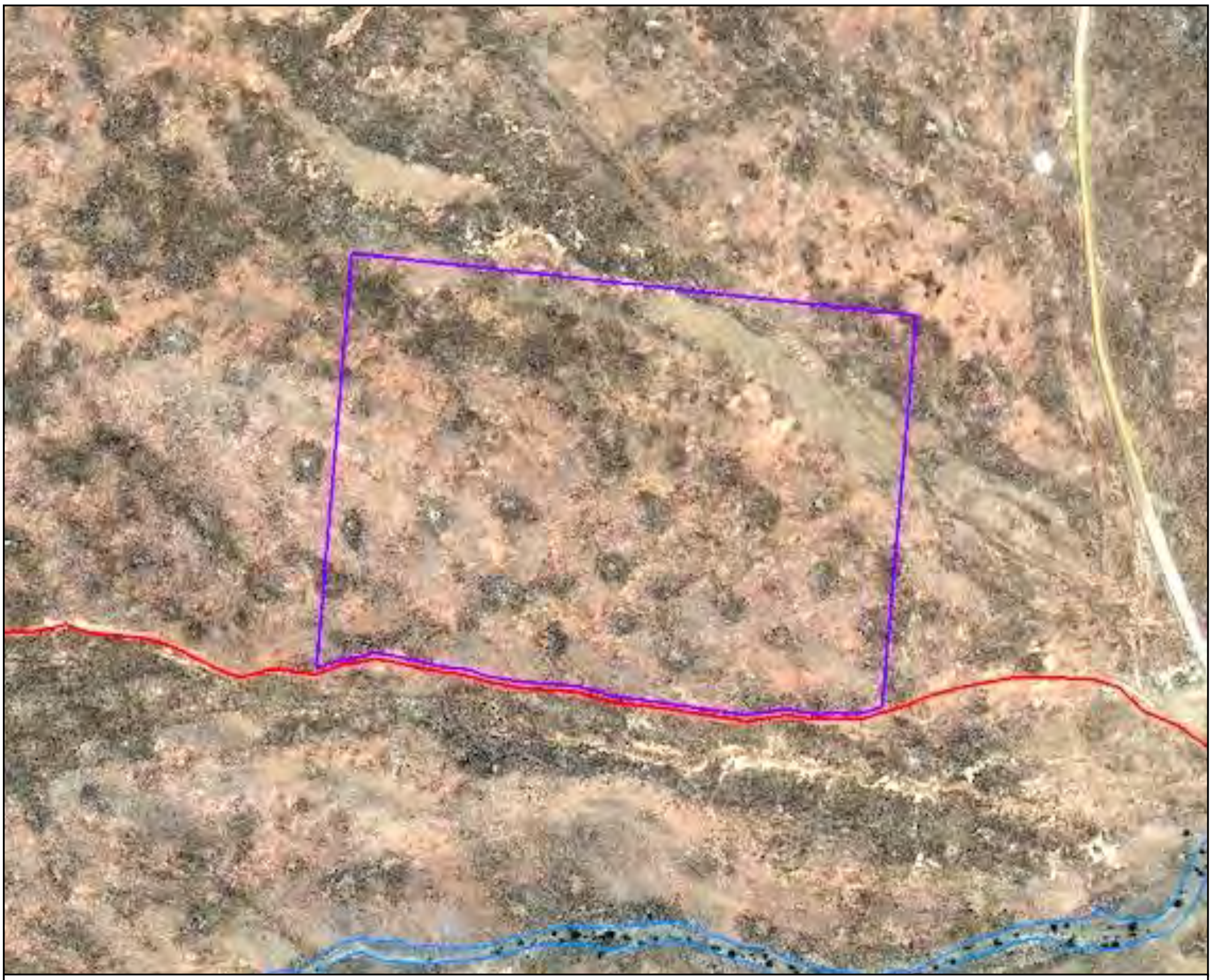

Figure 26: Construction camp Alternative 2.
(Road = red line, dry stream = blue line, construction camp boundary = purple line)

Construction Camp Alternative 3

This site is located adjacent to and east of the R356 public road on the Remainder of farm 190 Wind Heuvel. There are no sensitivities directly associated with this location, except that it is within a CBA1 area and as such despite being located within a CBA1 this alternative is considered favourable. but there is a significant watercourse to the east, although it is 60 m or more in distance away.

Figure 27: Construction camp Alternative 3.
(Road = red line, dry stream = blue line, construction camp boundary = purple line)

Construction Camp Alternative 4

This site is located at the intersection of an existing 4x4 track and the R356 on portion 1 of farm 190 Wind Heuvel. There is a rocky ridge running lengthways through this site that has higher biodiversity than flat areas. Otherwise it is adjacent to an existing gravel road, which is preferred and there are no other immediate sensitivities, except that the site is within a CBA1 area. As such this is considered the least preferred option from an ecological perspective.

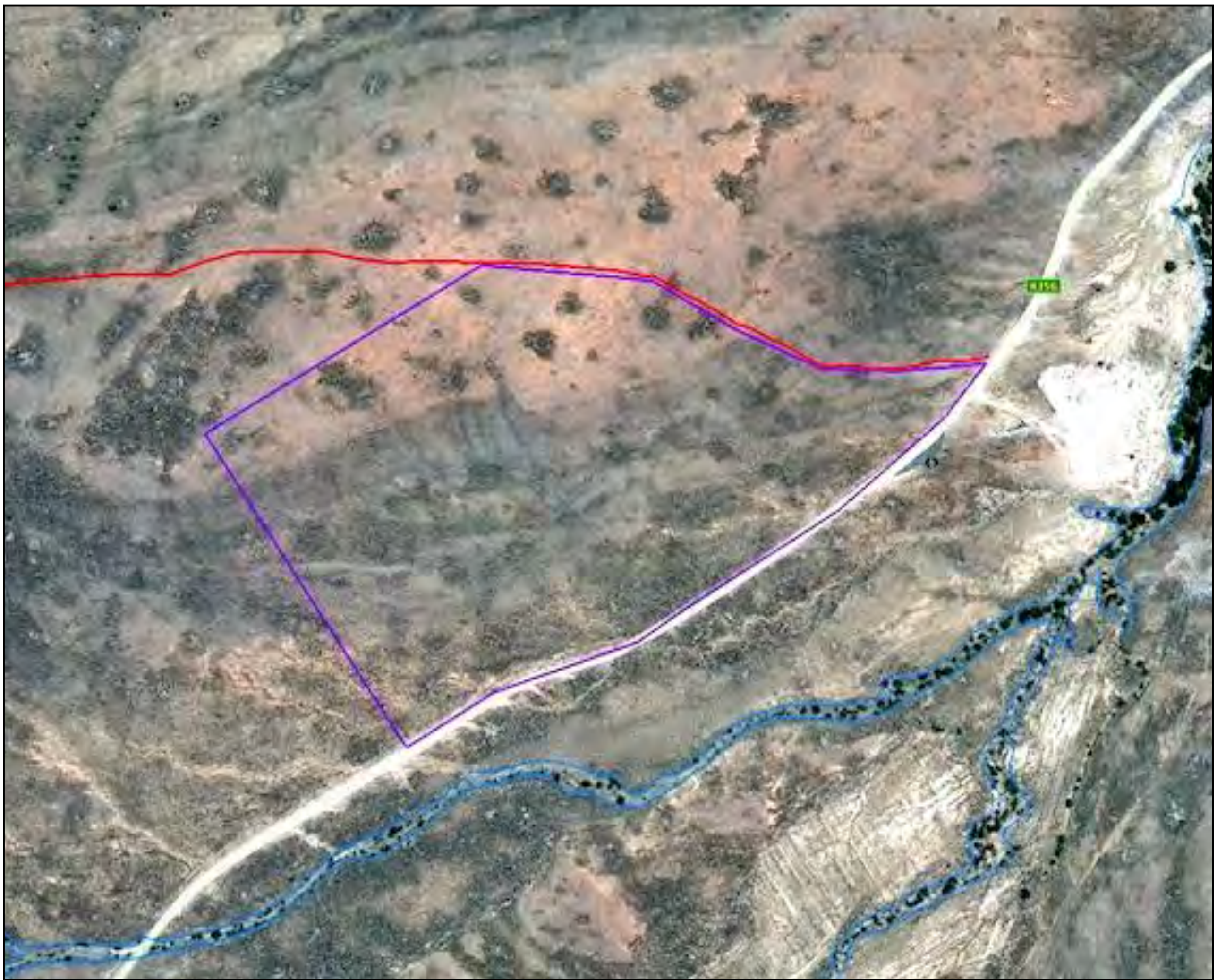

Figure 28: Construction camp Alternative 4.

(Road = red line, dry stream = blue line, construction camp boundary = purple line)

Construction Camp Alternative 5

This site is located at the intersection of the R356, access road alternative centre 2 and access road alternative south 1 extending to the north on the remainder of farm 192 Bloem Fontein. It is surrounded on three sides by watercourses, but otherwise is adjacent to an existing gravel road. There is some topographical variation within the construction camp site, which has resulted in a relativbely high degree of habitat diversity on site as well as fairly complex local drainage patterns within the site. This has led to there being a moderately higher species richness on this site compared to the other proposed construction camp sites. There are otherwise no additional sensitivities, except that the site is within a CBA2 area. This alternative is considered the least preferred option from an egological perspective.

Figure 29: Construction camp Alternative 5.
(Road = red line, dry stream = blue line, construction camp boundary = purple line)

Construction Camp Alternative 6

This site is located to the west of access road alternative centre 2 north of the R356 on the remainder of farm 192 Bloem Fontein. There is a watercourse to the north and the west of the site, but sufficient distance away to negate immediate concerns. The site is adjacent to an existing gravel road. There is some topographical variation within the construction camp site, otherwise there are no additional sensitivities. As a result, this alternative is considered to be favourble.

Figure 30: Construction camp Alternative 6.
(Road = red line, dry stream = blue line, construction camp boundary = purple line)

Comparison of construction camp alternatives

Ideally, construction camps, due to their relatively large size and the fact that the vegetation will, in all likelihood, be completely lost within the footprint, will need to be in an area that is relatively level (to minimize erosion and aid later rehabilitation) and will have the least effect on biodiversity and ecological processes. It is therefore desirable to avoid steeper slopes, rocky outcrops and drainage lines or riparian habitat. A summary of possible issues associated with each option is tabultated below (Table 10).

Table 40: Comparison of sensitivities associated with construction camp alternatives.

Alternative number	Slope steepness	Rock outcrops	Drainage	Biodiversity	Preference
1	Moderate	No	Yes, but can be avoided with slight re-alignment	Some habitat variability, but no particular issues	Favourable
2	Gentle	No	No	Some habitat variability, but no particular issues	Preferred
3	Flat	No	Riparian area on one side (>50 m away)	CBA1	Favourable
4	Moderate to locally steeper	Ridgeline with no clear outcrop	No	Local habitat variability, CBA1	Least preferred
5	Gentle	No	Drainage lines on three sides and complex surface drainage patterns on site.	CBA2	Least preferred
6	Gentle	No	Drainage lines on two sides (>50 m away)	CBA2	Favourable

Substation alternatives

Substation alternative 1

Substation alternative 1 is located south of turbine 22 on the remainder of farm 191 Hout Hoek (Figure 31). It is the substation situated the closest to where turbines will be located, which means that it will require the shortest amount of additional road to be constructed to it's location from where other roads will be constructed. There are no sensitivities associated with this site, apart from natural habitat in the mountains.

Substation alternative 2

Substation alternative 2 is located south of substation alternative 1 on the remainder of farm 191 Hout Hoek (Figure 31). There are no sensitivities associated with this site, apart from natural habitat in the mountains that is within a CBA2 area, as such this alternative is considered favourable

Substation alternative 3

Substation alternative 3 is located south east of substation alternative 2 on the remainder of farm 190 Wind Heuvel (Figure 31). A fairly long secion of road will need to be constructed to get to this substation from turbine 22, where other roads will end. There are no sensitivities associated with this site, with the exception of natural habitat in the mountains that is within a CBA2 area. Due to the length of the road construction this alternative is a least preferred.

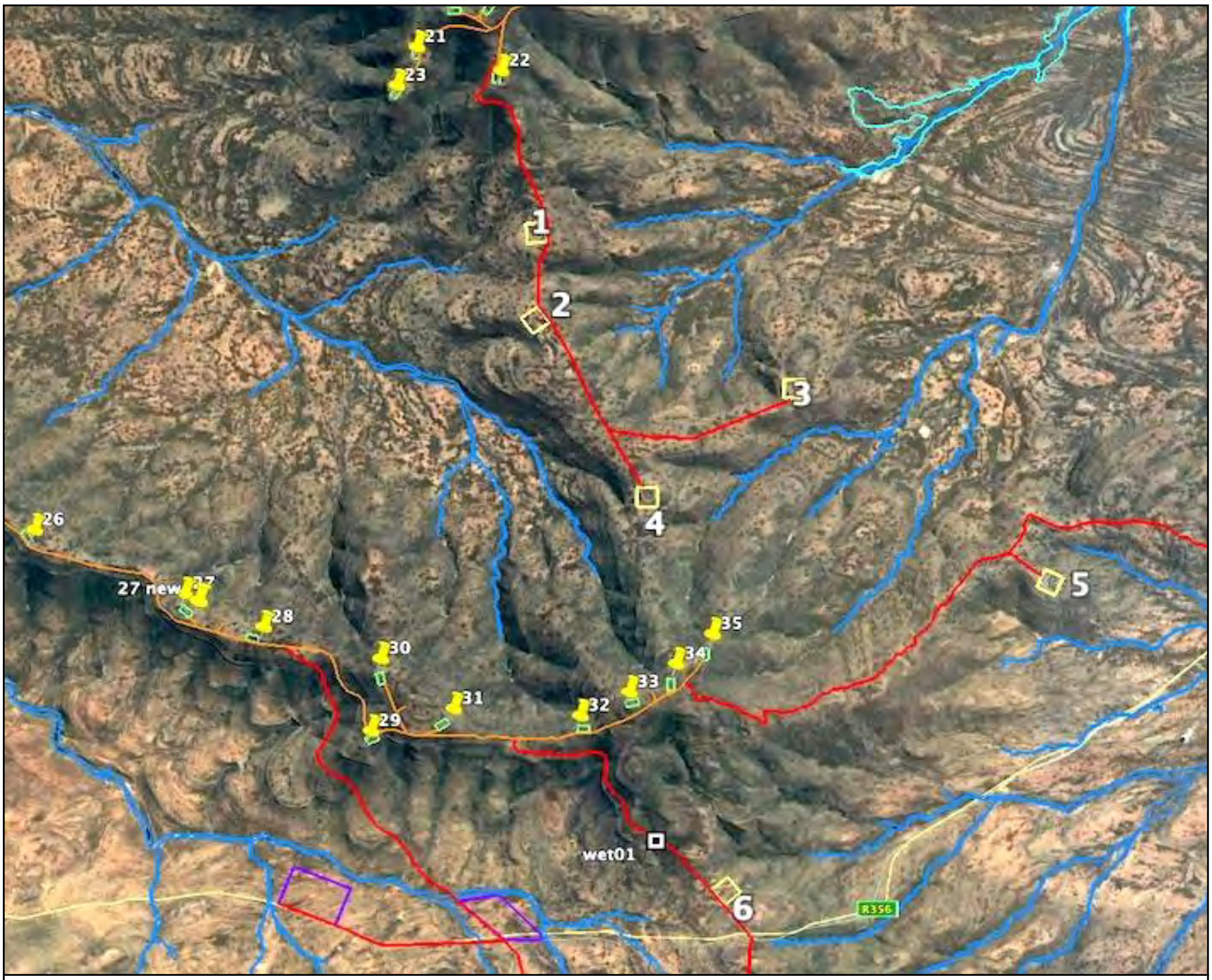

Figure 31: Alternative substation sites, numbered from 1 to 6.
(Access road = red line, internal roads = orange line, construction camps = purple line, dry stream = blue line, crane pads = green line, turbines = yellow pins, substation = yellow line)

Substation alternative 4
Substation alternative 4 is located north east of substation alternative 3 on the remainder of farm 190 Wind Heuvel (Figure 31). A fairly long section of road will need to be constructed to get to this substation from turbine 22, where other roads will end. There are no sensitivities associated with this site, with the exception of natural habitat in the mountains that is within a CBA2 area. Due to the length of the road construction this alternative is a least preferred.

Substation alternative 5
Substation alternative 5 is located west of construction camp alternative 4 along an existing 4x4 jeep track (Figure 31). A new section of road would need to be constructed from the existing R356 to this location. Of all substation options, this would require the longest distance of new / upgraded road to be constructed. There are no sensitivities associated with this site, with the exception of natural habitat in the mountains that is within a CBA2 area. As such this alternative is considered favourable.

Substation alternative 6
Substation alternative 6 is located adjacent to access road alternative center 1 to the east on portion 1 of farm 190 Wind Heuvel (Figure 31). A very short section of road will need to be constructed to get to this site from the R356. There are no sensitivities associated with this site, with the exception of natural habitat that is within a CBA2 area. According to the proponent, this option is not possible unless Access Road 1 Centre is built.

Comparison of substation alternatives
Substation Alternatives 1, 2, 3 and 4 are in similar habitat and affect areas of similar sensitivity. However, Alternative 1 would require the shortest amount of road construction, whereas the other three require increasing distances of additional road and are located further into currently unaffected habitat as well as habitat that will not be affected by turbines, internal access roads and/or crane pads. In principle, to minimize habitat loss, it is desirable to construct the shortest distance of road, because this would result in the least loss of natural habitat and the least amount of habitat fragmentation. Of these four alternatives (1, 2, 3 and 4), the one closest to the nearest turbine (Turbine 22) is therefore preferred, which is Substation Alternative 1.

Alternative 5 is along an existing road that has been constructed to provide access to a wind monitoring tower. This road would need to be upgraded further to permit construction activities, which is not desirable.

Alternative 6 is close to an existing main road. It is along one of the proposed access roads (Access Road Centre 1). Due to the fact that the proposed substation site is quite close to an existing road, this substation site can be considered to be favourable, EVEN IF ACCESS ROAD CENTRE 1 IS NOT BUILT.

In summary, Substation Options 1, 5 and 6 are considered favourable, but due to longer required road distances into unaffected mountain areas, options 2, 3 and 4 are least preferred.

Table 41: Comparison of sensitivities associated with substation alternatives.

Alternative number	Road distance	Biodiversity	Preference
1	Short (1,5 km)	No issues	Preferred
2	Medium (2,1 km)	CBA2	Least preferred
3	Longest (4,7 km)	CBA2	Least preferred
4	Longer (3,7 km)	CBA2	Least preferred
5	Longer (3,1 km)	CBA2	Favourable
6	Shortest (0,4 km)	CBA2	Favourable

Table 42: Comparative assessment of layout alternatives.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)
ACCESS ROADS		
NORTH RIDGE		
Access Road Alternative North 1	PREFERRED	Shorter distance of new road construction. Less impact on watercourse habitats. Possible to shift alignment to avoid sensitivite areas to some degree. There is an existing jeep-track along part of this alignment.
Access Road Alternative North 2	FAVOURABLE	Longer distance of new road construction. Significant effect on larger watercourse than Alt1. More complex climb and perched on ridge that would otherwise not be affected by the project, although there is an existing jeep-track along this route. Therefore would increase overall loss of habitat due to project.
CENTRE RIDGE		
Access Road Alternative Centre1	LEAST PREFERRED	This route is along the side of a steep mountain slope, which is not supported ecologically due to the high risks of downslope impacts. There is also a permanent wetland along this route, the only such wetland found on the entire site.
Access Road Alternative Centre 2	PREFERRED	This route is along the side of a steep mountain slope, which is not supported ecologically due to the high risks of downslope impacts. Nevertheless, this route option crosses a lower number of sensitive sites compared to the other alternative. It does, however, cross a riparian area, upon which impacts will need to be managed.
SOUTHERN RIDGE		
Access Road Alternative South 1	LEAST PREFERRED	This route is along the side of a steep mountain slope, which is not supported ecologically due to the high risks of downslope impacts.
Access Road Alternative South 2	PREFERRED	Route is situated on top of slope with less downslope risk. There is also an existing vehicle track along this route and the

Alternative	Preference	Reasons (incl. potential issues)
		terrain at the bottom of the slope is slightly degraded.
CONSTRUCTION CAMPS		
Construction Camp Alternative 1	FAVOURABLE	Favourable, if it can be shifted slightly away from watercourse. Adjacent to preferred road alternative.
Construction Camp Alternative 2	PREFERRED	No major sensitivities. Adjacent to preferred road alternative.
Construction Camp Alternative 3	FAVOURABLE	Adjacent to existing gravel road. Large watercourse nearby. CBA1 area.
Construction Camp Alternative 4	LEAST PREFERRED	Rocky ridge within site containing higher diversity than adjacent areas. Adjacent to existing gravel road. CBA1 area.
Construction Camp Alternative 5	LEAST PREFERRED	Adjacent to existing gravel road. Three watercourses close by, one of which is within the corner of the site. Moderately high internal habitat diversity and slightly higher species richness than comparable sites. CBA2 area.
Construction Camp Alternative 6	FAVOURABLE	Adjacent to existing gravel road. Two watercourses nearby. CBA2 area.
SUBSTATIONS		
Substation Alternative 1	PREFERRED	Shortest length of additional road required. Mountain vegetation.
Substation Alternative 2	LEAST PREFERRED	Intermediate amount of additional road required. Mountain vegetation. CBA2 area.
Substation Alternative 3	LEAST PREFERRED	Longer distance of additional road required. Mountain vegetation. CBA2 area.
Substation Alternative 4	LEAST PREFERRED	Longer distance of additional road required. Mountain vegetation. CBA2 area.
Substation Alternative 5	FAVOURABLE	Intermediate amount of additional road required, but along an alignment where there is an existing road. CBA2 area.
Substation Alternative 6	FAVOURABLE	Shortest length of additional road required. Mountain vegetation. CBA2 area.

