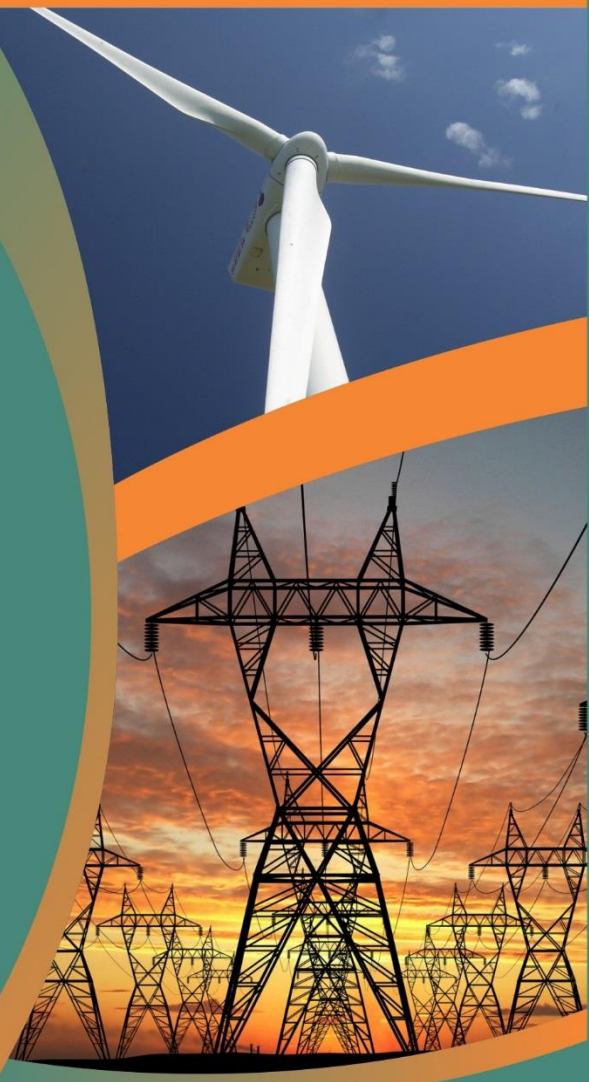
BASIC ASSESSMENT REPORT

Basic Assessment for the Proposed Construction and Operation of Electrical Grid Infrastructure to support the Sutherland, Sutherland 2 and Rietrug Wind Energy Facilities (WEFs), Northern and Western Cape Provinces



APPENDIX D.4: Heritage Impact Assessment (Archaeology, Palaeontology and Cultural Landscape)

HERITAGE IMPACT ASSESSMENT: PROPOSED CONSTRUCTION OF A MAJOR TRANSMISSION SUBSTATION, 400 KV TRANSMISSION LINE AND 132 KV DISTRIBUTION LINE TO SUPPORT THE PROPOSED RIETRUG, SUTHERLAND AND SUTHERLAND 2 WEFs, SUTHERLAND AND LAINGSBURG MAGISTERIAL DISTRICTS, NORTHERN AND WESTERN CAPE

SAHRA Case ID: 14379
HWC Case No.: 19042402AS0521E

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

Report for:

CSIR – Environmental Management Services
P.O. Box 320, Stellenbosch, 7599
Tel: 021 888 2495/2661
Email: mlevendal@csir.co.za

On behalf of:

South Africa Mainstream Renewable Power Developments (Pty) Ltd

Dr Jayson Orton
ASHA Consulting (Pty) Ltd
40 Brassie Street, Lakeside, 7945
Tel: (021) 788 1025 | 083 272 3225
Email: jayson@asha-consulting.co.za

1st draft: 13 August 2019
Revised: 11 September 2019

Specialist declaration

I, Jayson Orton, 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.

Name of Specialist: JAYSON ORTON

Signature of the specialist: _____

Date: 26 September 2019

EXECUTIVE SUMMARY

1. Site Name

Electrical grid infrastructure to support three Wind Energy Facilities (WEFs) (namely the Rietrug, Sutherland and Sutherland 2 WEFs).

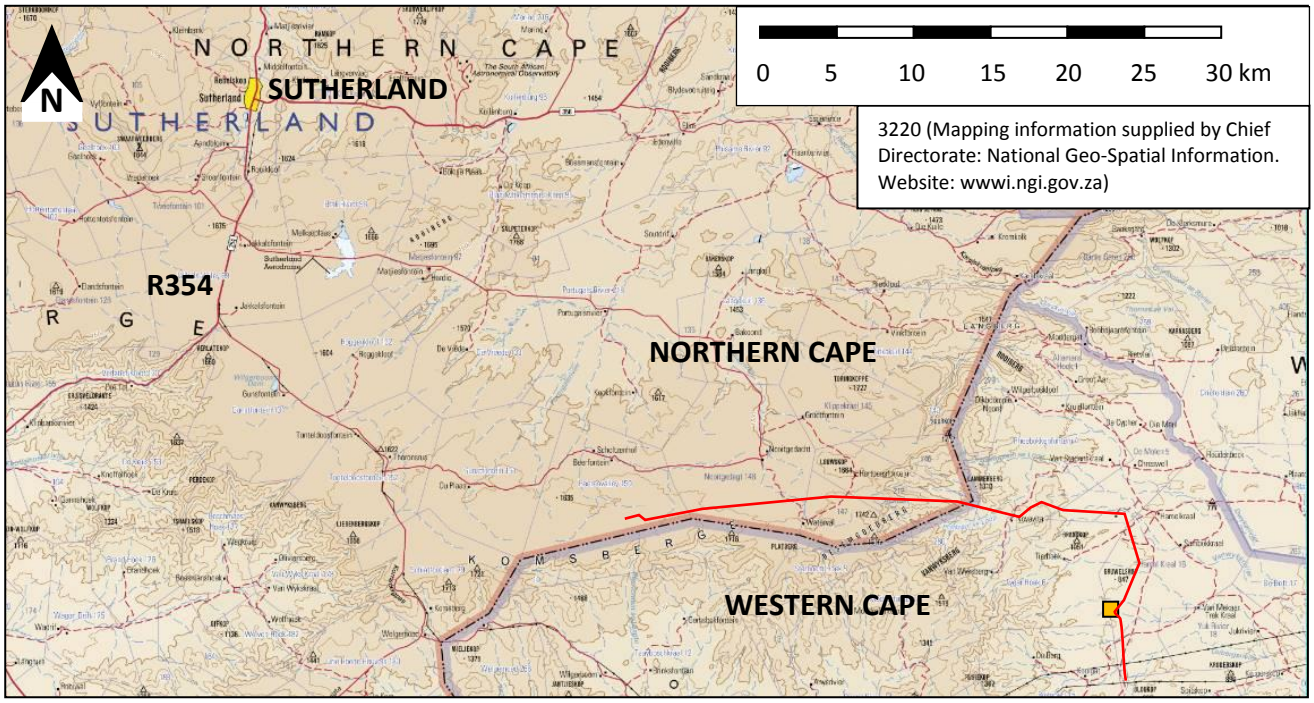
2. Location

The proposed power line would traverse the following properties (listed from west to east):

- Northern Cape: Remaining Extent of Beeren Valley 150, Remaining Extent of Nooitgedacht 148, Remaining Extent of Hartbeesfontein 147, Portion 1 and Remaining Extent of Farm 219; and
- Western Cape: Farm 280, Portion 1 of Rheebokkfontein 4, Portion 2 of Rheebokkfontein 4, Portion 2 of De Molen 5, Portion 6 of Hamelkraal 16, Portion 7 of Hamelkraal 16, and Remaining Extent of Spitskop Farm 20.

The proposed distribution line would run from an on-site substation for the already authorised Sutherland Wind Energy Facility (WEF) at S32° 38' 41.1" E20° 55' 02.5" (36 km southeast of Sutherland, Northern Cape) down the escarpment to a new Main Transmission Substation (MTS) at S32° 42' 00.2" E21° 15' 21.3" (24 km west of Merweville, Western Cape). A 400 kV power line would then extend for some 4.0 km further south to join an existing transmission line.

3. Locality Plan



Map showing the location of the study area. The proposed power line route is marked in red and the proposed substation location is at the orange square.

4. Description of Proposed Development

The project applicant is proposing the development of a 132 kV transmission line, a major transmission substation and 400 kV line and associated service roads, within the Renewable Energy Development Zone (REDZ): 2 Komsberg and the Central Power Corridor that was gazetted in February 2018.

The 132 kV line routing proposed as part of this application was considered in a previous assessment, but with a slightly different alignment in one place and ending at the proposed substation. A different alternative was authorised at that stage and the proponent now seeks to have a separate environmental authorisation for this alignment and a connection to the transmission lines to the south of the substation to allow for more flexibility.

Project components include:

- Major Transmission Substation;
- Overhead 132 kV line ~ 41 km;
- 400 kV ~ 4 km overhead transmission line connecting to an existing Eskom line; and
- Service roads will be constructed below the power lines (jeep track).

5. Heritage Resources Identified

Archaeological remains are generally scarce but are found throughout the area. Stone Age material was rare with a precolonial kraal complex (Northern Cape) and a geometric rock art site (Western Cape) being the most significant sites recorded. Isolated stone artefacts were remarkably rare, especially above the escarpment, but a few small scatters were recorded on the plains below the escarpment (Western Cape). The vast majority of archaeological remains found were historical and ranged from a ruined farm complex to small, isolated ruined structures and isolated individual artefacts. Several sites lie close to the alignment but the eastern part of it was devised by the present author to avoid these sites.

Although palaeontological resources were found throughout much of the study area, the vast majority were of low significance. Two important fossil sites were found in the broader area but both were located away from the proposed power line footprint and impacts are not expected.

Some graveyards and buildings are present in the wider area but all are located well away from the proposed power line alignments and no impacts are expected.

The rural cultural landscape extends throughout the study area but, aside from fences and farm tracks, human interventions are generally very sparse. The site lies within the Komsberg REDZ and Central Power Corridor (that was gazetted in February 2018), which promotes Renewable Energy and Electricity Grid Infrastructure development within these strategic geographical areas. It is thus noted that a new electrical layer is due to be added to this landscape in the very near future. The escarpment, however, remains an aesthetically significant landscape for its remoteness, long views, rugged scenery and distinctive sense of place.

6. Anticipated Impacts on Heritage Resources

Although heritage resources occur fairly close to the route in places, significant direct impacts are not expected. However, a potentially sensitive part of the route could not be surveyed in the field. No heritage resources were found to lie directly within the proposed development footprint. It is noted that the Stone Age kraal complex (in Northern Cape) is bisected by an access road that might be used during development. The greater landscape, especially along the escarpment, is visually significant but because it lies within a REDZ, the area is very likely to be devoted to renewable energy developments and the proposed electrical grid infrastructure would thus not be out of place.

7. Recommendations

Because there are unlikely to be significant impacts to heritage resources that cannot be managed or mitigated, it is recommended that the proposed development be authorised. However, the following conditions should be incorporated into the Environmental Authorisation:

- Any areas of the power line route and substation footprint not yet surveyed should be examined by an archaeologist in order to identify any areas or sites that should be protected or mitigated prior to commencement of construction (this includes any alterations made after completion of the assessment);
- The Environmental Control Officer (ECO) should be aware of the potential for fossils to be uncovered during excavations. As many excavations as possible should be monitored by the ECO during construction and if any fossils are uncovered, they should be protected *in situ* and immediately reported to a palaeontologist in order to plan a way forward;
- The farm road passing through the kraal complex at waypoint 546 (Northern Cape) may not be widened towards the east and should preferably not be widened at all;
- No pylon should be placed within 30 m of waypoint 1785 (Western Cape) and the site should be fenced with a 30 m buffer during the construction phase;
- Significant palaeontological and archaeological sites as listed in this report should be identified on project maps and regarded as no-go zones with buffers of at least 30 m around all associated features (the exception is the service road diversion which comes within 20 m of the rock art site but uses an existing farm track);
- These no-go sites should be examined periodically by the ECO during the construction phase to ensure that they are being respected; and
- If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist or palaeontologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

8. Author/s and Date

Heritage Impact Assessment: Dr Jayson Orton, ASHA Consulting (Pty) Ltd, 13 August 2019
Archaeological specialist study: Dr Jayson Orton, ASHA Consulting (Pty) Ltd, 13 August 2019
Palaeontological specialist study: Dr John Almond, Natura Viva cc, June 2019

Glossary

Background scatter: Artefacts whose spatial position is conditioned more by natural forces than by human agency

***Kraal*:** Afrikaans word for a livestock enclosure. The Afrikaans is popularly used throughout the area.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

***Muurkas*:** Wall cupboard. A depression in the wall which would typically have a wooden box inside it with doors on the front.

***Trapvloer*:** Threshing floor. Circular 'floor' lined with stones for threshing wheat.

***Waterput*:** A hole excavated into the ground, often into rock, that functioned as a well.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BAR: Basic Assessment Report

CSIR: Council for Scientific and Industrial Research

CRM: Cultural Resources Management

DEA: National Department of Environmental Affairs

ECO: Environmental Control Officer

GPS: global positioning system

HIA: Heritage Impact Assessment

HWC: Heritage Western Cape

I&APs: Interested and Affected Parties.

LSA: Later Stone Age

NC: Northern Cape

NCW: Not Conservation Worthy

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25 of 1999)

NID: Notification of Intent to Develop

PPP: Public Participation Process

REDZ: Renewable Energy Development Zone

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

WC: Western Cape

WEF: Wind Energy Facility

Compliance with Appendix 6 of the 2014 EIA Regulations

Requirements of Appendix 6 – GN R326 (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;	Section 1.4 Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii (Preliminary Section of this report)
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.3
(cA) an indication of the quality and age of base data used for the specialist report;	Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 4, 5, 6 and 7
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2
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
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 alternatives;	Section 1.1.1, 6, 9, Appendix 2
g) an identification of any areas to be avoided, including buffers;	Section 9
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 9
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.5
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6
k) any mitigation measures for inclusion in the EMPr;	Section 9
l) any conditions for inclusion in the environmental authorisation;	Section 13
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity and 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 12 and 13
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 11
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 11
q) any other information requested by the competent authority.	Not Applicable
2. Where a government notice gazetted by the Minister provides for any protocol of minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Not Applicable

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by the Council for Scientific and Industrial Research (CSIR) to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction of an electrical transmission and distribution line (hereafter referred to as 'the power line') and Major Transmission Substation (and associated infrastructure) to support three wind energy facilities (WEFs) that have already been authorised. These are referred to as the Rietrug, Sutherland and Sutherland 2 WEFs which are proposed by South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as 'Mainstream'). The distribution line would run from the on-site substation for the already authorised Sutherland WEF at S32° 38' 41.1" E20° 55' 02.5" (36 km southeast of Sutherland, Northern Cape) down the escarpment to a new Main Transmission Substation (MTS) at S32° 42' 00.2" E21° 15' 21.3" (24 km west of Merweville, Western Cape). A 400 kV power line would then extend for some 4.0 km further south to join an existing transmission line (Figure 1).

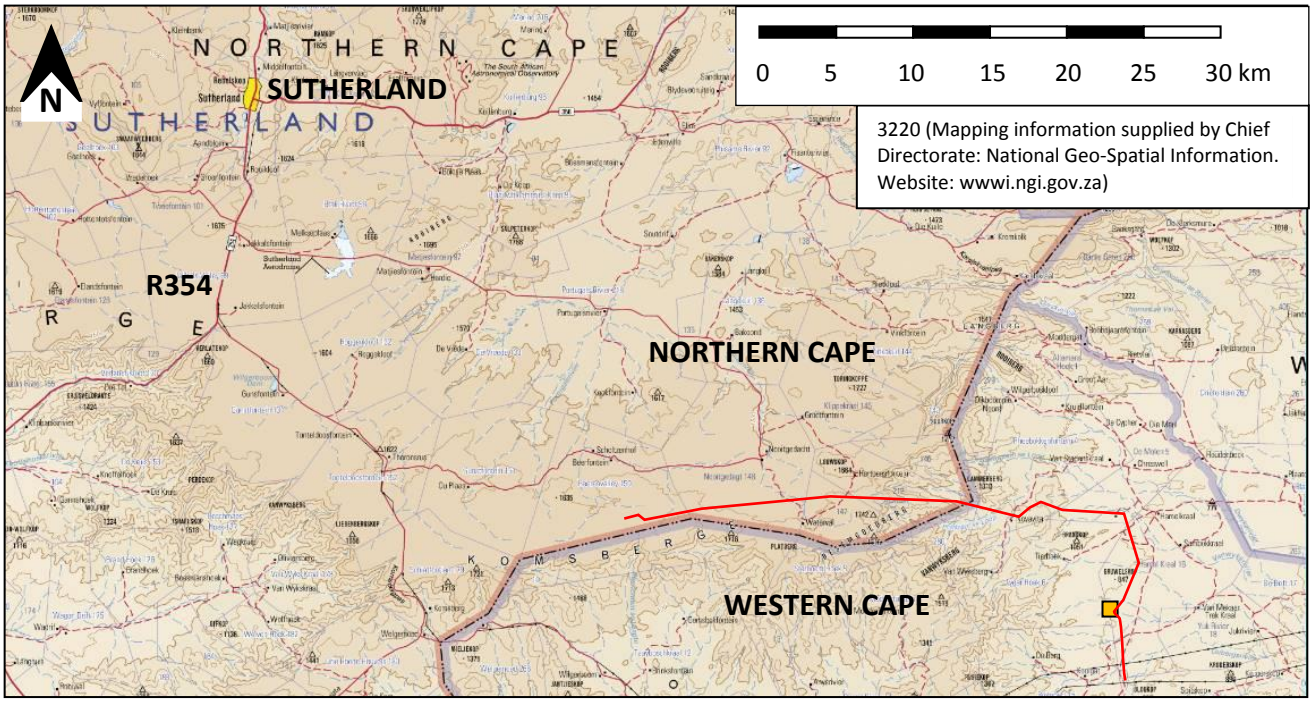


Figure 1: *Map showing the location of the study area. The red line shows the proposed distribution and transmission line route. The orange square represents the proposed MTS.*

From west to east, the proposed power line would traverse the following properties:

- Northern Cape
  - Remaining Extent of Beeren Valley Farm 150
  - Remaining Extent of Nooitgedacht Farm 148
  - Remaining Extent of Hartbeesfontein Farm 147
  - Portion 1 and Remaining Extent of Farm 219
- Western Cape
  - Farm 280
  - Portion 1 of Rheebokkfontein Farm 4

- Portion 2 of Rheebokkfontein Farm 4
- Portion 2 of De Molen Farm 5
- Portion 6 of Hamelkraal Farm 16
- Portion 7 of Hamelkraal Farm 16
- Remaining Extent of Spitskop Farm 20

Note that a very similar project was submitted to HWC and approved in 2017 under case 17020607AS0207E. The present alignment has been slightly altered and extended in length.

1.1. Project description

The project applicant, Mainstream, is proposing the development of a 132 kV transmission line, a major transmission substation and 400 kV line within the Renewable Energy Development Zone (REDZ) 2: Komsberg. The 132 kV line routing proposed as part of this application has been previously assessed as part of the proposed construction of the electrical grid infrastructure for the Sutherland WEF (14/12/16/3/3/1/1816), Rietrug WEF (14/12/16/3/3/1/1815) and Sutherland 2 WEF (14/12/16/3/3/1/1814/AM1). These projects received Environmental Authorisation in February 2018. Within the authorisations, the alternative line routing "1" was submitted as the preferred routing and subsequently approved.

The 132 kV line routing proposed as part of this application was considered in the previous assessment as alternative line routing "2", but with a slightly different alignment in one place and ending at the proposed substation. The line routing did not include any environmental fatal flaws and is a technically feasible option to enable the evacuation of the electricity generated by the abovementioned WEFs into the National Grid. The proponent now seeks to have a separate environmental authorisation for this alignment and a connection to the transmission lines to the south of the substation to allow for more flexibility.

Project components:
- Major Transmission Substation;
- Overhead 132 kV line ˜ 41 km;
- 400 kV ~ 4 km overhead transmission line connecting to an existing Eskom line; and
- Service roads will be constructed below the lines (jeep track).

1.1.1. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant, since excavations for foundations may impact on archaeological and/or palaeontological remains, while the above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

1.2. Terms of reference

ASHA Consulting was asked to submit a Notification of Intent to Develop (NID) form to Heritage Western Cape (HWC) for the Western Cape component of the project and compile a Heritage Impact Assessment (HIA) that would meet the requirements of the relevant heritage authorities in both Northern Cape (SAHRA) and Western Cape (HWC).

HWC responded to the NID with a request for an HIA that included specialist assessments of impacts to archaeological and palaeontological resources and visual impacts to the cultural landscape as follows:

> You are hereby notified that, since there is reason to believe that the proposed development will impact on heritage resources, HWC requires that a Heritage Impact Assessment (HIA) that satisfies the provisions of section 38(3) of the NHRA be submitted. This HIA must have specific reference to the following:
>
> - Visual impact on the cultural landscape
> - Archaeological impacts
> - Palaeontological impacts
>
> The required HIA must have an integrated set of recommendations.
>
> The comments of relevant registered conservation bodies and the relevant Municipality must be requested and included in the HIA where provided. Proof of these requests must be supplied.

It should also be noted, however, that following Section 38(3) of the National Heritage Resources Act (No. 25 of 1999), even though certain specialist studies may be specifically requested, <u>all</u> heritage resources should be identified and assessed.

It was required by CSIR that the reporting include a description and mapping of sensitive features based on a field survey, identification of legal requirements, assessment of impacts and recommendations for mitigation or management as might be appropriate.

1.3. Scope and purpose of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued for consideration by the National Department of Environmental Affairs (DEA) who will review the Basic Assessment Report (BAR) and grant or withhold authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation should this be granted.

1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting HIAs and archaeological specialist studies in the western part of South Africa since 2004 (Please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

2. HERITAGE LEGISLATION

The National Heritage Resources Act No. 25 of 1999 (NHRA)
protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: "any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith";
- Palaeontological material: "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";
- Archaeological material: a) "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"; b) "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"; c) "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 respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), 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"; and d) "features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found";
- Grave: "means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place"; and
- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

Section 3(3) describes the types of cultural significance that a place or object might have in order to be considered part of the national estate. These are as follows:

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;
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.

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38 (2a) states that if there is reason to believe that heritage resources will be affected then an impact assessment report must be submitted. This report fulfils that requirement.

Under the National Environmental Management Act (No. 107 of 1998; NEMA), as amended, the project is subject to a BA. HWC (for all heritage in Western Cape), Ngwao-Boswa Ya Kapa Bokoni (NBKB) (Heritage Northern Cape; for built environment and cultural landscapes in Northern Cape) and the SAHRA (for archaeology and palaeontology in Northern Cape) are required to provide comment on the proposed project in order to facilitate final decision making by the DEA.

3. APPROACH AND METHODOLOGY

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the proposed development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:250 000 map sourced from the Chief Directorate: National Geo-Spatial Information was also used. Data were also collected via field surveys.

3.2. Field survey

During the earlier assessment five days were spent covering various parts of the proposed alignment. These were 15, 17 and 18 November 2016 and 2 and 3 February 2017. Two further days were spent on site on 10 and 11 May 2019 working on both this and another project. These surveys were in different seasons but in this relatively dry environment the season makes little difference to the degree of vegetation cover and hence the visibility of heritage resources. During the surveys the positions of finds were recorded on a hand-held GPS receiver set to the WGS84 datum. Track paths were also recorded on the GPS (Figure 2). Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

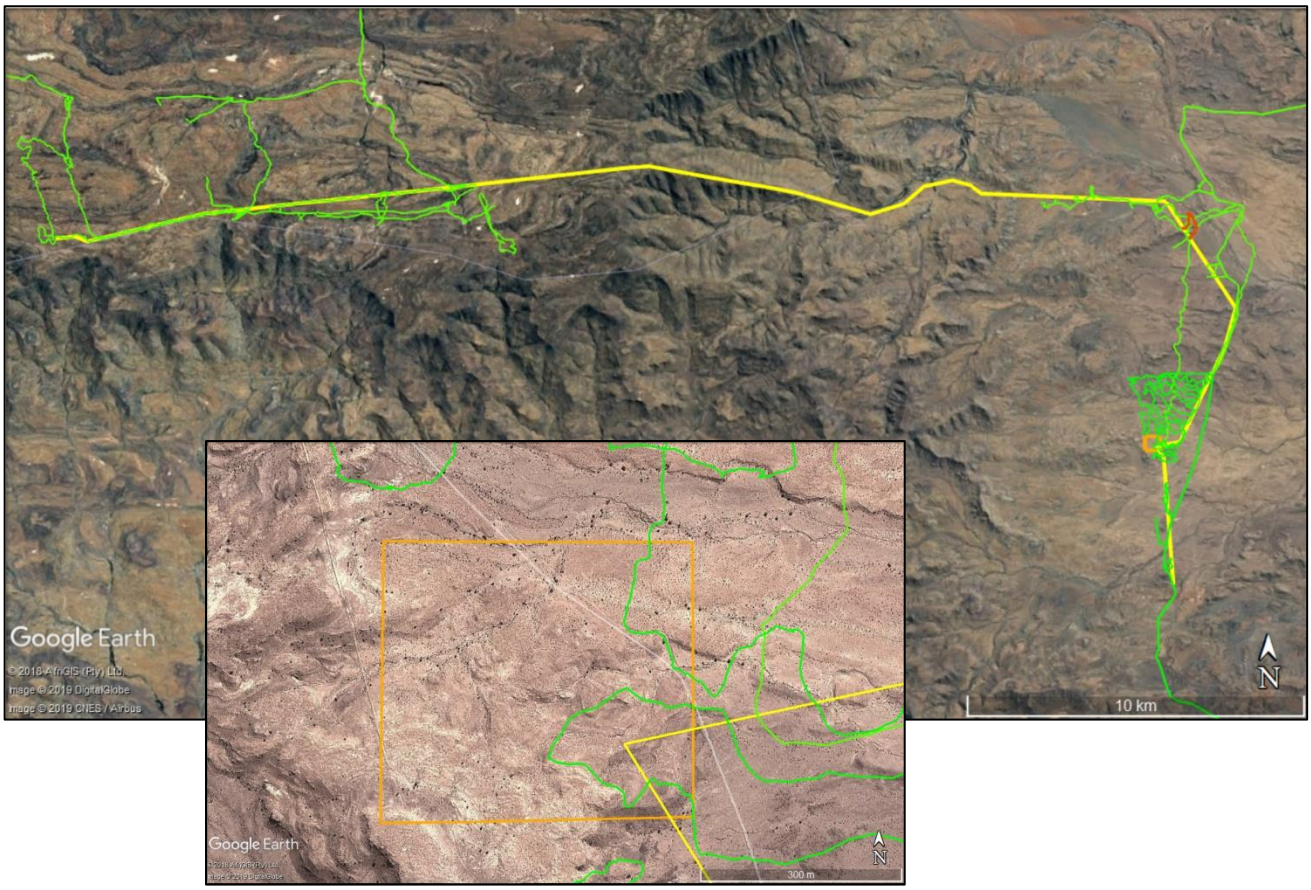


Figure 2: *Aerial view of the study area showing the proposed power line route (yellow line), substation location (orange polygon) and walk and drivepaths (green lines). The central portion was not surveyed. The inset shows the revised substation footprint.*

3.3. Impact assessment

For consistency, the impact assessment was conducted through application of a scale supplied by the CSIR.