Asssessment of No-Go alternative

If the project does not proceed then the current status quo will continue. This will involve continued use of the land for livestock production. Logic suggests that this will mean that the landscape remains unaltered into the future under an unchanging land-use regime. However, historical evidence has shown that livestock production, especially in arid parts of the country have led to overall degradation of the vegetation, especially in times of drought. This degradation has been shown to accumulate over time, incrementally reducing the productive capacity of the landscape. Indications are that, due to human-induced climate change, the risk of future degradation has increased. The site is in an arid area and, based on the scientific consensus that global climate change is affecting local climate and that South Africa is more significantly affected than other parts of the planet, in terms of a warming effect as well increased risk of drought, the risks to livestock production have probably worsened and will continue to do so into the future. This implies that stocking rates, and therefore profitability, will need to be reduced in order to avert land degradation, putting financial strain on producers. An alternative income stream is likely to improve the financial viability of any land manager, which in turn reduces the pressure to carry unsustainable stock numbers. This in turn puts less pressure on the land, which reduces the likelihood of grazing-induced degradation of the land. In summary, the No-Go option could increase the risk of land degradation due to over-grazing under adverse future climate scenarios, whereas there is a possibility of this effect being lessened in the case of the project promoting local economic diversity.

PROPOSED LAYOUT ADJUSTMENTS

On the basis of the walk-through survey of the proposed infrastructure, some minor adjustments to the position of infrastructure were proposed. The proposed shifts would assist in avoiding habitats and sites that have a higher sensitivity rating to the the surrounding areas. These were NOT required adjustments, merely suggestions to avoid more sensitive sites, where possible. Most of these suggestions have been accommodated, and this section is left in the report to document that modifications to the layout of the project have been made to take sensitivities into account.

Turbine 27

This turbine is located on the top of a small rock outcrop at the summit of the ridge. Rocky outcrops have been designated as sensitive and so have mountain summits. If technically possible, it would be preferable to shift the position of this turbine approximately 100 m south-eastwards of its current position (Figure 32). The new position would be approximately at the following co-ordinates: 32°45'32.22"S, 20°15'55.32"E. If not technically possible to make this adjustment, the current location is NOT a fatal flaw, but affects a feature that would be preferable to avoid.

Figure 32: Proposed shift in position of Turbine 27.
(Road & crane pad boundary = red line, current position = green marker, new position = yellow marker)

Turbine 25 access road

The access road onto the crane pad area at Turbine 25 is very close to the edge of the mountain slope. Although there is not a significant rocky outcrop at this point, there is a moderate outcropping of rocks at this point. However, the biggest concern is to minimize the risk of downslope erosion from the road, which would put a greater area at risk of degradation than just the road surface itself. It is therefore proposed that the access road be shifted inwards slightly to provide a buffer to the edge of the mountain slope. The proposed direction of shift is shown in Figure 33. The approximate position of this infrastructure is as follows: 32°44'58.59"S, 20°14'48.48"E.

This change to the layout has been made.

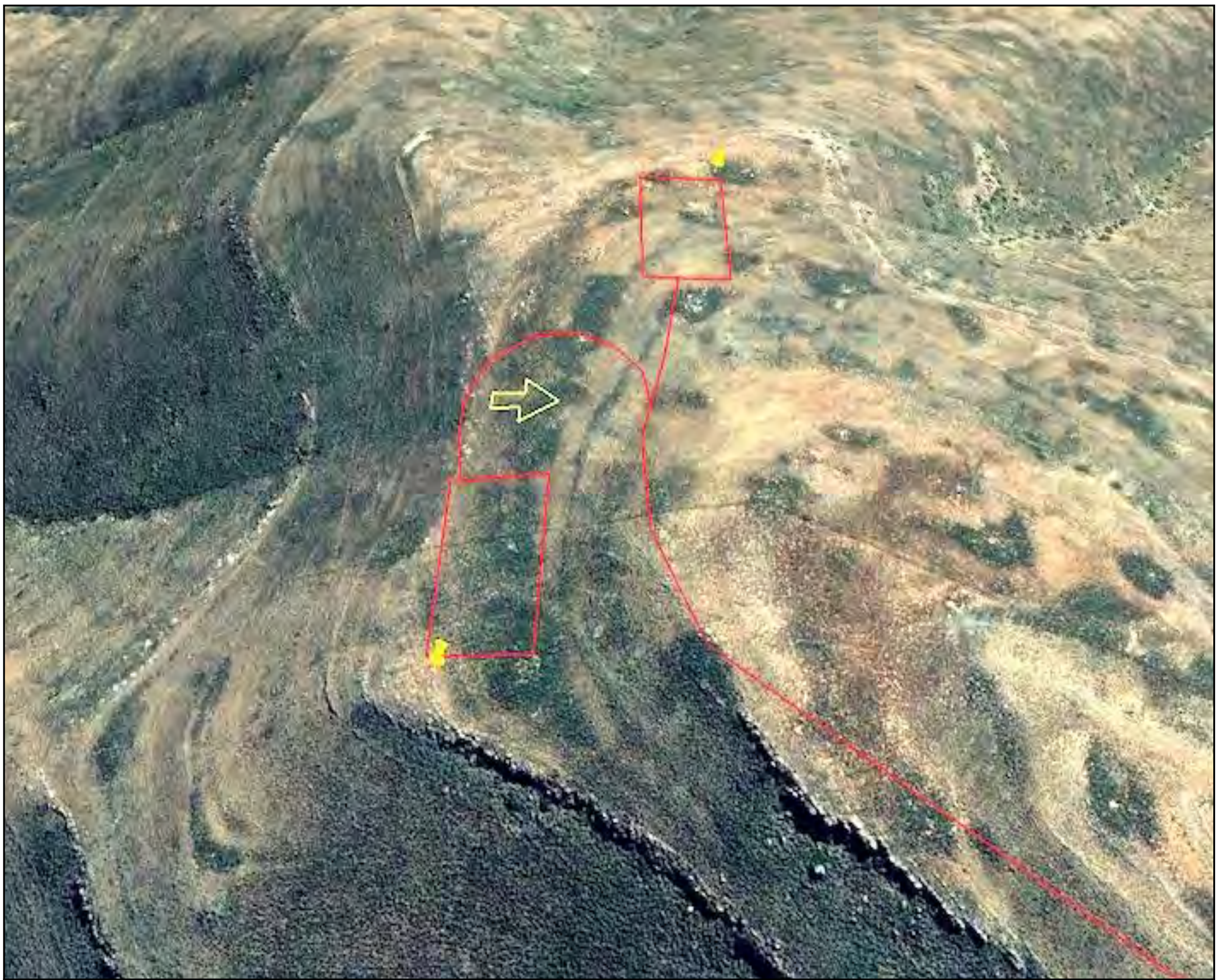

Figure 33: Proposed shift in position of access road to Turbine 25.
(Road & crane pad boundary = red line)

Road alignment near Turbines 27

The internal access road running past Turbine 27 crosses a rocky ridge / outcrop at the following approximate location: 32°45'31.57"S, 20°15'47.52"E. This is on the slope below Turbine 37 (Figure 34). If technically possible, this alignment should be shifted slightly to attempt to avoid this outcrop, or else to cross it at a less significant location. A previous proposal / suggestion is to shift the location of Turbine 27, which makes it difficult to propose a new alignment. If technically possible, the alignment should possibly be moved upslope above the outcrop.

This change to the layout has been made.

Figure 34: Proposed shift in position of internal access road between Turbines 28 and 29.
(Road & crane pad boundary = red line, proposed re-alignment = yellow lines)

Road alignment between Turbines 28 and 29

The internal access road running between Turbine 28 and Turbine 29 crosses a rocky ridge / outcrop at the following approximate location: 32°45'51.43"S, 20°16'39.56"E. This is on the slope below Turbine 30 (Figure 35). If technically possible, this alignment should be shifted slightly to attempt to avoid this outcrop. Two proposed possible alignments are shown in Figure 35. This would shift the road above the outcrop, or else pass it through the outcrop at a less significant location.

This change to the layout has been made.

Figure 35: Proposed shift in position of internal access road between Turbines 28 and 29.
(Road & crane pad boundary = red line, proposed re-alignment = yellow lines)

Crane pad at Turbine 29

The crane pad at Turbine 29 is located partially on the edge of a steep slope. If technically possible, it should be rotated slightly to be located more completely on the top of the flatter area, as shown in Figure 36. This is not a high priority suggestion and should only be considered if it does not result in adverse effects at other locations, for example, shifting the internal access road to a less favourable position.

This change to the layout has been made.

Figure 36: Proposed shift in position of crane pad at Turbines 29.
(Road & crane pad boundary = red line, proposed re-alignment = yellow lines)

Crane pad at Turbine 35

The crane pad at Turbine 35 is located partially on the edge of a steep slope with a minor rock outcrop. If technically possible, it should be rotated slightly to be located more completely on the top of the flatter area, as shown in Figure 37. This is not a high priority suggestion and should only be considered if it does not result in adverse effects at other locations, for example, shifting the internal access road to a less favourable position.

This change to the layout has been made.

Figure 37: Proposed shift in position of crane pad at Turbines 35.
(Road & crane pad boundary = red line, proposed re-alignment = yellow lines)

Road alignment between Turbines 29 and 31

The internal access road running between Turbine 29 and Turbine 31 crosses a rocky ridge / outcrop at the following approximate location: 32°45'51.43"S, 20°16'39.56"E. This is on the slope below Turbine 30 (Figure 38). If technically possible, this alignment should be shifted slightly to attempt to avoid this outcrop. Two proposed possible alignments are shown in Figure 38. This would shift the road above the outcrop, or else pass it through the outcrop at a less significant location.

This change to the layout has been made.

Figure 38: Proposed shift in position of internal access road between Turbines 28 and 29.
(Road & crane pad boundary = red line, proposed re-alignment = yellow lines)

Turbine 16

This turbine is located on the top of the summit of the ridge. Rocky outcrops have been designated as sensitive and so have mountain summits. It would be preferable to shift the position of this turbine approximately 40 m westwards of its current position (Figure 39). The new position would be approximately at the following co-ordinates: 32°42'23.50"S, 20°17'22.00"E. The crane pad must also not affect this outcrop and should be orientated in a similar fashion relative to the new position as it was to the old position.

This change to the layout has been made.

Figure 39: Proposed shift in position of Turbine 16.
(Road & crane pad boundary = red line, current position = green marker, new position = yellow marker)

Access road North Alternative 1

This alignment is shown running parallel to and in and out of a drainage line. This alignment would have a large impact on this particular drainage line, which is avoidable by shifting the alignment slightly away from the drainage line and then crossing it perpendicularly at a single point, as shown in Figure 40. Adjusting this alignment would also improve the acceptability of Construction Camp Alternative 1, also shown in Figure 40. The proposed position of the crossing of the drainage line would be approximately at the following co-ordinates: 32°39'7.20"S, 20°19'27.92"E.

This change to the layout has been made, including a modification to the design of the Construction Camp.

Figure 40: Proposed shift in alignment of Access Road Alternative North 1.
(Road & construction camp boundary = red line, new alignment = yellow line)

Access road North Alternative 2

This alignment is shown crossing a drainage line twice where it would be preferable to avoid the drainage line completely at this point, if technically possible. This alignment would have an impact on this particular drainage line, which is avoidable by shifting the alignment slightly away from the drainage line, as shown in Figure 41. The current position of the crossing of the drainage line is approximately at the following co-ordinates: 32°41'7.56"S, 20°19'57.19"E.

This change to the layout has been made.

Figure 41: Proposed shift in alignment of Access Road Alternative North 2.
(Road & construction camp boundary = red line, new alignment = yellow line)

Based on the suggested alignment changes Rondekop Wind Farm layout has been amended (Figure 42). This includes a shift in the location of Turbine 44 to avoid bat and bird buffers, although this was not identified as an issue from a vegetation perspective.

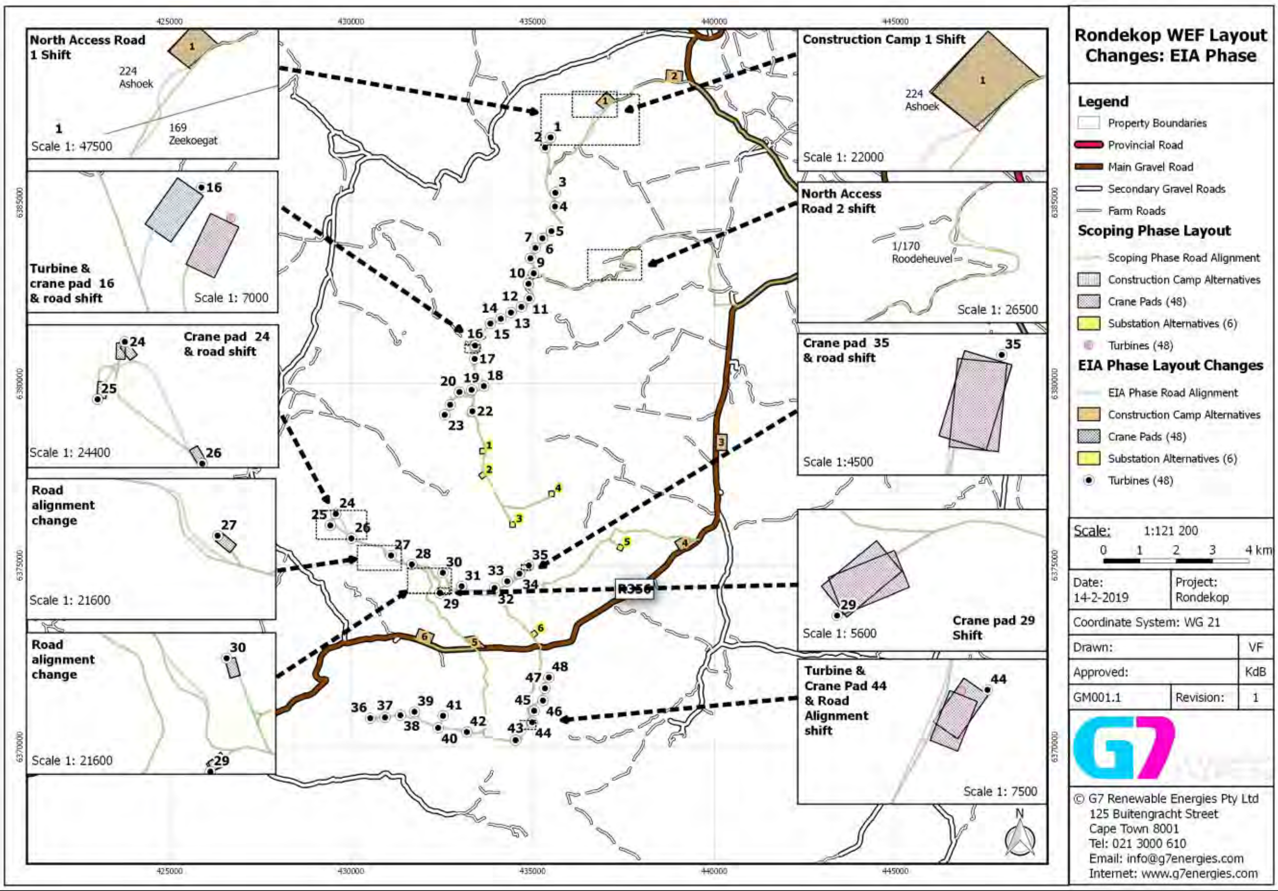

Figure 42: Layout changes implemented during the EIA phase of the project.

DISCUSSION AND CONCLUSIONS

General discussion of patterns seen on site

The project study area consists of natural habitat within a largely rural area. This is within an area where portions of the natural habitat have been assessed as having potential conservation value, although this project site falls outside of the NPAES entirely and are therefore not earmarked for future conservation. Currently, the rates of transformation within the vegetation in this area is low. The regional vegetation types that occur on site, Koedoesberge-Moordenaars Karoo and Central Mountain Shale Renosterveld, are listed as Least Threatened in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004) with less than 1% of the vegetation transformed. However, significant parts of the site are within Provincial Critical Biodiversity Areas. Two small areas of Critical Biodiversity Area 1 (Irreplaceable) occur on site, but are affected to a very small extent by the proposed project (turbine 25 and crane pad 25 and small section of an internal road – approximately 300 m). The southern half of the site occurs within Critical Biodiversity Area 2 (Important). These areas of natural habitat on site were therefore considered to possibly have high biodiversity value and the assessment was undertaken with this in mind.

The Northern Cape Critical Biodiversity Area Map, published in 2016 (Holness & Oosthuysen 2016) derives CBAs from the earlier Namakwa District Biodiversity Sector Plan (Desmet & Marsh 2008). To produce the original Namakwa map, general correlations between biophysical parameters and known biodiversity patterns were used to define the CBAs, including a perceived general increase in local diversity, as well as increased likelihood of encountering plant species of special concern, as elevation increases. A proportion of all higher elevation areas were allocated by regional planners to CBA2 areas according to an algorithm that seeks a least-cost outcome for preserving biodiversity, i.e. the least amount of land space for preserving the greatest amount of area of biodiversity importance, as well as meeting specific conservation targets. The net result is that CBA2 areas on site may be identical in character to other natural areas on site that are not included in a CBA. The floristic similarity between areas within the CBA2 areas and those outside was confirmed from detailed field surveys undertaken on site. Due to the similarity of areas inside and outside the CBA2 areas was found, **complete exclusion of the project from CBA2 areas is not justified** and, if necessary, similar habitat on other ridges within the general area could be targeted for conservation purposes to achieve the same regional targets.

There is one (1) plant species, *Hoodia gordonii*, protected according to the National Environmental Management: Biodiversity Act, two (2) clumps of which were found on site during the detailed field surveys, neither of which are directly affected by proposed infrastructure. There are a number of species protected according to the Northern Cape Nature Conservation Act that were recorded on site. None of these species are of conservation concern, but the fact that they are protected means that a permit will be required for their removal. This is a standard flora permit obtained from the provincial department. Final species and numbers will need to be determined from a walk-through survey of approved infrastructure, but preliminary details are provided in this report (page 54 in the section, “Protected Plants: Northern Cape Nature Conservation Act”, where a list of more than 40 species are known to occur within the footprint of the proposed infrastructure, many of these being common on site and in surroiunding areas.

There are a small number of fauna of possible conservation concern that were assessed as having a possibility of occurring on site. This includes the critically endangered Riverine Rabbit, the Vulnerable Leopard and Black-footed Cat, the near threatened Karoo Dwarf Tortoise, Grey Rhebok (seen on site) and Spectacled Dormouse, and a number of protected species, including the Armadillo Girdled Lizard, the Honey Badger, the Black-footed Cat, the Leopard and the Cape Fox. The likelihood of these occurring on site varies between species, with the Grey Rhebok definitely occurring on site, the Leopard almost certain to occur there, the Spectacled Dormouse and Karoo Dwarf Tortoise having a high probability, and the Black-footed Cat having a moderate probability of occurring there. Based on distribution, habitat requirements and other monitoring research, the Riverine Rabbit is unlikely to occur on site. Some of the species that could potentially occur on site are **highly mobile species that are unlikely to be affected by any activities on site, but others are more restricted or territorial and could be more significantly affected**. Of those that are more likely to be affected, if they occur there, are the Black-footed Cat, the Spectacled Dormouse, the Armadillo Girdled Lizard and the Karoo Dwarf Tortoise.

The vegetation on site consists largely of succulent dwarf shrubland typical of the regional vegetation type, Koedoesberge-Moordenaars Karoo. However, the pattern observed on site is that local diversity increases with increased elevation and with higher local surface rockiness. This means that the greatest diversity is at the highest elevations, but also located within specific habitats. Mountain summits, crests and plateau, as well as rocky outcrops, riparian habitats, and scarp valleys were identified as sensitive, either due to having higher diversity, higher value as refugia, or as being particularly sensitive to disturbance. The top of the mountain ridges is where turbines and access roads are proposed to be located, which partially affects some of these habitats. Proposals have been made at specific locations to avoid or minmise disturbance to such habitats. **However, overall based on the vegetation found on the site and the detailed site assessment the impact to this vegetaion is considered low due to the presense of this vegetation on other ridges in the area.**

For all infrastructure components, loss of habitat will occur. **This will be relatively insignificant in comparison to the total area of the regional vegetation types concerned but may be more significant in terms of local patterns and diversity that could be affected.** A detailed walk-through survey was undertaken on site of the footprint of all infrastructure components. This included compiling a flora list at every turbine location, and at all alternative construction camp and substation sites. This data indicated that there is not a high amount of floristic variability across the site. There is some variability between sites due to local conditions (microhabitats), which has a greater influence on floristic variability than any geographical gradient across the site. **No significant difference in floristic composition was found in areas occurring within the CBA2 areas and those outside.**

Based on the findings of the detailed site walkthrough it was observed that aspect, slope inclination, degree of rockiness, and drainage patterns have an important influence on floristic composition, with a lesser gradient associated with elevation. The exception to this general pattern is that the southern ridge had a higher probability of containing patches of renosterveld (Central Mountain Shale Renosterveld) than other parts of the site (Koedoesberge-Moordenaars Karoo). This pattern is a geographical gradient already captured in the national vegetation map, which clearly shows patches of this renosterveld vegetation type occurring on site. Although this is a relatively rare vegetation type on site, it occurs as an extensive unit off-site in the hills towards Matjiesfontein with a total area of nearly 1300 km^2. Therefore, the amount of vegetation that would be cleared for the proposed development would be minor in comparison to the overall expanse of the vegetation unit.

Other than the general floristic biodiversity patterns on site, the main sensitivity on site is the presence of various watercourses in which there are dry river beds and associated riparian vegetation. This habitat is disproportionately important due to the functional value of these watercourses and the important habitat and forage that they provide for animal populations. The habitat is also interconnected and any damage to one point will affect all downstream areas. For this reason, these riparian habitats, along with their floodplains, have been designated as especially sensitive. However, this is being assessed by an aquatic specialist and the access roads can be effectively mitigated to avoid these ares except with the few river crossings where impacts can be mitigated to an acceptable level. Other important habitats on site include rocky cliffs, outcrops and ridges, as well as some steep, south-facing slopes, especially scarp slopes at the head of drainage valleys. **However, mitigation measures as well as proposed alignment amendments have been suggested to reduce the overall impact on these features**.

The project involves construction of access roads onto three mountain ridges and the installation of wind turbines and associated infrastructure there. The topography of the mountains is relatively steep and this poses a challenge for construction, but also for causing damage to natural ecosystems. The arid nature of the study area, in combination with the skeletal soils, has resulted in the development of vegetation that is very slow-growing and unlikely to recover entirely from any disturbance where vegetation cover is removed. Therefore, in principle, the absolute smallest infrastructure footprint is desired with the least risk of future damage to natural habitats. It is important to identify the least-risk location for this infrastructure so that biodiversity is affected to the minimum degree possible. However, this as already been implemented during the design phase and based on the recommendations of this report.

A detailed assessment of potential impacts was undertaken which identified that loss of habitat is probably the most important potential impact on site. This is a typical outcome for a project proposed to be constructed within a greenfields area. However, it is important to emphasize that the **spatial scale of transformation of natural habitats on site due to the proposed project is negligible in area compared to the total area of vegetation types concerned, as well as any Critical Biodiversity Areas**. The footprint of the proposed project will be in the vicinity of 200 hectares, whereas the area of the vegetation type affected is close to five hundred (500) square kilometres, or 50 million hectares.

The loss of habitat associated with this project is therefore six orders of magnitude smaller than this and therefore regionally insignificant.

General summary

Biodiversity patterns on site have been established to a high level of detail and with a fairly high degree of confidence, including two weeks of field surveys on site and a detailed desktop assessment. From this detailed assessment, the following has been established:

1. No threatened plant or animal species are likely to be affected by the proposed project;
2. A number of plant species protected according to Provincial legislation will be affected, but these are all common and / or widespread species, none of which are of conservation concern. The presence of these species triggers a permit requirement, but does not affect rare or threatened species;
3. The vegetation types affected by the project are widespread and have been transformed overall to a small degree. They are therefore of low conservation concern. The amount of transformation due to the proposed project is small in absolute terms and also relative to the overall distribution of the regional vegetation;
4. There are habitats on site that have been identified as being of higher sensitivity and value than the general vegetation, including rocky outcrops and riparian vegetation. These have all been mapped in detail and all attempts made to ensure that the project affects these areas to the smallest degree possible, including shifting infrastructure, where possible. Residual impacts on these areas of elevated sensitivity are small compared to the distribution of these on site.
5. The only matter of concern for the site is the presence of Critical Biodiversity Areas, mostly CBA2 Important areas, within which approximately half of the project falls. **The CBAs include vegetation and floristic patterns that are virtually identical to parts of the site that are not included in the CBA. The total area affected by the project that falls within CBAs is relatively insignificant in comparison to the overall extent of the CBA.** Nevertheless, mitigation measures have been proposed to minimise this potential loss of habitat as much as possible, including changes to the location of infrastructure to avoid sensitive sites.

Conclusions

At the site-specific scale, some sensitivities have been identified, primarily related to natural habitat, but also to some individual (protected) species. Many of these can be minimised or avoided with the application of appropriate mitigation or management measures, including, in some cases, slight shifts of infrastructure positions. There will be residual impacts, primarily on natural habitat. **Overall based on the vegetation found on the site and the detailed site assessment the impact to this vegetaion is considered low due to the presense of this vegetation on other ridges in the area. The amount of habitat that will be lost to the project is insignificant compared to the area in hectares of the regional vegetation type that occurs on site and over the entire geographical range of the vegetation type**. In most cases, the exact location of important biodiversity features have been identified in the field at a relatively high level of confidence and suggestions made to relocate proposed infrastructure to avoid these. From this perspective it is unlikely that the proposed project will have an unacceptable impact on the natural environment. Based on the analysis provided in this report, the conclusion is that the project should be authorised (inclusive of all project alternatives).

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APPENDICES:

Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.

<u>Sources:</u> see text.

Taxon	Latest (IUCN version 3.1) Conservation Status**	Habitat	Flowering Time	Probability of occurrence*
Hoodia dregei APOCYNACEAE	Vulnerable	Merweville, Beaufort West and Prince Albert (to east of current site on flats between Groot Swartberg range and Karoo mountains). Gamka Karoo. Stony slopes of hills or stony flat areas.		**LOW**, habitat matches
Hoodia pilifera APOCYNACEAE	Near threatened (NT)	Montagu to Uniondale, Matjiesfontein to Laingsburg and Gamka Poort, and Klaarstroom (to south-east of current site along northern side of Groot Swartberg range). Fynbos. On steep shale slopes or near the foot of sandstone mountains, usually on hotter, northern aspects, occasional it is found on flat areas and cooler, southern slopes.		**LOW**, distribution out, no suitable habitat on site
Senecio erysimoides ASTERACEAE	Data Deficient – Taxonomically problematic	Unknown, but recorded from the valley on the western side of the site.	December-April	**HIGH**, habitat matches
Romulea albiflora IRIDACEAE	Critically Endangered	Known from three collections from one continuous subpopulation. Part of the subpopulation was lost to cereal cultivation and the rest occurs on the edge of a ploughed field. There are fewer than 250 mature individuals extant and decline due to crop cultivation is continuing.	September-October	**LOW**, known distribution is further north
Secale strictum subsp. africanum POACEAE	Critically Endangered	A range-restricted species that was once common on the Roggeveld, but is now known from one subpopulation on a farm, where there are fewer than 50 mature individuals. This taxon has experienced severe declines due to overgrazing and poor veld management. It is cultivated and several attempts are being made to reintroduce it to other properties on the Roggeveld.	December	**LOW**, known distribution is further north
Daubenya aurea HYACINTHACEAE	Endangered	Plants at four to five locations continue to decline due to ongoing expansion of crop cultivation and overgrazing.	September	**LOW**, known distribution is further north

Ixia thomasiae IRIDACEAE	Endangered	A rare, and highly restricted species, known from two to three locations and declining due to ongoing habitat loss to crop cultivation.	September-November	**LOW,** known distribution is further north
Oxalis lineolata OXALIDACEAE	Endangered	A range-restricted species and only known from three locations, within a small area around Doornbosch. There is continuous decline as a result of habitat loss due to expanding crop cultivation. The species is estimated to have a population size between 150-300 individuals.	May-June	**LOW,** known distribution is further northwest
Oxalis marlothii OXALIDACEAE	Endangered	A range-restricted species, occurring at two to three locations and declining due to ongoing habitat loss and degradation. Roggeveld Shale Renosterveld, Roggeveld Karoo, High altitude shale and sandstone plateaus.	September-October	**LOW,** known distribution is close to site, but different habitat
Polhillia involucrata FABACEAE	Endangered	A range-restricted Roggeveld endemic, this species has been recorded from three subpopulations that occur at two locations. Habitat loss in the past has occurred due to crop cultivation and livestock grazing. Being highly palatable, this species continues to experience ongoing decline as a result of overgrazing	January	**LOW,** known distribution is further north
Asparagus mollis ASPARAGACEAE	Vulnerable	A rare and poorly known species with a restricted range. There are fewer than 10 locations, and it continues to decline due to ongoing habitat loss in the Overberg. Subpopulations in the northern part of the range are not threatened only the population in the Overberg is threatened.	January	**LOW**
Carex acocksii CYPERACEAE	Vulnerable	One known location is potentially threatened by livestock overgrazing.	October-November	**LOW,** known distribution is much further north
Cliffortia arborea ROSACEAE	Vulnerable	Fewer than 10 known locations. Continues to decline due to inappropriate fire management and harvesting for firewood. Hantam Karoo, Hantam Plateau Dolerite Renosterveld, Upper Karoo Hardeveld, Nieuwdtville-Roggeveld Dolerite Renosterveld, Tanqua Escarpment Shrubland, Central Mountain Shale Renosterveld, Roggeveld Shale Renosterveld. Cliffs and ledges of dolerite, sandstone and shale escarpment.	October-December	**MEDIUM,** would occur in rocky areas, most likely in southern part of site.
Delosperma sphalmanthoides AIZOACEAE	Vulnerable	A rare, localized habitat specialist, known from two to three locations and potentially threatened by habitat	August	**LOW,** known distribution is further east

		degradation due to overstocking of rangelands for livestock. Roggeveld Shale Renosterveld, shallow soils over shale rock. 3220DA, DB		
Diascia lewisiae SCROPHULARIACEAE	Vulnerable	Known from five small subpopulations that together consist of fewer than 1000 mature individuals. Four of the five subpopulations occur on private land and are potentially threatened by crop cultivation and road widening.	August-September	**LOW,** known distribution is much further northwest
Geissorhiza spiralis IRIDACEAE	Vulnerable	Three known locations are potentially threatened by livestock overgrazing and soil erosion. Roggeveld Shale Renosterveld, Roggeveld Karoo, mountain renosterveld, on stony clay slopes. 3220DA, DB.	July-September	**LOW,** known distribution is slightly north-east and different habitat.
Gethyllis pectinata IRIDACEAE	Vulnerable	Known from one location. Potentially threatened by overgrazing and illegal bulb collecting.	December	**LOW,** known distribution is further northwest
Helictotrichon barbatum POACEAE	Vulnerable	Known from three disjunct locations and potentially threatened by overgrazing. Lower rocky slopes in mountain renosterveld on clays.	November	**MEDIUM**, but preferred habitat is lower mountain slopes, where WEF development is limited.
Helictotrichon namaquense POACEAE	Vulnerable	Acocks (1990) indicates that this taxon had a very similar distribution to *H. barbatum* occurring on all the Karoo mountains i.e. Bokkeveld, Kamiesberg, Roggeveld and Hantamsberg, but stated that it had disappeared from much of its range due to overgrazing. The species was rediscovered in 1986 in the Roggeveld where it was common along the roadside verges but declining due to being heavily grazed. Roggeveld and Hantamsberg Mountain.	September	**LOW,** known distribution is slightly north-east and different habitat.**,**
Hesperantha hantamensis IRIDACEAE	Vulnerable	Known from one location. Even though locally common and partly conserved in a nature reserve, it was and remains potentially threatened by dam expansion and road widening	July-September	**LOW,** known distribution is much further northwest
Hesperantha purpurea IRIDACEAE	Vulnerable	Known from the type locality. Threatened by livestock overgrazing and trampling	September	**LOW,** known distribution is much further northwest
Ixia rivulicola IRIDACEAE	Vulnerable	A localized habitat specialist, and potentially threatened by habitat degradation and disturbance due to crop cultivation and dam construction.	October-November	**LOW,** known distribution is further north

Jamesbrittenia incisa SCROPHULARIACEAE	Vulnerable	Known from seven locations. Declining in habitat quality and number of mature individuals due to livestock grazing.	September	**LOW,** known distribution is further north and east
Lachenalia longituba HYACINTHACEAE	Vulnerable	A range-restricted and localized habitat specialist, known from five locations and potentially threatened by habitat loss and degradation. Roggeveld Karoo, Roggeveld Shale Renosterveld, Central Mountain Shal Renosterveld. Stony clay in seasonally wet, boggy sites that bake hard in summer.	April-June	**MEDIUM,** occurs in wet, boggy sites
Lachenalia schelpei HYACINTHACEAE	Vulnerable	Known from one location. Not currently declining but potentially threatened by crop cultivation and overgrazing by goats.	June-September	**LOW,** known distribution is further north
Lotononis venosa FABACEAE	Vulnerable	Few known locations. Some of the habitat has been transformed for crop cultivation in the past. Further agricultural expansion and overgrazing by livestock are potential threats. Klein Roggeveld Mountains. Central Mountain Shale Renosterveld, Koedoesberge-Moordenaars Karoo. Open karroid scrub on sandy clay alluvium.	September	**HIGH,** vegetation type and habitat suitable.
Phyllobolus tenuiflorus (Mesembryanthemum tenuiflorum) AIZOACEAE	Vulnerable	Knersvlakte. Habitat at five to 10 locations is declining due to mining.	August	**LOW,** wrong distribution for current site.
Octopoma nanum AIZOACEAE	Vulnerable	A localized habitat specialist with fewer than 10 known locations and declining due to overgrazing by livestock and game. Tanqua Karoo, Western Little Karoo, Koedoesberge-Moordenaars Karoo, Matjiesfontein Quartzite Fynbos, Tanqua Wash Riviere, Flats and gentle slopes with loamy soils and sparse quartz gravel.	November	**MEDIUM,** Found on flats and gentle slopes with loamy soils and sparse quartz grave
Romulea hallii IRIDACEAE	Vulnerable	A Roggeveld endemic known from two locations. It is potentially threatened by road maintenance and expansion and livestock overgrazing.	July-August	**LOW** only Roggeveld plateau.
Romulea membranacea IRIDACEAE	Vulnerable	Known from six locations, five of which are threatened by rapidly expanding rooibos tea cultivation	July-August	**LOW,** known distribution is further northwest
Romulea multifida IRIDACEAE	Vulnerable	Known from three locations. Potentially threatened by crop cultivation	August	**LOW** only Roggeveld plateau
Ehrharta eburnean *POACEAE*	Near Threatened	Calvinia, Sutherland and Montagu. Rocky places in mountain renosterveld.	September-November	**HIGH**
Geissorhiza karooica *IRIDACEAE*	Near Threatened	Roggeveld Mountains to Matjiesfontein. Succulent karoo shrubland on course shale slopes.	August-September	**HIGH,** recorded on

				adjacent project
Lachenalia whitehillensis *HYACINTHACEAE*	Near Threatened	Southern Roggeveld Escarpment near Sutherland to Matjiesfontein in the southern Great Karoo. Sandy soils in riverbeds and on alluvial plains, sometimes in damp places among rocks in river beds.	October	**HIGH,** recorded on adjacent project
Manulea incana *SCROPHULARIACEAE*	Near Threatened	Roggeveld Escarpment.	September-October	**LOW,** known distribution is further northeast
Pauridia alticola *HYPOXIDACEAE*	Near Threatened	Hantamsberg near Calvinia southwards across the Roggeveld Escarpment to the Swartruggens Mountains and Koue Bokkeveld near Ceres. Seasonally inundated depressions on shale and dolerite, and shale bands in the Cedarberg.	June-September	**MEDIUM**, right distribution and habitat
Romulea komsbergensis *IRIDACEAE*	Near Threatened	Roggeveld Escarpment, Komsberg Pass to Middelpos.	August-September	**LOW,** known distribution is further northeast
Romulea subfistulosa *IRIDACEAE*	Near Threatened	Calvinia to Roggeveld Escarpment at Sutherland. A Roggeveld endemic known from 11 locations. Threatened by ongoing but slow conversion of habitat for crop cultivation.	August-October	**LOW,** known distribution is further northwest
Romulea syringodeoflora *IRIDACEAE*	Near Threatened	Roggeveld Plateau, a range-restricted Roggeveld endemic, known from nine location and possibly occurring at a few more in unsurveyed parts of its range. Suspected to occur at less than 15 locations in total. Experiencing ongoing decline of habitat to crop cultivation as well as habitat degradation as a result of livestock overgrazing.	October	**LOW,** known distribution is further northwest
Romulea unifolia *IRIDACEAE*	Near Threatened	Roggeveld, known from seven locations, but at least five more locations likely as this is a poorly explored area with much intact habitat. Estimate that fewer than 15 locations exist. Subpopulations are declining in some areas due to livestock trampling and habitat loss to wheat cultivation. Roggeveld, succulent karoo, dolerite flats.	August-September	**MEDIUM**, right distribution and habitat
Antimima androsacea *AIZOACEAE*	Critically rare	Roggeveld Escarpment, a range-restricted species (EOO 10 km²), known from one site where it is not threatened.	August	**LOW**
Moraea marginata *IRIDACEAE*	Critically rare	Sutherland, known from a single population. Not threatened.	November	**LOW**

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

Appendix 2: List of protected tree species (National Forests Act).

Acacia (Vachellia) *erioloba*	*Acacia haematoxylon*
Adansonia digitata	*Afzelia quanzensis*
Balanites maughamii subsp. *maughamii*	*Barringtonia racemosa*
Boscia albitrunca	*Brachystegia spiciformis*
Breonadia salicina	*Bruguiera gymnhorrhiza*
Cassipourea swaziensis	*Catha edulis*
Ceriops tagal	*Cleistanthus schlectheri* var. *schlechteri*
Colubrina nicholsonii	*Combretum imberbe*
Curtisia dentata	*Elaeodendron* (*Cassine*) *transvaalensis*
Erythrophysa transvaalensis	*Euclea pseudebenus*
Ficus trichopoda	*Leucadendron argenteum*
Lumnitzera racemosa var. *racemosa*	*Lydenburgia abottii*
Lydenburgia cassinoides	*Mimusops caffra*
Newtonia hildebrandtii var. *hildebrandtii*	*Ocotea bullata*
Ozoroa namaensis	*Philenoptera violacea* (*Lonchocarpus capassa*)
Pittosporum viridiflorum	*Podocarpus elongatus*
Podocarpus falcatus	*Podocarpus henkelii*
Podocarpus latifolius	*Protea comptonii*
Protea curvata	*Prunus africana*
Pterocarpus angolensis	*Rhizophora mucronata*
Sclerocarya birrea subsp. *caffra*	*Securidaca longependunculata*
Sideroxylon inerme subsp. *inerme*	*Tephrosia pondoensis*
Warburgia salutaris	*Widdringtonia cedarbergensis*
Widdringtonia schwarzii	

None have a geographical distribution that is close to the study area.

Appendix 3: Plant species previously recorded in the general area.

This list was compiled by extracting a list of species that have been recorded within a rectangular area that includes the study area as well as similar habitats in surrounding areas, as obtained from http://newposa.sanbi.org/ accessed on 10 October 2018. It is probable that it includes some species that occur in habitats that do not occur on site.

The list is arranged by family in alphabetical order. Species listed in green are those that were found on site.

Aizoaceae
Acrosanthes humifusa (Thunb.) Sond. Indigenous; Endemic X
Antimima pygmaea (Haw.) H.E.K.Hartmann Indigenous; Endemic
Aridaria noctiflora
Cheiridopsis namaquensis
Cleretum lyratifolium Ihlenf. & Struck Indigenous; Endemic
Conicosia elongata (Haw.) N.E.Br. Indigenous; Endemic X
Conophytum minimum (Haw.) N.E.Br. Indigenous; Endemic
Conophytum truncatum (Thunb.) N.E.Br. subsp. truncatum var. truncatum Indigenous; Endemic
Deilanthe peersii (L.Bolus) N.E.Br. Indigenous; Endemic X
Drosanthemum species
Galenia africana
Hammeria gracilis Burgoyne Indigenous; Endemic
Lampranthus species
Leipoldtia schultzei
Mesembryanthemum crystallinum L. Indigenous
Mesembryanthemum guerichianum Pax Indigenous
Mesembryanthemum nodiflorum L. Indigenous X
Mesembryanthemum tortuosum L. Indigenous; Endemic X
Psilocaulon junceum
Ruschia cradockensis
Ruschia intricata
Ruschia sp.

Amaranthaceae
Salsola kali
Salsola tuberculatiformis Botsch. Indigenous

Amaryllidaceae
Boophone disticha

Anacampserotaceae
Anacampseros sp.