3.4. Grading

Section 7 of the NHRA provides for the grading of heritage resources into those of National (Grade 1), Provincial (Grade 2) and Local (Grade 3) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade 1 and 2 resources are intended to be managed by the national and provincial heritage resources authorities, while Grade 3 resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. HWC (2012), however, uses a system in which resources of local significance are divided into Grade 3A, 3B and 3C. These approximately equate to high, medium and low local significance, while sites of very low or no significance (and generally not requiring mitigation or other interventions) are referred to as Not Conservation Worthy (NCW).

NBKB has no grading system in place but SAHRA (2007) has formulated its own system[1] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' and rated with an A (high/medium significance, requires mitigation), B (medium significance, requires recording) or C (low significance, requires no further action).

3.5. Assumptions and limitations

The study is carried out at the surface only and hence any completely buried archaeological sites or palaeontological occurrences will not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. Generally, however, archaeological material in the Karoo tends to be restricted largely to the surface.

For various reasons some parts of the project were not examined in the field:

- A 4.3 km long section above the escarpment (in Northern Cape) was not examined because it was remote and from aerial photography and the topography it seemed that the likelihood of significant finds would be extremely low;
- A 12 km long section on and running down to the base of the escarpment (in Northern Cape and Western Cape) could not be examined because the landowner did not provide consent for specialist site visits. Although much of this area is likely to be of very low archaeological sensitivity, the valley section may be more sensitive. The farm buildings are located in the valley and have not been seen and assessed by this author. This does limit the conclusions regarding visual impacts to heritage resources but archaeological impacts can be easily dealt with in the pre-construction phase; and
- A few short sections in the eastern part of the power line route and part of the substation footprint were not examined. The latter was because the footprint was altered due to environmental constraints after the specialist site visits. However, the amount of land seen in the surveys gives a good general understanding of the heritage environment.

Cumulative impacts can be difficult to assess accurately because of uncertainties as to what may or may not be constructed. A map of renewable energy projects was made available for the purpose of cumulative assessment and it is assumed here that each will have associated power lines and substations.

3.6. Consultation processes undertaken

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of an EIA which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA for the Northern Cape component of the project. Interested and affected parties (I&APs) would have the opportunity to provide comment on the heritage aspects of the project during the PPP.

However, in their response to the NID application, HWC did require comment from the relevant Western Cape municipality and the draft HIA was therefore submitted to the Laingsburg Municipality for comment. See Section 11 below.

[1] The system is intended for use on archaeological and palaeontological sites only.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is located in a predominantly natural landscape, although pockets of land could better be described as rural where farming occurs. The area is used predominantly for livestock grazing, but does lie within a promulgated REDZ and Power Corridor and many renewable energy facilities have been proposed in the area.

4.2. Site description

Because the areas above and below the escarpment are so different, they are described separately.

Atop the escarpment the study area is comprised of gently undulating hills. The vast majority is undeveloped land, but some small areas of agricultural land do occur in the wider area (the nearest to the power line route is about 1 km away). Although the terrain is often very rocky, the rocks tend to be flat (Figure 3). Small ridges do protrude in places though (Figure 4). Vegetation cover is usually low but, because of the slightly higher rainfall on the escarpment, it is fairly continuously present. In the river valleys there is somewhat denser bush (Figure 5). Although the rock is largely quite solid sandstone, there are places where dark shale bands occur which are eroding heavily (Figure 6). These are generally present on slopes or on the sides of incised valleys.

The central part of the study area spanning the provincial boundary could not be accessed. However, it is noted that the proposed distribution line route runs down an exposed 6 km long ridgeline from the edge of the escarpment into a river valley and then on across the plains.

Figure 3: *Flat rock slabs in the central part of the Northern Cape section.*

Figure 4: *A low rocky ridge in the central part of the Northern Cape section.*

Figure 5: *View up a river valley in the central part of the Northern Cape section showing the denser bush in the actual stream bed.*

Figure 6: *Weathering and eroding shale band in the side of a small river channel near the eastern end of the power line route.*

The easternmost part of the study area that lies within Western Cape was mildly undulating with stream beds of varying size but was much less rocky than the escarpment area (Figure 7). Low scarps occurred in places with the largest of these being in the region of 20 m high (Figure 8). The southern part of the study area is very flat and dominated by river floodplains (Figures 9 & 10). The main relief is a slightly higher-lying area to the west of the line where the substation would be built. The bulk of the visible bedrock in the Western Cape portion of the study area was highly weathered shale but the remains of more resistant rocks were often lying on the surface as gravel (Figures 11 & 12). Fine gravel tended to be widespread on the surface.

Figure 7: *View towards the south in the far eastern part of the study area. A small drainage line is marked by denser vegetation.*

Figure 8: *View towards the southeast from the top of a rocky scarp with river beds visible in the distance.*

Figure 9: *View towards the south from near the substation location showing a river floodplain. The clump of trees lies alongside a reservoir and wind pump. The large power lines are visible in the distance.*

Figure 10: *View towards the north from the very southern end of the power line route showing stream beds and gravel. The main gravel road through the area is visible at far left.*

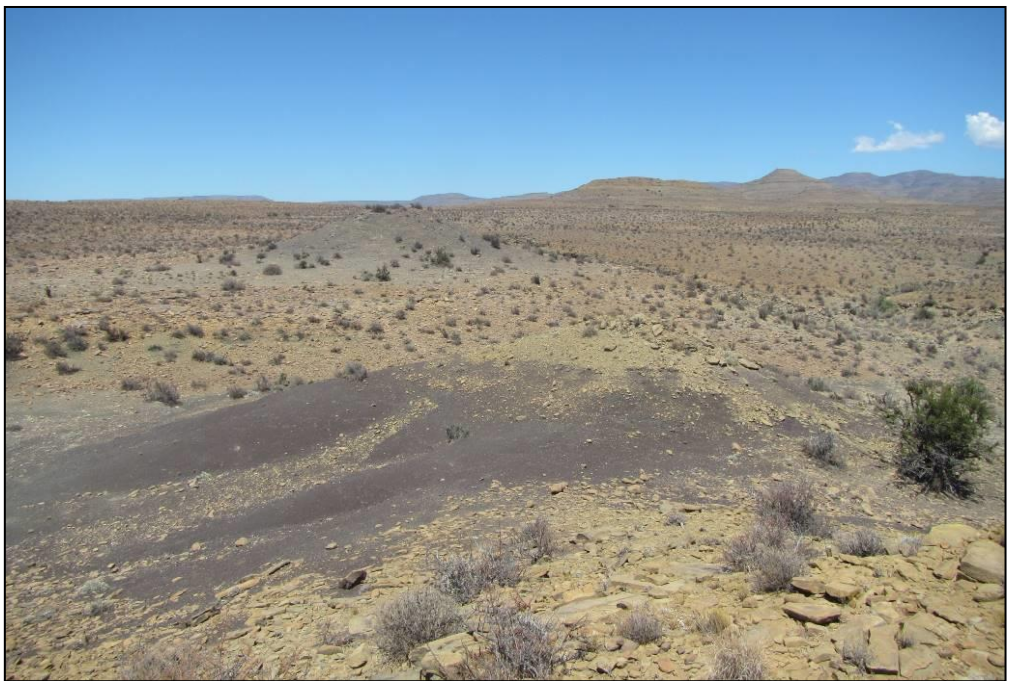


Figure 11: *View towards the southwest along a low rocky ridge in the eastern part of the study area showing the dark-coloured weathering shale overlain by the remnants of more resistant pale orange-coloured sandstone.*

Figure 12: *View towards the east across the original substation location. The new location is just to the northwest of this position (i.e. behind the camera and to the left).*

5. HERITAGE CONTEXT

This section of the report contains the desktop study and establishes what is already known about heritage resources in the vicinity of the study area. What was found during the field survey as presented below may then be compared with what is already known in order to gain an improved understanding of the significance of the newly reported resources. Findings from the 2017 surveys of this power line route (Orton 2017) are briefly mentioned but described more fully in Section 6 of the present report.

5.1. Archaeological aspects

Prior to the colonial incursion into the interior of southern Africa the Bushmen and, more recently, the Khoekhoen occupied the area. Very little archaeological research has been undertaken in the area, although a number of impact assessments have been carried out, especially in connection with proposed renewable energy facilities. Most surveys show that Stone Age material is generally quite sparse on the landscape, although scatters of Early (ESA), Middle (MSA) and Late Stone Age (LSA) material have been reported (Hart *et al.* 2010; Halkett & Webley 2011). Occasional small rock shelters have been recorded closer to Sutherland and well northwest of the present study area (e.g. Evans *et al.* (1985), Hart (2005), Orton & Halkett (2011)) with one having been excavated. This one yielded a typical LSA assemblage with small scrapers, thin-walled potsherds, ostrich eggshell beads and some *Nassarius kraussianus* beads. The latter are estuarine shells that must have been obtained from the coast.

A very important aspect of the pre-colonial archaeology of the area is the many stone-built *kraals* (livestock enclosures) that have been recorded in various areas. The vast majority are in the Seacow River valley to the east (Hart 1989; Sampson 1985, 2008), but two excellent examples of complex kraals have also been reported from the southern edge of Sutherland (Hart 2005) and from about 450 m south of the power line route in Northern Cape (Hart *et al.* 2010; Orton 2017). The first was a complex of 13 interlocking enclosures and the second had about 28 enclosures. A number of other examples are on record, largely from above the escarpment (Hart *et al.* 2010). Some had stone artefacts, red burnished, thin-walled pottery, and ostrich eggshell associated with them. Stone Age *kraals* are important sites and are as yet poorly understood.

Along the dry river beds at the base of the escarpment Hart *et al.* (2010) also identified sites which they thought were large Khoekhoe encampments situated among the Kameeldoring trees in the bottom of valleys. The sites contained thin-walled, burnished pottery, stone features, stone artefacts, grinding surfaces and graves, some of which have broken grinding stones on them. Also evident were discreet ash middens and animal bone. Hart *et al.* (2010) noted colonial period artefacts (19th century glass and ceramics) on some of the sites, possibly indicating continuous use of the area by Khoekhoe herders into the colonial period.

Although geometric rock art has been mapped by researchers across large swathes of South Africa, there is a gap in the distribution surrounding the study area (Orton 2013; Russell 2012; Smith & Ouzman 2004). Nevertheless, geometric rock art has been documented in the area. One site lies along the subject road near its western end (Orton & Halkett 2011) and the others are some 23 km and 29 km south of the road, just below the escarpment edge (Halkett & Webley 2011). Two sites contain geometric paintings, while the third is not discernible but may be a human figure.

Historical archaeology abounds in the area with many ruined stone-built structures being present (e.g. Hart *et al.* 2010; Halkett & Webley 2011; Kaplan 2009; Orton 2017). These include kraals, houses and other domestic features and often have artefactual material (broken ceramics and glass, metal items, etc) scattered about them. Occasionally a refuse midden is found alongside an old farmstead. These middens reflect the material remains of domestic life on the early frontier farms during the 18th and 19th centuries. Various other historical stone-built features include boundary walls, markers, cairns and beacons (e.g. Hart *et al.* 2010; Orton & Halkett 2011) as well as ruined military structures, such as those on Jakkalsvalley to the south of Sutherland (Orton & Halkett 2011).

5.2. Built environment and historical aspects

Various historical structures have been recorded in the area. Because many are ruined and in a state of disuse, they would generally fall into the category of archaeological resources rather than built environment heritage resources. The types of structures included here include:

- Farmhouses, outbuildings and farm workers dwellings occur widely in the region but, because of the size of the farms, are sparsely distributed. Some are built from dressed stone; and
- Dry stone *kraals* and boundary walls where these are well maintained/intact.

Hart *et al.* (2010) and Halkett & Webley (2011) recorded numerous graveyards, generally associated with homesteads and with abandoned settlements.

There are also many tracks which are likely to have their origins in the 19th century wagon routes between farms, although these are perhaps better regarded as elements of the cultural landscape.

5.3. Historical background

Schoeman (1986) has described the early settlement of the Roggeveld and Sutherland area from about 1750 onwards. The escarpment area, with its higher rainfall, was found to be good for small stock farming in summer but the extreme winter cold forced people down into the valleys and plains to the south. Initially, the European population remained small because many early loan farms were used merely as “stock posts” – the owners lived elsewhere and often had more than one loan farm. The early days of colonial settlement were conflict-ridden because indigenous groups, called “Boschiesman Hottentoten” (Khoekhoen and San/Bushmen) were unhappy about losing their traditional lands and attempted to force the Europeans to flee what can best be described as

'guerrilla warfare'. Livestock theft was rife and attacks on farmers and indigenous populations were commonplace. From the late 18th century commando groups (comprised of local farmers) were called up to attack the *kraals* of local Khoekhoe and Bushmen groups. Although they defended their positions with bow and arrow, the firearms of the framers generally resulted in many indigenes being killed (Schoeman 1986). These commandos were initiated in response to the so-called "Roggeveld Rebellion" of 1772 when many Khoekhoe labourers left their farms and banded together in response to a rumour that all Khoekhoen living in kraals would be killed (Penn 2005). They were defeated and the San and Khoekhoen were gradually driven northwards from the Roggeveld. By 1809 there was reported to have been only one Bushman *kraal* left in the area. Penn (2005:21) notes that "Without access to the resources on both sides of the escarpment, and the water of the escarpment itself, both pastoralists and hunter-gatherers were doomed; hence the desperate fighting of the 1770s, 1780s and 1790s. These were years of intense commando activity and Khoisan resistance."

The early 19th century saw an increase in permanent European settlement, although the farmers' main source of income was still small stock – wheat could only be grown with great difficulty in isolated and protected valleys and there was very little standing water and grazing suitable for cattle. The early settlers were responsible for the construction of the well-known stone corbeled houses on the Northern Cape (Kramer 2012). Three known corbeled houses occur between 8 km and 11 km from the proposed power line route.

Schoeman (1986) notes that during the early years of settlement in the Roggeveld, many of the Trekboers lived in grass huts or Matjies houses, or even in tents. The use of Matjies houses was reported as late as 1839. Attempts at constructing more permanent structures were inhibited by the lack of wood suitable for building. One technique that was often used to overcome this difficulty was to use drystone walling to half height and then construct a wooden framework to support a reed roof on top of it. These were tiny houses and were known as *Hartebeeshuise*. Sometimes they were made without the stone courses and looked like a tent made of vegetation. Examples were reported to the southwest of the study area below the escarpment by Almond (pers. comm. 2016 in Orton 2016).

During the South African War (a.k.a. Anglo-Boer War), the British forces built fortifications at a number of strategic passes through the Roggeveld. Two stone blockhouses guard a pass on the farm Gunsfontein (Discover Sutherland 2017). With the Boer leader Manie Maritz active in the Calvinia District, many young men from the Roggeveld joined the Boer cause. In 1901 there appear to have been some skirmishes in the vicinity of Skietfontein, a farm through which the Komsberg Pass runs.

6. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the project. The finds are mapped in Appendix 2. Table 1 provides a comprehensive list of the survey findings, but only selected examples are discussed in the text that follows. Note that the earlier surveys covered a wider area (Orton 2017) and only sites located within a 1 km wide corridor spanning the alignment have been recorded in the present report. In Western Cape, waypoints recorded for another project which has been discontinued have been included in the table. These lie to the north of the substation location and, because the revised substation site was not surveyed, they give a good indication of the heritage features expected to occur.

Table 1: *List of heritage resources recorded during the field surveys. Grades follow the system in use for each province as relevant. Note that in addition to the finds relevant to the present application area, finds for an abandoned second application in the same area are also included for the record.*

Waypoint	Co-ordinates	Description	Grade	Cultural significance
NORTHERN CAPE				
521	S32 38 23.2 E20 58 16.5	Small round stone structure overlooking a dam on high ground near the edge of the escarpment.	GP B	Low-Medium
522	S32 38 24.1 E20 58 16.4	Small rectangular stone structure overlooking a dam on high ground near the edge of the escarpment. There is also a small oven alongside it.	GP B	Low-Medium
523	S32 38 06.3 E21 01 02.4	Half an isolated lower grindstone found face up alongside a small tributary stream above a larger stream bed.	---	---
524	S32 38 10.1 E21 01 03.7	Small stone structure in a small, steep-sided river valley. Almost certainly a shepherd's hut. More intact than many other historical finds.	GP A	Medium
546	S32 38 09.9 E21 02 11.8	Pre-colonial kraal complex with numerous enclosures and stone-walled features (about 27 or 29 in total) scattered around and on top of a low rocky outcrop. A few Stone Age artefacts were found as well as a number of fragments of ostrich eggshell. A few recent items (liquor bottle and a shoe fragment) testify to more recent use of the area. Note that waypoints 528 to 553 inclusive were all at this kraal complex but that 546 is taken as an approximately central location for the site.	III A	High
554	S32 38 10.5 E21 02 19.8	Small stone structure perched on the edge of a scarp. Unknown function but perhaps a lookout point?	GP C	Low
555	S32 38 09.2 E21 02 21.1	Small semi-circular stone structure with entrance to the east. There are also a few other stone features close by.	GP B	Low-Medium
576	S32 38 42.8 E20 54 53.4	Small piled stone structure of about 1.5 m by 3 m. Two unburnt and one burnt bone fragments were only associated materials present.	GP C	Low
580	S32 37 57.6 E21 02 11.6	An isolated flake. Seems fairly fresh and is likely LSA.	---	---
581	S32 37 56.4 E21 01 54.5	Point along old fence line which employed long, thin rock slabs as fence poles accompanied by small, locally-sourced sticks. Fence is parallel to proposed power line.	GP C	Low
582	S32 37 58.1 E21 01 35.9	Point along old fence line which employed long, thin rock slabs as fence poles accompanied by small, locally-sourced sticks. Fence is parallel to proposed power line.	GP C	Low
583	S32 37 59.4 E21 01 15.9	Point along old fence line which employed long, thin rock slabs as fence poles accompanied by small, locally-sourced sticks. Fence is at 90 degrees to proposed power line.	GP C	Low
584	S32 38 22.0 E20 59 32.5	Isolated 19th century refined white earthenware fragment. Note that Halkett & Webley (2010) reported three graves here but none were seen – there are loose clusters of natural stones overlying weathered bedrock.	---	---

Waypoint	Co-ordinates	Description	Grade	Cultural significance
585	S32 38 23.3 E20 59 32.7	Loosely-packed stone cairn downslope from overhang with stone-walled structure inside it.	GP C	Low
586	S32 38 24.6 E20 59 30.8	Stone-packed structure underneath a rock overhang. The rock was sourced from the roof collapse and subsequent collapse has damaged part of the site.	GP B	Low-Medium
587	S32 38 10.6 E21 02 06.2	Small, rectangular structure built against a rock outcrop. From its construction (of flat slabs) and preservation is must be historical.	GP B	Low-Medium
588	S32 38 10.6 E21 02 07.0	Semi-circular stone walling along the edge of and extending partly away from a rock scarp. Very close to the small structure at 587. It is made from rounded rocks and piled in a manner more similar to pre-colonial walling. It may be historical or it may relate to the pre-colonial kraal cluster located 50 m to the east.	GP C	Low
Site 51	S32 37 52.3 E21 04 23.1	Historical circular kraal with associated glass and ceramics recorded by Hart *et al.* (2010). Given Grade IIIA (on WC system) by them.	IIIA	High
WESTERN CAPE				
485	S32 41 02.5 E21 15 45.0	A very tiny "dam" created by placing a single line of about 15 stones across the lowest point of a tiny pan. Mud was probably placed along the stones to trap the water in the pan.	NCW	Very low
486	S32 41 47.3 E21 15 51.1	A stone feature that may be either a circle or a semi-circle. No obvious associated material in the vicinity.	NCW	Very low
488	S32 40 15.2 E21 16 42.2	A section of historical road alignment left behind after the main road was straightened.	NCW	Very low
489	S32 39 17.7 E21 17 02.4	Isolated (probable) lower grindstone in a pan.	NCW	Very low
492	S32 38 16.5 E21 15 59.4	Rock art site with eight finger-painted vertical stripes applied to three different 'canvases' (small faces on a very irregular surface). No associated artefacts seen and there is no proper rock shelter. The site overlooks a river valley.	IIIA	High
493	S32 38 19.2 E21 16 00.7	A small stone structure measuring 1.2 x 1.6 m and about 0.8 m high. It lies on the top of a scarp, very close to the edge. Slabs create a roof with an interior far too small for human use.	IIIC	Low
		Waypoints 497-500 & 601-608 are all part of a single historical farm complex, while the track marked by 609-612 is no doubt directly related to it. The entire complex is graded as a whole and mapped as waypoint 497.		
497	S32 38 08.8 E21 15 21.5	Elongated stone feature.	IIIA	High
498	S32 38 09.2 E21 15 21.1	Small one-roomed stone house with a pitched roof and four rooms (roofs all missing) added to it on the west and south. Two of the rooms on the west have curved walls – an extremely unusual feature. Also two paved surfaces on the north and east sides of the house. Main house has had roof trusses and metal roof sheets added in more recent times (perhaps early-mid-20th century) to allow the structure to continue to be used. Internal plaster was probably also added at this time but is peeling off. Unworked / minimally worked wooden		

Waypoint	Co-ordinates	Description	Grade	Cultural significance
		beams used on roofs of added rooms. It is notable that there is no dump in the vicinity of the house and outbuildings. However, there are many fragments of glass, ceramics and metal (including many car parts) scattered in low density over the general area. Much of this material is mid-20th century in age but there is definitely some 19th century material. A fragment of a cobalt blue bottle has "Cape Town" embossed on it. There are also many stone-dressing flakes in the area and many of the blocks in the structures are dressed stones.		
499	S32 38 09.4 E21 15 19.1	A circular '*trapvloer*' of about 7 m diameter with standing stones around its margin.		
500	S32 38 07.8 E21 15 19.8	A second dwelling house with two rooms, both of which have curved walls. Each room has a very small '*muurkas'* (more of a shelf) built into it. A low stone wall encloses a stoep area on the east side and a small stone pillar stands on one side of the entrance to this stoep area. Unworked / minimally worked wooden beams used on roof. Also a scattering of glass, ceramics and metal (again including a few presumed car parts) around the general area.		
601	S32 38 07.4 E21 15 20.1	A small, circular stone feature of about 2 m diameter.		
602	S32 38 08.0 E21 15 20.1	A packed stone feature of about 2 x 4 m.		
603	S32 38 09.1 E21 15 20.5	A small, circular stone feature of about 2 m diameter but slightly taller than 501.		
604	S32 38 09.1 E21 15 22.5	The remains of a fenced kraal that has several standing stone fence posts but no sign of any wire fencing. Approximately 15 x 17 m in size.		
605	S32 38 11.2 E21 15 21.8	An assortment of scattered slabs, rocks and one standing stone fence post on the river floodplain across the river from the house.		
606	S32 38 12.5 E21 15 21.3	A small, low stone-lined dam with a line of stones of indeterminate function very nearby. The dam is under thorn trees so size not determined.		
607	S32 38 13.1 E21 15 24.5	A rectangular stone foundation of about 4 x 8 m. Running towards the north is a series of U-shaped (worked) slabs planted on edge. Their function is unknown.		
608	S32 38 11.6 E21 15 25.9	A probable grave which has been partially excavated by an animal. This has resulted in collapse of some of the stones making it difficult to be certain of whether it is a grave. But it seems very likely.		
609	S32 38 11.9 E21 15 26.2	These points lie along an ephemeral track that runs along the base of the hill past 509 then turns eastwards past 510 and 511 then fading out at 512. It appears from aerial photography to continue towards the north east.	IIIC	Low
610	S32 38 07.4 E21 15 30.6			
611	S32 38 06.4 E21 15 34.2			
612	S32 38 05.9 E21 15 36.8			
613	S32 38 29.7 E21 15 50.1	Small stone cairn.	NCW	Very low
		Waypoints 614-618 are all part of a single historical farm complex. The entire complex is graded as a whole and mapped by waypoint 614.		

Waypoint	Co-ordinates	Description	Grade	Cultural significance
614	S32 37 50.2 E21 14 08.8	A small, rectangular stone one-roomed house of beautifully dressed blocks. It has a door facing east, a window facing west and a small '*muurkas*' (more of a shelf) in each end wall. It is 2.5 x 2 m. There is a cleared area around the house with stones pushed loosely to the edge. There are various loose piles of stones or 'features' around the edge of the cleared area.	IIIA	High
615	S32 37 49.3 E21 14 08.7	A rectangular stone foundation of about 2 x 3 m.		
616	S32 37 49.0 E21 14 07.6	A 2.5 x 2.5 m possible grave or a collapsed structure. One standing stone 'post' might be a headstone and would be in position for one burial in a double grave but it's position would mean the grave is facing north instead of east. The stones are not well-ordered suggesting it to more likely be a collapsed structure. It also lies on a rocky slope which would not be suited to the excavation of a grave. The stones are not deep enough for a stone-packed surface grave. There is a second stone feature some 10 m to the southwest.		
617	S32 37 50.8 E21 14 07.1	A '*waterput*' excavated into the bedrock. It is 2.5 m in diameter and about 4 m deep.		
618	S32 37 51.1 E21 14 07.6	A small, low stone-lined dam of about 9 x 10 m.		
619	S32 38 05.6 E21 13 15.0	A dam across a small river valley with a stone-packed wall of about 1 m high.	IIIC	Low
620	S32 39 14.0 E21 16 31.8	A pile of stones, possibly a cairn of sorts.	NCW	Very low
1771	S32 40 49.9 E21 14 52.9	A light scatter of MSA artefacts located on a small flat-topped koppie and overlooking stream beds. The artefacts are made on an orange-patinated rock that is assumed to be a hornfels.	NCW	Very low
1772	S32 40 52.5 E21 14 52.7	A light scatter of MSA artefacts located on the north-western edge of a larger, flat, raised area overlooking stream beds. The artefacts are made on an orange-patinated rock that is assumed to be a hornfels.	NCW	Very low
1773	S32 40 52.2 E21 14 53.2	An isolated lower grindstone found face-up along the northern edge of the same raised area as waypoint 1772.	NCW	Very low
1774	S32 40 52.6 E21 14 58.5	A light scatter of MSA artefacts located on the eastern side of the elevated area mentioned in waypoint 1772. The artefacts are made on a grey rock.	NCW	Very low
1775	S32 41 03.3 E21 15 00.3	A light scatter of MSA artefacts located on the south-eastern edge of a elevated area overlooking stream beds. The artefacts are made on a grey rock.	NCW	Very low
1776	S32 41 16.3 E21 15 08.5	A small scatter of dark brown wine bottle fragments, likely all from a single bottle but probably not the whole bottle present. It is located just east of a small pan. There are also rare MSA artefacts in this general area.	NCW	Very low
1777	S32 41 31.3 E21 15 29.2	A small, collapsed cairn of small stones gathered in a silty area. Seems highly unlikely to be a grave covering considering the small pile.	NCW	Very low

Waypoint	Co-ordinates	Description	Grade	Cultural significance
1778	S32 40 53.8 E21 15 14.5	A light scatter of MSA artefacts located on an elevated area overlooking a large river bed. The artefacts are made on a grey rock.	NCW	Very low
1779	S32 40 57.4 E21 15 15.1	A light scatter of MSA artefacts located on an elevated area overlooking a large river bed. The artefacts are made on a grey rock.	NCW	Very low
1780	S32 41 07.2 E21 15 48.6	An isolated enamel pot with a handle. It is squashed and rusted.	NCW	Very low
1782	S32 43 00.0 E21 15 39.4	A small stone-walled dam located alongside a wind pump. Has been superseded by a small concrete reservoir.	IIIC	Low
1783	S32 42 43.1 E21 15 30.5	A dolomite slab with several marks on it indicating someone chopping something on it. Age presumed to be historical.	NCW	Very low
1784	S32 42 43.0 E21 15 31.8	A dolerite slab with some very light scratches on it. Impossible to tell what the scratches represent but presumably some sort of composition. Age presumed to be historical.	NCW	Very low
1785	S32 42 43.5 E21 15 34.1	A dolomite slab with a historical engraving featuring a circle with dots in it, a “Q” and an “H”. Age presumed to be historical.	IIIB	Medium
1786	S32 42 28.9 E21 15 33.3	An ephemeral scatter of quartzite artefacts on high ground overlooking a wide, sandy floodplain.	NCW	Very low
1787	S32 40 48.9 E21 15 53.6	A stone cairn (now more like a cluster of rocks) that sites above weathered bedrock (i.e. definitely not a grave).	NCW	Very low
1788	S32 40 48.0 E21 15 38.0	A small stone-walled dam built in a small stream bed against a hill. There is what looks like an old borehole next to it which may have once had a wind pump above it.	IIIC	Low
1789	S32 41 05.2 E21 15 58.3	An isolated fossil bone. Looks like a rib of a large animal.	See palaeo report	
1790	S32 40 57.4 E21 16 15.7	Two green wine bottle fragments.	NCW.	Very low

6.1. Archaeology

Stone Age archaeological resources were found to be rare throughout the study area. Occasional isolated stone artefacts attributable to the background scatter were found in places including three lower grindstones. Two of the latter were found above the escarpment close to streams with one of them being very large and featuring a prominent groove indicative of extensive use (Figure 13). None of the grindstones was accompanied by any other visible artefacts. Other isolated artefacts, generally flakes, were found to be more common on the plains below the escarpment, although even so, only a handful were seen during four days of survey there (Figure 14). A small, ephemeral scatter of stone artefacts was located along the power line route at waypoint 786 to the south of the proposed substation (Figure 15). It was on a raised area overlooking a stream. Other similar scatters were found in similar locations in a nearby area examined for the discontinued project showing that there is a pattern of small sites on higher-lying land between streams. The apparent absence of prepared platforms and the generally very limited patination suggests that they are more likely to date to the LSA than the MSA.

Figure 13: *Isolated grooved lower grindstone found alongside a stream at waypoint 515 in the western part of the study area. It is approximately 60 cm long and 37 cm wide.*

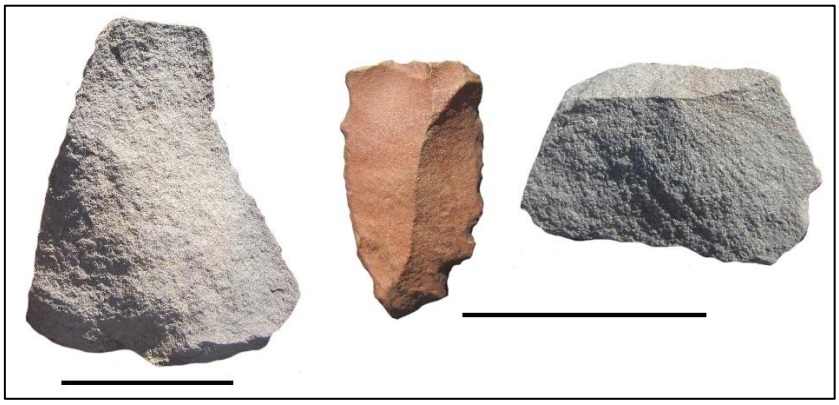


Figure 14: *Isolated flaked stone artefacts from below the escarpment. Scale bars are both 5 cm long. The central artefact is a notched MSA flake, while the other two are undiagnostic.*

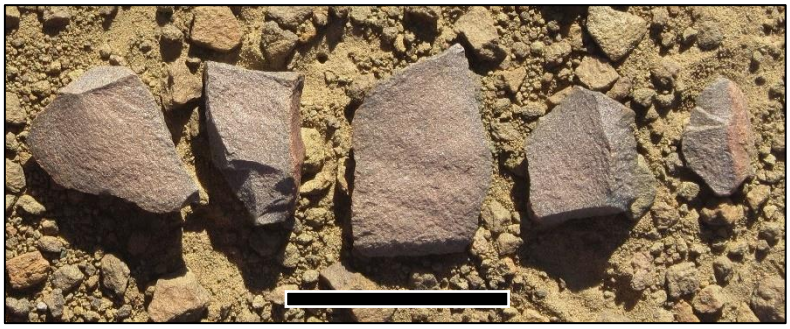


Figure 15: *Artefacts from an ephemeral scatter of quartzite flakes on high ground overlooking a steam bed.*

Only two significant Stone Age sites were found. The first, located in Northern Cape, was a complex of stone-walled kraals at waypoint 546. The complex does not lie along the power line alignment but, importantly, is bisected by one of the access roads in the area. Figures 16 to 19 show views of some of the individual enclosures. Altogether there were about 27 enclosures or stone-walled features. Because of its importance it was mapped carefully (Figure 20).

Figure 16: *View of a large enclosure on the east side of the rock outcrop.*

Figure 17: *A very small enclosure on the northeast side of the rock outcrop.*

Figure 18: *Two enclosures, one very large, on the north-western side of the outcrop.*

Figure 19: *An enclosure on the top of the rock outcrop.*

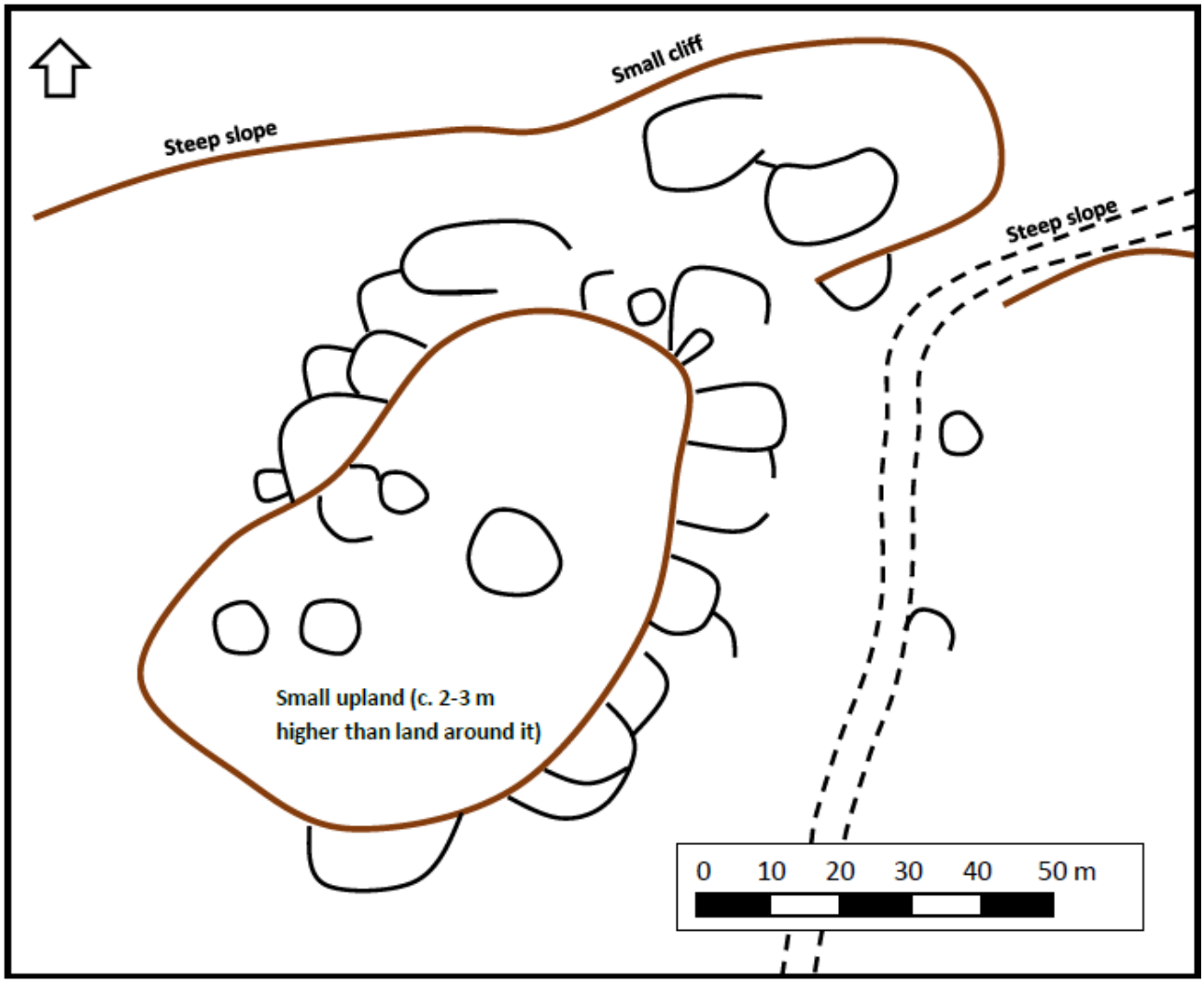


Figure 20: *Plan of the kraal complex at waypoint 546 showing topographic features in brown and stone walling in black. The double dashed lines indicate the position of the current access road which takes advantage of a break in the scarp.*

Careful examination of the substrate revealed very few cultural materials; eight ostrich eggshell fragments, five quartzite flakes, one quartzite core, one quartz flake and one quartz chunk were the only Stone Age items found. These sixteen items were found spread over a total of eight locations on the site. Also present, and located together on the eastern edge of the outcrop closest to the road, were the sole of an old shoe and a piece of a liquor bottle, signs that the area was used in more recent times as well. The walls of the complex are made from piled stone which is what differentiates them from historical kraals and stone features which are made from packed stone. It is positioned on the crest of a north-facing scarp in a prominent position overlooking the plains to the north (Figure 21).

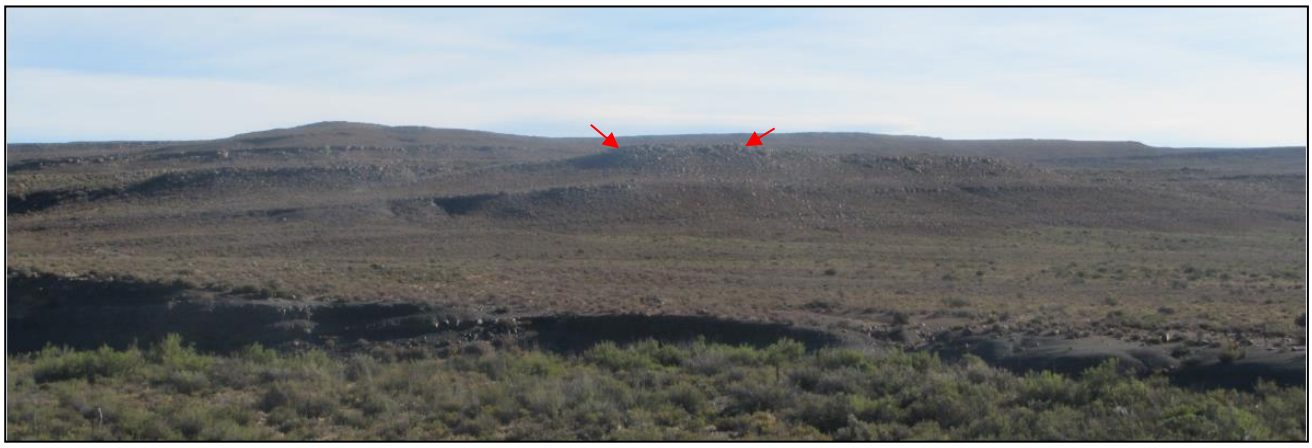


Figure 21: *View towards the south showing the location of the Stone Age kraal complex. The skyline in the background is the crest of the escarpment.*

The second important Stone Age site was a small rock art site located at the foot of the escarpment in Western Cape. Because the imagery is comprised of a series of finger-painted red lines, it is classed as a geometric rock art site (Figure 22). Finger-painted smear/lines are one of the categories of geometric art identified by Eastwood and Smith (2005). A key element of geometric art is that it tends to be found in non-inhabitable shelters overlooking water sources. The present site overlooks a riverbed and has neither a flat base that would allow occupation nor an overhang that would offer shelter from the elements (Figure 23).

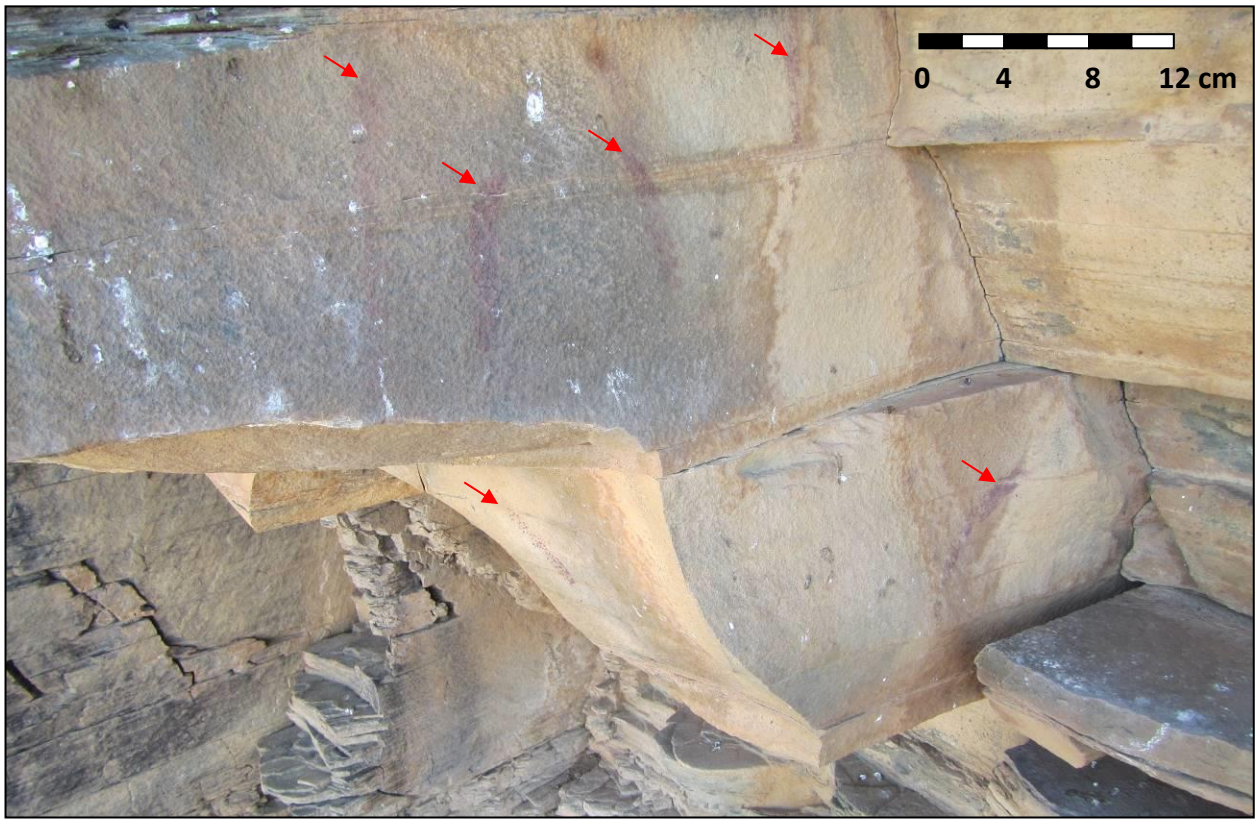


Figure 22: *View of the main painted area with the upper end of each finger smear identified by red arrows. Two further smears lie out of view to the right.*

Figure 23: *View towards the south of the low cliff line on which the geometric paintings were located (waypoint 492). The red arrows indicate the approximate positions of the finger-painted smears.*

Also in Western Cape and along the southernmost section of the power line route a small rock outcrop capping a low, 90 m long rise was found to have three marked stones on it. These included a rock that had been used as a chopping block at the western end of the rise (Figure 24), another with an engraving at the eastern end (Figures 25 & 26), and a third in between with very faint scratches on it (they made some sort of composition but this could not be discerned). All are historical.

Figure 24: *The chopped stone at waypoint 1783.* ***Figure 25:*** *The engraved rock at waypoint 1785.*

Figure 26: *Close-up of the engraving at waypoint 1785.*

Historical archaeological features were fairly common in the broader study area with several found close to the power line route. These features included small, isolated stone features like cairns (Figures 27 & 28), small dams (Figure 29), and various ruined structures.

Figure 27: *A loosely-packed stone cairn on a rocky ridge at waypoint 613.*

Figure 28: *A loosely-packed stone cairn built on bedrock at waypoint 1787.*

Figure 29: *A small stone-walled in-stream dam at waypoint 1788.*

A number of small, usually isolated and very low structures were found above the escarpment in Northern Cape. These may well relate to shepherds constructing small shelters for themselves. At waypoint 576 a small, isolated stone structure with tumbled walling retained enough integrity to see that it had been packed in the traditional historical style (Figure 30). Three fragments of bone, one of them burnt, were found there. A more formal but still very small structure formal was a stone hut with a doorway that was located in a small but pronounced river valley close to a small waterfall which no doubt provided water during wetter times (Figure 31).

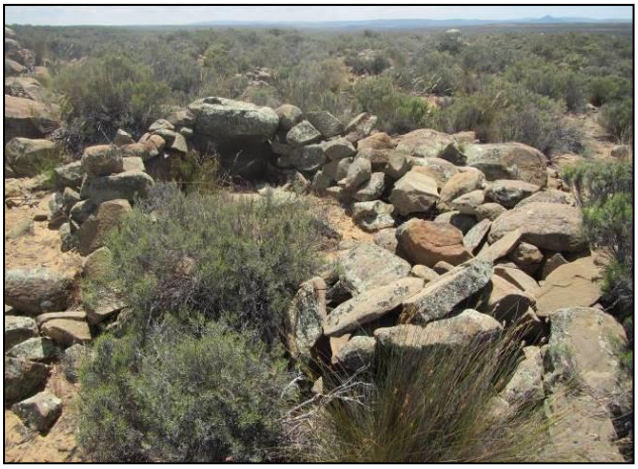


Figure 30: *A small oval structure standing in the open away from any landscape features at waypoint 576.*

Figure 31: *View of the south face and entrance of the small stone hut at waypoint 524.*

The most impressive historical archaeological sites were located on the farm De Molen 5/2 below the escarpment in Western Cape. Here there was a small historic farmstead as well as a smaller outpost. The main farmstead was built on the edge of a stream bed and had a number of features. There were two houses that no doubt had their roots deep in the 19th century (Figures 32 & 33). Survey diagram 1589/1861 indicates that farm De Molen 5 was first surveyed in 1860, but no structures are indicated (this does not mean there were none as they are only sometimes marked). Portion 2, then named 'Chreswell', was subdivided off in 1930 but again no structures were marked. These ruins are unusual because of the use of curved stone walling in them, one exclusively and the other in conjunction with straight walls. The main house has an iron roof on it that was a later addition as evidenced by its supporting joinery. The remaining rooms of both structures have a number of rough beams present which have largely collapsed with time. These beams are really just unworked tree trunks.

The main house has a paved stoep area to the east that overlooks a small track leading down to the river bed below. The north side of the house where the entrance lies also has a paved area. Both paved areas are supported by a low stone retaining wall. The house is comprised of a main rectangular structure with four added rooms. The smaller house had two linked rooms and a small enclosed courtyard on its east side where the entrance lay. Interestingly, this structure had two small '*muurkaste'* built into its walls.

Artefactual material was thinly spread over much of the surrounding area but nowhere was there anything resembling a dump. What material there was seemed typical of the late 19th and early 20th centuries and included blue glass, small clear medicine bottles, sponge printed refined white earthenware, a fragment of a cast iron *'potjie'*, the handle of a (probably) nickel silver fork and a spoked motor car wheel. The fork handle was inscribed with "WT&S" which denotes the company

“William Tay and Sons” who seem to have been in operation during the first third of the 20th century (Dognose n.d.).

Nearby and above the stream was a fairly well-preserved threshing floor (Figure 34), while within the stream floodplain a few stone features were noted. These latter included loose clusters of rocks that no doubt were once arranged differently, a set of upright elongated rocks that once formed fence posts for a stock enclosure, a stone-lined reservoir, a foundation, and a set of rocks that may have held a pipe (Figure 35).