Anacardiaceae
Laurophyllus capensis Thunb. Indigenous; Endemic
Searsia lancea (L.f.) F.A.Barkley Indigenous
Searsia undulata (Jacq.) T.S.Yi, A.J.Mill. & J.Wen Indigenous

Apocynaceae
Eustegia filiformis (L.f.) Schult. Indigenous; Endemic
Hoodia gordonii
Huernia barbata (Masson) Haw. subsp. *barbata* Indigenous

Asparagaceae
Asparagus burchellii Baker Indigenous; Endemic
Asparagus capensis L. var. capensis Indigenous

Asparagus suaveolens Burch. Indigenous

Asphodelaceae
Aloe comosa
Aloe microstigma
Astroloba bullata
Tulista pumila (L.) G.D.Rowley Indigenous; Endemic

Asteraceae
Amphiglossa tomentosa
Arctotis argentea Thunb. Indigenous; Endemic
Athanasia minuta (L.f.) Kallersjo subsp. inermis (E.Phillips) Kallersjo Indigenous; Endemic
Berkheya spinosa (L.f.) Druce Indigenous; Endemic
Chrysocoma ciliata
Cineraria lobata L'Her. subsp. *lobata* Indigenous
Cotula leptalea
Cotula macroglossa Bolus ex Schltr. Indigenous; Endemic
Cullumia bisulca (Thunb.) Less. Indigenous; Endemic
Elytropappus rhinocerotis
Eriocephalus ericoides
Eumorphia sp.
Euryops erectus (Compton) B.Nord. Indigenous; Endemic
Euryops lateriflorus
Euryops microphyllus (Compton) B.Nord. Indigenous; Endemic
Euryops rehmannii Compton Indigenous; Endemic
Euryops tenuissimus (L.) DC. subsp. tenuissimus Indigenous
Felicia australis
Felicia filifolia
Felicia lasiocarpa DC. Indigenous; Endemic
Felicia muricata
Felicia whitehillensis Compton Indigenous; Endemic
Garuleum bipinnatum (Thunb.) Less. Indigenous; Endemic
Gazania rigida
Gazania tenuifolia Less. Indigenous
Gorteria alienata (Thunb.) Stangb. & Anderb. Indigenous; Endemic
Helichrysum archeri Compton Indigenous; Endemic
Helichrysum asperum
Helichrysum cylindriflorum (L.) Hilliard & B.L.Burtt Indigenous; Endemic
Helichrysum lancifolium (Thunb.) Thunb. Indigenous; Endemic
Helichrysum pulchellum DC. Indigenous; Endemic
Hymenolepis incisa DC. Indigenous; Endemic
Lasiospermum brachyglossum DC. Indigenous
Leysera tenella DC. Indigenous
Macledium spinosum
Osteospermum calendulaceum L.f. Indigenous; Endemic
Othonna pavonia E.Mey. Indigenous; Endemic
Othonna pteronioides Harv. Indigenous; Endemic
Othonna ramulosa DC. Indigenous; Endemic
Pentzia incana (Thunb.) Kuntze Indigenous
Pteronia ambrariifolia Schltr. Indigenous; Endemic
Pteronia aspalatha DC. Indigenous; Endemic
Pteronia empetrifolia DC. Indigenous; Endemic
Pteronia glauca
Pteronia glomerata
Pteronia incana
Rosenia sp.
Senecio achilleifolius DC. Indigenous

Senecio arenarius Thunb. Indigenous
Senecio erysimoides DC. Indigenous; Endemic
Senecio laxus DC. Indigenous; Endemic
Senecio sp.
Steirodiscus capillaceus (Thunb.) Less. Indigenous; Endemic
Syncarpha paniculata (L.) B.Nord. Indigenous; Endemic
Ursinia nana
Ursinia pilifera (P.J.Bergius) Poir. Indigenous; Endemic
Ursinia punctata (Thunb.) N.E.Br. Indigenous; Endemic

Brassicaceae
Heliophila bulbostyla P.E.Barnes Indigenous; Endemic
Heliophila carnosa (Thunb.) Steud. Indigenous
Heliophila digitata L.f. Indigenous; Endemic
Heliophila pectinata Burch. ex DC. Indigenous; Endemic
Lepidium desertorum Eckl. & Zeyh. Indigenous

Bruniaceae
Audouinia laxa (Thunb.) A.V.Hall Indigenous; Endemic

Campanulaceae
Microcodon glomeratus A.DC. Indigenous; Endemic

Capparaceae
Cadaba aphylla

Celastraceae
Maytenus oleoides (Lam.) Loes. Indigenous; Endemic

Chenopodiaceae
Manochlamys albicans

Colchicaceae
Ornithoglossum undulatum Sweet Indigenous; Endemic

Crassulaceae
Cotyledon papillaris
Cotyledon orbiculata
Crassula arborescens (Mill.) Willd. subsp. *arborescens* Indigenous; Endemic
Crassula columnaris subsp. *columnaris*
Crassula cotyledonis
Crassula deltoidea
Crassula dependens
Crassula montana Thunb. subsp. *quadrangularis* (Schonland) Toelken Indigenous; Endemic
Crassula muscosa L. var. *muscosa* Indigenous; Endemic
Crassula rupestris
Crassula saxifraga Harv. Indigenous; Endemic
Crassula subaphylla subsp. *subaphylla*
Crassula tomentosa subsp. *glabrifolia*
Tylecodon paniculatus (L.f.) Toelken Indigenous; Endemic
Tylecodon reticulatus (L.f.) Toelken subsp. *reticulatus* Indigenous; Endemic
Tylecodon wallichii (Harv.) Toelken subsp. *wallichii* Indigenous; Endemic

Cyperaceae
Ficinia deusta (P.J.Bergius) Levyns Indigenous; Endemic

Ebenaceae

Diospyros lycioides Desf. subsp. *lycioides* Indigenous
Euclea undulata Thunb. Indigenous

Ericaceae
Erica arcuata Compton Indigenous; Endemic
Erica loganii Compton Indigenous; Endemic
Erica rigidula (N.E.Br.) E.G.H.Oliv. Indigenous; Endemic
Erica tenuis Salisb. Indigenous; Endemic
Erica terniflora E.G.H.Oliv. Indigenous

Euphorbiaceae
Euphorbia clava Jacq. Indigenous; Endemic
Euphorbia decussata
Euphorbia loricata Lam. Indigenous; Endemic
Euphorbia multiceps A.Berger Indigenous; Endemic
Euphorbia rhombifolia Boiss. Indigenous; Endemic
Euphorbia sp.
Euphorbia stellispina Haw. Indigenous; Endemic
Euphorbia stolonifera Marloth ex A.C.White, R.A.Dyer & B.Sloane Indigenous; Endemic
Euphorbia tenax Burch. Indigenous; Endemic
Euphorbia tuberosa L. Indigenous; Endemic

Fabaceae
Aspalathus crassisepala R.Dahlgren Indigenous; Endemic
Aspalathus hystrix L.f. Indigenous; Endemic
Aspalathus nigra L. Indigenous; Endemic
Aspalathus sericea P.J.Bergius Indigenous; Endemic
Aspalathus shawii L.Bolus subsp. *shawii* Indigenous; Endemic
Aspalathus subtingens Eckl. & Zeyh. Indigenous; Endemic
Calobota psiloloba (E.Mey.) Boatwr. & B.-E.van Wyk Indigenous; Endemic
Lessertia annularis Burch. Indigenous
Medicago polymorpha L. not Indigenous; Naturalised; Invasive
Melolobium candicans
Rafnia elliptica Thunb. Indigenous; Endemic
Trifolium suffocatum L. notIndigenous; Naturalised
Vachellia karroo

Frankeniaceae
Frankenia pulverulenta L. Indigenous

Geraniaceae
Monsonia crassicaulis
Pelargonium abrotanifolium
Pelargonium alternans J.C.Wendl. subsp. alternans Indigenous; Endemic
Pelargonium brevipetalum N.E.Br. Indigenous; Endemic
Pelargonium crispum (P.J.Bergius) L'Her. Indigenous; Endemic
Pelargonium crithmifolium
Pelargonium hystrix Harv. Indigenous; Endemic
Pelargonium laevigatum (L.f.) Willd. subsp. diversifolium (J.C.Wendl.) Schonken Indigenous; Endemic
Pelargonium magenteum
Pelargonium nervifolium Jacq. Indigenous; Endemic
Pelargonium rapaceum (L.) L'Her. Indigenous; Endemic
Pelargonium stipulaceum (L.f.) Willd. subsp. stipulaceum Indigenous; Endemic
Pelargonium trifidum Jacq. Indigenous; Endemic
Sarcocaulon crassicaule

Hyacinthaceae

Albuca setosa
Drimia filifolia (Jacq.) J.C.Manning & Goldblatt Indigenous; Endemic
Drimia physodes (Jacq.) Jessop Indigenous; Endemic
Drimia sp.
Lachenalia comptonii W.F.Barker Indigenous; Endemic
Lachenalia ensifolia (Thunb.) J.C.Manning & Goldblatt Indigenous; Endemic
Lachenalia isopetala Jacq. Indigenous; Endemic
Lachenalia alba
Lachenalia sp.
Lachenalia whitehillensis W.F.Barker Indigenous; Endemic
Massonia depressa Houtt. Indigenous; Endemic

Iridaceae
Ferraria variabilis Goldblatt & J.C.Manning Indigenous; Endemic
Gladiolus splendens (Sweet) Herb. Indigenous; Endemic
Moraea crispa Thunb. Indigenous
Moraea karroica Goldblatt Indigenous; Endemic
Moraea miniata Andrews Indigenous; Endemic
Moraea species
Moraea setifolia (L.f.) Druce Indigenous; Endemic
Romulea atrandra G.J.Lewis var. *atrandra* Indigenous; Endemic
Romulea austinii E.Phillips Indigenous; Endemic
Romulea hirta Schltr. Indigenous; Endemic

Lamiaceae
Salvia disermas L. Indigenous

Lobeliaceae
Wimmerella secunda (L.f.) Serra, M.B.Crespo & Lammers Indigenous; Endemic

Malvaceae
Anisodontea anomala (Link & Otto) Bates Indigenous; Endemic
Anisodontea elegans (Cav.) Bates Indigenous; Endemic
Anisodontea procumbens (Harv.) Bates Indigenous; Endemic
Hermannia aspera J.C.Wendl. Indigenous; Endemic
Hermannia burkei Burtt Davy Indigenous
Hermannia cuneifolia Jacq. var. *cuneifolia* Indigenous
Hermannia cuneifolia Jacq. var. *glabrescens* (Harv.) I.Verd. Indigenous
Hermannia filifolia L.f. var. *filifolia* Indigenous; Endemic
Hermannia filifolia L.f. var. *grandicalyx* I.Verd. Indigenous; Endemic
Hermannia grandiflora Aiton Indigenous
Hermannia incana Cav. Indigenous; Endemic
Hermannia odorata Aiton Indigenous; Endemic
Hermannia sp.

Melianthaceae
Melianthus comosus Vahl Indigenous

Molluginaceae
Pharnaceum lanatum Bartl. Indigenous; Endemic

Orchidaceae
Disperis purpurata Rchb.f. subsp. *purpurata* Indigenous; Endemic
Holothrix secunda (Thunb.) Rchb.f. Indigenous; Endemic
Pterygodium schelpei H.P.Linder Indigenous; Endemic

Oxalidaceae

Oxalis melanosticta Sond. var. *melanosticta* Indigenous; Endemic
Oxalis palmifrons T.M.Salter Indigenous; Endemic
Oxalis tenuipes T.M.Salter var. *tenuipes* Indigenous; Endemic

Poaceae
Aristida diffusa Trin. subsp. *burkei* (Stapf) Melderis Indigenous
Cymbopogon marginatus (Steud.) Stapf ex Burtt Davy Indigenous
Ehrharta calycina Sm. Indigenous
Ehrharta sp.
Lophochloa pumila (Desf.) Bor notIndigenous; Naturalised
Pentameris airoides Nees subsp. *airoides* Indigenous
Pentameris distichophylla (Lehm.) Nees Indigenous; Endemic
Pentameris eriostoma (Nees) Steud. Indigenous
Pentameris macrocalycina (Steud.) Schweick. Indigenous; Endemic
Pentaschistis airoides
Phragmites australis
Poa bulbosa L. Indigenous
Schismus barbatus (Loefl. ex L.) Thell. Indigenous
Schismus scaberrimus Nees Indigenous; Endemic
Tenaxia stricta
Tribolium hispidum (Thunb.) Desv. Indigenous; Endemic
Tribolium obtusifolium (Nees) Renvoize Indigenous; Endemic
Tribolium tenellum (Nees) Verboom & H.P.Linder Indigenous

Polygalaceae
Muraltia commutata Levyns Indigenous; Endemic
Muraltia heisteria (L.) DC. Indigenous; Endemic
Muraltia karroica Levyns Indigenous; Endemic
Muraltia macrocarpa Eckl. & Zeyh. Indigenous

Proteaceae
Leucadendron barkerae I.Williams Indigenous; Endemic
Leucadendron salignum P.J.Bergius Indigenous; Endemic
Protea canaliculata Andrews Indigenous; Endemic
Protea laurifolia Thunb. Indigenous; Endemic
Protea lepidocarpodendron (L.) L. Indigenous; Endemic
Spatalla confusa (E.Phillips) Rourke Indigenous; Endemic

Restionaceae
Elegia asperiflora (Nees) Kunth Indigenous; Endemic

Rhamnaceae
Phylica lanata Pillans Indigenous; Endemic
Phylica odorata Schltr. Indigenous; Endemic
Phylica paniculata Willd. Indigenous
Phylica pulchella Schltr. Indigenous; Endemic
Phylica rigidifolia Sond. Indigenous; Endemic
Phylica sp.
Phylica vulgaris Pillans var. *vulgaris* Indigenous; Endemic

Rutaceae
Adenandra fragrans (Sims) Roem. & Schult. Indigenous; Endemic
Adenandra villosa (P.J.Bergius) Licht. ex Roem. & Schult. subsp. *umbellata* (J.C.Wendl.) Strid Indigenous; Endemic
Agathosma barnesiae Compton Indigenous; Endemic
Diosma acmaeophylla Eckl. & Zeyh. Indigenous; Endemic
Euchaetis elsieae I.Williams Indigenous; Endemic

Santalaceae
Thesium capituliflorum Sond. Indigenous; Endemic
Thesium hillianum Compton Indigenous; Endemic
Thesium lineatum
Thesium marlothii Schltr. Indigenous; Endemic
Viscum capense L.f. Indigenous

Sapindaceae
Dodonaea viscosa Jacq. var. *angustifolia* (L.f.) Benth. Indigenous

Scrophulariaceae
Aptosimum indivisum Burch. ex Benth. Indigenous
Nemesia ligulata

Solanaceae
Lycium

Thymelaeaceae
Lachnaea penicillata Meisn. Indigenous; Endemic
Lasiosiphon deserticola (Gilg) C.H.Wright Indigenous; Endemic
Passerina comosa (Meisn.) C.H.Wright Indigenous; Endemic
Passerina obtusifolia Thoday Indigenous; Endemic
Passerina truncata (Meisn.) Bredenk. & A.E.van Wyk subsp. truncata Indigenous; Endemic
Struthiola confusa C.H.Wright Indigenous; Endemic

Zygophyllaceae
Roepera lichtensteiniana (Cham.) Beier & Thulin Indigenous
Zygophyllum sp.

Appendix 4: Animal species with a geographical distribution that includes the study area.

Notes:
1. Species of conservation concern are in red lettering.
2. Species protected according to the National Environmental Management: Biodiversity Act of 2004 (Act 10 of 2000) (see Appendix 6) marked with "N"

Mammals (excluding bats):
Red hartebeest
Springbok
[N]Black rhinoceros (arid ecotype) EN
Klipspringer
Grey rhebok NT
Steenbok
Cape grysbok
Common duiker
Rock hyrax
Water mongoose
Black-backed jackal
Caracal
Yellow mongoose
[N]Black-footed cat VU
African wild cat
Small grey mongoose
Small-spotted genet
Striped polecat
[N]Honey badger
Bat-eared fox
[N]Leopard VU
Aardwolf
Suricate
[N]Cape fox
Cape golden mole
Reddish-grey musk shrew
Lesser dwarf shrew
[N]Riverine rabbit CR
Cape/desert hare
Scrub/savannah hare
Hewitt's red rock rabbit
Chacma baboon
Vervet monkey
Grant's rock mouse
Namaqua rock mouse
Common mole rat
Grey climbing mouse
Short-tailed gerbil
Cape mole rat
Hairy-footed gerbil
Spectacled dormouse NT
Porcupine
Large-eared mouse
Pygmy mouse
Vlei rat
Saunder's vlei rat
Karoo bush rat
(Brant's whistling rat)
(Springhare)
(Barbour's rock mouse)
Pygmy rock mouse
Striped mouse
Cape gerbil
(Cape rock sengi)
(Karoo rock sengi)
Western rock sengi
Karoo round-eared sengi
Aardvark

Reptiles:
<u>Pelomedusidae:</u>
Marsh terrapin
<u>Testudinidae:</u>
Angulate tortoise
Parrot-beaked dwarf tortoise
Karoo dwarf tortoise NT
Greater dwarf tortoise
Tent tortoise
(Leopard tortoise)
<u>Gekkonidae:</u>
Common giant gecko
Bibron's gecko
Striped pygmy gecko
Cape gecko
Southern rough gecko
Ocellated gecko
Thin-skinned gecko
Spotted gecko
Common banded gecko
Golden spotted gecko
Purcell's gecko
Weber's gecko
Spotted barking gecko
<u>Amphisbaenidae:</u>
<u>Lacertidae:</u>
Knox's desert lizard
Spotted desert lizard
Karoo sandveld lizard
Western sandveld lizard
Burchell's sand lizard
Karoo sand lizard
Common sand lizard
Namaqua sand lizard

Cordylidae:
Cape girdled lizard
Western dwarf girdled lizard
Cape cliff lizard
Southern karusa lizard
[N]Armadillo (girdled) lizard
Nuweveldberg crag lizard
Gerrhosauridae:
Dwarf plated lizard
(Karoo plated lizard)
Cape long-tailed seps
Scincidae:
Striped dwarf legless skink
Cape legless skink
Cape skink
Red-sided skink
Western three-striped skink
Western rock skink
Variegated skink
Varanidae:
Chamaeleonidae:
Namaqua chameleon
Agamidae:
Western ground agama
(Anchieta's agama)
Southern rock agama
Southern spiny agama
Typhlopidae:
Delelande's beaked blind snake
Leptotyphlopidae
Slender thread snake
Viperidae:
Puff adder
Horned adder
Red adder
Lamprophiidae:
Spotted harlequin snake
Common house snake
Aurora snake
Fisk's snake
Spotted rock snake
Brown water snake
Dwarf beaked snake
Cross-marked grass snake
Karoo sand snake
Spotted grass snake
(South African slug eater)
Sundevall's shovel-snout
Mole snake
Elapidae:
Coral shield cobra
Rinkhals
Cape cobra
Colubridae:
Red-lipped snake
Rhombic egg eater
Boomslang
Beetz's tiger snake

Amphibians
Karoo toad
Common platanna
Boettger's caco
Karoo caco
Cape river frog
Cape sand frog
Tandy's sand frog
Raucous toad
Poynton's river frog

Appendix 5: Flora protected under the Northern Cape Nature Conservation Act No. 9 of 2009.

SCHEDULE 1: SPECIALLY PROTECTED SPECIES
As per the Northern Cape Nature Conservation Act, No. 9 of 2009, Schedule 1

Family: AMARYLLIDACEAE	Common name / Additional notes
Clivia mirabilis	Oorlofskloof bush lily / Clivia
Haemanthus graniticus	April fool
Hessea pusilla	
Strumaria bidentata	
Strumaria perryae	
Family: ANACARDIACEAE	
Ozoroa spp.	All species
Family: APIACAEAE	
Centella tridentata	
Chamarea snijmaniae	
Family: APOCYNACEAE	
Hoodia gordonii	
Pachypodium namaquanum	Elephant's trunk
Family: ASPHODOLACEAE	
Aloe buhrii	
Aloe dichotoma	
Aloe dichotoma var. *rumosissima*	Maiden quiver tree
Aloe dabenorisana	
Aloe erinacea	
Aloe meyeri	
Aloe pearsonii	
Aloe pillansii	
Trachyandra prolifera	
Family: ASTERACEAE	
Athanasia adenantha	
Athanasia spathulata	
Cotula filifolia	
Euryops mirus	
Euryops rosulatus	
Euryops virgatus	
Felicia diffusa subsp. *khamiesbergensis*	
Othonna armiana	
Family: CRASSULACEAE	
Tylecodon torulosus	
Family: DIOSCORACEAE	
Dioscorea spp.	Elephant's foot, all species
Family: ERIOSPERMACEAE	
Eriospermum erinum	
Eriospermum glaciale	
Family: FABACEAE	
Amphithalea obtusiloba	
Lotononis acutiflora	
Lotononis polycephala	
Lessertia spp.	
Sceletium toruosum	
Sutherlandia spp.	Cancer Bush, all species

Wiborgia fusca subsp. *macrocarpa*	
Family: GERANIACEAE	
***Pelargonium* spp.**	Pelargonium, all species
Family: HYACINTHACEAE	
Drimia nana	
Ornithogalum bicornutum	
Ornithogalum inclusum	
Family: IRIDACEAE	
Babiana framesii	
Ferraria kamiesbergensis	
Freesia marginata	
Geissorhiza subrigida	
Hesperantha minima	
Hesperantha oligantha	
Hesperantha rivulicola	
Lapeirousia verecunda	
Moraea kamiesensis	
Moraea namaquana	
Romulea albiflora	
Romulea discifera	
Romulea maculata	
Romulea rupestris	
Family: MOLLUGINACEAE	
Hypertelis trachysperma	
Psammotropha spicata	
Family: ORCHIDACEAE	
Corycium ingeanum	
Disa macrostachya	Disa
Family: OXALIDACEAE	
Oxalis pseudo-hirta	Sorrel
Family: PEDALIACEAE	
Harpagophytum spp.	Devils' claw
Family: POACEAE	
Prionanthium dentatum	
Secale strictum subsp. *africanum*	Wild rye
Family: PROTEACEAE	
Leucadendron meyerianum	Tolbos
Mimetes spp.	All species
Orothamnus zeyheri	
Family: ROSACEAE	
Cliffortia arborea	Sterboom
Family: SCROPHULARIACEAE	
Charadrophila capensis	Cape Gloxinia
Family: STANGERIACEAE	
Stangeria spp.	Cycads, all species
Family: ZAMIACEAE	
Encephalartos spp.	Cycads, all species

SCHEDULE 2: PROTECTED SPECIES
As per the Northern Cape Nature Conservation Act, No. 9 of 2009, Schedule 2

Family: ACANTHACEAE	Common Name
Barleria paillosa	
Monechme saxatile	

Peristrophe spp.	All species
Family: ADIANTHACEAE	
Adiantium spp.	Maidenhair Fern, all species
Family: AGAPANTHACEAE	
Agapanthus spp.	All species
Family: AIZOACEAE (MESEMBRYANTHEMACEAE)	**All species**
Family:AMARYLLIDACEAE	**All species except those listed in Schedule 1**
Family: ANTHERICACEAE	All species
Family: APIACEAE	All species except those listed in Schedule 1
Family: APOCYNACEAE	All species except those listed in Schedule 1
Family: AQUIFOLIACEAE	All species
Ilex mitis	
Family: ARACEAE	
Zantedeschia spp.	Arum lilies, all species
Family: ARALIACEAE	
Cussonia spp.	Cabbage trees, all species
Family: ASPHODOLACEAE	**All species except those listed in Schedule 1 and the species *Aloe ferox***
Family: ASTERACEAE	
Helichrysum jubilatum	
Felicia deserti	
Gnaphalium simii	
Lopholaena longipes	
Senecio albo-punctatus	
Senecio trachylaenus	
Trichogyne lerouxiae	
Tripteris pinnatilobata	
Troglophyton acocksianum	
Vellereophyton lasianthum	
Family: BURMANNIACEAE	
Burmannia madagascariensis	Wild ginger
Family: BURSERACEAE	
Commiphora spp.	All species
Family: CAPPARACEAE	
Boscia spp.	Shepherd's trees, all species
Family: CARYOPHYLLACEAE	
***Dianthus* spp.**	**All species**
Family: CELASTRACEAE	
Gymnosporia spp.	All species
Family: COLCHICACEAE	
Androcymbium spp.	All species
Gloriosa spp.	All species
Family: COMBRETACEAE	
Combretum spp.	All species
Family: CRASSULACEAE	**All species except those listed in Schedule 1**
Family: CUPPRESSACEAE	
Widdringtonia spp.	Wild cypress, all species
Family: CYATHEACEAE	
Cyathea spp.	Tree ferns, all species
Cyathea capensis	Tree Fern
Family: CYPERACEAE	
Carex acocksii	
Family: DROSERACEAE	
Drosera spp.	Sundews, all species