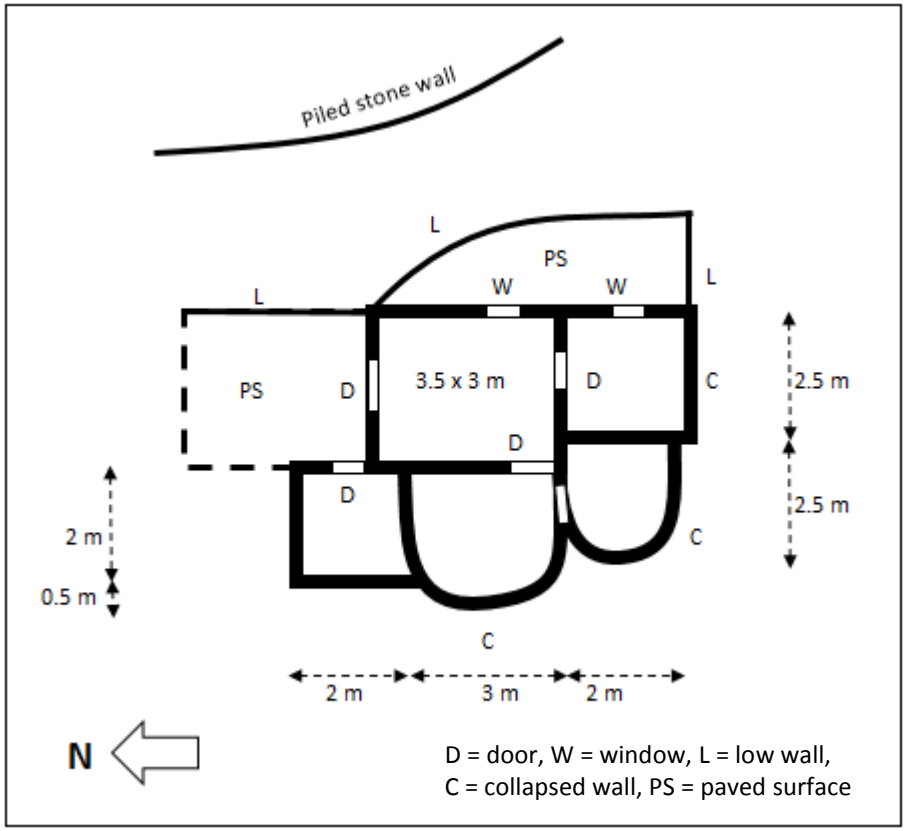


Figure 32: *Plan of the ruined stone-walled house at waypoint 498 with (A) a view of the entrance and north-eastern corner, (B) View of the south-western corner of the site showing the curved walling, (C) the east-facing window in the central structure, and (D) the north-facing doorway in the central structure. Not to scale but approximate measurements are indicated.*

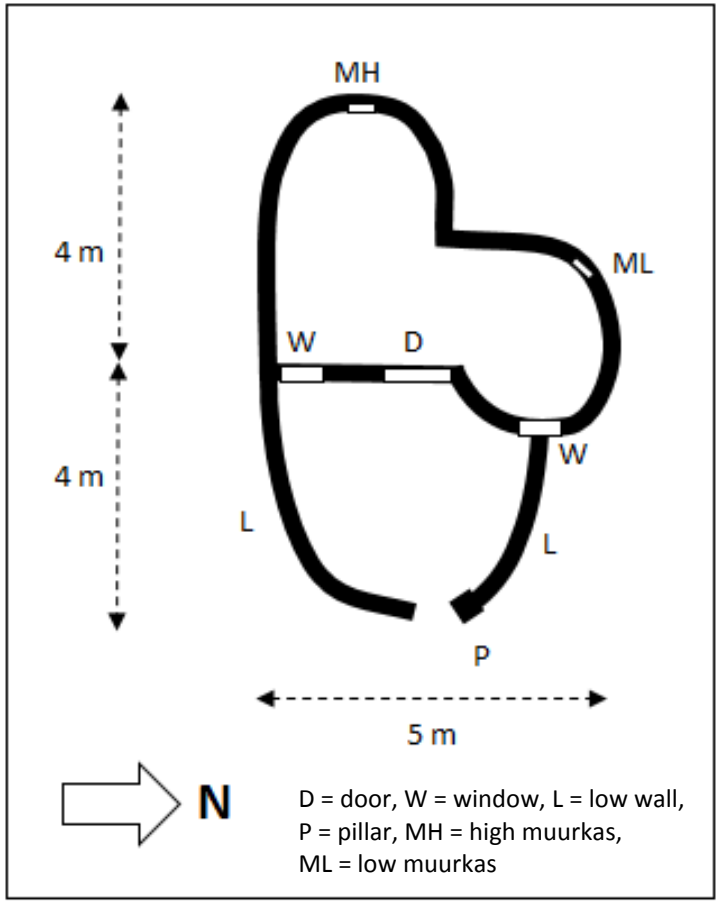


Figure 33: *Plan of the ruined stone-walled house at waypoint 500 with (A) a view towards the west of the entrance, (B) a view towards the south of the northern lobe showing remaining roof 'beams', (C) a view of the high 'muurkas' in the western lobe and (D) a view of the east-facing window with wooden planks and sticks in the southern lobe. Not to scale but approximate measurements are indicated.*

Figure 34: *View towards the north of the threshing floor with the lobed structure (from Figure 33) visible in the background.*

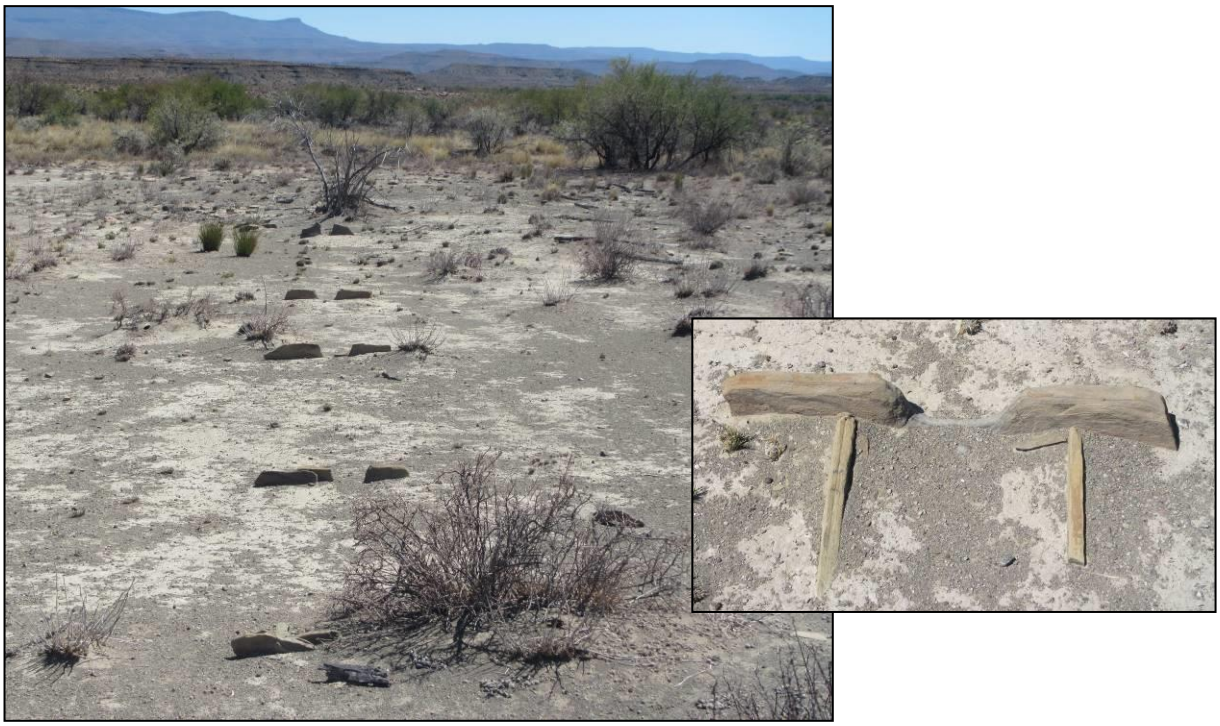


Figure 35: *A set of stones that may have held a pipe or similar.*

Further to the west lay a smaller ruined complex, perhaps an outpost of the one just described. It had a single-roomed rectangular structure with similar unworked roof beams. There was a cleared area and various piles of rocks around the structure and, further away, a large grave-like feature (but almost certainly not a grave due to its size and location over bedrock), a stone-lined reservoir and a '*waterput*' (Figure 36).

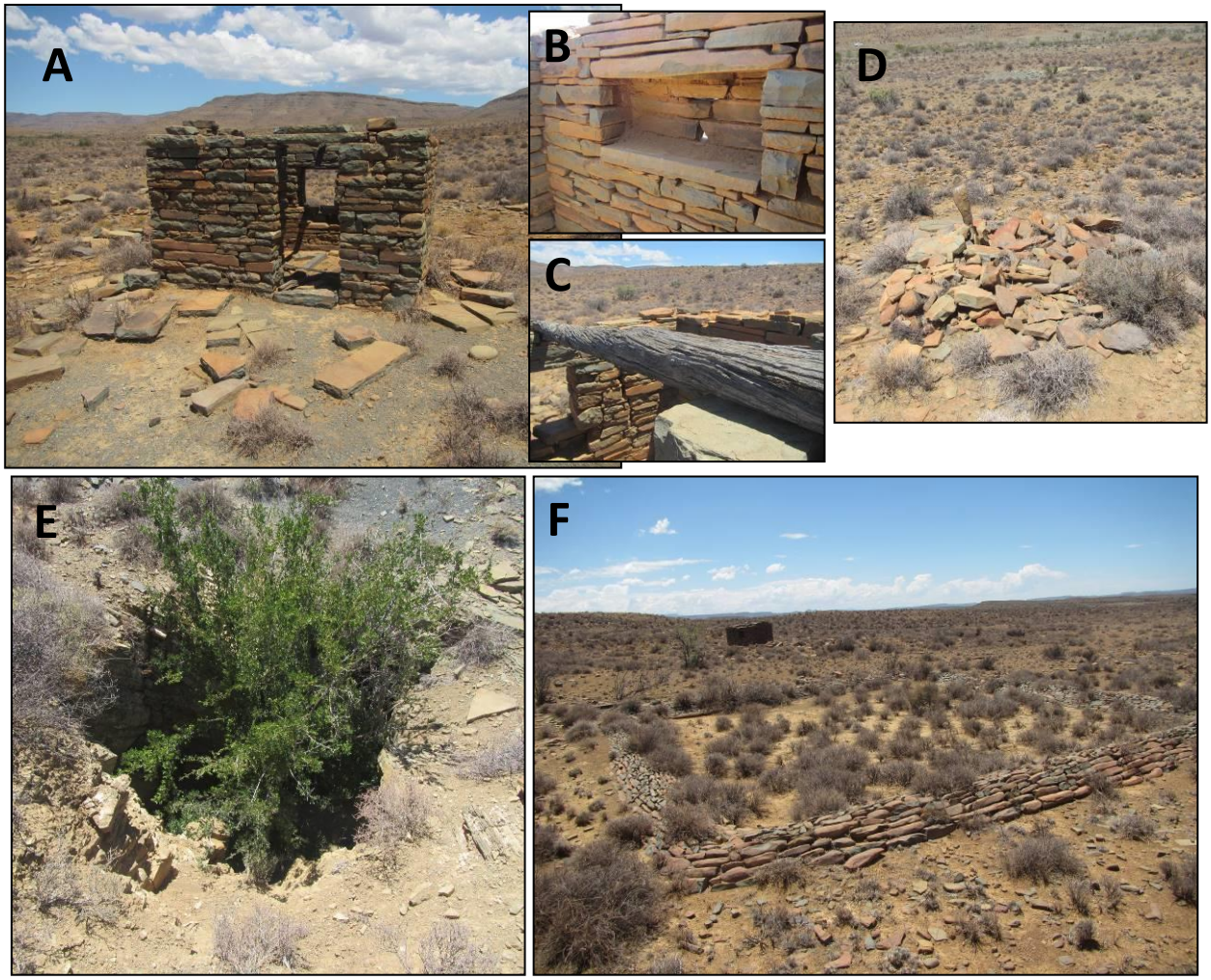


Figure 36: *The complex at waypoint 614; (A) shows the house, (B) a muurkas, (C) a roof beam, (D) the stone pile at waypoint 616, (E) the waterput at waypoint 617 and (F) the stone-lined reservoir.*

6.2. Palaeontology

A specialist palaeontological study was carried out by Dr John Almond (2019) and is included as Appendix 3 of the present report.

Almond (2019:1) reports that the study area "is entirely underlain by continental sediments of the Abrahamskraal Formation (Lower Beaufort Group) of Middle Permian age. This fluvial and lacustrine succession is generally assigned a high palaeontological sensitivity due to its rich fossil biota including pareiasaur reptiles, a wide range of therapsids, fish, amphibians, petrified wood and other remains of the *Glossopteris* Flora as well as trace fossils and microfossils. The Palaeozoic sedimentary bedrocks are extensively covered by Late Caenozoic superficial sediments (*e.g.* scree, gravelly soils) that are usually unfossiliferous."

Despite finding a few interesting fossils, including some blocks of petrified wood, a number of tetrapod burrows, and an articulated post-cranial skeleton, Almond (2019) has considered the study area to be of generally low sensitivity because he located no important fossils along the route and in many areas the surface (and any potentially fossiliferous bedrock) is covered by a large amount of superficial sediment.

6.3. Graves

No graves were found close to the power line route.

6.4. Built environment

A number of farm buildings were seen in the general vicinity of the study area, generally while driving into the study area, but most lie well away (generally more than 1 km) from the proposed routes (see Orton 2017). There are two exceptions. At Waterval, above the escarpment, the farmhouse is 1.03 km from the powerline. It is a humble vernacular structure older than 60 years and in reasonable condition (Figure 37). The second exception is the farm buildings on Rheebokkenfontein at the base of the escarpment. The owner would not allow access and, as such, no assessment of the structures is possible.

Figure 37: *The Waterval farmhouse.*

6.5. Cultural landscape

Winter and Oberholzer (2013) regard the escarpment as a significant natural landscape at the local level. It is a very extensive landscape extending for many hundreds of kilometres through central South Africa, often providing very long and aesthetically pleasing views which afford a cultural aspect to its significance. Figures 38 and 39 show two contrasting views from the top and bottom of the escarpment respectively. It can also be regarded as a cultural landscape, perhaps not so much in the regular sense of a 'landscape shaped by man' but in the opposite way where we find a landscape that has determined how and where human settlement and activities have taken place. Farmsteads are relatively few and far between, often tied to natural water sources and the landscape, although best described as a rural one, frequently has a strong feeling of emptiness and remoteness. It is used almost exclusively for small stock grazing and the many small historic stone features scattered across the landscape are indicative of this use in times gone by. In some remote areas the only indicators of human intervention for many kilometres are occasional fences and vehicle tracks.

Figure 38: *View from the crest of the escarpment towards the south into Western Cape. The edge of the escarpment and the provincial boundary are at the fence line in view. The power line would pass about 200 m north of this point (i.e. behind the camera).*

Figure 39: *View towards the southeast in the eastern part of the study area showing the typical landscape below the escarpment. It is comprised largely of plains and low hills.*

It is pertinent to note, however, that this landscape will not be pristine for much longer because the present study area falls within a declared REDZ (Komsberg) and many other renewable energy facilities have been proposed here. In addition, the study area falls within the Central Power Corridor that was gazetted in February 2018 following the completion of the Electricity Grid Infrastructure Strategic Environmental Assessment commissioned by the DEA. This will mean that wind turbines and power lines will comprise a new layer on this landscape, the strongest anthropogenic layer yet.

6.6. Visual impact assessment

Holland (2017) has assessed the visual impacts to the landscape from the slightly shorter original power line route. Due to his unavailability to update the assessment, an addendum considering the

addition 4 km length of powerline and the substation has been prepared by Masson (2019). Both reports are considered here but the new viewshed prepared by Masson (2019) is used. Figure 40 shows the visual exposure map (viewshed) for the proposed power line. Note that because the powerline will be taller than the substation, it is visible over a larger area and the substation viewshed would be within that for the powerline (a viewshed specific to the substation can be consulted in Masson (2019: fig. 4-4).

Holland (2017: table 1-2) notes that "the landscape has a rural-agricultural character with a strong sense of remoteness and potential for views valued for their scenic qualities. It is moderately sensitive to the proposed electrical infrastructure which may reduce the sense of remoteness and the potential for scenic views." Sensitive visual receptors are largely farm houses and outbuildings but the majority are below the escarpment and viewers would generally not see the powerline in silhouette due to the escarpment being a backdrop. From a heritage point of view, the Waterval homestead (above the escarpment in NC) is a heritage structure but Masson (2019) shows that it lies within an area of low-medium visibility. It is also relevant to note that, due to its east-facing aspect, views of the power line from the front door would be far longer than 1 km. Due to access restrictions, it is unknown whether heritage structures occur at Rheebokkenfontein (in WC). Citing Holland (2017), Masson (2019) notes that the power line would pass within 600 m of the farmhouse and 320 m from other structures. The present author, however, using Google Earth, finds no structures within 500 m of the line with the main farm house being some 720 m from it[2].

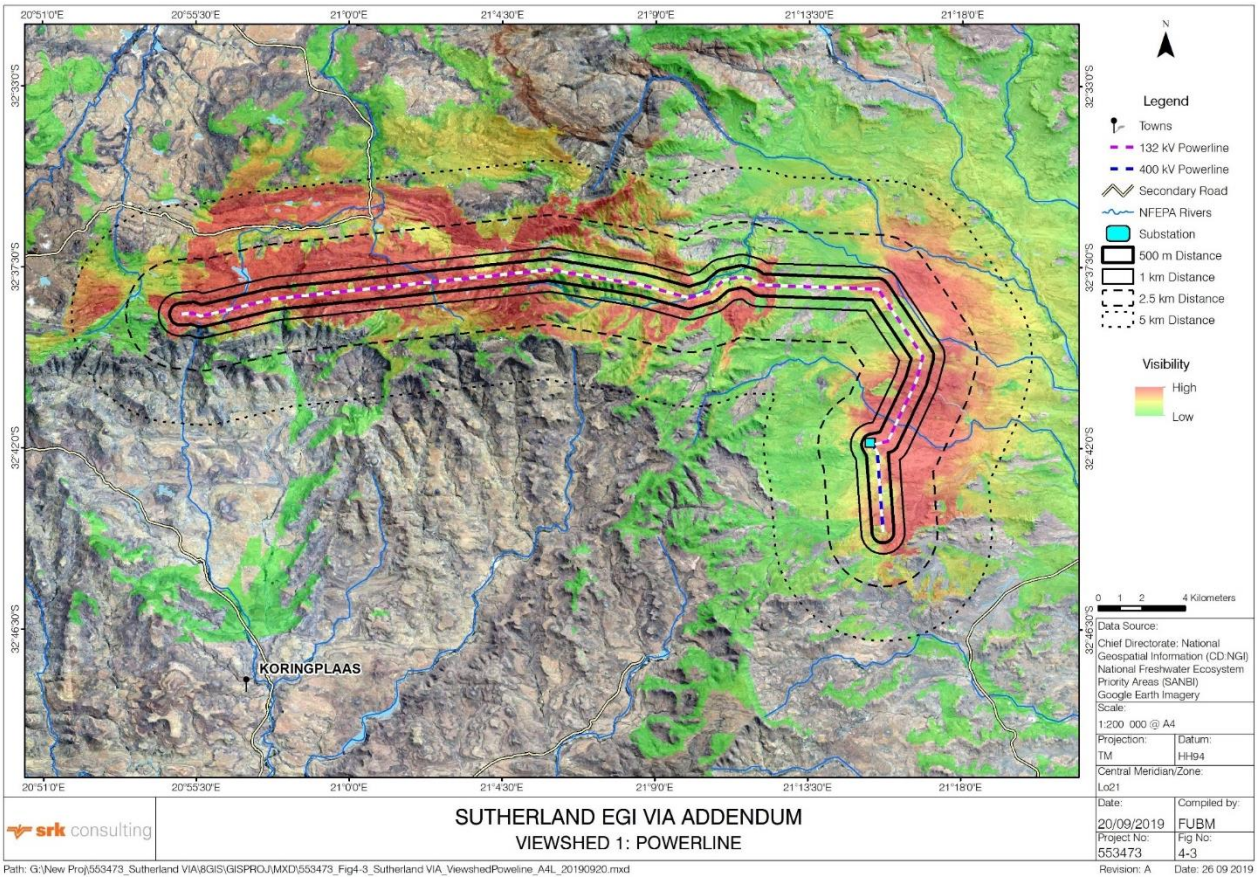


Figure 40: *Map showing the visual exposure of the proposed power line. Note that the map considers the authorised alignment with the new extension indicated by the bold black line.*

[2] Masson (2019) sourced the distances from Holland (2017) and it appears as though Holland's distance were based on an earlier alignment that was revised during the 2017 assessment.

The scenic Rooiberg Pass is the nearest pass up the escarpment. It is located 14 km west of the western end of the route in Northern Cape and will not be affected. The Komsberg Pass to Sutherland lies even further to the west.

6.7. Summary of heritage indicators

Archaeological remains are generally scarce but are found throughout the area. Very little significant Stone Age material was found with the most important sites being a kraal complex (waypoint 546 in Northern Cape) and a geometric rock art site (waypoint 492 in Western Cape). Isolated stone artefacts were almost non-existent above the escarpment and rare below it, although ephemeral scatters did occur near water courses. The vast majority of archaeological remains found were historical and ranged from a ruined farm complex to small, isolated ruined structures and isolated individual artefacts. The eastern part of the power line route has more significant sites in close proximity to it but, because the alignment was devised by the present author to avoid these sites, direct impacts are not expected.

- Indicator: Significant archaeological sites should be avoided or mitigated.

Although palaeontological resources were found throughout much of the study area, the vast majority were of very limited significance. Two important fossil sites were found but both were located away from the proposed power line footprint and impacts are not expected.

- Indicator: Significant palaeontological sites should be avoided or mitigated.

While graveyards are present in the wider area, all are located well away from the proposed power line alignment. No impacts are expected and no further consideration is needed.

One heritage structure is located about 1 km from the route in Northern Cape and other structures of unknown heritage significance occur within about 500 to 700 m of the line in Western Cape.

- Indicator: The powerline should not visually dominate the landscape in close proximity to heritage structures.

The rural cultural landscape extends throughout the study area but, aside from fences and farm tracks, human interventions are generally very sparse. The site lies within the Komsberg REDZ and Central Power Corridor (that was gazetted in February 2018), which promotes Renewable Energy and Electricity Grid Infrastructure development within these strategic geographical areas. It is thus noted that a new electrical layer is due to be added to this landscape in the very near future. The escarpment, however, remains an aesthetically significant landscape for its remoteness, long views, rugged scenery and distinctive sense of place.

- Indicator: The proposed development should not strongly dominate the landscape from multiple viewpoints and especially not from scenic routes.

6.8. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

The vast majority of archaeological resources are deemed to have low cultural significance ('IIIC' or 'NCW' in the HWC grading system and 'GP B' or 'GP C' in the SAHRA system) for their scientific value. There are, however, a few more important sites in the study area that are worthy of a IIIA grading (both systems). These include the kraal for it scientific value, the rock art site for its scientific and spiritual values and the ruined historical farm complexes for their architectural, historical, scientific, social and technological values.

The cultural and natural landscape in its current form (i.e. with no renewable energy facilities and very few power lines) has high significance and should be allocated a grade of 'IIIA' (in the HWC system). However, considering the renewable energy facilities planned for the area this grading may require revision in areas within easy sight of these facilities; it should still not drop below 'IIIB' (again the SAHRA system does not apply to landscapes).

7. IMPACT ASSESSMENT

The majority of impacts will be felt during the construction phase when land is cleared and excavations are made for the purposes of erecting the power line pylons. The impact assessments are summarised in Tables 2 to 5.

Only impacts to archaeology, palaeontology and the cultural landscape are specifically assessed. This is because impacts to graves are not expected to occur and the impact to the heritage value of the Waterval homestead (in NC) is considered to be negligible (note that the Rheebokkenfontein farm buildings (in WC) could not be assessed for their heritage value). Those sites found were located too far away from the proposed alignments to be of any concern.

The no-go alternative is not specifically assessed here because no new impacts would occur through continued use of the landscape according to the status quo (i.e. small stock farming). Impacts would thus be seen as of **very low** significance.

7.1. Construction Phase Impacts

Potential impact to archaeological resources

Direct impacts to archaeological resources may occur when construction vehicles move through the area, when service tracks are created, and when foundation excavations are made. Because of the very sparse distribution of archaeological resources (significant or otherwise) and the very few that were located in or close to the proposed footprint (only one of any significance is on the alignment), the impact significance is regarded as being **moderate** before mitigation. Potential mitigation measures include avoiding and protecting all sites that are not within the actual footprint and adequately recording and/or sampling any sites that cannot be avoided (No sites requiring mitigation have thus far been found within the project footprint with photography of the engraving at waypoint 1785 being a sufficient record). The farm road passing through the kraal complex (waypoint 546 in Northern Cape) may not be widened towards the east and preferably should not be widened at all. Although not a site of high significance, the engraving at waypoint 1785 should be avoided (the lines may span over the site). The mid-section of the alignment that has not been surveyed, as well as any realigned sections, should be subjected to a pre-construction walk-down survey to locate any sites that need to be avoided or mitigated. With mitigation the impact significance is likely to be reduced to **very low**.

Aspect/activity	All construction works (substation, pylons and service tracks)
Type of impact	Direct
Potential Impact	Damage or destruction of archaeological resources
Impact Significance (Pre-Mitigation)	Moderate
Mitigation required	• Avoid and protect all nearby sites if possible • No widening of road at waypoint 546 • No pylon placement within 30 m of waypoint 1785 • Pre-construction survey of any as yet unsurveyed sections to identify no-go areas or further mitigation requirements • Record/sample any sites to be impacted
Impact Significance (Post-Mitigation)	Very low

Potential impact to palaeontological resources

Direct impacts to palaeontological resources may occur when construction vehicles move through the area, when land is cleared for development, and when foundation excavations are made. Because of the very sparse visible distribution of palaeontological resources and the fact that no significant finds were made in or close to the proposed footprint, the impact significance is regarded as being **very low** before the implementation of mitigation measures. Potential mitigation measures include avoiding and protecting known fossil occurrences that are not within the actual footprint and adequately recording and/or sampling any localities that cannot be avoided (none have been found to date). Because of the low likelihood of finding fossils during construction, the impact significance with mitigation is likely to also be **very low**.

Aspect/activity	All construction works (substation, pylons and service tracks)
Type of impact	Direct
Potential Impact	Damage or destruction of fossils
Impact Significance (Pre-Mitigation)	Very low
Mitigation required	• Avoid and protect fossils if possible. • Monitoring by the Environmental Control Officer (ECO) and rescue of isolated finds.
Impact Significance (Post-Mitigation)	Very low

Potential impacts to the cultural landscape

The cultural landscape will be impacted indirectly through the presence of incompatible structures (the proposed power line and its pylons) and the construction vehicles in the rural landscape. Direct impacts would result from landscape scarring. Although the construction phase is quite short, the direct impacts caused would be long-lasting due to the length of time required for full rehabilitation to occur. Because the area is within a proposed REDZ and many other renewable energy facilities and power lines are proposed (some are due for construction soon), the impact significance is assessed as being **low** without the implementation of mitigation measures (it would otherwise have been moderate). Mitigation measures for the proposed power line are generally impossible because one cannot hide them, but a measure applicable to the proposed service road is to avoid steep slopes which would require much cut-and-fill and which would be visible from longer distances. This is mainly applicable to the long ridge down the escarpment and to the scarp within the eastern part of the alignment. With respect to the latter, the detour route around the east side of the scarp as proposed previously has now been included as part of the project design. Rehabilitation of any areas disturbed during construction and that would not be required during operation (e.g. laydown areas) should be carried out to reduce landscape scarring. Mitigation measures will not alter the impact significance which remains **low** after mitigation.

Aspect/activity	All construction works (substation, pylons and service tracks)
Type of impact	Direct and Indirect
Potential Impact	Scarring of the landscape and visual/contextual impacts to the rural/natural landscape
Impact Significance (Pre-Mitigation)	Low
Mitigation required	• Avoid steep slopes and cut-and-fill activities. • Rehabilitate any areas not required during operation.
Impact Significance (Post-Mitigation)	Low

7.2. Operation Phase Impacts

Potential impact to archaeological resources

Direct impacts to archaeological resources are highly unlikely to occur during this phase because vehicles will use the already established service road. The impact significance would be **very low** without the implementation of mitigation measures. The only suggested mitigation measure is to ensure that all vehicles remain on the service road at all times. With mitigation the impact significance would remain **very low**.

Aspect/activity	All operational works (substation, pylons and service tracks (including maintenance activities))
Type of impact	Direct
Potential Impact	Damage or destruction of archaeological resources
Impact Significance (Pre-Mitigation)	Very low
Mitigation required	• No driving off the established service tracks.
Impact Significance (Post-Mitigation)	Very low

Potential impact to palaeontological resources

Direct impacts to palaeontological resources are highly unlikely to occur during this phase because vehicles will use the already established service road. Accelerated erosion of steep sections could expose fossils that would then degrade but the likelihood is very low. The impact significance would be **very low** without the implementation of mitigation measures. The only suggested mitigation measure is to ensure that all vehicles remain on the established service road at all times. With mitigation the impact significance would remain **very low**.

Aspect/activity	All operational works (substation, pylons and service tracks (including maintenance activities))
Type of impact	Direct
Potential Impact	Damage or destruction of fossils.
Impact Significance (Pre-Mitigation)	Very low
Mitigation required	• No driving off the established service tracks.
Impact Significance (Post-Mitigation)	Very low

Potential impacts to the cultural landscape

The cultural landscape will be indirectly impacted through the presence of incompatible structures (the proposed power line and its pylons) in the rural landscape and directly by landscape scarring. These impacts would commence during the construction phase and remain constant throughout the lifetime of the project. Because the area is within a proposed REDZ and many other renewable energy facilities and power lines are proposed (some are due for construction soon), the impact significance is again assessed as being **low** without the implementation of mitigation measures. The only mitigation measure would be to ensure that vehicles remain on the established service tracks. The impact significance remains **low**.

Aspect/activity	All operational works (substation, pylons and service tracks (including maintenance activities))
Type of impact	Direct and Indirect
Potential Impact	Scarring of the landscape and visual/contextual impacts to the rural/natural landscape
Impact Significance (Pre-Mitigation)	Low
Mitigation required	• No driving off the established service tracks.
Impact Significance (Post-Mitigation)	Low

7.3. Decommissioning Phase Impacts

Potential impact to archaeological resources

Direct impacts to archaeological resources are highly unlikely to occur during this phase because vehicles will use the already established service road. The impact significance would be **very low** without the implementation of mitigation measures. The only suggested mitigation measure is to ensure that all vehicles remain on the service road at all times. With mitigation the impact significance would remain **very low**.

Aspect/activity	All decommissioning works (removal of infrastructure, including substation components, pylons and associated structures)
Type of impact	Direct
Potential Impact	Damage or destruction of archaeological resources
Impact Significance (Pre-Mitigation)	Very low
Mitigation required	• No driving off the established service tracks.
Impact Significance (Post-Mitigation)	Very low

Potential impact to palaeontological resources

Direct impacts to palaeontological resources are highly unlikely to occur during this phase because vehicles will use the already established service road. The impact significance would be **very low** without the implementation of mitigation measures. The only suggested mitigation measure is to ensure that all vehicles remain on the service road at all times. With mitigation the impact significance would remain **very low**.

Aspect/activity	All decommissioning works (removal of infrastructure, including substation components, pylons and service tracks)
Type of impact	Direct
Potential Impact	Damage or destruction of fossils.
Impact Significance (Pre-Mitigation)	Very low
Mitigation required	• No driving off the established service tracks.
Impact Significance (Post-Mitigation)	Very low

Potential impacts to the cultural landscape

The cultural landscape will be impacted through the presence of construction vehicles in the rural landscape when the power lines are removed. Because the impact will be of short term duration and the power lines would be removed, the impact significance is assessed as being **very low** without the implementation of mitigation measures. Mitigation measures would be to ensure that vehicles remain on the established tracks and that rehabilitation is effective with no landscape scarring remaining visible from long distances. The impact significance will remain **very low**.

Aspect/activity	All decommissioning works (removal of infrastructure, including substation components, pylons and service tracks)
Type of impact	Direct and Indirect
Potential Impact	Scarring of the landscape and visual/contextual impacts to the rural/natural landscape
Impact Significance (Pre-Mitigation)	Very low
Mitigation required	• No driving off the established service tracks. • Ensure effective rehabilitation of the landscape
Impact Significance (Post-Mitigation)	Very low

7.4. Cumulative Impacts

Potential cumulative impact to archaeological resources

Cumulative impacts to archaeological resources are the same as the construction phase impacts except that they may occur over a larger area. Because of the very sparse distribution of archaeological resources (significant or otherwise) and the very few that were located in or close to the proposed footprint, the cumulative impact significance is regarded as being **low** without the implementation of mitigation measures. Potential mitigation measures include avoiding and protecting all sites that are not within the actual footprint and adequately recording and/or sampling any sites that cannot be avoided (none have been found to date). Those sections of the final alignment that have not been surveyed should be subjected to a pre-construction walk-down survey to locate any sites that need to be avoided or mitigated. With mitigation the impact significance is likely to be reduced to **very low**.

Aspect/activity	All construction works (pylons and service tracks)
Type of impact	Direct
Potential Impact	Damage or destruction of archaeological resources
Impact Significance (Pre-Mitigation)	Low
Mitigation required	• Avoid and protect all nearby sites if possible • No widening of road at waypoint 546 • Pre-construction survey of any as yet unsurveyed sections to identify no-go areas or further mitigation requirements • Record/sample any sites to be impacted
Impact Significance (Post-Mitigation)	Very low

Potential impact to palaeontological resources

Direct impacts to palaeontological resources are similar to the construction phase impacts except that they may occur over a larger area. Despite the very sparse distribution of palaeontological resources and the fact that most are not visible on the surface, there is a very real chance that significant fossils may be impacted during the very many excavations that would be required for all the proposed turbine and power line foundations that would need to be constructed in the area. The cumulative impact significance is therefore regarded as being **moderate** without the implementation of mitigation measures. This is elevated partly by the high degree of uncertainty because several renewable energy facilities in the area have yet to be studied in the field. Potential mitigation measures include avoiding and protecting known fossil occurrences that are not within the actual footprint and adequately recording and/or sampling any localities that cannot be avoided (none have been found to date). Because of the relatively low likelihood of finding fossils within the present development area, the cumulative impact significance with mitigation is likely to be **very low**.

Aspect/activity	All construction works (pylons and service tracks)
Type of impact	Direct
Potential Impact	Damage or destruction of fossils
Impact Significance (Pre-Mitigation)	Moderate
Mitigation required	• Avoid and protect fossils if possible. • Monitoring by the Environmental Control Officer (ECO) and rescue of isolated finds.
Impact Significance (Post-Mitigation)	Very low

Potential impacts to the cultural landscape

The cultural landscape will be impacted indirectly through the presence of incompatible structures (the proposed power line and its pylons) and the construction vehicles in the rural landscape. Direct impacts would result from landscape scarring. Although the construction phase is quite short, the direct impacts caused would be long-lasting due to the length of time required for full rehabilitation to occur. Because the area is within a proposed REDZ and many other renewable energy facilities and power lines are proposed (some are due for construction soon), the cumulative impact significance is assessed as being **moderate** without the implementation of mitigation measures (it would otherwise have been moderate). Mitigation measures for the proposed power line are generally impossible because one cannot hide them, but a measure applicable to the proposed service road is to avoid steep slopes which would require much cut-and-fill and which would be visible from longer distances. This is mainly applicable to the long ridge down the escarpment and to the scarp within the eastern part of the alignment. With respect to the latter, the detour route around the east side of the scarp as proposed previously has now been included as part of the project design. Rehabilitation of any areas disturbed during construction and that would not be required during operation (e.g. laydown areas) should be carried out to reduce landscape scarring. Mitigation measures will not alter the impact significance and given that the power line would likely be viewed against a backdrop of wind turbines in places, the significance remains **moderate** after mitigation.

Aspect/activity	All construction works (pylons and service tracks)
Type of impact	Direct and Indirect
Potential Impact	Scarring of the landscape and visual/contextual impacts to the rural/natural landscape
Impact Significance (Pre-Mitigation)	Moderate
Mitigation required	• Avoid steep slopes and cut-and-fill activities. • Rehabilitate any areas not required during operation.
Impact Significance (Post-Mitigation)	Moderate

Table 2: *Impact assessment summary table – Construction Phase direct impacts (though cultural landscapes experience indirect impacts as well).*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Can impact be avoided?	Can impact be managed/mitigated?	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
												Without mitigation /management	With mitigation /management (residual		
Construction of proposed power lines, substation and service road	**Destruction of archaeological remains**	Negative	Site	Permanent	Substantial	Very likely	Non-reversible	High	Yes	Yes	• Avoid and protect all nearby sites if possible • No widening of road at waypoint 546 • No pylon placement within 30 m of waypoint 1785 • Pre-construction survey of any as yet unsurveyed sections to identify no-go areas or further mitigation requirements • Record/sample any sites to be impacted	Moderate	Very low	5	High
	Destruction of palaeontological material	Negative	Site	Permanent	Slight	Unlikely	Non-reversible	Moderate	No	Yes	• Avoid and protect fossils if possible. • Monitoring by the Environmental Control Officer (ECO) and rescue of isolated finds.	Very low	Very low	5	Medium
	Alteration of the cultural landscape	Negative	Local	Long term	Moderate	Very likely	High	Moderate	No	Yes (slightly)	• Avoid steep slopes and cut-and-fill activities. • Rehabilitate any areas not required during operation.	Low	Low	4	High

Table 3: *Impact assessment summary table – Operation Phase direct impacts (though cultural landscapes experience indirect impacts as well).*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Can impact be avoided?	Can impact be managed/mitigated?	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
												Without mitigation /management	With mitigation /management (residual risk/impact)		
Existence and maintenance of power lines, substation and service road	**Destruction of archaeological remains**	Negative	Site	Permanent	Slight	Extremely unlikely	Non-reversible	High	Yes	Yes	• No driving off the established service tracks.	Very low	Very low	5	High
	Destruction of palaeontological material	Negative	Site	Permanent	Slight	Extremely unlikely	Non-reversible	Moderate	Yes	Yes	• No driving off the established service tracks.	Very low	Very low	5	High
	Alteration of the cultural landscape	Negative	Local	Long term	Moderate	Very likely	High	Moderate	No	Yes (slightly)	• No driving off the established service tracks.	Low	Low	4	High

Table 4: *Impact assessment summary table – Decommissioning Phase direct impacts (though cultural landscapes experience indirect impacts as well).*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Can impact be avoided?	Can impact be managed/mitigated?	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
												Without mitigation /management	With mitigation /management (residual risk/impact)		
Removal of power lines and substation and rehabilitation of service road	**Destruction of archaeological remains**	Negative	Site	Permanent	Slight	Extremely unlikely	Non-reversible	High	Yes	Yes	• Stay on service road at all times.	Very low	Very low	5	High
	Destruction of palaeontological material	Negative	Site	Permanent	Slight	Extremely unlikely	Non-reversible	Moderate	Yes	Yes	• Stay on service road at all times.	Very low	Very low	5	High

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Can impact be avoided?	Can impact be managed/mitigated?	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
												Without mitigation /management	With mitigation /management (residual risk/impact)		
	Alteration of the cultural landscape	Negative	Local	Short term	Slight	Very likely	High	Moderate	No	Yes (slightly)	• Stay on service road at all times. • Ensure rehabilitation is effective and that no landscape scarring remains visible from long distances.	Very low	Very low	4	High

Table 5: *Impact assessment summary table – Cumulative direct impacts (though cultural landscapes experience indirect impacts as well) (Construction Phase).*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Can impact be avoided?	Can impact be managed/mitigated?	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of impact/risk	Confidence level
												Without mitigation /management	With mitigation /management (residual risk/impact)		
Construction of proposed power lines, substation and service road	**Destruction of archaeological remains**	Negative	Local	Permanent	Moderate	Very likely	Non-reversible	High	Yes	Yes	• Avoid and protect sites if possible. • No widening of road at waypoint 546 • Pre-construction survey of any as yet unsurveyed sections to identify no-go areas or further mitigation requirements • Record significant sites in footprint to be impacted.	Low	Very low	5	Medium
	Destruction of palaeontological material	Negative	Local	Permanent	Substantial	Unlikely	Non-reversible	Moderate	Yes	Yes	• Avoid and protect fossils if possible. • Monitoring by ECO and rescue of isolated finds.	Moderate	Very low	5	Medium
	Alteration of the cultural landscape	Negative	Local	Long term	Substantial	Very likely	High	Moderate	No	Yes	• Avoid creating roads up steep slopes. • Follow suggested service road detour. • Rehabilitate any areas not required during operation	Moderate	Moderate	3	High

8. LEGISLATIVE AND PERMIT REQUIREMENTS

Because the project spans two provinces with three heritage resources authorities, there are slightly different requirements.

In Northern Cape:

There are no permits required of the developer – the final comment acts as the approval (with conditions). Should there be a need to conduct archaeological or palaeontological mitigation this would need to be done under a permit applied for by and issued in the name of the person doing the mitigation work. This would need to be an appropriately qualified person.

In Western Cape:

There are no permits required of the developer – the final comment acts as the approval (with conditions). Should there be a need to conduct archaeological or palaeontological mitigation this would need to be done under a workplan applied for by and issued in the name of the person doing the mitigation work. This would need to be an appropriately qualified person.

9. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

Points for inclusion in the Environmental Management Programme (EMPr) are as follows:

- Ensure that all areas not already surveyed are examined by an archaeologist in order to identify any areas or sites that should be protected or mitigated prior to commencement of development. Note that this requirement pertains to unsurveyed parts of the proposed route as well as to any alterations made after completion of this report;
- The ECO should be aware of the potential for fossils to be uncovered during excavations. Excavations should be monitored by the ECO during construction and if any fossils are uncovered they should be protected *in situ* and immediately reported to a palaeontologist in order to plan a way forward. It is understood that the ECO would not be able to watch the excavation team full time, but as many holes as possible should be examined along with their spoil heaps;
- Significant palaeontological and archaeological sites (see list and mapping below) should be identified on project maps and regarded as no-go zones with buffers of at least 30 m around all associated features. There are two buffer exceptions. One is the rock art site (waypoint 492 in Western Cape) which is within 20 m of the service track, while the other is the kraal complex (waypoint 546 in Northern Cape) that has an existing farm road passing through it. In both instances, vehicles and activity must be confined to the existing roads, preferably with no widening.
- The engraving at waypoint 1785 in Western Cape should be fenced off during construction with a 30 m buffer but fencing of the other sites is not necessary since, with the exception of the rock art site, none are very close to the route. The rock art is not easily discernible by a non-specialist and it is better not to draw attention to it. However, no entry signs should be placed at regular intervals around the two historical complexes in Western Cape.
- These no-go sites should be examined periodically by the ECO during the construction phase to ensure that they are being respected;

- If any archaeological or palaeontological material is encountered during any phase of the project it should be protected *in situ* and reported to an appropriate specialist and/or to the relevant heritage resources authority so that a decision can be made as to how to proceed.

The relevant waypoints to be avoided with buffers of at least 30 m around all associated features are as follows (from west to east): 524, 546, Site 51, 614 (whole complex included), 498 (whole complex included), 492 and 1785. Note that this list includes only those sites located within 500 m of the footprint area. They are mapped in Figures 41 to 44.

Figure 41: *Overview of the heritage sites within 500 m of the power line route that should be protected and avoided.*

10. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development.

This project will enable electricity produced by a renewable energy facility to enter the national grid. As such, it will be of economic benefit to the people of South Africa in that it will play a part in the stabilisation of the grid and the provision of electricity to all. Although the project would not create long term employment, it will likely provide jobs during the construction phase and would support other projects that will provide long term employment.

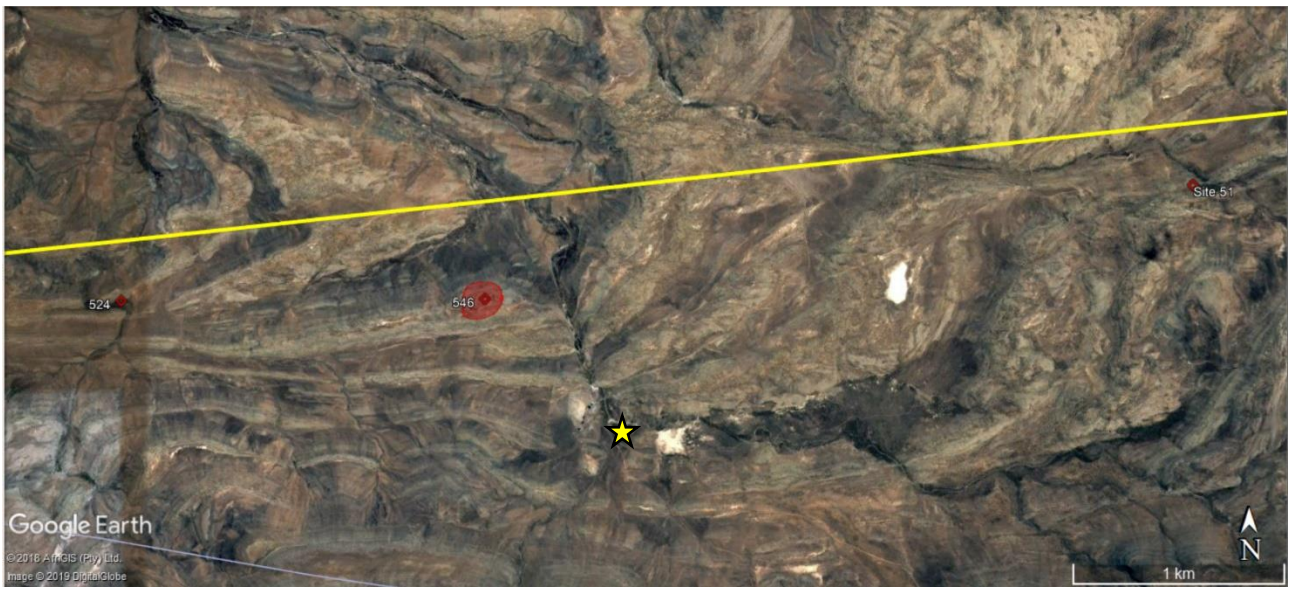


Figure 42: *Three archaeological sites that should be avoided in Northern Cape. The 30 m buffer is only shown on the one that may need active monitoring by the ECO. Also shown is the location of the Waterval farmstead, just over 1 km from the powerline route (yellow star).*

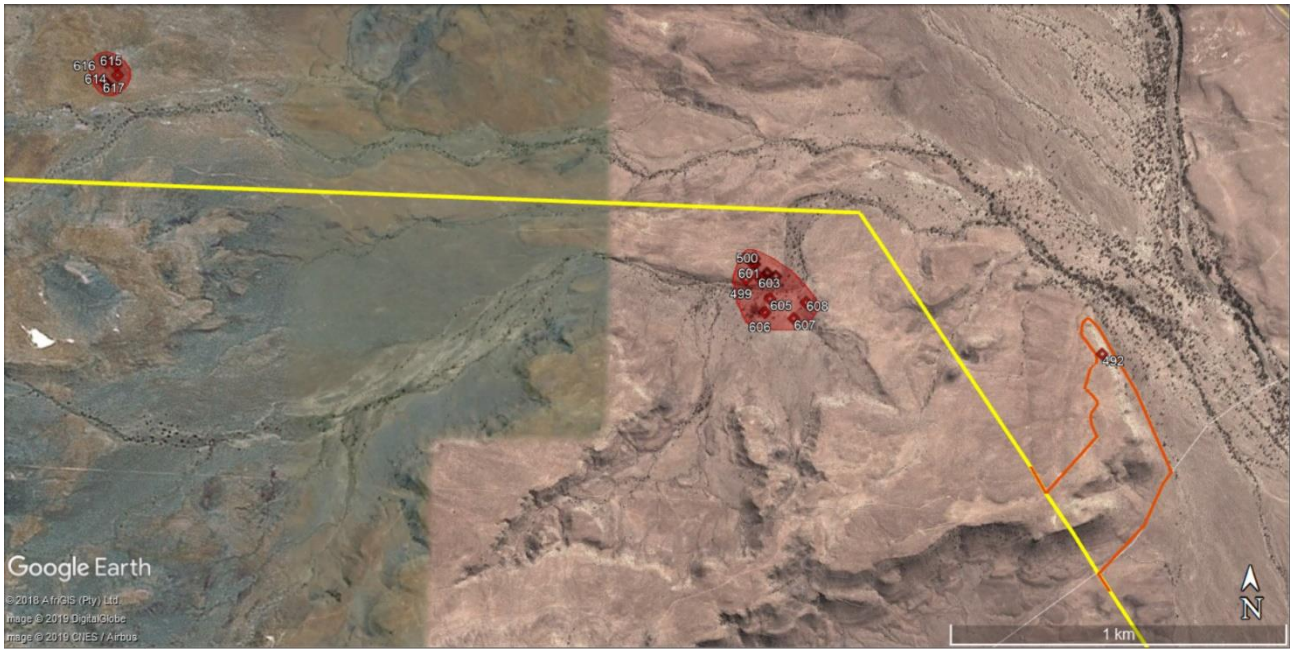


Figure 43: *Three archaeological sites that must be avoided in the north-eastern part of the Western Cape section of the route. 30 m buffers are shown on the two ruined historical complexes. The brown line shows the route that will be followed by the service road in that area.*

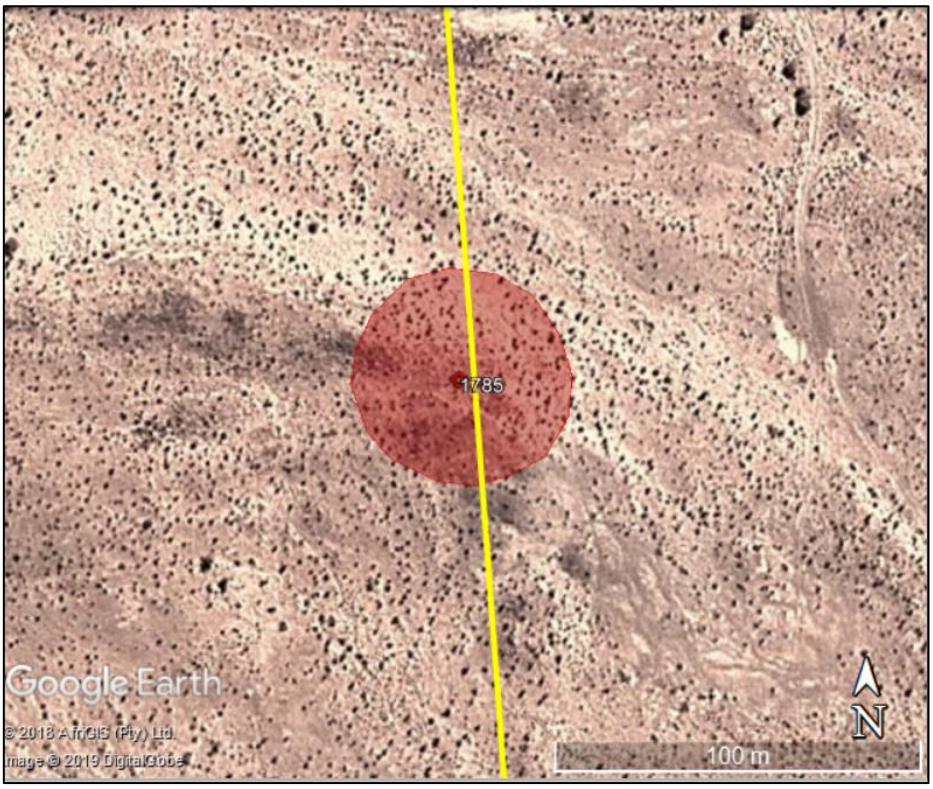


Figure 44: *The engraving site that must be avoided in the southern part of the Western Cape section of the route. The power line may span over the site but pylons and the service track must avoid it.*

11. CONSULTATION WITH HERITAGE CONSERVATION BODIES

This assessment is part of a Basic Assessment Process which will undergo the full legislated PPP. During this PPP, I&APs will have the opportunity to comment on aspects of the project, including the heritage assessment. HWC requires that the relevant municipality within the Western Cape Province be requested to provide comment on the HIA – there are no heritage conservation organisations registered in the area. The municipality will have opportunity to comment during the PPP.