Family: DRYOPTERIDACEAE	
Rumohra spp.	Seven Weeks Fern, all species
Family: ERICACEAE	Erica, all species
Family: EUPHORBIACEAE	
Alchornea laxiflora	Venda Bead-string
***Euphorbia* spp.**	**All species**
Family: FABACEAE	
Aspalathus spp.	Tea Bush, all species
Erythrina zeyheri	Ploughbreaker
Argyrolobium petiolare	
Caesalpinia bracteata	
Calliandra redacta	
Crotalaria pearsonii	
Indigofera limosa	
Lebeckia bowieana	
Polhillia involucrate	
Rhynchosia emarginata	
Wiborgia humilis	
Family: HYACINTHACEAE	
Daubenya spp	
Lachenalia spp.	Daubenya, all species
Veltheimia spp.	Viooltjie, all species
Eucomis spp.	Pineapple flower, all species
Neopatersonia namaquensis	
Ornithogalum spp.	All species
Family: IRIDACEAE	**All species except those listed in Schedule 1**
Family: LAURACEAE	
Ocotea spp.	Stinkwood, all species
Family: MESEMBRYANTHEMACEAE	**All species**
Family: MELIACEAE	
Nymania capensis	Chinese Lantern
Family: OLEACEAE	
Olea europea subsp. *africana*	Wild olive
Family: ORCHIDACEAE	Orchids, all species except those listed in Schedule 1
Family: OROBANCHACEAE	
Harveya spp.	Harveya, all species
Family: OXALIDACEAE	
Oxalis spp.	Sorrel, all species except those listed in Schedule 1
Family: PLUMBAGINACEAE	
Afrolimon namaquanum	
Family: POACEAE	
Brachiaria dura var. *dura*	
Dregeochloa calviniensis	
Pentaschistis lima	
Family: PODOCARPACEAE	
Podocarpus spp.	Yellowwoods, all species
Family: PORTULACACEAE	
Anacampseros spp.	All species
Avonia spp.	All species
Portulaca foliosa	
Family: PROTEACEAE	All species except those listed in Schedule 1
Family: RESTIONACEAE	All species
Family: RHAMNACEAE	

Phylica spp.	All species
Family: RUTACEAE	
Agathosma spp.	Buchu, all species
Family: SCROPHULARIACEAE	
Diascia spp.	All species
Halleria spp.	All species
Jamesbrittenia spp.	All species
Manulea spp.	All species
Nemesia spp.	All species
Phyllopodium spp.	All species
Polycarena filiformis	
Chaenostoma longipedicellatum	
Family: STRELITZIACEAE	
Strelitzia spp.	All species
Family: TECOPHILACEAE	
Cyanella spp.	All species
Family: THYMELAEACEAE	
Gnidia leipoldtii	
Family: ZINGIBERACEAE	
Siphonochilus aethiopicus	Wild ginger

Appendix 6: Flora and vertebrate animal species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)

(as updated in R. 1187, 14 December 2007)

CRITICALLY ENDANGERED SPECIES

Flora

Adenium swazicum
Aloe pillansii
Diaphananthe millarii
Dioscorea ebutsniorum
Encephalartos aemulans
Encephalartos brevifoliolatus
Encephalartos cerinus
Encephalartos dolomiticus
Encephalartos heenanii
Encephalartos hirsutus
Encephalartos inopinus
Encephalartos latifrons
Encephalartos middelburgensis
Encephalartos nubimontanus
Encephalartos woodii

Reptilia

Loggerhead sea turtle
Leatherback sea turtle
Hawksbill sea turtle

Aves

Wattled crane
Blue swallow
Egyptian vulture
Cape parrot

Mammalia

Riverine rabbit
Rough-haired golden mole

ENDANGERED SPECIES

Flora

Angraecum africae
Encephalartos arenarius
Encephalartos cupidus
Encephalartos horridus
Encephalartos laevifolius
Encephalartos lebomboensis
Encephalartos msinganus
Jubaeopsis caffra
Siphonochilus aethiopicus
Warburgia salutaris
Newtonia hilderbrandi

Reptilia

Green turtle
Giant girdled lizard
Olive ridley turtle
Geometric tortoise

Aves

Blue crane
Grey crowned crane
Saddle-billed stork
Bearded vulture
White-backed vulture
Cape vulture
Hooded vulture
Pink-backed pelican
Pel's fishing owl
Lappet-faced vulture

Mammalia

Robust golden mole
Tsessebe
Black rhinoceros
Mountain zebra
African wild dog
Gunning's golden mole
Oribi
Red squirrel
Four-toed elephant-shrew

VULNERABLE SPECIES

Flora

Aloe albida
Encephalartos cycadifolius
Encephalartos Eugene-maraisii
Encephalartos ngovanus
Merwilla plumbea
Zantedeschia jucunda

Aves

White-headed vulture
Tawny eagle
Kori bustard
Black stork
Southern banded snake eagle
Blue korhaan
Taita falcon
Lesser kestrel
Peregrine falcon

Bald ibis
Ludwig's bustard
Martial eagle
Bataleur
Grass owl

Mammalia
Cheetah
Samango monkey
Giant golden mole
Giant rat
Bontebok
Tree hyrax
Roan antelope
Pangolin
Juliana's golden mole
Suni
Large-eared free-tailed bat
Lion
Leopard
Blue duiker

PROTECTED SPECIES
Flora
Adenia wilmsii
Aloe simii
Clivia mirabilis
Disa macrostachya
Disa nubigena
Disa physodes
Disa procera
Disa sabulosa
Encephelartos altensteinii
Encephelartos caffer
Encephelartos dyerianus
Encephelartos frederici-guilielmi
Encephelartos ghellinckii
Encephelartos humilis
Encephelartos lanatus
Encephelartos lehmannii
Encephelartos longifolius
Encephelartos natalensis
Encephelartos paucidentatus
Encephelartos princeps
Encephelartos senticosus
Encephelartos transvenosus
Encephelartos trispinosus
Encephelartos umbeluziensis
Encephelartos villosus
Euphorbia clivicola
Euphorbia meloformis
Euphorbia obesa
Harpagophytum procumbens
Harpagophytum zeyherii
Hoodia gordonii
Hoodia currorii
Protea odorata
Stangeria eriopus

Amphibia
Giant bullfrog
African bullfrog

Reptilia
Gaboon adder
Namaqua dwarf adder
Smith's dwarf chameleon
Armadillo girdled lizard
Nile crocodile
African rock python

Aves
Southern ground hornbill
African marsh harrier
Denham's bustard
Jackass penguin

Mammalia
Cape clawless otter
South African hedgehog
White rhinoceros
Black wildebeest
Spotted hyaena
Black-footed cat
Brown hyaena
Serval
African elephant
Spotted-necked otter
Honey badger
Sharpe's grysbok
Reedbuck
Cape fox

Appendix 7: Species profile for the Riverine Rabbit.

Common names: Riverine Rabbit, Oewerkonyn, doekvoet, pondhaas, Bushman's hare, Deelfontein hare, boshaas, vlei has.

Scientific name: Bunolagus monticularis

Conservation status: Critically Endangered

IDENTIFICATION
The riverine rabbit can reach approximately 52 cm in size and has large ears. It has a distinguishing dark brown to black band running along the side of the lower jaw upwards to the bottom of the ears (from mouth to cheek). The upper parts are a grizzled drab grey while the sides are slightly darker and rufous where it blends with the dense grey hair on the underside. The eyes are encircled with white rings with dark elongated patches above these. The fringed inner margins of the long ears are covered with white hair, the outer margins with short buffy hair and the tips are covered with short black hair. The hair on the nape of the neck is slightly shorter and is a rich rufous colour. The grey-brown tail is short and fluffy, but darker towards the tip.

HABITAT
Riverine rabbits are very habitat-specific and are found in dense patches of riverine bush along seasonal rivers of the semi-arid central Karoo. They are the only indigenous burrowing rabbit in Africa and are dependent on deep and soft alluvial soils (It burrows in rich, silty soils). To the south of the escarpment they are found in areas with sparse vegetation near seasonal rivers in both Succulent Karoo and Renosterveld vegetation.

FOOD
They feed on shrubs and young grasses. Its favourite foods are inkbush, buchu and other plants that remain green for longer in the seasonal river beds. They obtain their Vitamin B by eating their day droppings which are wetter and softer than the dry droppings that form by night.

LIFE HISTORY
This rare, nocturnal and often solitary species can jump very well when alarmed. They are dependent on deep soft alluvial soils to construct stable breeding stops. The males mate with more than one female and their home range varies between 12 and 20 ha. A litter of one, rarely two, blind hairless rabbits are born between August and May. Their lifespan in the wild is not more than four years.

DISTRIBUTION
Most of their distribution range falls outside the Western Cape Province above the escarpment of the Nuweveld mountains in the semi- arid Central Karoo. This 'traditional' range includes Williston, Fraserburg, Carnarvon, Victoria West and Loxton. More populations of riverine rabbit have recently been discovered south of the escarpment in the districts of Touwsriver, Montagu and Barrydale, as well as at Prince Albert and Klaarstroom, immediately north of Meiringspoort. It has recently been reported that a small population has been found in Anysberg Nature Reserve near Laingsburg. The secretive and nocturnal nature of this species and widely distributed recent sightings suggest that the species may have a more widespread distribution within its overall range.

THREATS
Not long after its discovery in 1902, the riverine rabbit was known as the 'pondhaas' because Captain G.C. Shortridge, the curator of the Kaffrarian Museum in King William's Town, offered a pound for each rabbit brought to him.
There is no state-owned land protecting the riverine rabbit and its habitat and already two-thirds of its original habitat has been destroyed. Most known habitat occurs on private land.

Threats to the riverine rabbit and its habitat are as follows:

- The main threat is habitat destruction through cultivation and extensive livestock grazing, which are particularly damaging to seasonal river beds and banks.
- Predation by domestic dogs.

- Hunting and trapping.
- Potential catastrophic events such as flooding, global climate change, fire and disease.
- Road kills.
- Lack of general awareness about and knowledge of the species. Inbreeding due to low population numbers.

CONSERVATION

The Endangered Wildlife Trust has established a Riverine Rabbit Programme to manage and coordinate the Riverine Rabbit Conservation Project, to maintain close relations with landowners and conservation authorities and to ensure the survival of the riverine rabbit and its habitat. Part of the programme involves revegetation of dry banks.

The presence of this species on a farm has become prestigious and an indicator of a healthy river ecosystem.

Further initiatives are:

- The establishment of statutory conservation areas in riverine rabbit habitats.
- The establishment of more private conservation areas such as conservancies and conservation stewardship sites.
- Collation of existing data and knowledge. Control of dog predation on farms. Habitat rehabilitation.
- The recent discovery of the riverine rabbit in the Sanbona Wildlife Reserve and Vaalkloof Private Nature Reserve are positive signs for the survival of this species. The presence of several individuals at Sanbona Wildlife Reserve were found using camera traps.

Information sources:
https://www.capenature.co.za/fauna-and-flora/riverine-rabbit/ accessed on 9 October 2018.
http://karoospace.co.za/the-rarest-rabbit/ accessed on 9 October 2018.

Appendix 8: Curriculum vitae: Dr David Hoare

Education

Matric - Graeme College, Grahamstown, 1984
B.Sc (majors: Botany, Zoology) - Rhodes University, 1991-1993
B.Sc (Hons) (Botany) - Rhodes University, 1994 with distinction
M.Sc (Botany) - University of Pretoria, 1995-1997 with distinction
PhD (Botany) – Nelson Mandela Metropolitan University, Port Elizabeth

Main areas of specialisation

- Vegetation ecology, primarily in grasslands, thicket, coastal systems, wetlands.
- Plant biodiversity and threatened plant species specialist.
- Alien plant identification and control / management plans.
- Remote sensing, analysis and mapping of vegetation.
- Specialist consultant for environmental management projects.

Membership

Professional Natural Scientist, South African Council for Natural Scientific Professions, 16 August 2005 – present. Reg. no. 400221/05 (Ecology, Botany)
Member, International Association of Vegetation Scientists (IAVS)
Member, Ecological Society of America (ESA)
Member, International Association for Impact Assessment (IAIA)
Member, Herpetological Association of Africa (HAA)

Employment history

1 December 2004 – present, Director, David Hoare Consulting (Pty) Ltd. Consultant, specialist consultant contracted to various companies and organisations.
1January 2009 – 30 June 2009, Lecturer, University of Pretoria, Botany Dept.
1January 2013 – 30 June 2013, Lecturer, University of Pretoria, Botany Dept.
1 February 1998 – 30 November 2004, Researcher, Agricultural Research Council, Range and Forage Institute, Private Bag X05, Lynn East, 0039. Duties: project management, general vegetation ecology, remote sensing image processing.

Experience as consultant

Ecological consultant since 1995. Author of over 380 specialist ecological consulting reports. Wide experience in ecological studies within grassland, savanna and fynbos, as well as riparian, coastal and wetland vegetation.

Publication record:

Refereed scientific articles (in chronological order):

Journal articles:

HOARE, D.B. & BREDENKAMP, G.J. 1999. Grassland communities of the Amatola / Winterberg mountain region of the Eastern Cape, South Africa. *South African Journal of Botany* 64: 44-61.

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Total of over 380 specialist consulting reports for various environmental projects from 1995 – present.

Workshops / symposia attended:

International Association for Impact Assessment Annual Congress, Durban, 16 – 19 May 2018.

Workshop on remote sensing of rangelands presented by Paul Tueller, University of Nevada Reno, USA, VIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.

VIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.

BioMap workshop, Stellenbosch, March 2002 to develop strategies for studying vegetation dynamics of Namaqualand using remote sensing techniques

South African Association of Botanists Annual Congress, Grahamstown, January 2002.

28th International Symposium on Remote Sensing of Environment, Somerset West, 27-31 March 2000.

Workshop on Vegetation Structural Characterisation: Tree Cover, Height and Biomass, 28th International Symposium on Remote Sensing of Environment, Strand, 26 March 2000.

South African Association of Botanists Annual Congress, Potchefstroom, January 2000

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Sustainable Land Management – Guidelines for Impact Monitoring, Orientation Workshop: Sharing Impact Monitoring Experience, Zithabiseni, 27-29 September 1999.

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34th Annual Congress of the Grassland Society of South Africa, Warmbaths, 1-4 February 1999

Expert Workshop on National Indicators of Environmental Sustainable Development, Dept. of Environmental Affairs and Tourism, Roodevallei Country Lodge, Roodeplaat Dam, Pretoria, 20-21 October 1998.

South African Association of Botanists Annual Congress, Cape Town, January 1998

Randse Afriakaanse Universiteit postgraduate symposium, 1997.

South African Association of Botanists Annual Congress, Bloemfontein, January 1995.

Appendix 6I

Traffic Impact Assessment

JG AFRIKA
EXPERIENCE QUALITY INTEGRITY

Cape Town
Tel: +27 21 530 1800
Fax: +27 21 532 0950

14 Central Square
Pinelands 7405

PO Box 38561
Pinelands 7430
South Africa

Your Ref.: 15260/Rondekop

Our Ref.: 4880/Rondekop

20 February 2019

SiVEST (PTY) LTD
PO Box 2921
Rivonia,
2126

ATTENTION: LIANDRA SCOTT-SHAW

TRANSPORT STUDY: ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 325 MW RONDEKOP WIND ENERGY FACILITY (WEF) BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE PROVINCE (DEA REF: 14/12/16/3/3/2/1115)

Your email dated 19 February 2019 with regards to the revised layout (attached as Annexure A) refers.

Please note the following:

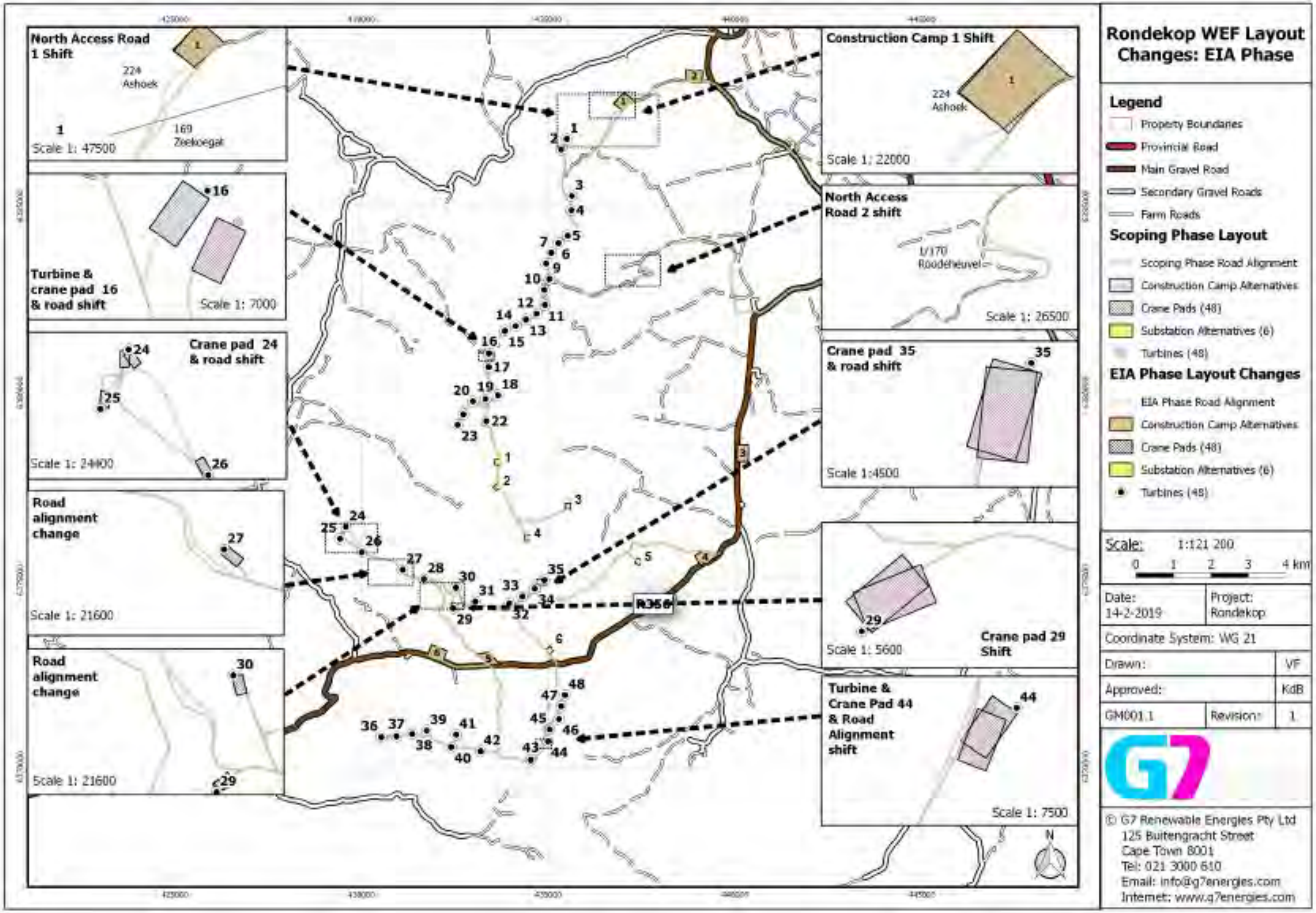
1) The change in turbine capacity from between 3MW and 6.5MW to be up to 8MW will not affect the findings of the Transport Study.
2) The revised layout indicates the following proposed changes:
    - All turbines are still valid (slight alignment shifts mainly to turbine 16 [ecology changes] 44 [to avoid the 200m bat and bird buffer surrounding the watercourse]).
    - Turbine 25 access road to crane pad: minor alignment change as the current alignment was very close to the edge of the ridge and ecologist was concerned about downslope erosion).
    - Turbine 27 access road: minor alignment shift to avoid crossing a rocky ridge / outcrop as per the ecology requirement.
    - Road between turbine 28 & 29: minor change in alignment to avoid rocky outcrop.
    - Crane pad 29 & 35: minor change in alignment to avoid the rocky outcrops.
    - Access road north 1: shifted the alignment slightly away from the drainage line and then crossing it perpendicularly at a single point.
    - Access road 2: shifted to only cross the drainage line at one point.
    - Construction Camp 1: shift to follow road alignment.

The overall impact rating reflected in the report, Transport Study: Environmental Impact Assessment for the Proposed 325MW Rondekop Wind Energy Facility (WEF) between Matjiesfontein and Sutherland in the Northern Cape Province dated 8 November 2018 is not affected by the abovementioned changes.

Yours faithfully

I WINK
for: <u>JG AFRIKA (PTY) LTD</u>

Annexure A – Revised Layout



TRANSPORT STUDY:

Environmental Impact Assessment for the proposed 325 MW Rondekop Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape

Report prepared for:

SiVEST SA (PTY) LTD

PO Box 2921

Rivonia, 2126

South Africa

Report prepared by:

JG AFRIKA (PTY) LTD

Branch: Cape Town

PO Box 38561

7430

08 November 2018

VERIFICATION PAGE	Form 4.3.1
	Rev 13

TITLE:

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED 325 MW RONDEKOP WIND ENERGY FACILITY BETWEEN MATJIESFONTEIN AND SUTHERLAND IN THE NORTHERN CAPE

JGA REF. NO.	DATE:	REPORT STATUS
4880	08/11/2018	First Issue

CARRIED OUT BY:	COMMISSIONED BY:
JG AFRIKA (PTY) LTD **Cape Town** PO Box 38651 Pinelands 7430 Tel.: 021 530 1800 Email: Wink@jgafrika.com	**SiVEST (PTY) LTD** **Johannesburg** PO Box 2921 Rivonia, 2126 Tel: 011 798 0600 Email: ShivaniN@sivest.co.za
AUTHOR	**CLIENT CONTACT PERSON**
Adrian Johnson *PrTechEng*	Shivani Naidoo

SYNOPSIS

Preparation of a Transport Study for the Environmental Impact Assessment for the proposed 325 MW Rondekop Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape, pertaining to all relevant traffic and transportation engineering aspects.