12. CONCLUSIONS

This assessment has found that the study area around the proposed power line routes and associated electrical infrastructure does contain some significant heritage resources. These include prehistoric and historical archaeological sites, palaeontological occurrences and the escarpment landscape. The north-eastern part of the power line route was routed by the heritage specialist especially to avoid significant heritage sites, but one small historical engraving lies along the southernmost part of the route. Because the line here will be 400 kV it should be easy to span this site and avoid physical damage. The central part of this route could not be surveyed in the field and will need to be covered pre-construction. It is noted that the Stone Age kraal complex (at waypoint 546 in Northern Cape) is bisected by an access road that might be used during the proposed development. The greater landscape, especially along the escarpment, is visually significant, but

because it lies within the Komsberg REDZ, the area is very likely to be devoted to renewable energy developments and the proposed power line and associated electrical infrastructure would thus not be out of place. Importantly, the proposed power line would not be built if the renewable energy facilities it is meant to support do not go ahead.

The proposed heritage indicators are expected to be largely complied with. Outstanding issues (e.g. archaeological sites in unsurveyed areas) will be dealt with before construction starts. Although the powerline would dominate the landscape from close to its alignment, the route is generally in very remote areas with little opportunity to spoil views of the landscape.

12.1. Reasoned opinion of the specialist

There are no fatal flaws and because there are few heritage sites located within close proximity of the alignments, the potential impacts to all types of heritage resources are of generally moderate-low significance before mitigation and very low significance after mitigation. From a heritage point of view it is therefore suggested that the proposed power line development may be authorised.

13. RECOMMENDATIONS

Because there are unlikely to be significant impacts to heritage resources that cannot be managed or mitigated, it is recommended that the proposed development be authorised. However, the following conditions should be incorporated into the Environmental Authorisation:

- Any areas of the power line route and substation footprint not yet surveyed should be examined by an archaeologist in order to identify any areas or sites that should be protected or mitigated prior to commencement of construction (this includes any alterations made after completion of the assessment);
- The ECO should be aware of the potential for fossils to be uncovered during excavations. As many excavations as possible should be monitored by the ECO during construction and if any fossils are uncovered, they should be protected *in situ* and immediately reported to a palaeontologist in order to plan a way forward;
- The farm road passing through the kraal complex at waypoint 546 (Northern Cape) may not be widened towards the east and should preferably not be widened at all;
- No pylon should be placed within 30 m of waypoint 1785 (Western Cape) and the site should be fenced with a 30 m buffer during the construction phase;
- Significant palaeontological and archaeological sites as listed in this report should be identified on project maps and regarded as no-go zones with buffers of at least 30 m around all associated features (the exception is the service road diversion which comes within 20 m of the rock art site but uses an existing farm track);
- These no-go sites should be examined periodically by the ECO during the construction phase to ensure that they are being respected; and
- If any archaeological material, palaeontological material or human burials are uncovered during the course of development then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist or palaeontologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

14. REFERENCES

Almond, J.E. 2019. Palaeontological Heritage: Desktop & Field-based Basic Assessment Proposed Construction of Electrical Grid Infrastructure to support the authorised Rietrug, Sutherland and Sutherland 2 Wind Energy Facilities, Northern and Western Cape Provinces. Unpublished report prepared for the CSIR. Cape Town: Natura Viva cc.

Discover Sutherland. 2017. http://www.discoversutherland.co.za/see_and_do/places_of_ interest/. Website accessed 17th February 2017.

Dognose. n.d. Re: Some Birmingham information and advertisements. Accessed online on 21st March 2017 at: http://www.925-1000.com/forum/viewtopic. php?t=14729&start=240#p 113739.

Eastwood, E.B. & Smith, B.W. 2005. Fingerprints of the Khoekhoen: geometric and handprinted rock art in the Central Limpopo Basin, southern Africa. *South African Archaeological Society Goodwin Series* 9: 63–76.

Evanion Catalogue. n.d. Accessed online on 4th February 2017 at: http://www.bl.uk/catalogues/ evanion/FullImage.aspx?EvanID=024-000004286&ImageId=51959.

Evans, T.L., Thackeray, A.I. & Thackery, J.F. 1985. Later Stone Age Rescue Archaeology in the Sutherland District. The South African Archaeological Bulletin 40:106-108.

Halkett, D., Bluff, K. & Pinto, H. 2011. Heritage Impact Assessment: proposed renewable energy facility at the Sutherland site, Western and Northern Cape Provinces. Unpublished report for ERM, SA.

Halkett, D. & Webley, L. 2011. Heritage Impact Assessment proposed renewable energy facility at the Sutherland site, Western and Northern Cape Provinces. Unpublished report prepared for ERM SA.

Hart, T.J.G. 1989. Haaskraal and Volstruisfontein: Later Stone Age events at two rockshelters in the Zeekoe Valley, Great Karoo, South Africa. Unpublished M.A. dissertation, University of Cape Town.

Hart, T. 2005. Heritage Impact Assessment of a proposed Sutherland Golf Estate, Sutherland, Northern Cape Province.

Hart, T., Bluff, K., Halkett, D & Webley, L. 2010. Heritage Impact Assessment: Proposed Suurplaat Wind Energy facility near Sutherland, Western Cape and Northern Cape. Unpublished report for Savannah Environmental Services

Hopkins, H.C. & Marais, G.V. 2005. Kudde onder the suidersterre: Ned Gereformeerde Kerk Sutherland se geskiedenis die afgelope 150 jaar.

Kaplan, J. 2009. Phase 1 Archaeological Impact Assessment of the Proposed Driefontein Resort (Driefontein Farm No. 127), Sutherland, Northern Cape Province. Unpublished report for EnviroAfrika.

Kramer, P. 2012. The history, form and context of the 19th century corbelled buildings of the Karoo. MPhil dissertation. Rondebosch: University of Cape Town.

Masson, S. 2019. Electrical Grid Infrastructure to Support the Sutherland, Sutherland 2 and Rietrug Wind Energy Facilities: Visual Impact Assessment Addendum. Unpublished report prepared for CSIR: Rondebosch: SRK Consulting.

Orton, J. 2013. Geometric rock art in western South Africa and its implications for the spread of early herding. *South African Archaeological Bulletin* 68: 27-40.

Orton, J. 2016. Heritage Impact Assessment for the proposed Brandvalley Wind Energy Facility, Sutherland, Ceres and Laingsburg Magisterial Districts, Northern Cape and Western Cape. Unpublished report prepared for Brandvalley Wind Farm (Pty) Ltd. Muizenberg: ASHA Consulting (Pty) Ltd.

Orton, J. 2017. Heritage Impact Assessment: proposed construction of a substation and 132 kV distribution line to support the proposed Sutherland WEF, Sutherland and Laingsburg Magisterial Districts, Northern and Western Cape. Unpublished report prepared for CSIR. Lakeside: ASHA Consulting (Pty) Ltd.

Orton, J. & Halkett, D. 2011. Heritage impact assessment for the proposed photovoltaic solar energy facility on the remainder of farm Jakhalsvalley 99, Sutherland Magisterial District, Northern Cape. Unpublished report prepared for The Environmental Evaluation Unit. University of Cape Town: Archaeology Contracts Office.

Penn, N. 2005. *The forgotten frontier: colonist and Khoisan on the Cape's northern frontier in the 18th century*. Cape Town: Double Storey Books.

Russell, T. 2012. The position of Rock Art. A consideration of how GIS can contribute to the understanding of the age and authorship of rock art. In: Smith, B., Morris, D. & Helskog, K. (eds) *Working with Rock Art*: 36–45. Johannesburg: Wits University Press.

SAHRA. 2007. Minimum Standards: archaeological and palaeontological components of impact assessment reports. Document produced by the South African Heritage Resources Agency, May 2007.

Sampson, C.G. 1985. Atlas of Stone Age settlement in the central and upper Seacow Valley. *Memoirs of the National Museum (Bloemfontein)* 20: 1-116.

Sampson, CG 2008. Chronology and dynamics of Later Stone Age herders in the upper Seacow River valley, South Africa. *Journal of Arid Environments* 74: 842–848.

Schoeman, K. 1986. *Die wereld van die digter: 'n boek oor Sutherland en die Roggeveld ter ere van N.P. van Wyk Louw*. Human & Rousseau: Cape Town.

Smith, B.W. & Ouzman, S. 2004. Taking stock: identifying Khoekhoen herder rock art in southern Africa. *Current Anthropology* 45: 499–526.

Winter, S. & Oberholzer, B. 2013. Heritage and Scenic Resources: Inventory and Policy Framework for the Western Cape. Report prepared for the Provincial Government of the Western Cape Department of Environmental Affairs and Development Planning. Sarah Winter Heritage Planner, and Bernard Oberholzer Landscape Architect / Environmental Planner, in association with Setplan.

APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address:	6A Scarborough Road, Muizenberg, 7945
Telephone:	(021) 788 8425
Cell Phone:	083 272 3225
Email:	jayson@asha-consulting.co.za

Birth date and place:	22 June 1976, Cape Town, South Africa
Citizenship:	South African
ID no:	760622 522 4085
Driver's License:	Code 08
Marital Status:	Married to Carol Orton
Languages spoken:	English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science)	1997
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Memberships and affiliations:

South African Archaeological Society Council member	2004 –
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
ASAPA Cultural Resources Management Section member	2007 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –

Professional Accreditation:

ASAPA membership number: 233, CRM Section member

Principal Investigator:	Coastal shell middens (awarded 2007)
	Stone Age archaeology (awarded 2007)
	Grave relocation (awarded 2014)
Field Director:	Rock art (awarded 2007)
	Colonial period archaeology (awarded 2007)

Fieldwork and project experience:

Extensive fieldwork as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

APPENDIX 2 – Mapping

Symbols coloured as follows:

Colour	NC	WC
Red	IIIA	IIIA
Orange	GPA	IIIB
Yellow	GPB, GPC	IIIC
White	other waypoints	NCW

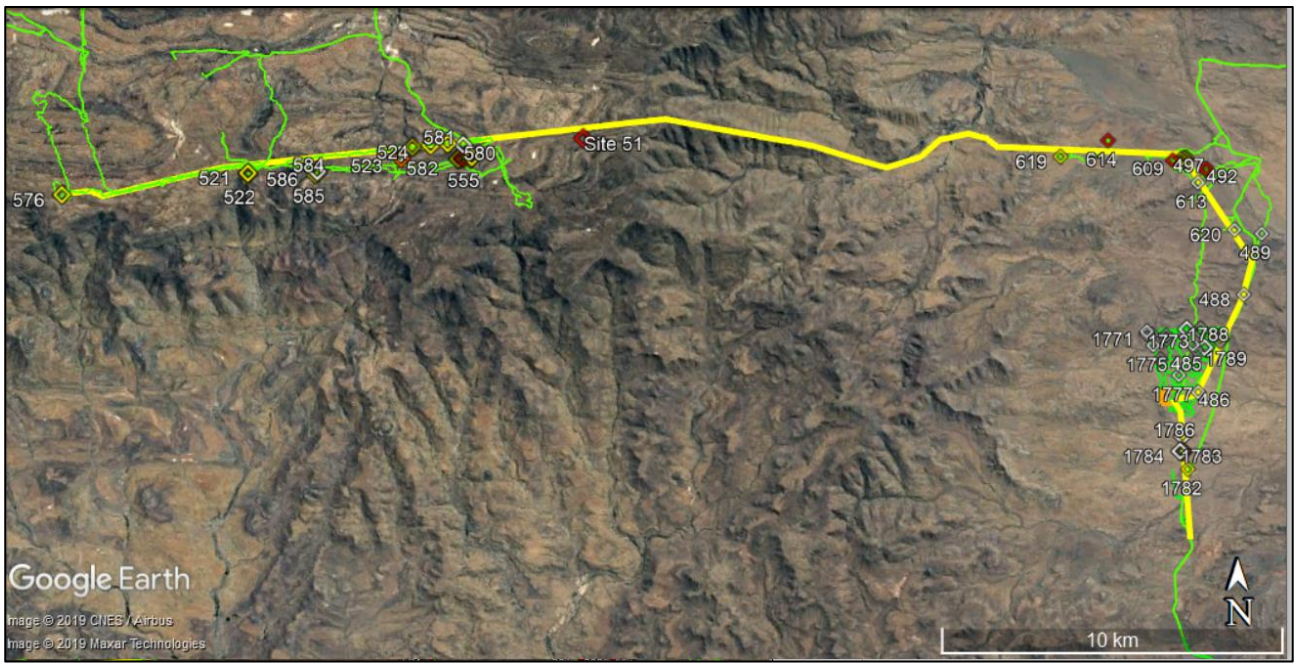


Figure A2.1: *Aerial view of the study area showing the recorded waypoints along the power line route. The yellow line indicates the power line routing and the numbered symbols are waypoints. The green lines are survey tracks.*

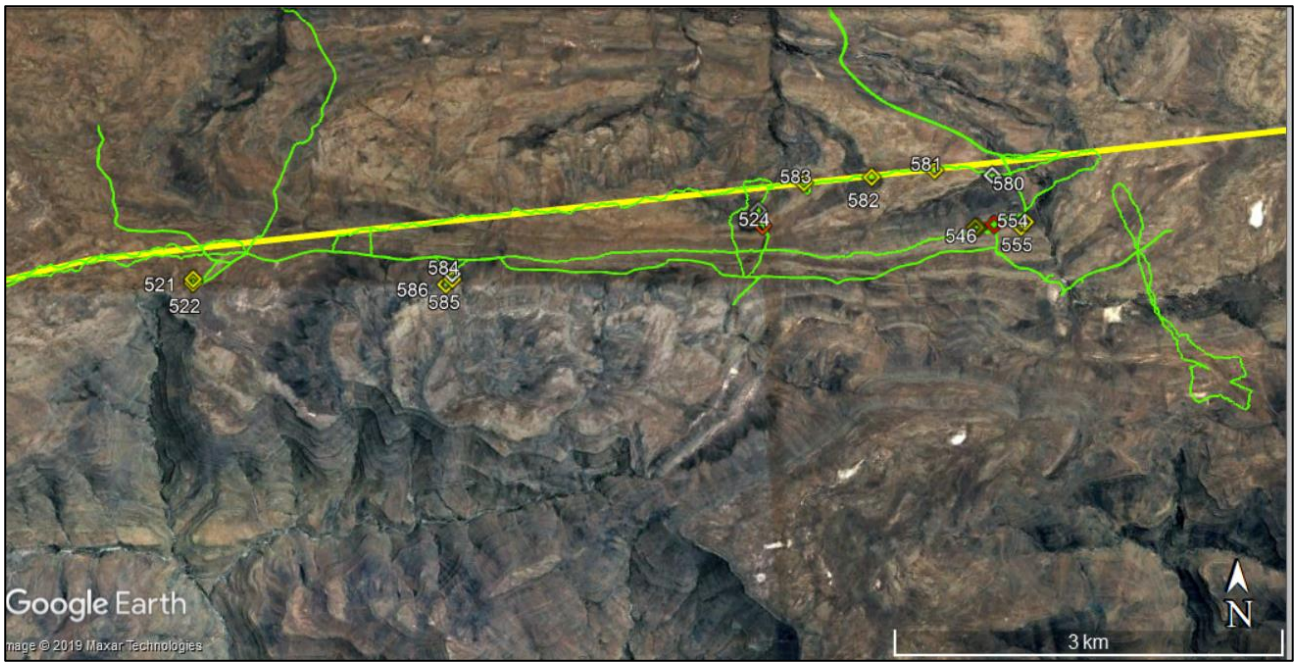


Figure A2.2: *Aerial view of the western part of the power line route. The yellow line indicates the power line routing and the numbered symbols are waypoints. The green lines are survey tracks.*

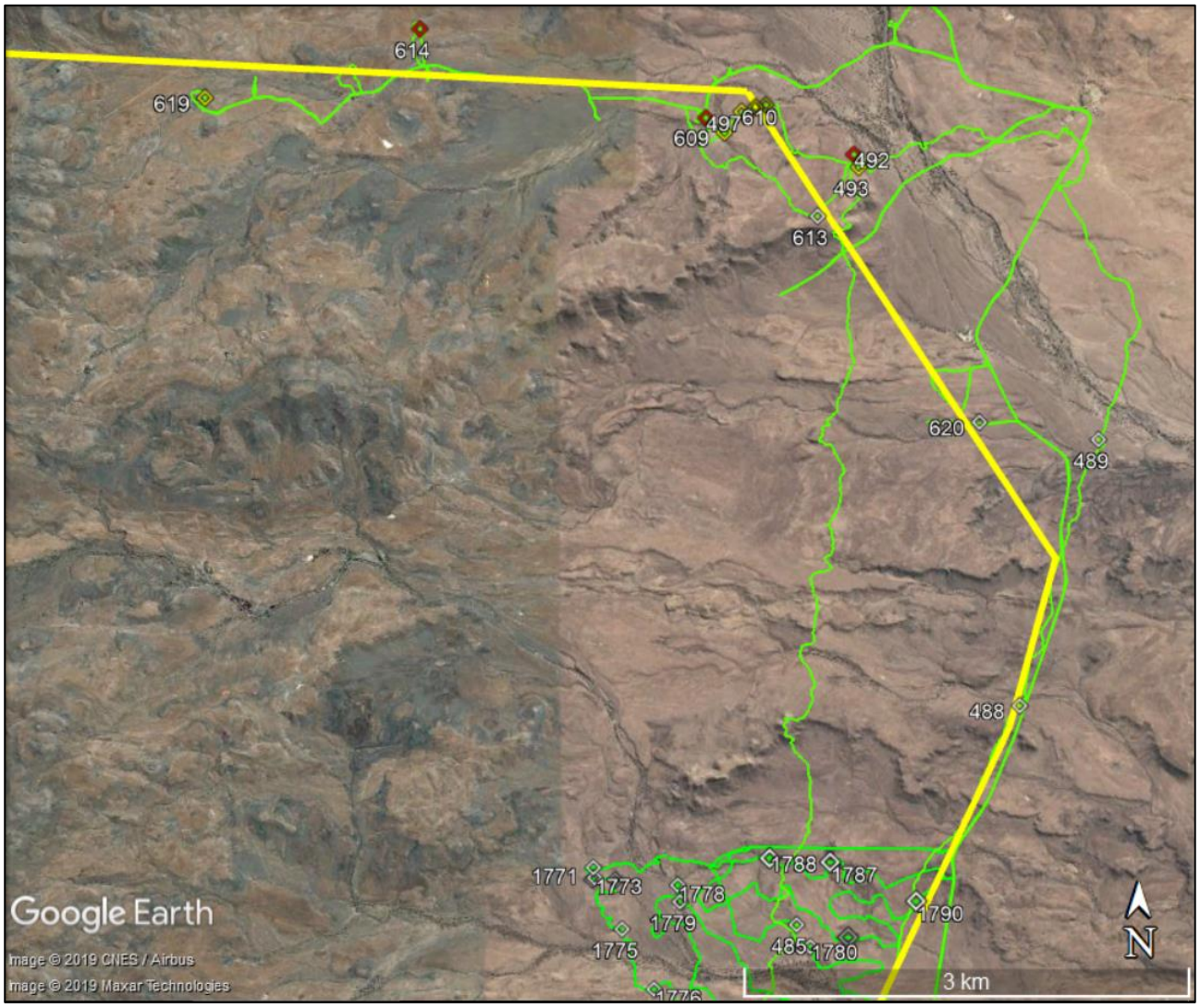


Figure A2.3: *Aerial view of the north-eastern part of the power line route. The yellow line indicates the power line routing and the numbered symbols are waypoints. The green lines are survey tracks.*

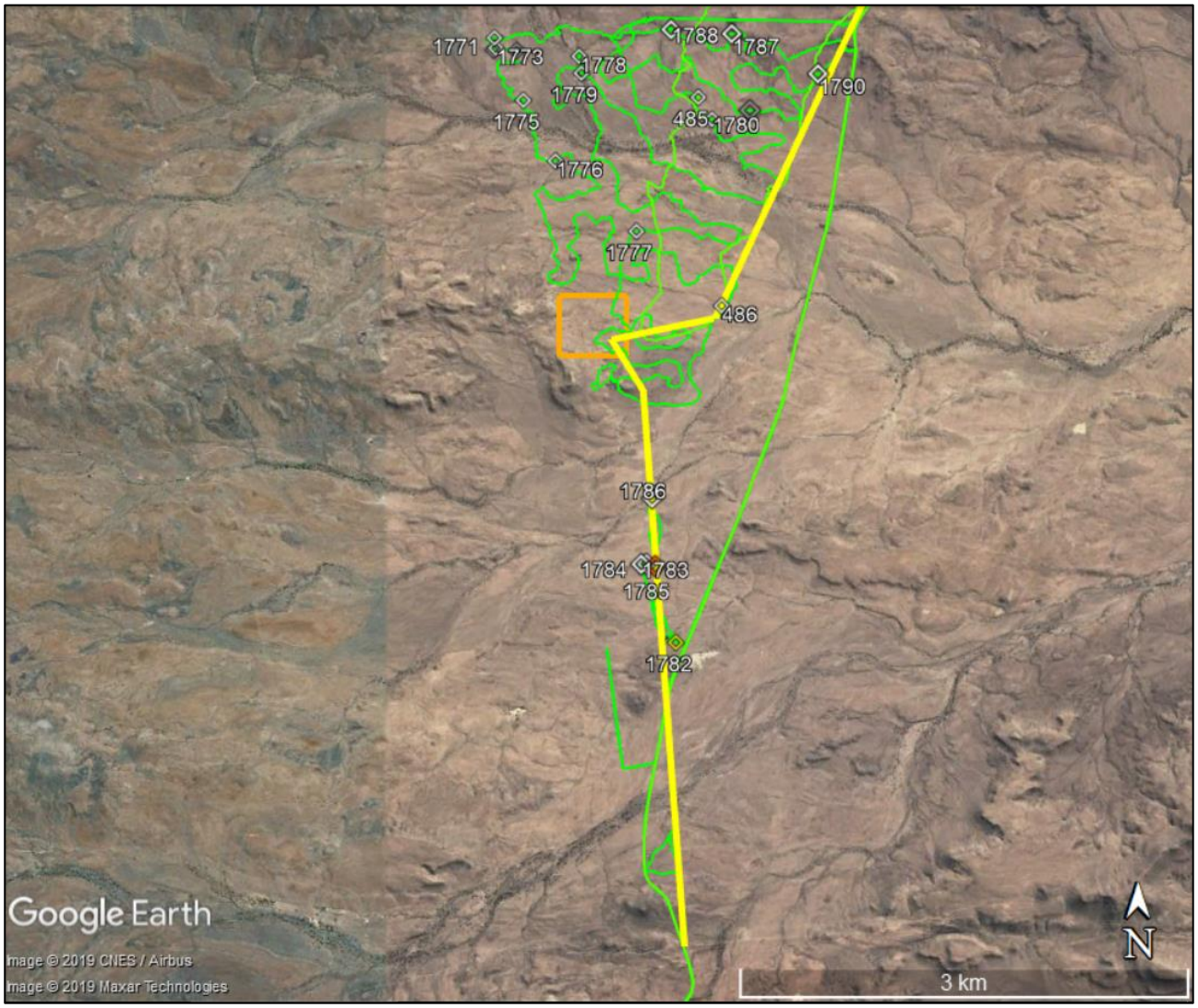


Figure A2.4: *Aerial view of the north-eastern part of the power line route. The yellow line indicates the power line routing and the numbered symbols are waypoints. The green lines are survey tracks.*

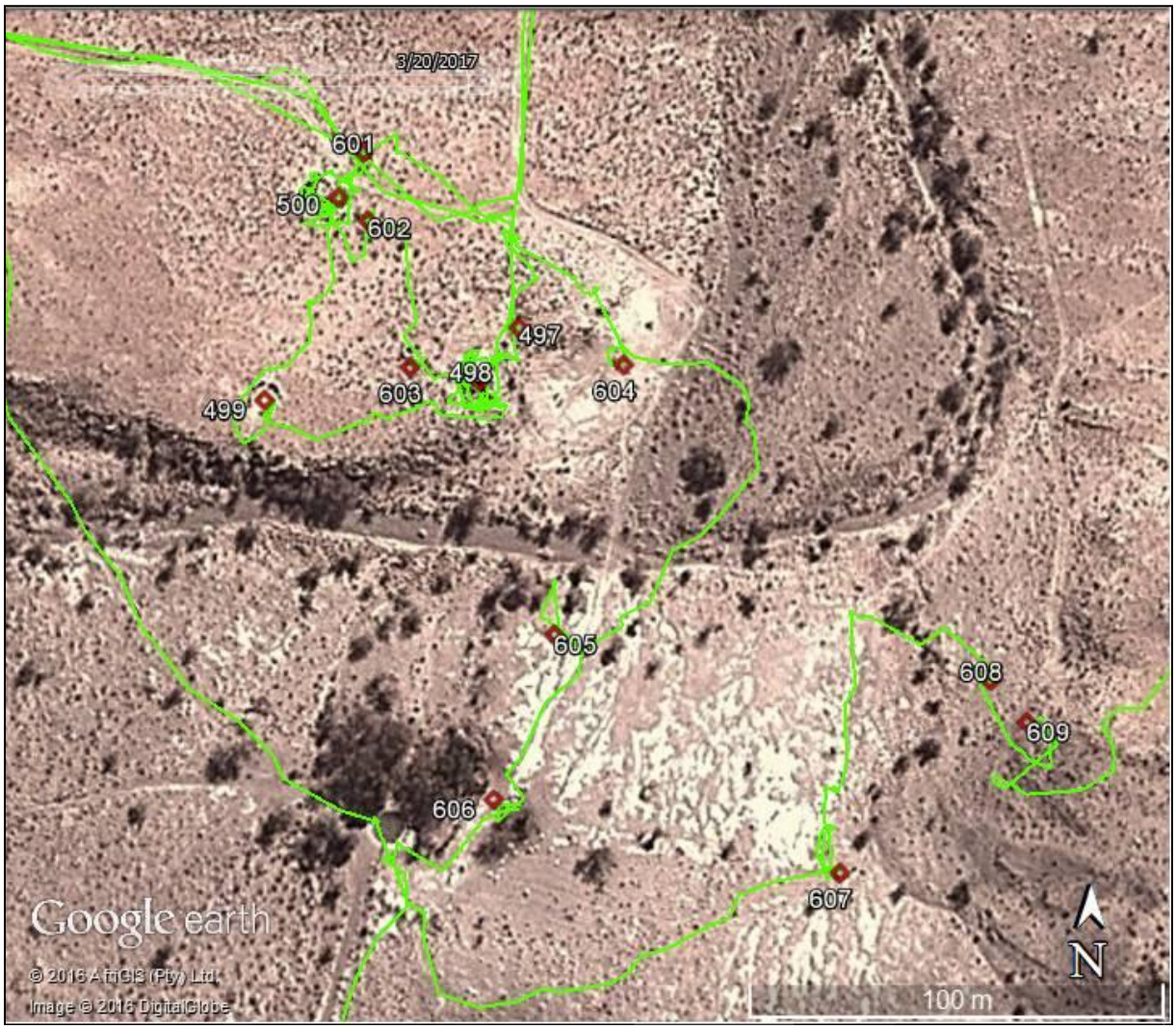


Figure A2.5: *Aerial view of the historic farm complex around waypoint 497.*

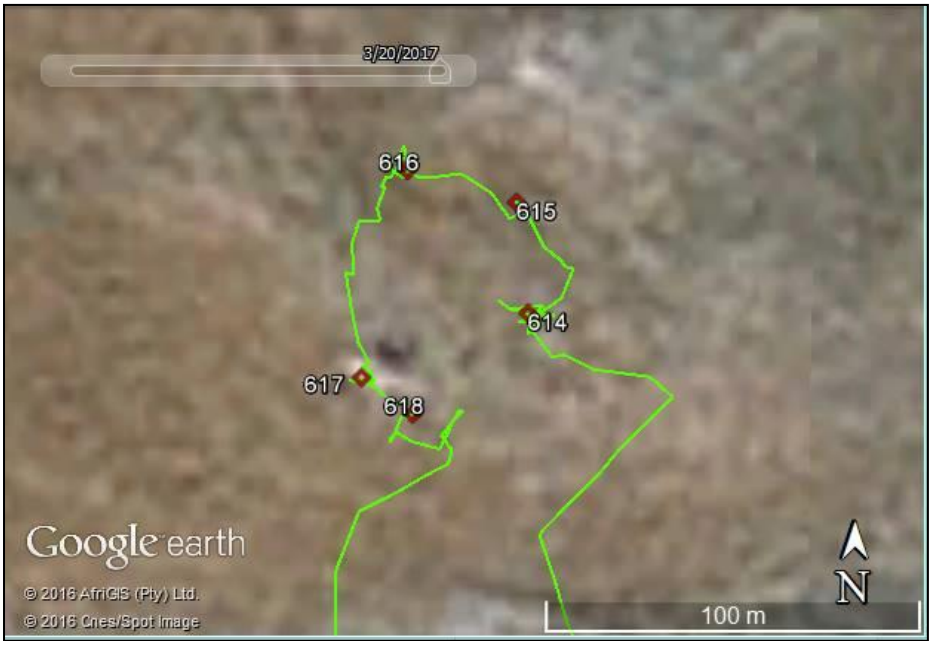


Figure A2.6: *Aerial view of the historic farm outpost around waypoint 614.*

APPENDIX 3 – Palaeontological study

Refer to overleaf.

PALAEONTOLOGICAL HERITAGE: DESKTOP & FIELD-BASED BASIC ASSESSMENT

Proposed construction of electrical grid infrastructure to support the authorised Rietrug, Sutherland and Sutherland 2 Wind Energy Facilities, Northern and Western Cape Provinces

John E. Almond PhD (Cantab.)
***Natura Viva* cc, PO Box 12410 Mill Street,**
Cape Town 8010, RSA
naturaviva@universe.co.za

July 2019

EXECUTIVE SUMMARY

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) are proposing to build additional electrical grid infrastructure in order to connect the authorised Rietrug, Sutherland and Sutherland 2 Wind Energy Facilities, situated on the Roggeveld Plateau to the southeast of Sutherland, to the national grid. The new infrastructure will comprise a *c*. 40 km – long 132 kV transmission line, a 4 km - long 400 kV transmission line, a Major Transmission Substation (MTS) located on Portion 6 of Hamelkraal 16 (footprint *c*. 25 ha); and a service road.

The electrical grid connection study area extends from the Roggeveld Plateau eastwards into the western Koup region at the foot of the Besemgoedberg Escarpment, *c.* 20 km to the west of Merweville. It is entirely underlain by continental sediments of the Abrahamskraal Formation (Lower Beaufort Group) of Middle Permian age. This fluvial and lacustrine succession is generally assigned a high palaeontological sensitivity due to its rich fossil biota, including pareiasaur reptiles, a wide range of therapsids, fish, amphibians, petrified wood and other remains of the *Glossopteris* Flora as well as trace fossils and microfossils. The Palaeozoic sedimentary bedrocks are extensively covered by Late Caenozoic superficial sediments (*e.g.* scree, gravelly soils) that are usually unfossiliferous.

Fossil material recorded from the Abrahamskraal Formation during a seven-day field-based survey of the broader study region between Sutherland and Merweville includes sparsely-scattered, and often highly-weathered, bones of unidentified robust-bodied tetrapods (probably pareiasaurs and / or dinocephalians) with only one well-articulated post-cranial skeleton. Trace fossils include several tetrapod burrow casts, lungfish burrows and low-diversity invertebrate trace assemblages. An extensive surface scatter of petrified wood blocks, some of which are well-preserved, was located in the western Koup. With the exception of the articulated skeleton and petrified wood scatters which lie well away from the electrical infrastructure footprint, most of these fossil occurrences are of limited palaeontological value. Fossil occurrences within or close to the footprint are of low conservation significance and do not warrant mitigation. The overall palaeontological sensitivity of the electrical grid infrastructure footprint is rated as low.

The impact significance of the construction phase of the proposed electrical grid infrastructure, including the MTS substation, is assessed as LOW (negative) in terms of palaeontological heritage resources. This is a consequence of (1) the paucity of irreplaceable, unique or rare fossil remains within or close to the development footprint as well as (2) the extensive superficial sediment cover

overlying most potentially-fossiliferous bedrocks here. Significant further impacts during the operational and de-commissioning phases of the electrical grid infrastructure are not anticipated. The no-go alternative (*i.e.* no development) will probably have a low (neutral) impact on palaeontological heritage.

Cumulative impacts on palaeontological heritage resources that are anticipated as a result of alternative energy or other developments currently proposed or authorised for the Roggeveld Plateau – western Koup region cannot be assessed realistically at this stage. This is mainly because field-based palaeontological assessments for the most relevant wind farm projects - *i.e.* the Sutherland, Sutherland 2, Rietrug and Suurplaat WEFs - have not yet been carried out. This region of the SW Karoo remains very poorly-known palaeontologically, while recent fieldwork for the present WEF electrical infrastructure projects shows that important fossil material, including articulated vertebrate skeletons, tetrapod burrows and well-preserved fossil wood, may occasionally be found here. It is therefore imperative that the pre-construction palaeontological studies for the various relevant Sutherland WEFs are followed through, as required by the South African Heritage Resources Agency (SAHRA) (Case ID 9622, Interim Comment of 5 July 2016).

There are no fatal flaws in the electrical grid connection infrastructure development proposals as far as fossil heritage is concerned. *Provided that* the recommendations for palaeontological monitoring and mitigation outlined below (See also Section 5 of this report) are followed through, there are no objections on palaeontological heritage grounds to authorisation of the proposed MTS substation, 132 kV and 400 kV powerlines and associated service road. Pending the potential discovery of substantial new fossil remains during the construction phase, no specialist palaeontological mitigation is recommended for this project.

The Environmental Control Officer (ECO) responsible for the WEF electrical grid connection developments should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for new access roads, MTS substation, pylon footings) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis by the ECO. Should substantial fossil remains - such as vertebrate bones and teeth, or petrified logs of fossil wood - be encountered at surface or exposed during construction, the ECO should safeguard these, preferably *in situ*. They should then alert the relevant provincial heritage management authority as soon as possible - *i.e.* Heritage Western Cape for the Western Cape (Contact details: Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za) and SAHRA for the Northern Cape (Contact details: Dr Ragna Redelstorff, SAHRA, P.O. Box 4637, Cape Town 8000. Tel: 021 202 8651. Email: rredelstorff@sahra.org.za). This is to ensure that appropriate action - *i.e.* recording, sampling or collection of fossils, *plus* recording of relevant geological data - can be taken by a professional palaeontologist at the developer's expense.

These mitigation recommendations should be incorporated into the Environmental Management Programme (EMPr) for the electrical grid connection project and be included as conditions for its authorization. Please note that:

- All South African fossil heritage is protected by law (South African Heritage Resources Act, Act 25 of 1999) and fossils cannot be collected, damaged or disturbed without a permit from SAHRA (N. Cape) or other relevant Provincial Heritage Resources Agency (*e.g.* Heritage Western Cape for the Western Cape);

- The palaeontologist concerned with potential mitigation work will need a valid fossil collection permit from Heritage Western Cape (HWC) (W. Cape) / SAHRA (N. Cape) and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection);

- All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by HWC (2016) and SAHRA (2013).

1. INTRODUCTION

1.1. Project Outline and Brief

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) are proposing to build additional electrical grid infrastructure in order to connect the authorised Rietrug, Sutherland and Sutherland 2 Wind Energy Facilities - referred to hereafter as the Sutherland WEFs - situated on the Roggeveld Plateau to the southeast of Sutherland, to the national grid. The WEFs and the proposed electrical grid infrastructure fall within the Komsberg Renewable Energy Development Zone (REDZ) and span the boundary between the Western and Northern Cape Provinces (Sutherland and Laingsburg Districts). The grid connection infrastructure will comprise the following main components (See satellite maps Fig. 1 to 3:

- A Major Transmission Substation (MTS) located on Portion 6 of Hamelkraal 16 (footprint *c*. 25 ha);
- A 132 kV overhead transmission line *c*. 41 km in length between the authorised WEF on-site substation on the farm Beeren Valley 150 and the new MTS;
- A 400 kV overheard transmission line *c*. 4 km in length connecting the MTS to an existing W-E Eskom line running to the south of the MTS; and
- Service roads (jeep tracks 4-6 m wide) below the lines, including a short deviation from the line route to avoid a steep slope.

The 132 kV line routing proposed as part of this application has been largely assessed previously as part of the proposed construction of the electrical grid infrastructure for the Sutherland, Sutherland 2 and Rietrug Wind Energy Facilities which were all authorised in 2018. The routing considered in the present report differs only slightly from that considered in previous assessments as Alternative Routing 2 (Almond 2017). The report also assesses a slightly revised location for the MTS as well as an additional short 400 kV connection between the MTS and existing transmission lines to the south to allow for greater flexibility.

The purpose of the present report is to provide a palaeontological heritage Basic Assessment of the proposed additional electrical grid infrastructure for the Sutherland WEF, Sutherland 2 WEF and Rietrug WEF. This report has been commissioned on behalf of the developer by the CSIR – Environmental Management Services, Stellenbosch (Contact details: Ms Surina Laurie, CSIR CSIR – Environmental Management Services. Address: 11 Jan Celliers Street, Stellenbosch. PO Box 320, Stellenbosch, 7599. Tel: 021 888 2561. Cell: 082 468 0962. Fax: 021 888 2693. E-mail: slaurie@csir.co.za). It will contribute to the consolidated Heritage Basic Assessment for the

development that is being compiled by Dr Jason Orton (ASHA Consulting (Pty) Ltd. Tel: 021 788 1025. Cell: 083 272 3225. E-mail: jayson@asha-consulting.co.za).

It is noted here that both the original Mainstream Sutherland WEF (now split into the Sutherland, Sutherland 2 and Rietrug WEFs) and the nearby Suurplaat WEF have not yet been subjected to a full, field-based palaeontological heritage assessment. In all cases a pre-construction palaeontological field survey of the land parcels involved was recommended in the pre-scoping desktop assessment (Almond 2010b, 2010c). A pre-construction palaeontological walk-down of the final project footprint of the Sutherland, Sutherland 2 and Rietrug WEFs has now been required by the South African Heritage Resources Agency (SAHRA) (Case ID 9622, Interim Comment of 5 July 2016).

1.2. Legislative context for palaeontological assessment studies

The present combined desktop and field-based palaeontological heritage report contributes to the Heritage Basic Assessment for the proposed electrical grid infrastructure and falls under the South African Heritage Resources Act (Act No. 25 of 1999). It will also inform the Environmental Management Programme (EMPr) for this Project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites; and
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
(2) All archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
(4) No person may, without a permit issued by the responsible heritage resources authority—
    (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
    (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
    (c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
    (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and

(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013).

1.3. Approach to the palaeontological heritage study

The approach to a Phase 1 palaeontological heritage study is briefly as follows. Fossil bearing rock units occurring within the broader study area are determined from geological maps and satellite images. Known fossil heritage in each rock unit is inventoried from scientific literature, previous assessments within the broader study region, and the author's field experience and palaeontological database. Based on this data as well as field examination of representative exposures of all major sedimentary rock units present in the vicinity of the development footprint as well as further afield, the impact significance of the proposed development is assessed with recommendations for any further studies or mitigation to be incorporated into the EMPr.

1.4. Assumptions & limitations

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mapable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover

(soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

In the case of the present electrical grid infrastructure study area between Sutherland and Merweville in the Western and Northern Cape, preservation of potentially fossiliferous bedrocks is favoured by the semi-arid climate and sparse vegetation but bedrock exposure is limited by extensive superficial deposits, especially in areas of low relief, as well as pervasive Karoo *bossieveld* vegetation (*e.g.* Roggeveld Shale Renosterveld on the Roggeveld Plateau). However, sufficient bedrock exposures were examined during the course of this study (See Appendix 1) to assess the palaeontological heritage sensitivity of the majority of the study area. Comparatively few academic palaeontological studies or field-based fossil heritage impact studies have been carried out in the region, so any new data from impact studies here are of scientific interest.

Project areas for both the Moyeng Energy (Pty) Ltd Suurplaat WEF as well as the original Mainstream Sutherland WEF have not yet been subjected to a full, field-based palaeontological heritage assessment. In all cases a pre-construction palaeontological field survey of the land parcels involved was recommended in the pre-scoping desktop assessment (Almond 2010b, 2010c). It was therefore not possible to take into consideration palaeontological field data for these

large and highly relevant areas for the associated electrical grid infrastructure palaeontological assessment. A pre-construction walk-down of the final WEF development footprints has now been required by SAHRA (Case No. 9622, Interim Comment of 5 July 2016).

1.5. Information sources

The present combined desktop and field-based palaeontological study was largely based on the following sources of information:

1. A detailed project outline supplied by the CSIR– Environmental Management Services as well as a draft HIA compiled by Dr Jason Orton of ASHA.

2. Relevant geological maps and sheet explanations (*e.g.* Theron 1983, Cole & Vorster 1999) as well as Google earth© satellite imagery.

3. Several palaeontological heritage assessment reports by the present author for proposed developments in the Karoo region between Sutherland and Merweville, including a golf course at Sutherland (Almond 2005), the Eskom Gamma – Omega 765 kV transmission line running across the Moordenaars Karoo and Koup region (Almond 2010a) and several alternative energy facilities (Almond 2010b, 2010c, 2011, 2014, 2015a – 2015i, 2016a, 2016b, 2017). These last reports notably include field-based assessments for the separate Gunsfontein WEF (Almond 2015g), pre-scoping desktop assessments for the Mainstream Sutherland WEF (Almond 2010c) and Suurplaat WEF (Almond 2010b) as well as a field-based assessment of the grid connection for the Rietrug WEF (Almond 2017).

4. An initial six-day palaeontological field assessment of the broader Sutherland WEF electrical grid infrastructure study area, including the access road to the north from Sutherland (29 Nov – 2 December 2016 and 1-2 February 2017) by the author and an experienced assistant. This was followed by a one-day field assessment of the revised MTS site and adjoining 132 and 400 kV transmission line routes on Hamelkraal 16 by the same team on 29 June 2019.

5. The author's previous field experience with the formations concerned and their palaeontological heritage (*cf* Almond & Pether 2008 and references listed above).

GPS data for all numbered palaeontological localities mentioned in the text are provided in Appendix 1.

Figure 1 (following page). Google earth© satellite image of the original Rietrug WEF Electrical Grid Infrastructure study area previously assessed by Almond (2017) showing powerline routes Alternative 1 (yellow) and Alternative 2 (red) which were then under consideration. Coloured polygons demarcate relevant land parcels. The present report assesses a 132 kV transmission line route that corresponds closely, but *not* exactly, to Alternative 2, originating at the authorised WEF on-site substation on the farm Beeren Valley 150 (See geological map Figure 19). The proposed new MTS site is located close to but outside the Nuwerust Substation study area previously assessed in 2017. Numbered flags represent recorded fossil sites (See Appendix 1 for GPS data and short descriptions). Note that no palaeontologically significant (high sensitivity) fossil sites were recorded within the 2017 substation site study areas. The majority of the fossil sites recorded during the field assessments are of low palaeontological heritage significance and do not require mitigation and / or lie outside the project footprint. Please refer to the following Figures 2 and 3 for more detailed mapping of fossil sites in the eastern sector of the revised electrical infrastructure project, below the main escarpment, including new sites identified in 2019.

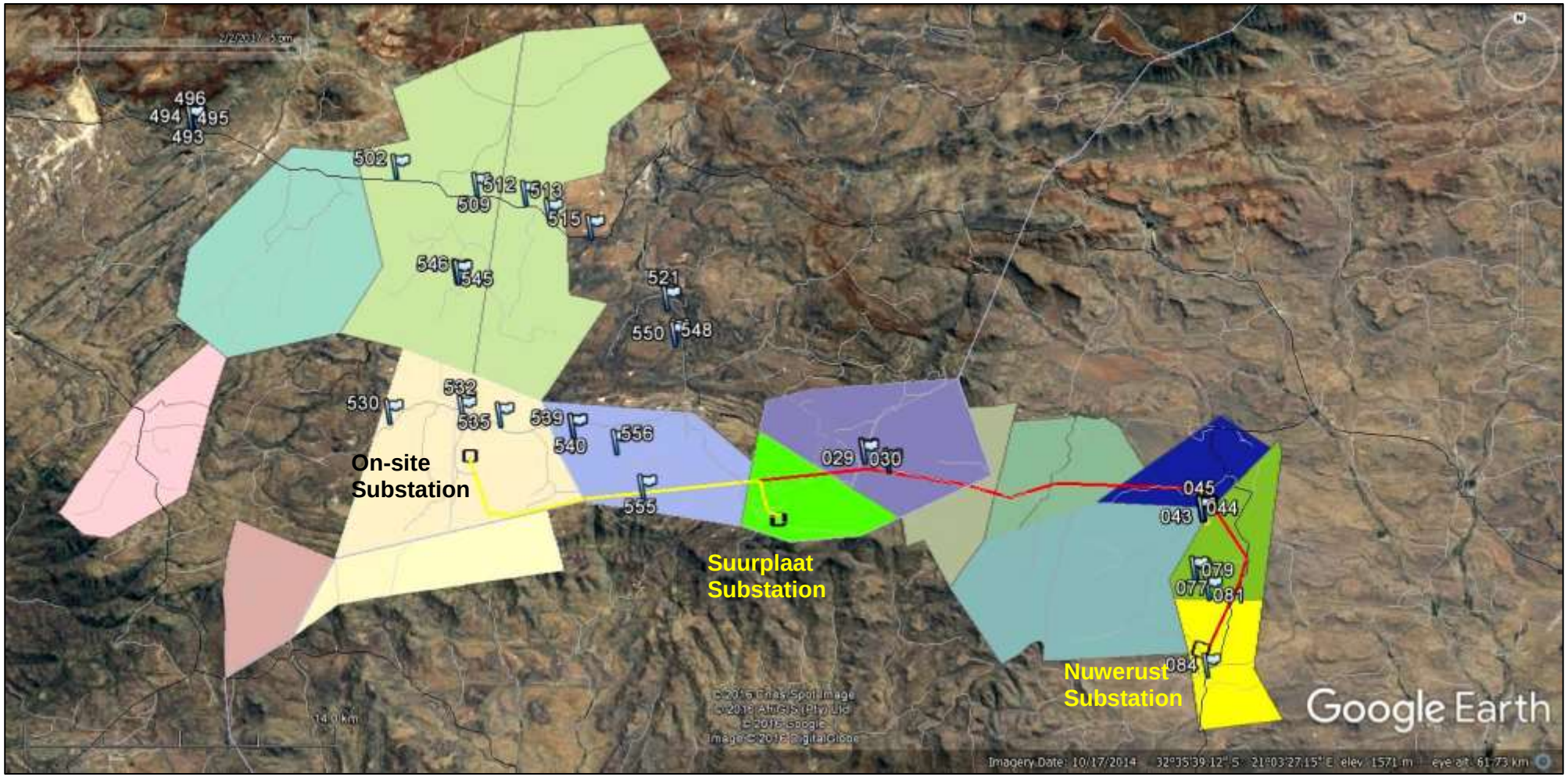

496
494
495
493
502
512
513
509
515
546
545
521
550
548
530
532
535
539
540
556
555
On-site
Substation
029
030
045
043
044
Suurplaat
Substation
079
077
081
084
Nuwerust
Substation
Google Earth

Figure 2. Google Earth© image of the eastern sector of the revised electrical infrastructure project (Hamel Kraal Farm 16), located in the Great Karoo region some 20 km west of Merweville (N towards the left of the image). Numbered flags represent recorded fossil sites from the previous report by Almond (2017) as well as more recent fieldwork (See Appendix 1 for GPS data and short descriptions). The fossil material comprises poorly-preserved petrified wood, moulds of woody stems, fragmentary tetrapod skeletal remains and invertebrate trace fossils. The majority of the recorded fossil sites are of low palaeontological heritage significance (Proposed Field Rating IIIB or IIIC) and / or lie outside the development footprint. See following figure for more detail of the MTS study area and adjoining transmission lines.

Figure 3. Google Earth© image of the proposed MTS project area (black rectangle) and adjoining 132 kV and 400 kV transmission lines (N towards the left of the image) on Hamel Kraal Farm 16. Numbered flags represent recorded fossil sites from the previous report by Almond (2017) as well as more recent fieldwork (See Appendix 1 for GPS data and short descriptions). The fossil material comprises poorly-preserved petrified wood, moulds of woody stems, fragmentary tetrapod skeletal remains and invertebrate trace fossils. The majority of the recorded fossil sites are of low palaeontological heritage significance (Proposed Field Rating IIIB or IIIC) and / or lie outside the development footprint.

Figure 4. Flat-lying, sandy terrain with no bedrock exposure in the development area for the proposed Sutherland 2 on-site substation, Portion 1 of Tonteldoosfontein Farm 152.

Figure 5. Abrahamskraal Formation bedrocks exposed along a shallow incised drainage line on Gunstfontein 151 with Salpeterkop in the distance to the north.

Figure 6. Flat sandy terrain with sparse surface gravels of sandstone seen in the development area for the proposed Suurplaat On-site Substation, Hartebeeste Fontein Farm 147.

Figure 7. Gently undulating terrain of the Roggeveld Plateau bordering the Suurplaat On-site Substation study area with rocky ridges of Abrahamskraal Formation channel sandstones in the foreground.