KEY WORDS:

Wind Energy Facility, Transport Study, Environmental Impact Assessment

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO9001: 2008 which has been independently certified by DEKRA Certification under certificate number 90906882

Verification	Capacity	Name	Signature	Date
By Author	Senior Technologist	Adrian Johnson		08/11/18
Checked by:	Associate	Iris Wink		08/11/18
Authorised by:	Director	Harold Tiganis		08/11/2018

Filename:	X\4880\04\4880 RONDEKOP WEF TIA JG Afrika

SPECIALIST EXPERTISE

IRIS SIGRID WINK

Profession	Civil Engineer (Traffic & Transportation)
Position in Firm	Associate
Area of Specialisation	Manager: Traffic & Transportation Engineering
Qualifications	PrEng, MSc Eng (Civil & Transportation)
Years of Experience	16 Years
Years with Firm	6 Years

SUMMARY OF EXPERIENCE

Iris is a Professional Engineer registered with ECSA (20110156). She joined JG Afrika (Pty) Ltd. in 2012. Iris obtained a Master of Science degree in Civil Engineering in Germany and has more than 15 years of experience in a wide field of traffic and transport engineering projects. Iris left Germany in 2003 and has worked as a traffic and transport engineer in South Africa and Germany. She has technical and professional skills in traffic impact studies, public transport planning, non- motorised transport planning and design, design and development of transport systems, project planning and implementation for residential, commercial and industrial projects and providing conceptual designs for the abovementioned. She has also been involved with transport assessments for renewable energy projects and traffic safety audits.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

PrEng	-	Registered with the Engineering Council of South Africa No. 20110156 Registered Mentor with ECSA for the Cape Town Office of JG Afrika
MSAICE	-	Member of the South African Institution of Civil Engineers
ITSSA	-	Member of ITS SA (Intelligent Transport Systems South Africa)
SAWEA	-	Member of the South African Wind Energy Association
SARF	-	South African Road Federation: Committee Member of Council

EDUCATION

1996 - Matric – Matric (Abitur) – Carl Friedrich Gauss Schule, Hemmingen, Germany
1998 - Diploma as Draughtsperson – Lower Saxonian State Office for Road and Bridge Engineering
2003 - MSc Eng (Civil and Transportation) – Leibniz Technical University of Hanover, Germany

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)
2016 – Date
Position – Associate

- **Kudusberg Windfarm** – Transport study for the proposed Kudusberg Windfarm near Sutherland, Northern Cape – Client: G7 Renewable Energies
- **Kuruman Windfarm –** Transport study for the proposed Kuruman Windfarm in Kuruman, Northern Cape – Client: Mulilo Renewable Project Developments
- **Coega West Windfarm** – Transportation and Traffic Management Plan for the proposed Coega Windfarm in Coega, Port Elizabeth – Client: Electrawinds Coega

- **Traffic and Parking Audits** for the Suburb of Groenvallei in Cape Town – Client: City of Cape Town Department of Property Management.
- **Road Safety Audit** for the Upgrade of N1 Section 4 Monument River – Client: Aurecon on behalf of SANRAL
- **Sonop Windfarm** – Traffic Impact Assessment for the proposed Sonop Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Universal Windfarm -** Traffic Impact Assessment for the proposed Universal Windfarm, Coega, Port Elizabeth – Client: Founders Engineering
- **Road Safety Audit** for the Upgrade of N2 Section 8 Knysna to Wittedrift – Client: SMEC on behalf of SANRAL
- **Road Safety Audit** for the Upgrade of N1 Section 16 Zandkraal to Winburg South – Client: SMEC on behalf of SANRAL
- **Traffic and Road Safety Studies** for the Improvement of N7 Section 2 and Section 3 (Rooidraai and Piekenierskloof Pass) – Client: SANRAL
- **Road Safety Appraisal**s for Northern Region of Cape Town – Client: Aurecon on behalf of City of Cape Town (TCT)
- **Traffic Engineering Services** for the Enkanini Informal Settlement, Kayamandi - Client: Stellenbosch Municipality
- **Lead Traffic Engineer** for the Upgrade of a 150km Section of the National Route N2 from Kangela to Pongola in KwaZulu-Natal, Client: SANRAL
- **Traffic Engineering Services** for the Kosovo Informal Settlement (which is part of the Southern Corridor Upgrade Programme), Client: Western Cape Government
- **Traffic and Road Safety Studies** for the proposed Kosovo Informal Housing Development (part of the Southern Corridor Upgrade Program), Client: Western Cape Government.
- **Road Safety Audit** Stage 3 – Upgrade of the R573 Section 2 between Mpumalanga/Gauteng and Mpumalanga/Limpopo, Client: AECOM on behalf of SANRAL
- **Road Safety Audit** Stage 1 and 3 – Upgrade of the N2 Section 5 between Lizmore and Heidelberg, Client: Aurecon on behalf of SANRAL
- **Traffic Safety Studies** for Roads Upgrades in Cofimvaba, Eastern Cape – Client: Cofimvaba Municipality
- **Road Safety Audit** Stage 1 and 3 – Improvement of Intersections between Olifantshoek and Kathu, Northern Cape, Client: Nadeson/Gibb on behalf of SANRAL
- **Road Safety Audit** Stage 3 – Upgrade of the Beacon Way Intersection on the N2 at Plettenberg Bay, Client: AECOM on behalf of SANRAL
- **Traffic Impact Assessment** for a proposed Primary School at Die Bos in Strand, Somerset West, Client: Edifice Consulting Engineers
- **Road Safety Audit** Stage 1 and 3 – Improvement of R75 between Port Elizabeth and Uitenhage, Eastern Cape, Client: SMEC on behalf of SANRAL

SPECIALIST DECLARATION

I, **IRIS WINK**, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: ____________________

Name of Specialist: IRIS WINK

Date: 08 November 2018

EXECUTIVE SUMMARY

This transport study was commissioned to assess the potential impact of activities related to the delivery of the turbine components and associated supporting infrastructure to site for the construction, operation and decommissioning phases of the proposed Rondekop Wind Energy Facility (WEF).

It is assumed that the wind turbine components will be imported to South Africa via the Port of Saldanha, although the Port of Ngqura is a viable alternative. The preferred route from the Port of Saldanha utilizes existing National and Provincial Roads as far as possible. Alternative routes were assessed but these routes have geometrical constraints and includes large sections of gravel roads that will require upgrading.

There are three ridges on the proposed site viz. North Ridge, Centre Ridge and South Ridge. Two access roads alternatives are proposed for each of the three ridges i.e. six access routes have been proposed. All access road alternatives are considered suitable. Access road alternative **North Ridge 1** is deemed the **preferred** access road to the North Ridge as it is an existing farm road. Access alternatives **Centre Ridge 1** and **South Ridge 1** are the **preferred** access road for the Centre ridge and South Ridge respectively as these roads are shorter and therefore less expensive to upgrade and maintain. It should be noted that there is no preference between the construction camp and substation alternatives presented as these do not affect or have any impact on the traffic on the surrounding road network.

The main transport impacts will be during the construction and decommissioning phases of a WEF where the delivery of the infrastructure will generate significant traffic. The duration of these phases is short term i.e. the impact of the traffic on the surrounding road network is temporary and when the WEF is operational, do not add any significant traffic to the road network. The traffic impact on the surrounding network is therefore deemed low.

Table 1: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
CONSTRUCTION PHASE					
Congestion	Increased traffic	-70		-35	
Noise pollution	Increased traffic	-35		-6	
Dust pollution	Increased traffic	-35		-6	
			- 47		**-16**
			Medium Negative Impact		Low Negative Impact
DECOMMISSIONING PHASE					
Congestion	Increased traffic	-70		-35	
Noise pollution	Increased traffic	-35		-6	
Dust pollution	Increased traffic	-35		-6	
			- 47		**-16**
			Medium Negative Impact		Low Negative Impact
CUMULATIVE ASSESSMENT					
Congestion	Increased traffic	-72		-35	
Noise pollution	Increased traffic	-60		-35	
Dust pollution	Increased traffic	-60		-35	
			- 64		**-35**
			High Negative Impact		Medium Negative Impact

Traffic generated by the construction activities of the WEF will have a significant impact on the road infrastructure, albeit of a short-term nature. Additionally, the construction of the WEF will create dust and noise pollution that will have a low (short term) impact during the construction and decommissioning phases. Proposed mitigation measures include:

- Staggered delivery and trips can be scheduled to occur outside of peak traffic periods in line with the prevailing legislation for transportation of abnormal loads
- Dust suppression during the construction and decommissioning phases, as required
- Regular maintenance of gravel roads during the construction and decommissioning phases by the Contractor
- The use of mobile batching plants, or a batching plant in close proximity to the site and quarries in close proximity to the site would decrease the impact on the surrounding road network.
- Staff and general trips should occur outside of peak traffic periods as far as possible.

The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to.

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Yes. See attached CV
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Yes. See attached declaration
c) an indication of the scope of, and the purpose for which, the report was prepared;	Yes. See section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	n/a
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Yes. See section 1.6
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	n/a
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Yes. See section 1.1
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Yes. Section 1.3
g) an identification of any areas to be avoided, including buffers;	Yes. Section 1.3
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	n/a
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Yes. Section 1.1
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Yes. Section 1.5
k) any mitigation measures for inclusion in the EMPr;	Yes. Section 1.6
l) any conditions for inclusion in the environmental authorisation;	n/a
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	n/a
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Yes. Section 1.6
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
q) any other information requested by the competent authority.	n/a
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	n/a

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TRANSPORT STUDY

1.1. INTRODUCTION AND METHODOLOGY

1.1.1. Scope and Objectives

Rondekop Wind Farm (Pty) Ltd is proposing to develop the 325 MW Rondekop Wind Energy Facility (WEF) between Sutherland and Matjiesfontein in the Northern Cape Province. The site is envisaged to accommodate a maximum of 48 wind turbines.

As part of the Environmental Impact Assessment (EIA) undertaken by the SiVEST SA (Pty) Ltd (SiVEST), the services of a Transportation Specialist are required to conduct a Transport Study.

The main objective of this report is to undertake the Transport Study (including the traffic and transport risk assessments and a route investigation) for the proposed Rondekop WEF site.

The following two main transportation activities will be investigated:
- Abnormal load vehicles transporting wind turbine components to the site.
- The transportation of construction materials, equipment and people to and from the site/facility.

The transport study will aim to provide the following objectives:
- Activities related to traffic movement for the construction, operation (maintenance) and decommissioning phases of the WEF.
- Provide a main route for the transportation of the wind turbine components from the entry point to the proposed site.
- Provide a preliminary transportation route for the transportation of materials, equipment and people to site.

1.1.1.1. Terms of Reference

The Terms of Reference for this Transport Study include the following:

General:
- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements;
- Provide a thorough overview of all applicable legislation, guidelines
- Cumulative impact identification and assessment as a result of other renewable energy (RE) developments in the area (including; a cumulative environmental impact table(s) and statement, review of the specialist reports undertaken for other Renewable Energy developments and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered);
- Identification sensitive areas to be avoided (including providing shapefiles/kmls);
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    - Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.

- Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
- Cumulative impacts are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.

- Comparative assessment of alternatives;
- Recommend mitigation measures in order to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).

Specific:

- Extent of the transport study and study area;
- The proposed development;
- Assumptions concerning candidate turbines;
- Trip generation for the wind farm during construction, operation and decommissioning;
- Traffic impact on external road network;
- Accessibility and turning requirements;
- National and local haulage routes between port of entry/manufacturer and site;
- Assessment of internal roads and site access;
- Assessment of freight requirements and permitting needed for abnormal loads; and
- Traffic accommodation during construction.

1.1.1.2. Approach and Methodology

The report deals with the traffic impact on the surrounding road network in the vicinity of the site:

- during the construction of the access roads;
- construction and installation of the turbines;
- maintenance in the operational phase; and
- the decommissioning phase.

This transport study was informed by the following:

<u>Site Visit and Project Assessment</u>

- Site visit and initial meeting with the client to gain sound understanding of the project; and
- Research of all available documentation and information relevant to the proposed facility.

<u>Correspondence with Authorities</u>

- Correspondence with the relevant Authorities dealing with the external road network, such as SANRAL and the relevant provincial government departments.

<u>The transport study considered and assessed the following:</u>

<u>Traffic and Haul Route Assessment</u>

- Estimation of trip generation;
- Discussion on potential traffic impacts;
- Assessment of possible haul routes between port of entry / manufacturing location; and
- Construction, operational (maintenance) and decommissioning vehicle trips.

<u>Site layout, Access Points and Internal Roads Assessment per Site</u>

- Description of the surrounding road network;
- Description of site layout;

- Assessment of the proposed access points;
- Assessment of the proposed internal roads on site; and
- Assessment of internal circulation of trucks and proposed roads layout regarding turbine positions and turbine laydown areas.

The findings of this transport assessment are detailed in this report prepared as part of the EIA process for the proposed Rondekop WEF.

1.1.1.3. Assumptions and Limitations

The following assumptions and limitations apply:

- This study is based on the project information provided by SiVEST.
- It is assumed that the turbine positions would be optimized in the future and that the exact and final turbine locations have not been provided. Therefore, turbine corridors were used as an indication of the possible location.
- According to the Eskom Specifications for Power Transformers (Eskom Power Series, Volume 5: Theory, Design, Maintenance and Life Management of Power Transformers), the following dimensional limitations need to be kept when transporting the transformer – total maximum height 5 000mm, total maximum width 4 300 mm and total maximum length 10 500 mm.
- Maximum vertical height clearances along the haulage route is 5.2 m for abnormal loads.
- The imported elements will be transported from the most feasible port of entry, which is deemed to be Port of Saldanha. It is expected that the inverter will be imported and shipped.
- All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads.
- Material for the construction of internal access roads will be sourced locally as far as possible.

1.1.1.4. Source of Information

Information used in a transport study includes:

- Project Information provided by SiVEST
- Google Earth.kmz provided by SiVEST
- Google Earth Satellite Imagery
- Information gathered during site visit
- Project research of all available information
- Correspondence with authorities

1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE TRANSPORT STUDY

1.2.1.1. Port of Entry

It is assumed that the wind turbine components will be imported to South Africa via the Port of Saldanha, which is located in the Western Cape. The Port of Saldanha is the largest and deepest natural port in the Southern Hemisphere able to accommodate vessels with a draft of up to 21.5 meters. The port covers a land and sea surface of just over 19,300 hectares within a circumference of 91 kilometer with maximum water depths of 23.7 meters. Unique to the port is a purpose-built rail link directly connected to a jetty bulk loading facility for the shipment of iron ore. The Port is operated by Transnet National Ports Authority.

Alternatively, wind turbine components could be imported via the Port of Ngqura in Coega, Port Elizabeth. The Port of Ngqura is a world-class deep-water transshipment hub offering an integrated, efficient and competitive port service for containers on transit. The Port forms part of the Coega Industrial Development Zone (CIDZ) and is operated by Transnet National Ports Authority.

1.2.1.2. Selected Candidate Turbine

The possible range of wind turbines varies widely with various wind turbine manufacturers operating worldwide. The project information states that a turbine with a maximum hub height of up to 140 m and a blade length of up to 90 m (maximum rotor diameter of 180 m) is to be considered.

In general, each turbine unit consists of a tower, a Nacelle (final weight dependent on the supplier and whether the nacelle has gears or not) and three rotor blades.

The transport impact is also dependent on the type of turbine namely steel towers vs concrete towers. The steel and concrete towers generally consist of 20 m sections. Steel cylindrical tower sections are delivered to the site and do not require on site assembly to form the sections. The concrete tower sections, however, are delivered in 2 – 4 precast segments which are assembled on site to form a 20 m tower section. Concrete towers can require 18 truckloads per turbine, whereas steel towers can require four truckloads per turbine.

1.2.1.3. Transportation requirements

1.2.1.3.1. Abnormal Load Considerations

Abnormal permits are required for vehicles exceeding the following permissible maximum dimensions on road freight transport in terms of the Road Safety Act (Act No. 93 of 1996) and the National Road Traffic Regulations, 2000:

- Length: 22 m for an interlink, 18.5 m for truck and trailer and 13.5 m for a single unit truck
- Width: 2.6 m
- Height: 4.3 m measured from the ground. Possible height of load – 2.7 m.
- Weight: Gross vehicle mass of 56 t resulting in a payload of approximately 30t
- Axle unit limitations: 18 t for dual and 24 t for triple-axle units
- Axle load limitation: 7.7 t on the front axle and 9 t on the single or rear axles

Any dimension / mass outside the above will be classified as an Abnormal Load and will necessitate an application to the Department of Transport and Public Works for a permit that will give authorisation for the conveyance of said load. A permit is required for each Province that the haulage route traverses.

1.2.1.3.1.1. Further Guideline Documentation

The Technical Recommendations for Highways (TRH 11): “Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads” outlines the rules and conditions that apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges and culverts.

The general conditions, limitations and escort requirements for abnormally dimensioned loads and vehicles are also discussed and reference is made to speed restrictions, power / mass ratio, mass distribution and general operating conditions for abnormal loads and vehicles. Provision is also made for the granting of permits for all other exemptions from the requirements of the Road Traffic Act and the relevant regulations.

1.2.1.3.1.2. Permitting – General Rules

The limits recommended in TRH 11 are intended to serve as a guide to the Permit Issuing Authorities. It must be noted that each Administration has the right to refuse a permit application or to modify the conditions under which a permit is granted. It is understood that:

a) A permit is issued at the sole discretion of the Issuing Authority. The permit may be refused because of the condition of the road, the culverts and bridges, the nature of other traffic on the road, abnormally heavy traffic during certain periods or for any other reason.
b) A permit can be withdrawn if the vehicle upon inspection is found in any way not fit to be operated.
c) During certain periods, such as school holidays or long weekends an embargo may be placed on the issuing or permits. Embargo lists are compiled annually and are obtainable from the Issuing Authorities.

1.2.1.3.1.3. Load Limitations

The maximum load that a road vehicle or combination of vehicles will be allowed to carry legally under permit on a public road is limited by:

- the capacity of the vehicles as rated by the manufacturer;
- the load which may be carried by the tyres;
- the damaging effect on pavements;
- the structural capacity on bridges and culverts;
- the power of the prime mover(s);
- the load imposed by the driving axles; and
- the load imposed by the steering axles.

1.2.1.3.1.4. Dimensional Limitations

A load of abnormal dimensions may cause an obstruction and danger to other traffic. For this reason, all loads must, as far as possible, conform to the legal dimensions. Permits will only be considered for indivisible loads, i.e. loads that cannot, without disproportionate effort, expense or risk of damage, be divided into two or more loads for the purpose of transport on public roads. For each of the characteristics below there is a legally permissible limit and what is allowed under permit:

- Width;
- Height;
- Length;
- Front Overhang;
- Rear Overhang;
- Front Load Projection;
- Rear Load Projection;
- Wheelbase;
- Turning Radius; and
- Stability of Loaded Vehicles.

1.2.1.3.2. Transporting Wind Turbine Components

Wind turbine components can be transported in a number of ways with different truck / trailer combinations and configurations, which will need to be investigated at a later stage when the transporting contractor and the plant hire companies apply for the necessary permits from the Permit Issuing Authorities. All required permits will be obtained prior to the commencement of construction.

1.2.1.3.2.1. Nacelle

The heaviest component of a wind turbine is the Nacelle (approximately 100 tons depending on manufacturer and design of the unit). Combined with road-based transport, it has a total vehicle mass of approximately 145 000 kg for a 100-ton unit. Thus, route clearances and permits will be required for transporting the Nacelle by road-based transport (see example of a road-based transport below). The unit will require a minimum height clearance of 5.1metres.

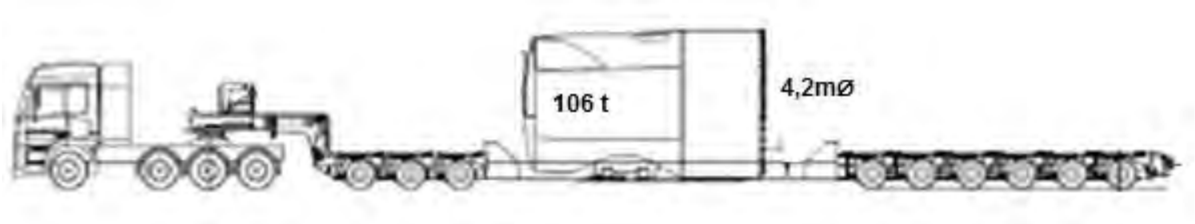

Figure 1: Transporting the Nacelle

1.2.1.3.2.2. Blades

These are the longest and possibly most vulnerable components of a wind turbine and hence needs to be transported with upmost care. The set of three blades will have a rotor diameter of up to 180 m (~90 m per blade) and they need to be transported on an extendible blade transport trailer or in a rigid container with rear steerable dollies. The blades can be transported individually, in pairs or in three's; although different manufacturers have different methods of packaging and transporting the blades. It should be noted that larger blades are transported individually. The transport vehicle exceeds the dimensional limitation (length) of 22 m and will only be allowed under permit, provided the trailer is fitted with steerable rear axles or dollies.

Figure 2: Example: 3 x 45m Blades on extendible trailers

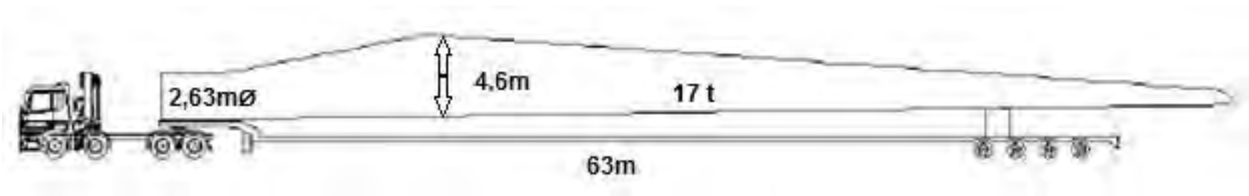

Figure 3: Example of Blade Transport

Turbine blades of up to 90m in length have been proposed. Due to this abnormal length, special attention needs to be given to the route planning, especially to suitable turning radii and adequate sweep clearance. Therefore, vegetation or road signage may have to be removed before transport. Once transported to site, the blades need to be carefully stored in their respective laydown areas before being installed onto the rotary hub.

1.2.1.3.2.3. Tower Sections

Steel tower sections generally consist of sections of around 20 m in length and hence the number of tower sections required depends on the selected hub height. For a hub height of 140 metres, it is assumed that seven tower sections are required. Each section is transported separately on a low-bed trailer. Depending on the trailer configuration and height when loaded, some of these components may not meet the dimensional limitations (height and width) but will be permitted under certain permit conditions (see examples below).

Concrete tower sections or keystones might also be considered. Concrete tower sections will, however, add to additional traffic as tower sections are delivered to the site in smaller sections that require on-site assembly.

Figure 4: Transporting the Tower Sections

Figure 5: Concrete Tower Sections

1.2.1.3.2.4. Turbine Hub and Rotary Units

These components need to be transported separately, due to their significant weights - a hub unit weighs around 45 tons and the rotary unit weighs over 90 tons.

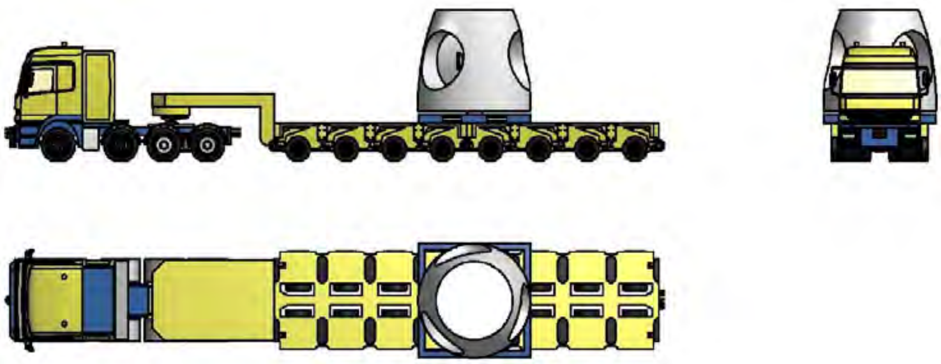

Figure 6: Transporting the Hub and Rotary Units

1.2.1.4. Transporting Cranes, Mobile Crane and other Components

This technology has developed rapidly, and several different heavy lifting options are available on the market. Costs involved to hire cranes vary and hence should be compared beforehand. For this assessment, some possible crane options are outlined as follows.

1.2.1.4.1. Cranes for Assembly and Erection on Site

<u>Option 1: Crawler Crane & Assembly Crane</u>

One possible option is that the main lift crane that would be capable of performing the required lifts, i.e. lifting the tower sections into position, lifting the Nacelle to the hub height and lifting the Rotor and Blades into place, needs to be similar to the Liebherr Crawler Crane LR1750 with a SL8HS (Main Boom and Auxiliary Jib) configuration. A smaller 200-ton Liebherr Mobile Crane LTM 1200- 5.1 is also required to lift the components and assist in the assembly of the crawler crane at each turbine location.

- **Crawler Crane LR1750 with the SL8HS boom system (Main Lifting Crane):**

The Crawler Crane will be transported to site in components and the heaviest load will be the superstructure and crawler centre section (83 tons). The gross combination mass (truck, trailer and load) will be approximately 133 000 kg. The boom sections, counterweights and other equipment will be transported on conventional tri-axle trailers and then assembled on site. It will require a number of truckloads of components to be delivered for assembly of the Crawler Crane before it can be mobilised to perform the heavy lifts.

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

The Liebherr LTM 1200-5.1 crane is a 5-axle vehicle with rubber tyres, which will travel to site on its own. However, the counterweights will be transported on conventional tri-axle trailers and then assembled on site. The assembly crane is required to assemble the main lift crane as well as assist in the installation of the wind turbine components.

<u>Option 2: GTK 1100 Crane & Assembly Crane</u>

For the single wind turbine at Coega, the GTK 1100 hydraulic crane was used (see example in picture below). The GTK 1100 was designed to lift ultra-heavy loads to extreme heights and its potential lies in being deployed on facilities such as wind turbine farms.

Figure 7: Cranes at work

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

As above - a smaller 200-ton Liebherr Mobile Crane LTM 1200-5.1 is also required to lift the components and assist in the assembly of the hydraulic crane at each turbine location.

1.2.1.4.2. Cranes at Port of Entry

Most shipping vessels importing the turbine components will be equipped with on-board cranes to do all the safe off-loading of WTG components to the abnormal transport vehicles, parked adjacent to the shipping vessels.

Figure 8: Cranes at Port of Entry

The imported turbine components may be transported from the Port of Entry to the nearby turbine laydown area. Mobile cranes will be required at these turbine laydown areas to position the respective components at their temporary storage location.

1.2.1.5. Transporting Other Plant, Material and Equipment

In addition to transporting the specialised lifting equipment, the normal Civil Engineering construction materials, plant and equipment will need to be brought to the site (e.g. sand, stone, cement, concrete batching plant, gravel for road building purposes, excavators, trucks, graders, compaction equipment, cement mixers, transformers in the sub-station, cabling, transmission pylons etc.). Other components, such as electrical cables, pylons and substation transformers, will also be transported to site during construction. The transport of these items will generally be conducted with normal heavy loads vehicles.

1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

1.3.1.1. Description of the site

The proposed Rondekop WEF will be located off the R356 between Matjiesfontein and Sutherland in the Northern Cape Province, as shown below.

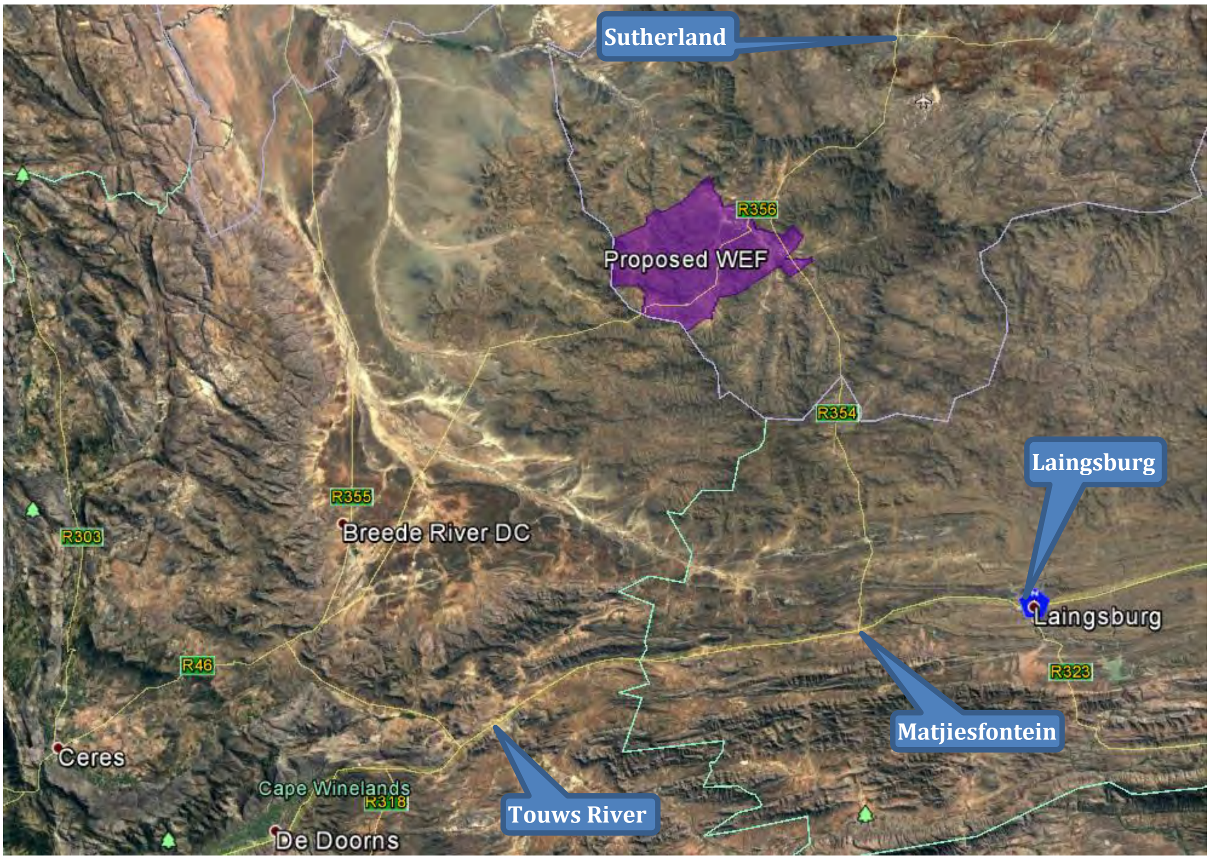

Figure 9: Aerial View of Proposed Rondekop WEF

The Rondekop WEF will have an energy generation capacity of up to 325 megawatt (MW), and will include the following as per the SiVEST Terms of Reference for Specialists:

- Up to 48 wind turbines, each between 3 MW and 6.5 MW in nameplate capacity with a foundation of up to 30 m in diameter and up to 5 m in depth.
- The hub height of each turbine will be up to 140 m and its rotor diameter up to 180 m.
- Permanent compacted hardstanding laydown areas for each wind turbine of 90 m x 50 m during construction and for ongoing maintenance purposes for the lifetime of the turbines.
- Electrical transformers (690V/33kV) adjacent to each turbine.
- Underground 33kV cabling and overhead 33kV lines.
- Access roads to the site will be approximately 9m wide.
- Access roads to the substation will be approximately 6m wide.
- Internal access roads up to 12 m wide.
- One 33/132kV onsite substation.
- Up to 4 x 140m tall (depending on the final hub height) wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.
- Temporary infrastructure including a construction camp which includes an on-site concrete batching plant and various buildings e.g. maintenance building.
- Fencing (up to 6m high) will be limited to around the construction camp and batching plant.

- Temporary infrastructure to obtain water from available local sources/ new or existing boreholes including a potential temporary above ground pipeline (approximately 35cm diameter) to feed water to the on-site batching plant. Water will potentially be stored in temporary water storage tanks.

It should be noted that there is no preference between the construction camp and substation alternatives presented as these do not affect or have any impact on the traffic on the surrounding road network.

1.3.1.2. National Route to Site

The most suitable port is the Port of Saldanha, which is located 392km travel distance from the proposed WEF site. However, the Port of Ngqura in Coega, Port Elizabeth can also be considered as an alternative. The Port of Ngqura is located approximately 670km travel distance from the proposed WEF site.

The preferred route for abnormal load vehicles will be from the port, heading east on the R45 to Hopefield and onto the R311 at Moorreesburg (see Figure 9). At Hermon, the abnormal load vehicle will travel on the R46 to Ceres, passing Gouda and Tulbagh. The abnormal load vehicle will turn right at the R355/R46 intersection and continue on the R46 towards the N1. At Matjiesfontein on the N1, the vehicle will turn north onto the R354, left at DR02249 and left at R356.

Figure 10: Preferred route from Port to WEF site

An alternative option exists to access the proposed site via the R355, avoiding the N1 highway, as shown in the Figure 11 below. This route follows the same alignment as the Preferred Route to the R46, turning right onto the R355 and then heading east on the R356 to the R356/MN04469 intersections. The section of R356 would require upgrading of the road and an assessment of the drainage structures along the route. This route, however, would require extensive upgrading and there is a significant number of drainage structures located along the route. Although the upgrade work would be extensive, this is a potential viable alternative.

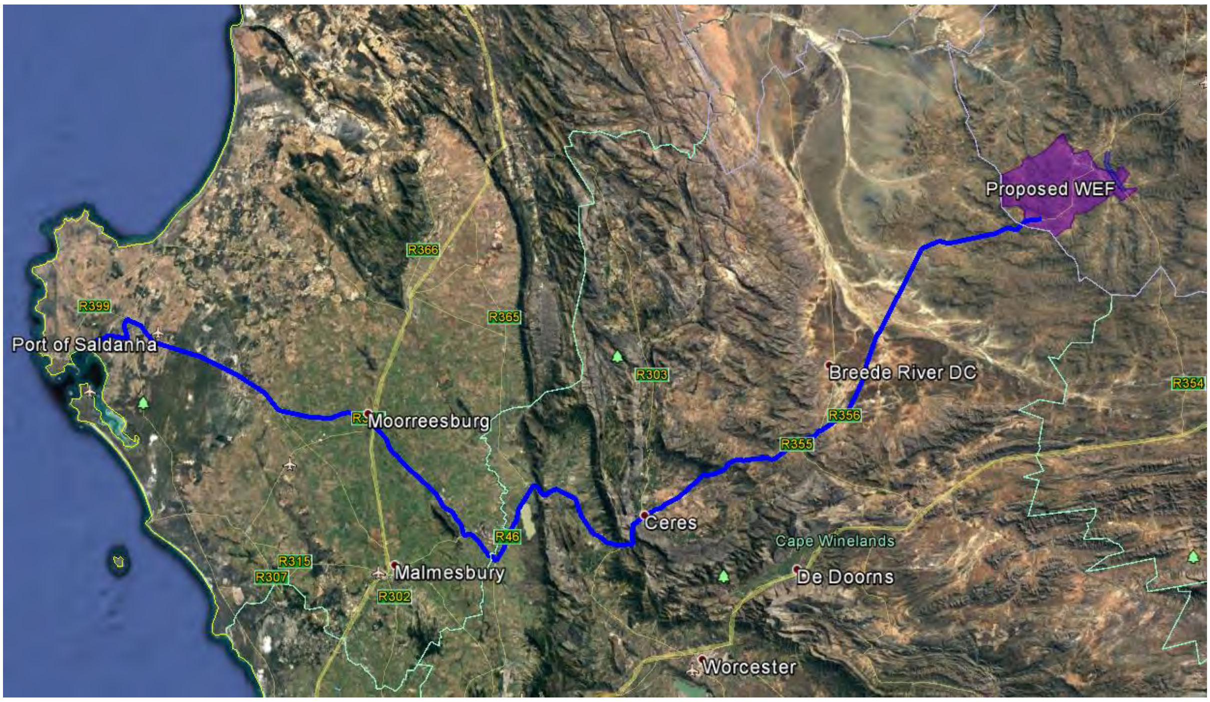

Figure 11: Alternative Route 1

It is critical to ensure that the abnormal load vehicle will be able to move safely and without obstruction along the preferred routes. The preferred route should be surveyed to identify problem areas e.g. intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification. After the road modifications have been implemented, it is recommended to undertake a "dry-run" with the largest abnormal load vehicle, prior to the transportation of any turbine components, to ensure that the delivery of the turbines will occur without disruptions.

It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.

1.3.1.3. Main Route for the Transportation of the Wind Turbine Components

The investigation showed that it will be possible to transport the imported wind turbine components by road to the proposed site. The proposed main route will be along the surfaced R354, which connects Matjiesfontein and Sutherland, turning west onto the district gravel road DR02249 and then turning left onto the R356 to the Rondekop WEF (see figure below).

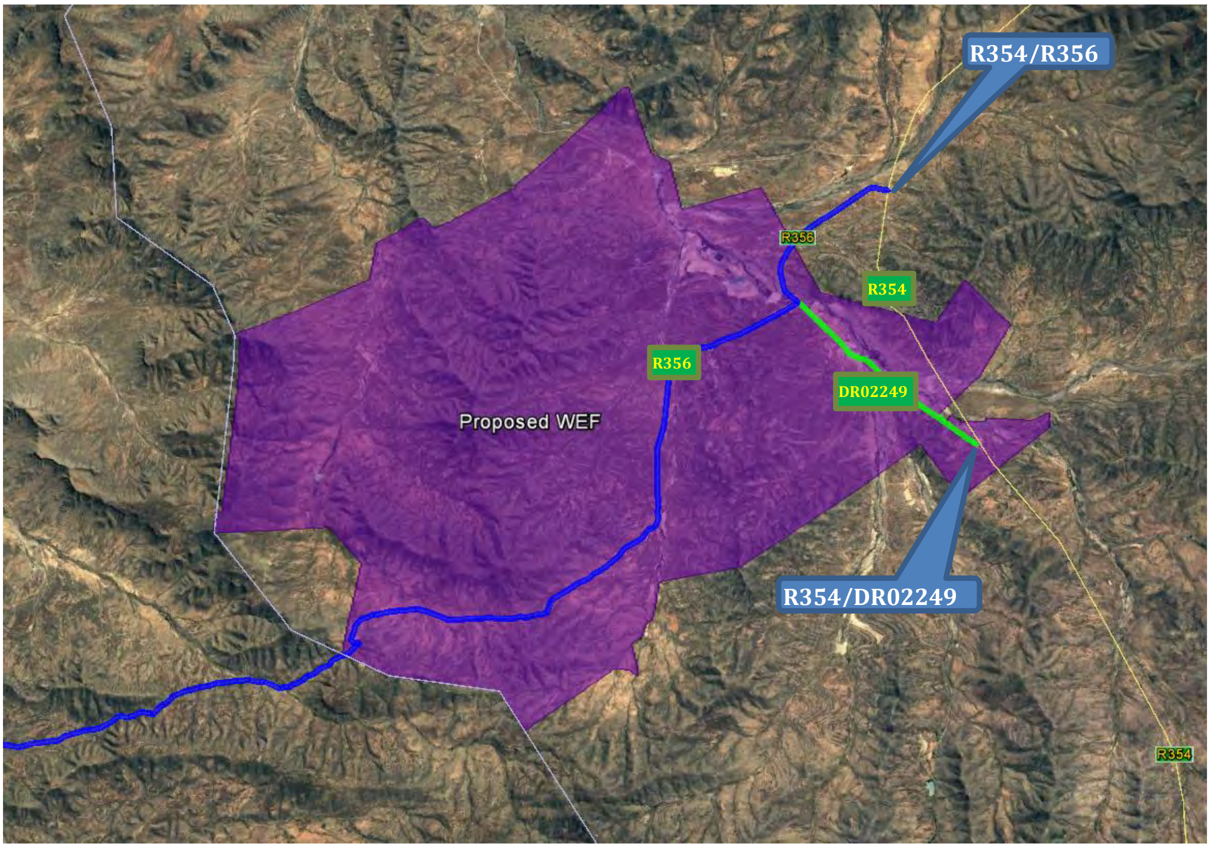

Figure 12: Proposed Main Route

For this option, DR02249 would require upgrading and intersections would have to be widened to accommodate the turning movements of heavy vehicles. The watercourse structures along the route are in a poor condition and the load bearing capacity of these structures would need to be assessed. In all likelihood these structures would have to be replaced or upgraded. In addition, farm gates and cattle grids would have to be widened to accommodate abnormal loads.

Figure 13: Narrow bridge on DR02249

Figure 14: Narrow cattle grid

The R356 could be accessed off the R354, which is approximately 10.8km from the DR02249/R354 intersection, as shown in Figure 12. The section of R356 between the R354/R356 intersection and the R356/DR02249 intersection, however, would also require significant upgrading of the road and the drainage structures along the route. The route was therefore deemed unsuitable as an alternative as the required upgrading would be too extensive.

It should be noted that any low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes would have to be moved to accommodate the abnormal load vehicles.

1.3.1.4. *Proposed main access road to the proposed WEF*

Access to the proposed WEF will be provided via the R356. Six access road alternatives branch off the R356, connecting it to the road network between the turbines of the proposed WEF. There are three ridges on the proposed site viz - North Ridge, Centre Ridge and South Ridge. Two access roads alternatives are proposed for each of the three ridges.

These roads are shown in the figure below and described as follows:

- Access road alternative North Ridge 1 (NR 1) – An existing farm road. Approximately 11.8 km in length.
- Access road alternative North Ridge 2 (NR 2) – An existing farm road. Approximately 12.8 km in length.
- Access road alternative Centre Ridge 1 (CR1) – Approximately 2.6 km in length.
- Access road alternative Centre Ridge 2 (CR2) – Approximately 3.1 km in length.
- Access road alternative South Ridge 1 (SR1) – Approximately 1.9 km in length.
- Access road alternative South Ridge 2 (SR2) – Approximately 4.2 km in length.

All access road alternatives are considered suitable. Access road alternative *North Ridge 1* is deemed the preferred access road to the North Ridge as it is an existing farm road and is shorter than access road alternative *North Ridge 2*, i.e. less expensive to upgrade and maintain.

Access alternatives *Centre Ridge 1* and *South Ridge 1* are the preferred access roads for the Centre ridge and South Ridge respectively as these roads are shorter and therefore less expensive to upgrade and maintain.

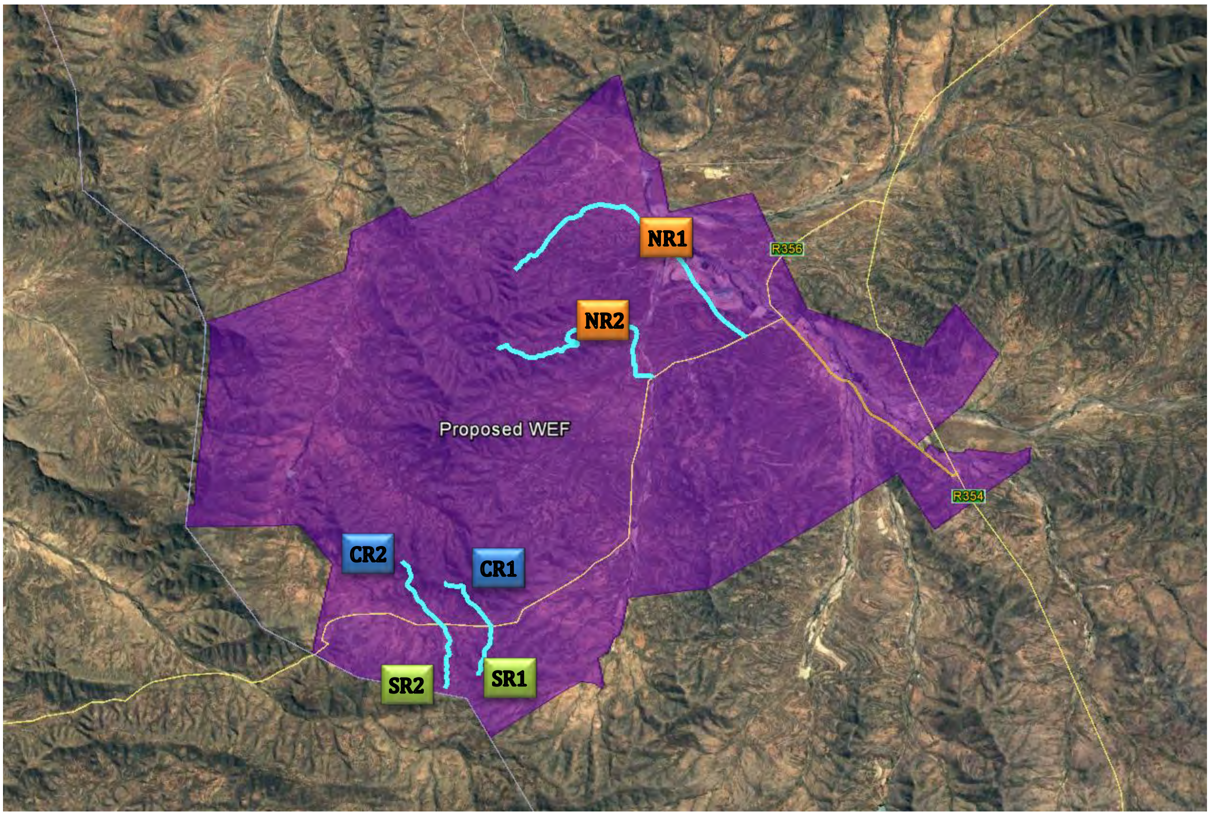

Figure 15: Access Roads

The access road alternatives are summarised in the table below.

Table 2: Summary of access road alternatives

Access Road Alternative	Preference	Reasons (incl. potential issues)
NORTH RIDGE		
Access Road Alternative North 1	Preferred	Existing farm road. Less expensive to upgrade and maintain.
Access Road Alternative North 2	Favourable	Longer road i.e. more expensive to upgrade and maintain.
CENTRE RIDGE		
Access Road Alternative Centre1	Preferred	Shorter therefore less expensive to upgrade and maintain
Access Road Alternative Centre 2	Favourable	Longer road i.e. more expensive to upgrade and maintain.
SOUTH RIDGE		
Access Road Alternative South 1	Preferred	Shorter therefore less expensive to upgrade and maintain
Access Road Alternative South 2	Favourable	Longer road i.e. more expensive to upgrade and maintain.

A minimum required road width of 4 m needs to be kept and all turning radii must conform with the specifications needed for the abnormal load vehicles and haulage vehicles. It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will hence need to be maintained during the additional loading of the construction phase and then reinstated after construction finishes. The gravel roads will require grading with a road grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. Geometric design constraints might be encountered due to the rolling, hilly topography of the area, as shown in the photographs below. The road designer should take cognizance that the turbines are to be positioned at the top of the hills. Therefore, the roads need to be designed with smooth, relatively flat gradients to allow an abnormal load vehicle to ascend to the top of the hill. It should be noted that there is no preference between the construction camp and substation alternatives presented as these do not affect or have any impact on the traffic on the surrounding road network

1.3.1.5. Main Route for the Transportation of Materials, Plant and People to the proposed WEF

The nearest towns in relation to the proposed WEF site are Sutherland, Matjiesfontein and Laingsburg. It is envisaged that most of the materials, plant and labour will be sourced from these towns and transported to the WEF will be via the N1 and R354.

Concrete batch plants and quarries in the vicinity could be contracted to supply materials and concrete during the construction phase, which would reduce the impact on traffic on the surrounding road network. Alternatively, mobile concrete batch plants and temporary construction material stockpile yards could be commissioned on vacant land near the proposed WEF site. Delivery of materials to the mobile batch plant and the stockpile yard could be staggered to minimise traffic disruptions.

It is envisaged that most materials, water, plant, services and people will be procured within a 50 km radius from the proposed WEF, however, this would be informed by the REIPPPP requirements.

1.4. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

Key legal requirements pertaining to the transport requirements for the proposed WEF development are:

- Abnormal load permits, (Section 81 of the National Road Traffic Act)
- Port permit (Guidelines for Agreements, Licenses and Permits in terms of the National Ports Act No. 12 of 2005), and
- Authorisation from Road Authorities to modify the road reserve to accommodate turning movements of abnormal loads at intersections.

1.5. IDENTIFICATION OF KEY ISSUES

1.5.1.1. Identification of Potential Impacts

The potential transport related impacts are described below.

1.5.1.2. Construction Phase

- *Potential impact 1*
  - Construction related traffic
  - The construction traffic would also lead to noise and dust pollution.
  - This phase also includes the construction of roads, excavations of turbine footings, trenching for electrical cables and other ancillary construction works that will temporarily generate the most traffic.

1.5.1.3. Operational Phase

During operation, it is expected that staff and security will periodically visit the turbines. It is assumed that approximately less than ten (10) full-time employees will be stationed on site. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.

1.5.1.4. Decommissioning Phase

- *Potential Impact 2*
  - Construction related traffic
  - Noise and dust pollution

1.5.1.5. Cumulative impacts

- Traffic congestion/delays on the surrounding road network.
- Noise and dust pollution.

1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

1.6.1.1. Potential Impact 1 (Construction Phase)

- *Nature of the impact*
  - Potential traffic congestion and delays on the surrounding road network and associated noise and dust pollution.

- *Significance of impact without mitigation measures*

- Traffic generated by the construction of the WEF will have a significant impact on the surrounding road network. The exact number of trips generated during construction will be determined by the haulage company transporting the components to site, the turbine model, the staff requirements and where equipment is sourced from.

For the transportation of the turbines to the WEF site, it was assumed that the turbine blades will be transported to site individually due to the size of the blades being up to 90 m each.

Consequently, for each steel wind turbine three abnormal loads will be required for the blades, seven abnormal loads for the tower sections and another abnormal load for the nacelle. All further components will be transported with normal limitations haulage vehicles. With approximately 11 abnormal loads trips, the total trips to deliver the components of 48 turbines to the WEF site will be around 528 trips. This would amount to less than 2 vehicle trips per day for a typical construction period of 18-24months.

As concrete towers require up to 18 abnormal load trips per turbine, the total number of abnormal load trips for a concrete turbine is approximately 22 trips. The total trips to deliver the components of 48 turbines to the WEF site will be around 1 056 trips. This would amount to approximately 3 vehicle trips per day for a typical construction period of 18-24months.

The constructions of roads and concrete footings will also have a significant impact on the surrounding road network as vehicles deliver materials to the site. A concrete footing (approximately 500 m^3) adds over 80 trips by concrete trucks to the surrounding road network.

The significance of the transport impact without mitigation measures during the construction and decommissioning phases can be rated as high. However, considering that this is temporary and short term in nature, the impact can be mitigated to an acceptable level.

- *Proposed mitigation measures*
  - The delivery of wind turbine components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
  - Dust suppression of gravel roads during the construction and decommissioning phases, as required.
  - Regular maintenance of gravel roads by the Contractor during the construction and decommissioning phases.
  - The use of mobile batch plants and quarries near the site would decrease the impact on the surrounding road network.
  - Staff and general trips should occur outside of peak traffic periods as far as possible.
  - Any low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.
  - The preferred route should be surveyed to identify problem areas e.g. intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, that may require modification. After the road modifications have been implemented, it is recommended to undertake a “dry-run” with the largest abnormal load vehicle, prior to the transportation of any turbine components, to ensure that the delivery of the turbines will occur without disruptions. This process is to be undertaken by the haulage company transporting the components and the contractor, who will modify the road and intersections to accommodate abnormal vehicles. It needs to be ensured that the gravel sections of the haulage routes remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.
  - Design and maintenance of internal roads. The internal gravel roads will require grading with a road grader to obtain a flat even surface and the geometric design of these gravel roads needs to be confirmed at detailed design stage. This process is to be undertaken by a civil engineering consultant or a geometric design professional.

Geometric design constraints might be encountered due to the rolling, hilly topography of the area, as shown in the photographs below. The road designer should take cognizance that the turbines are to be positioned at the top of the hills, therefore roads need to be designed with smooth, relatively flat gradients to allow an abnormal load vehicle to ascend to the top of the hill.

- *Significance of impact with mitigation measures*
  The proposed mitigation measures for the construction traffic will result in a minor reduction of the impact on the surrounding road network, but the impact on the local traffic will remain moderate as the existing traffic volumes are deemed to be low. The dust suppression, however, will result in significantly reducing the impact.

1.6.1.2. Potential Impact 2 (Decommissioning Phase)

This phase will result in the same impact as the Construction Phase as similar trips are expected. The significance of the transport impact without mitigation measures during the construction and decommissioning phases can be rated as substantial. However, considering that this is temporary and short term in nature, the impact can be mitigated to an acceptable level.

1.6.1.3. Cumulative Impacts

To assess the cumulative impact, it was assumed that all wind farms within 50 km currently proposed and authorized, would be constructed at the same time. This is the precautionary approach as in reality; these projects would be subject to a highly competitive bidding process. Only a handful of projects would be selected to enter into a power purchase agreement with Eskom.

The construction and decommissioning phases of a WEF are the only significant traffic generators. The duration of these phases is short term i.e. the impact of the WEF traffic on the surrounding road network is temporary and WEFs, when operational, do not add any significant traffic to the road network. Even if all wind farms are constructed and decommissioned at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.

1.6.1.4. No-Go Alternative

The no-go alternative implies that the proposed development of the Rondekop WEF does not proceed. This would mean that there will be no negative environmental impacts and no traffic impact on the surrounding network. However, this would also mean that there would be no socio-economic benefits to the surrounding communities and it will not assist government in meeting the targets for renewable energy. **Hence, the no-go alternative is not a preferred alternative.**

1.7. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in the tables below.

Table 3: Comparison of summarised impacts on environmental parameters

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
CONSTRUCTION PHASE					
Congestion	Increased traffic	-70		-35	
Noise pollution	Increased traffic	-35		-6	
Dust pollution	Increased traffic	-35		-6	
			- 47		**-16**
			Medium Negative Impact		Low Negative Impact
DECOMMISSIONING PHASE					
Congestion	Increased traffic	-70		-35	
Noise pollution	Increased traffic	-35		-6	
Dust pollution	Increased traffic	-35		-6	
			- 47		**-16**
			Medium Negative Impact		Low Negative Impact
CUMULATIVE ASSESSMENT					
Congestion	Increased traffic	-72		-35	
Noise pollution	Increased traffic	-60		-35	
Dust pollution	Increased traffic	-60		-35	
			- 64		**-35**
			High Negative Impact		Medium Negative Impact

Table 4: Impact Rating - Construction Phase

IMPACT TABLE – CONSTRUCTION PHASE		
Environmental Parameter	*Traffic Congestion*	
Issue/Impact/Environmental Effect/Nature	*Transport of equipment, material and staff to site will lead to congestion.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative Medium impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	2
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	-70 (high negative)	-35 (medium negative)
Mitigation measures	▪ *Stagger turbine component delivery to site* ▪ *Reduce the construction period* ▪ *The use of mobile batch plants and quarries in close proximity to the site* ▪ *Staff and general trips should occur outside of peak traffic periodsRegular maintenance of gravel roads by the Contractor during the construction and decommissioning phases.*	

Table 5: Impact Rating - Construction Phase

IMPACT TABLE – CONSTRUCTION PHASE		
Environmental Parameter	*Air quality will be affected by dust pollution*	
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate dust.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative Medium impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	2
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	3	1
Significance rating	-35 (medium negative)	-6 (low negative)
Mitigation measures	▪ *Dust Suppression* of gravel roads during the construction and decommissioning phases, as required.*Regular maintenance of gravel roads by the Contractor during the construction and decommissioning phases.*	

Table 6: : Impact Rating - Construction Phase

IMPACT TABLE – CONSTRUCTION PHASE	
Environmental Parameter	*Noise pollution due to increased traffic.*
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate noise.*
Extent	*Local*
Probability	*Definite*
Reversibility	*Completely reversible*
Irreplaceable loss of resources	*No loss*
Duration	*Short term*
Cumulative effect	*Low cumulative impact*
Intensity/magnitude	*High*
Significance Rating	*Negative Medium impact*

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	2
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	1
Intensity/magnitude	3	1
Significance rating	-35 (medium negative)	-6 (low negative)
Mitigation measures	▪ *Stagger turbine component delivery to site* ▪ *Reduce the construction period* ▪ *The use of mobile batch plants and quarries in close proximity to the site* ▪ *Staff and general trips should occur outside of peak traffic periods*	

Table 7: Impact Rating - Operational Phase

IMPACT TABLE – OPERATIONAL PHASE
The traffic generated during this phase will be minimal and will have not have any impact on the surrounding road network.

Table 8: Impact Rating - Decommissioning Phase

IMPACT TABLE – DECOMMISSIONING PHASE		
Environmental Parameter	*Traffic Congestion.*	
Issue/Impact/Environmental Effect/Nature	*Transport of equipment, material and staff to site will lead to congestion.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative Medium impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	2
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	-70 (high negative)	-35 (medium negative)
Mitigation measures	▪ *Stagger turbine component removal from site* ▪ *Reduce the construction period* ▪ *Staff and general trips should occur outside of peak traffic periods*	

Table 9: Impact Rating - Decommissioning Phase

IMPACT TABLE – DECOMMISSIONING PHASE		
Environmental Parameter	*Air quality will be affected by dust pollution*	
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate dust.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative Medium impact*	
	Pre-mitigation impact rating	Pre-mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	3	3
Significance rating	-35 (medium negative)	--6 (low negative)
Mitigation measures	▪ *Dust Suppression*	

Table 10: Impact Rating - Decommissioning Phase

IMPACT TABLE – DECOMMISSIONING PHASE		
Environmental Parameter	*Noise pollution due to increased traffic.*	
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate noise.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative Medium impact*	
	Pre-mitigation impact rating	Pre-mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	2	2
Intensity/magnitude	3	3
Significance rating	-35 (medium negative)	-6 (low negative)
Mitigation measures	▪ *Stagger turbine component delivery to site* ▪ *Reduce the construction period* ▪ *The use of mobile batch plants and quarries in close proximity to the site* ▪ *Staff and general trips should occur outside of peak traffic periods*	

Table 11: Impact Rating - Cumulative Impact

IMPACT TABLE – CUMULATIVE IMPACT		
Environmental Parameter	*Traffic Congestion.*	
Issue/Impact/Environmental Effect/Nature	*Transport of equipment, material and staff to site will lead to congestion.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Medium term*	
Cumulative effect	*High cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative High impact*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	3
Reversibility	2	1
Irreplaceable loss	1	1
Duration	2	1
Cumulative effect	4	3
Intensity/magnitude	3	2
Significance rating	-72 (high negative)	-35 (medium negative)
Mitigation measures	▪ *Stagger turbine component removal from site* ▪ *Reduce the construction period* ▪ *Staff and general trips should occur outside of peak traffic periods*	

Table 12: Impact Rating - Cumulative Impact

IMPACT TABLE – CUMULATIVE IMPACT		
Environmental Parameter	*Air quality will be affected by dust pollution*	
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate dust.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative High impact*	
	Pre-mitigation impact rating	Pre-mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	4	2
Intensity/magnitude	3	2
Significance rating	-60 (high negative)	-35 (medium negative)
Mitigation measures	▪ *Dust Suppression*	

Table 13: Impact Rating - Cumulative Impact

IMPACT TABLE – CUMULATIVE IMPACT		
Environmental Parameter	*Noise pollution due to increased traffic.*	
Issue/Impact/Environmental Effect/Nature	*Traffic on roads will generate noise.*	
Extent	*Local*	
Probability	*Definite*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*No loss*	
Duration	*Short term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Negative Medium impact*	
	Pre-mitigation impact rating	Pre-mitigation impact rating
Extent	2	2
Probability	4	4
Reversibility	1	1
Irreplaceable loss	1	1
Duration	1	1
Cumulative effect	3	2
Intensity/magnitude	3	3
Significance rating	-60 (high negative)	-35 (medium negative)
Mitigation measures	▪ *Stagger turbine component delivery to site* ▪ *Reduce the construction period* ▪ *The use of mobile batch plants and quarries in close proximity to the site* ▪ *Staff and general trips should occur outside of peak traffic periods*	

1.8. INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

It is recommended that dust suppression and maintenance of gravel roads form part of the EMPr. This would be required during the Construction and Decommissioning phases where an increase is vehicle trips can be expected. No traffic related mitigation measures are envisaged during the Operation phase due to the negligible traffic volume generated during this phase.

Table 14: EMPr Input – Construction Phase

Impact	**Mitigation/Management Objectives**	**Mitigation/Management Actions**	**Monitoring**		
			Methodology	***Frequency***	***Responsibility***
A. CONSTRUCTION PHASE					
A.1. TRAFFIC IMPACTS					
Dust and noise pollution Transportation of material, components, equipment and staff to site	Minimize impacts on road network.	▪ Stagger turbine component delivery to site ▪ The use of mobile batch plants and quarries near the site would decrease the impact on the surrounding road network ▪ Dust suppression ▪ Reduce the construction period ▪ Maintenance of gravel roads ▪ Apply for abnormal load permits prior to commencement of delivery via abnormal loads	▪ Regular monitoring of road surface quality. ▪ Apply for required permits prior to commencement of construction	▪ Before construction commences and regularly during construction phase.	▪ Holder of the EA

		▪ Assess the preferred route and undertake a 'dry run' to test ▪ Staff and general trips should occur outside of peak traffic periods as far as possible. ▪ Any low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.			

Table 15: EMPr Input – Decommissioning Phase

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
B. DECOMMISIONING PHASE					
A.1. TRAFFIC IMPACTS					
Dust and noise pollution	Avoid or minimize impacts on road network.	▪ Dust suppression ▪ Maintenance of gravel roads ▪ Stagger turbine component removal from site ▪ Reduce the construction period	▪ Regular monitoring of road surface quality.	▪ Before and during the decommissioning phase.	▪ Contractor

		▪ Apply for abnormal load permits prior to commencement of work ▪ Staff and general trips should occur outside of peak traffic periods as far as possible. ▪ Any low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.			

1.9. COMPARATIVE ASSESSMENT OF ALTERNATIVE

1.1 Comparative Assessment of Layout Alternatives

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Comparative Assessment of the proposed access roads has been assessed in Section 1.3.2.4 above. The construction camp and substation alternatives has been assessed below.

Table 16: Comparative Assessment of Construction Camp and Substation Alternatives

CONSTRUCTION CAMPS		
Construction Camp Alternative 1	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Construction Camp Alternative 2	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Construction Camp Alternative 3	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Construction Camp Alternative 4	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Construction Camp Alternative 5	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Construction Camp Alternative 6	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
SUBSTATIONS		
Substation Alternative 1	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Substation Alternative 2	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.

Substation Alternative 3	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Substation Alternative 4	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Substation Alternative 5	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.
Substation Alternative 6	**NO PREFERENCE**	There is no difference between the proposed alternatives from a Traffic perspective. All alternatives are acceptable.

1.10. CONCLUSION AND RECOMMENDATIONS

The potential transport related impacts for the construction, operation and decommissioning phases for the proposed Rondekop WEF were assessed.

- The construction phase traffic, although significant, will be temporary and impacts are considered to have a **low significance**.
- During operation, it is expected that staff and security will periodically visit the facility. It is assumed that approximately less than ten (10) full-time employees will be stationed on site. The traffic generated during this phase will be minimal and will not have an impact on the surrounding road network.
- The traffic generated during the decommissioning phase will be lower than the construction phase traffic and the impact on the surrounding road network will also be **low**.

The potential mitigation measures mentioned in the construction and decommissioning phases are:

- Dust suppression
- Component delivery to/ removal from the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
- The use of mobile batch plants and quarries near the site would decrease the impact on the surrounding road network.
- Staff and general trips should occur outside of peak traffic periods.
- A "dry run" of the preferred route.
- Design and maintenance of internal roads.
- Any low hanging overhead lines (lower than 5.1m) e.g. Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.

The construction and decommissioning phases of a WEF are the only significant traffic generators and therefore noise and dust pollution will be higher during these phases. The duration of these phases is short term i.e. the impact of the WEF traffic on the surrounding road network is temporary and WEFs, when operational, do not add any significant traffic to the road network.

There are three ridges on the proposed site viz. North Ridge, Centre Ridge and South Ridge. Two access roads alternatives are proposed for each of the three ridges i.e. six access routes have been proposed. All access road alternatives are considered suitable. Access road alternative **North Ridge 1** is deemed the **preferred** access road to the North Ridge as it is an existing farm road. Access alternatives **Centre Ridge 1** and **South Ridge 1** are the **preferred** access road for the Centre ridge and South Ridge respectively as these roads are shorter and therefore less expensive to upgrade and maintain. It should be noted that there is no preference between the construction camp and substation alternatives presented as these do not affect or have any impact on the traffic on the surrounding road network.

The development is supported from a transport perspective provided that the recommendations and mitigations contained in this report are adhered to.

The impacts associated with Rondekop wind farm are acceptable and can therefore be authorised.

1.11. REFERENCES

- Google Earth Pro
- SANS 10280/NRS 041-1:2008 - Overhead Power Lines for Conditions Prevailing in South Africa
- Road Safety Act (Act No. 93 of 1996)
- The Technical Recommendations for Highways (TRH 11): “Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads
- S Gouws: “Concrete Towers – a business case for sustained local investment”, Concrete growth, www.slideshare.net/SantieGouws/concrete-towers-a-business-case-for-sustained-investmentrev-5