Figure 8. Typical rubble-strewn terrain underlain by thick Abrahamskraal Formation channel sandstones on the Roggeveld Plateau, Hartebeeste Fontein Farm 147.

Figure 9. Laterally extensive, tabular channel sandstones of the Moordenaars Member (Abrahamskraal Formation) weathering out as narrow *kranzes* on the slopes of Louwskop, Farm 219.

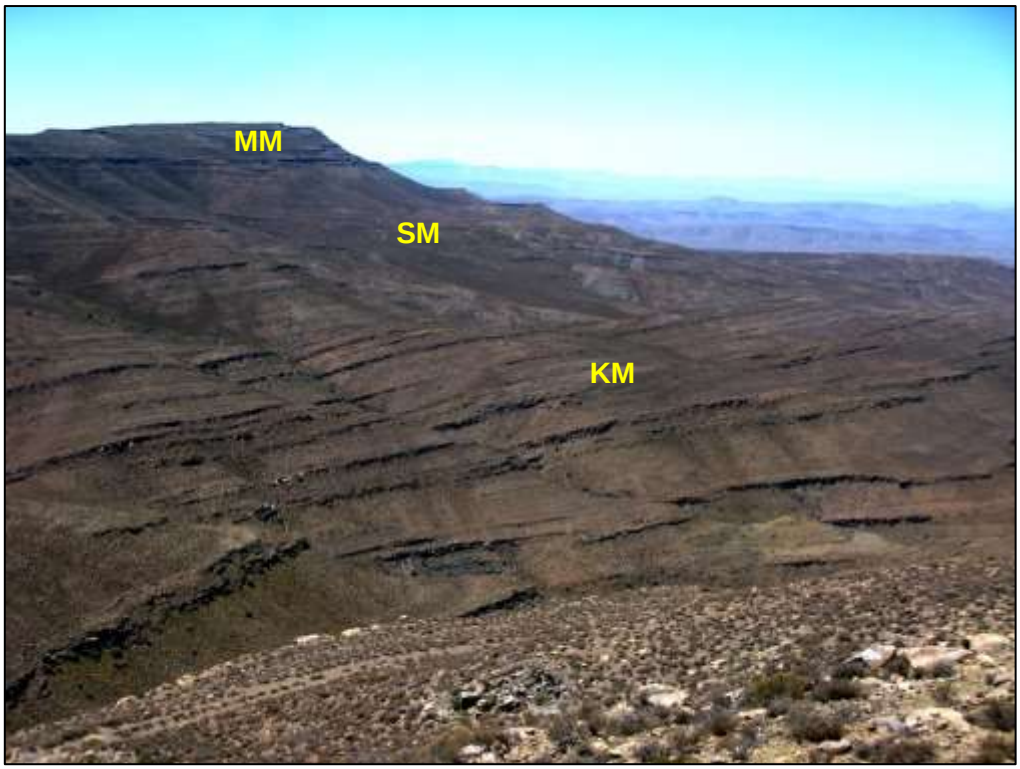


Figure 10. View north-eastwards along the upper part of the Besemgoedberg Escarpment close to Blouval (Farm 219). The sandstone-rich Moordenaars Member (MM, along ridge crest) is separated from the Koornplaats Member (KM, closely-spaced lower sandstones) by a sandstone-poor zone, the Swaerskraal Member (SM).

Figure 11. View southwards from the Langpunt track showing yellowish channel sandstones of the Koornplaats Member overlying the dark grey, mudrock-dominated Leeuvlei Member at the foot of the Besemgoedberg Escarpment near Novavita (Farm 280/RE).

Figure 12. Typical exposure of grey-green overbank mudrocks and yellowish channel sandstones of the Koornplaats Member at Bruwelskop (Hamelkraal Farm 16), western Koup region.

Figure 13. Brownish hills of the Koornplaats Member close to the northern edge of Hamel Kraal Farm 6 with occasional isolated exposures of grey-green mudrocks in the alluvial *vlaktes* in the foreground (Loc. 006).

Figure 14. Bakenkop – site of the proposed MTS on Hamel Kraal Farm 16 – seen from the east with a wide, gravelly alluvial plain in the foreground.

Figure 15. Eastern flanks of Bakenkop close to the MTS site showing typical sandstone-dominated terrain of the Koornplaats Member with large, dark brown *koffieklip* concretions (foreground) and rubbly surface gravels of downwasted yellowish-brown sandstone.

Figure 16. Topographically subdued alluvial *vlaktes* in the southern sector of Hamel Kraal Farm 16 showing patchy exposures of Beaufort Group mudrocks in the foreground and the existing transmission line at the southern termination of the proposed new 400 kV grid connection.

2. GEOLOGICAL CONTEXT

The combined study area for the Sutherland WEF, Sutherland 2 WEF and Rietrug WEF 132 kV and 400 kV transmission lines and associated MTS substation comprises a narrow, west-east trending band of semi-arid Karoo terrain some 35 km long (W-E) and *c*. 15 km wide (N-S), spanning the boundary between the Northern and Western Cape (Figs. 1 to 3). The western ~17 km of the area is situated on the Roggeveld Plateau at elevations of between 1500 and 1600 m amsl. The terrain here is rugged but without major contrasts in elevation, featuring numerous low sandstone ridges but only a few, low *koppies* such as Bakenkop (1560 m amsl.) and Louwskop (1670 ma amsl), rising to its greatest height close to the escarpment edge (Boesmanskop 1715) (Figs. 4 to 9). This western portion of the study area, to the north of the south-facing Komsberg Escarpment, has only a few, minor, northeast-directed drainage lines (*e.g.* Portugalsrivier). Several of these lie along well-defined radial fractures associated with the Late Cretaceous intrusion and uplift of the Sutherland Suite (*e.g.* Salpeterkop volcanic complex) (See NW portion of Fig. 1). The eastern 20 km or so of the study area, from Blouval on Hartebeeste Fontein Farm 147 eastwards to Novavita Farmstead on Farm Rheebokkenfontein 4, descends the steep, east-facing Besemgoedberg Escarpment between Lammerberg and Rooiberg, with a fall of some 600 m in altitude along the Langpunt track. The scenically spectacular escarpment zone features numerous, ridge-like sandstone *kranzes* and is dissected by several deeply-incised *klowe* (stream gorges) (Figs. 4 & 10). To the east of Novavita Farmstead the powerline routes enter the western Koup region to the west of Merweville, characterised by arid, gravelly *vlaktes* and low, stepped *koppies* such as Blikhuiskop (1150 m amsl.), Brandkop (1050 m amsl.), Brewelskop (850 m amsl) and Bakenkop (828 m amsl) (Figs. 12 to 16). This comparatively low-lying region (mainly *c*. 700-750 m

amsl) of the Great Karoo *sensu stricto* is drained by numerous intermittent-flowing tributaries of the Dwyka River such as the Juksrivier, Oubergsrivier and Vanwyksrivier. The karroid shrubby vegetation here is noticeably lower and sparser than seen in the less arid Roggeveld Plateau region to the west.

The geology of the Sutherland region is outlined on the 1: 250 000 scale geology sheet 3220 Sutherland (Theron 1983) (Fig. 19) as well as the updated 1: 250 000 Sutherland metallogenic map that includes important new stratigraphic detail for the Lower Beaufort Group succession (Cole & Vorster 1999) (*cf* Fig. 18). The study area is entirely underlain by Middle Permian continental sediments of the **Lower Beaufort Group** (Adelaide Subgroup, Karoo Supergroup), and in particular the **Abrahamskraal Formation** (Pa) at the base of the Lower Beaufort Group succession (Johnson *et al.* 2006 and references cited below). The Beaufort Group sediments here are folded along numerous west-east trending fold axes (narrow black lines on geological map, Fig. 19). In the Sutherland area to the north of the WEF powerline study area the Lower Beaufort Group sediments have been extensively intruded and thermally metamorphosed (baked) by dolerite sills and dykes of the **Karoo Dolerite Suite** of Early Jurassic age (*c*. 182 Ma = million years ago; Duncan & Marsh 2006). These igneous rocks were intruded during an interval of crustal uplift and stretching that preceded the break-up of the supercontinent Gondwana. They show up on satellite images as rusty-brown areas (Fig. 1). No dolerite or younger (Cretaceous) intrusions are mapped within the present study region, however; major dolerite and younger Cretaceous igneous bodies of the **Sutherland Suite** (*e.g.* Salpeterkop) intrude the Lower Beaufort Group some 6 to 12 km to the north. The Palaeozoic bedrocks in the study area are extensively overlain by Late Caenozoic **superficial deposits** such as scree and other slope deposits (colluvium and hillwash), stream alluvium, down-wasted surface gravels, calcretes and various sandy to gravelly soils.

A useful recent overview of the Beaufort Group continental succession has been given by Johnson *et al.* (2006). Almond (2015g) has provided a short account of the Lower Beaufort Group sediments of the Roggeveld plateau to the south of Sutherland that is broadly applicable to the present WEF powerline study area. The Lower Beaufort Group succession here belongs to the **Abrahamskraal Formation**. This is a very thick (*c*. 2.5 km) succession of fluvial deposits laid down in the Main Karoo Basin by meandering rivers on an extensive, low-relief floodplain during the Middle Permian Period, some 266-260 million years ago (Rossouw & De Villiers 1952, Johnson & Keyser 1979, Turner 1981, Theron 1983, Smith 1979, 1980, 1990, 1993a, 1993b, Smith & Keyser 1995a, Loock *et al*., 1994, Cole & Vorster 1999, McCarthy & Rubidge 2005, Johnson *et al*., 2006, Almond 2010a, Day 2013a, Day & Rubidge 2014, Wilson *et al.* 2014). These sediments include (a) lenticular to sheet-like channel sandstones, often associated with thin, impersistent intraformational breccio-conglomerates (larger clasts mainly of reworked mudflakes, calcrete nodules, *plus* sparse rolled bones, teeth, petrified wood), (b) well-bedded to laminated, grey-green, blue-grey to purple-brown floodplain mudrocks with sparse to common pedocrete horizons (calcrete nodules formed in ancient soils), (c) thin, sheet-like crevasse-splay sandstones, as well as more (d) localized playa lake deposits (*e.g.* wave-rippled sandstones, laminated mudrocks, limestones, evaporites). A number of greenish to reddish weathering, silica-rich “chert” horizons are also found. Many of these appear to be secondarily silicified mudrocks or limestones, perhaps associated with playa lakes, but at least some contain reworked volcanic ash (tuffs, tuffites). A wide range of sedimentological and palaeontological observations point to deposition under seasonally arid climates. These include, for example, the abundance of pedogenic calcretes and evaporites (silicified gypsum pseudomorphs or “desert roses”), reddened mudrocks, sun-cracked muds, “flashy” river systems, sun-baked fossil bones, well-developed seasonal growth rings in

fossil wood, rarity of fauna, and little evidence for substantial bioturbation or vegetation cover (*e.g.* root casts) on floodplains away from the river banks.

The Abrahamskraal Formation in the SW Karoo has been subdivided by various authors into a series of alternating sandstone- and mudrock-dominated packages, most recently by Day and Rubidge (2014) (Fig. 17). According to the 1: 250 000 metallogenic map of Cole and Vorster (1999) the majority of the WEF powerline study area up on the Roggeveld Plateau near Sutherland is underlain by a thick, channel sandstone-rich package known as the **Moordenaars Member** (Figs. 9 & 10) (Mudrocks of the overlying Kareskraal Member, the youngest subunit of the Abrahamskraal Formation, crop out just to the north of, but not within, the present study area. They are indicated by darker, purple-brown tints on satellite images; Fig. 1). An older package of closely-spaced, yellowish-tinted, tabular channel sandstone bodies exposed on the lower slopes of the Besemgoedberg Escarpment as well as over much of the western Koup region as far as Merweville represents the **Koornplaats Member**. This sandy unit underlies most of the eastern portion of the study area, including the MTS site (Figs. 10 to 15). The thin mudrock-dominated interval between these two sandstone packages - visible, for example, from Blouval and the Langpunt track - belongs to the **Wilgerbos Member** (renamed the **Swaerskraal Member** by Day & Rubidge 2014) (Fig. 10). A thick mudrock package exposed on hillslopes in the south-western corner of Farm Hamelkraal 16 may also belong here. Dark mudrock successions with lenticular sandstone bodies exposed on lower valley slopes near Novavita Farmstead, along the foot of the escarpment, probably belong to the upper part of the **Leeuvlei Member** (Fig. 20).

According to Loock *et al.* (1994 the **Koornplaats Member** of the Abrahamskraal Formation. is characterized by:

- Yellow-weathering sheet-like channel sandstone packages with heavy mineral laminations (up to 2 cm thick) towards the top and basal lag breccio-conglomerates. A prominent, laterally-persistent package of five yellowish fine-grained sandstone units marks the upper part of the member in the Roggeveld – Nuweveld Escarpment area. The sandstones are associated with fossil tetrapod material and reworked plant material, including silicified wood (rarely with exotic extra-basinal pebbles) and *Vertebraria* glossopterid roots. Uranium mineralization may be associated with transported plant material.
- Grey and maroon overbank mudrocks with calcrete horizons, tetrapod fossils.

The **Wilgerbos / Swaerskraal Member** comprises some 120 m of recessive-weathering, grey-green to purple-brown mudrocks with subordinate thin sandstones. Extensive playa lake deposits have been recognized within this unit (Loock *et al.* 1994).

The **Moordenaars Member** is a 300-350 m – thick, sandstone-rich succession of continental fluvial rocks characterized by stacked sheet sandstones with intervening, more recessive-weathering mudrocks (Stear 1980, Le Roux 1985, Loock *et al.* 1994, Cole & Vorster 1999). The prominent, laterally-persistent sandstone ledges generate a distinctive terraced topography on hill slopes in the Sutherland area (Figs. 9 & 26). The sheet sandstones are generally pale-weathering (enhanced by epilithic lichens), fine-grained, and structured by horizontal lamination (flaggy, with primary current lineation) or tabular to trough cross-bedding. The tabular-laminated units often contain numerous dark, very thin, laterally persistent laminae composed of heavy minerals that suggest density sorting during high energy sheet-flow conditions. The lower contacts of the channel sandstones are erosive, with lenticular basal breccias that may infill small-scale erosive gullies. The breccias, which may also occur within the body of the channel sandstone unit, are

composed of reworked mudflake intraclasts, small rounded to irregular calcrete glaebules or nodules as well as occasional rolled vertebrate bones, teeth and local concentrations of plant debris. Some of the originally more organic-rich breccias are associated with secondary iron / manganese-rich ('*koffieklip*") and uranium ore mineralization (Cole & Vorster 1999).

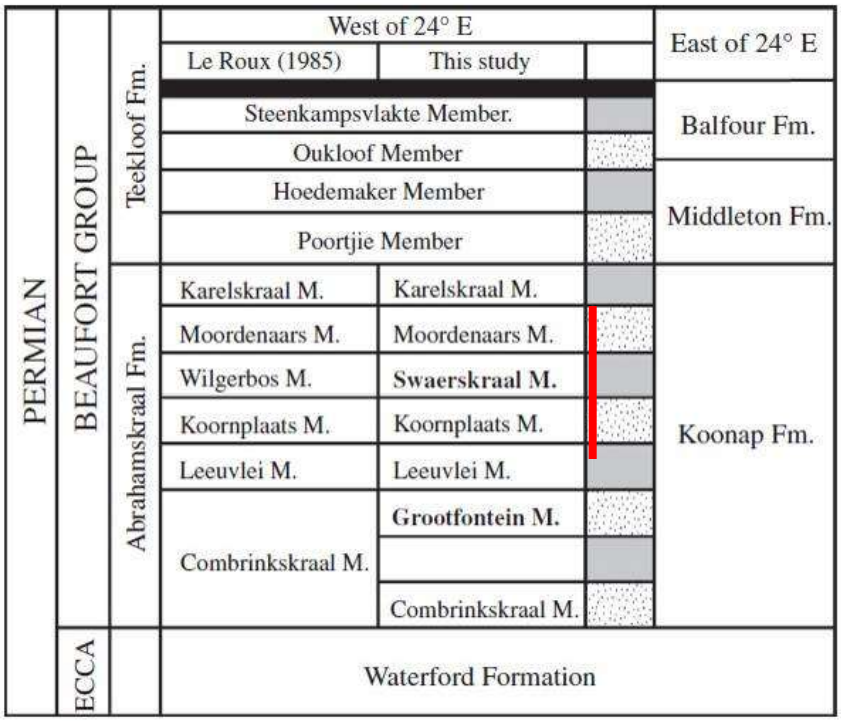


Figure 17. Revised stratigraphic subdivision of the Abrahamskraal Formation of Day and Rubidge (2014). The red bar indicates members that are represented within the electrical infrastructure study area between Sutherland and Merweville. Mudrock-dominated units are indicated in grey and sandstone packages by stippling.

Levels of tectonic deformation of the Lower Beaufort Group bedrocks within the study area are generally low. According to the 1: 250 000 Sutherland sheet map they have been gently folded along east-west or WNW-ESE fold axes (Fig. 19). In the study area the beds are fairly flat-lying with only local development of tectonic cleavage. A series of southwards down-stepping monoclinal folds with W-E trending axes is developed in the escarpment zone, visible for example to the N and NW of Novavita Farmstead.

Representative exposures of Abrahamskraal Formation bedrocks are illustrated below in Figures 20 to 30. Selected unconsolidated superficial deposits overlying these bedrocks are shown in Figures 31 and 33. Although lying outside the brief for the present palaeontological study, two small-scale geological features of geo-scientific interest encountered during the present field study are noted here:

- The unusually extensive occurrence of *koffieklip* (dark brown-patinated, ferruginised sandstone) spanning a dust road on Farm Hamel Kraal 16, situated some 1.5 km southeast of the proposed MTS (Loc. 084, Fig. 23). Elongate lenticular outcrops of black, dolerite-like sandstone blocks extend some 200 m in a NW-SE direction and are possibly related to Mid Permian palaeochannels. A uranium anomaly has not been mapped at this

site, and no associated fossil plant material was recorded here (but there are trace fossils; *cf* 61).

- The lenticular cluster of pebble- to cobble-sized exotic clasts ("lonestones") embedded within a succession of fine-grained, purple-brown mudrocks that is recorded on Nooitgedagt 148 (Loc. 540; Fig. 18) includes some of the largest extra-basinal clasts recorded from the Lower Beaufort Group in the SW Karoo (*cf* Almond 2010a, 2015h and refs. therein). The larger clasts appear to be igneous (possibly andesite) and show a modest degree of rounding; the smaller pebbles are well-rounded. It is notable that the megaclasts are associated with crumbly, weathered, dark tillite-like material, suggesting a possible re-exhumed Dwyka Group provenance along the Karoo Basin margin (or alternatively a gritty palaeosol). Plausible explanations as to how such exotic "lonestones" were introduced so far out into the Beaufort Group depository include transport on the roots of floating logs (*cf* Broom 1909) or by floating river ice during winter. In the present case the distal floodplain setting of the conglomeratic lens, far from a river channel, is noteworthy.

Furthermore, it is noted that several uranium anomalies are indicated on the 1: 250 000 Sutherland metallogenic map close to the proposed 132 kV powerline route and on-site substation site. They are situated on the farms Gunstfontein 151 (Anomalies 180, 181) and Beeren Valley 150 (Anomalies 183, 186) (Fig. 18). Co-ordinates for these anomalies are given in the sheet explanation by Cole and Vorster (1999) and in Appendix 1 herein. According to the Mineral and Petroleum Resources Development Act, 2002, the company proposing the wind farm developments on these properties is required to submit a report from the Council for Geoscience on the mineral potential of the development area to the Department of Mineral Resources (Dr Doug Cole, Council for Geoscience, Bellville, pers. comm. 2015). As a precautionary measure, it is suggested that these sites are protected by a 30 m – radius buffer zone during the construction phase. Uranium ore occurrences associated with *koffieklip* are sometimes associated with concentrations of fossil plant material (See discussion and references in Almond 2015g relating to the proposed Gunsfontein WEF).

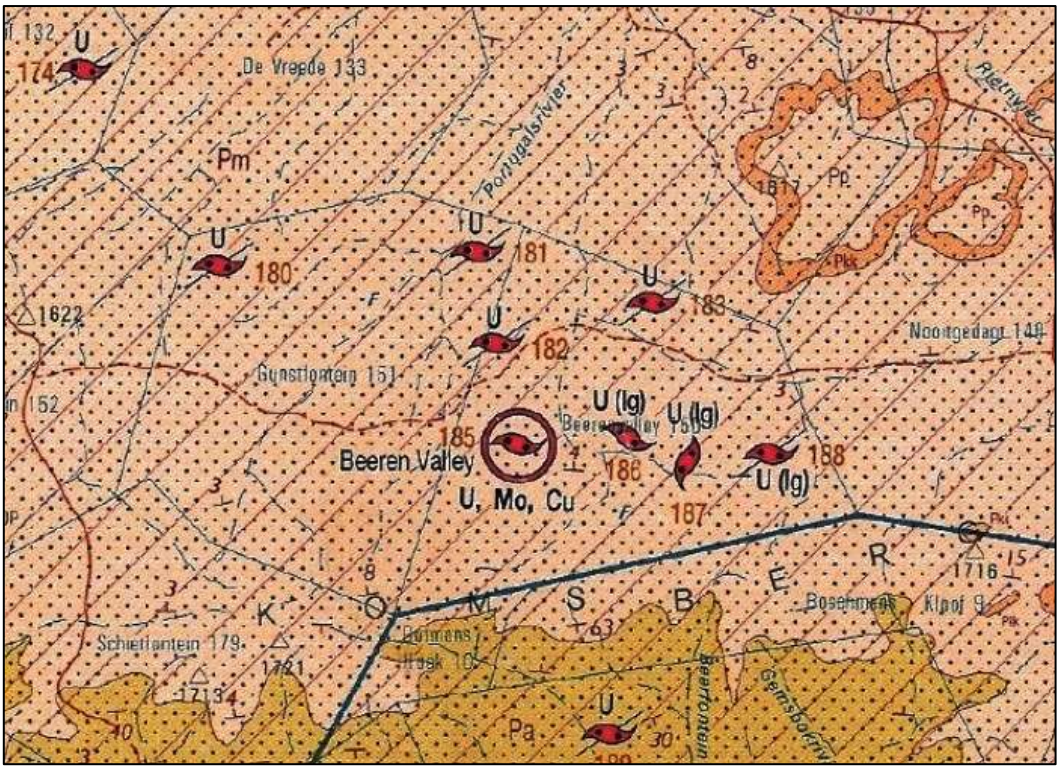


Figure 18. Extract from the 1: 250 000 Sutherland metallogenic map showing several uranium anomalies mapped on the farms Gunsfontein 151 and Beeren Valley 150 (red symbols) (Council for Geoscience, Pretoria). Anomalies 180, 181, 183 and 187 lie close to the proposed electrical grid infrastructure for the Sutherland, Sutherland 2 and Rietrug WEFs (GPS data for these sites is provided by Cole & Vorster 1999). Uranium ore occurrences within *koffieklip* (ferruginous sandstone) may sometimes be associated with fossil plant material, though this was not established during the present field study. As a precautionary measure, it is recommended that these sites are protected by a 30-m radius buffer zone.

John E. Almond (2019) *Natura Viva* cc

Figure 19 (previous page). Extract from 1: 250 000 geological sheet 3220 Sutherland (Council for Geoscience, Pretoria) showing the *approximate* footprint of the proposed additional Electrical Grid Infrastructure for the Sutherland WEF, Sutherland 2 WEF and Rietrug WEF. The slightly revised 132 kV powerline route (~ 41 km) between the on-site substation for the authorised Sutherland WEF on the farm Beeren Valley 150 (green square) and the proposed new MTS on Portion 6 of Hamelkraal 16 (blue square) is shown in black. The short (~4 km) line shows the proposed additional 400 kV connection between the MTS and existing W-E transmission lines to the south. A short deviation of the access road from the grid connection route *c*. 6.5 km NNE of the MTS is shown in red.

The main geological bedrock units represented in the study region include:

Pa (pale green) = Abrahamskraal Formation (Lower Beaufort Group)
Pte (dark green) = Teekloof Formation (Lower Beaufort Group)
Jd (red) = Karoo Dolerite Suite

***N.B.* Late Caenozoic superficial deposits that are not mapped at 1: 250 000 scale also occur here, including alluvium, colluvium, surface gravels, soils and calcrete.**

Figure 20. Lenticular channel sandstones incised into dark grey mudrocks of the Leeuvlei Member at the base of the escarpment to the west of Novavita Farmstead.

Figure 21. Well-developed ferruginised basal channel breccia within the Koornplaats Member, Bruwelskop, Hamel Kraal Farm 16 (Loc. 079) (Hammer = 30 cm). Such breccias are composed mainly of mudflakes and calcrete nodules but may also contain fossil wood, teeth and bones (*cf* Figs. 40, 56, 57 and 60).

Figure 22. Close-up of basal channel breccia in the Koornplaats Member, Hamel Kraal Farm 16 (Loc. 004) containing reworked calcrete nodules and mudfalkes in a ferruginised sandy matrix (Scale in cm).

Figure 23. Unusually thick and extensive *koffieklip* lens (sandstone secondarily mineralised with iron and manganese minerals) within a channel sandstone of the Koornplaats Member, *c*. 1.5 km SE of the proposed Main Transmission Substation.

Figure 24. Thick package of grey-green and purple-brown overbank mudrocks within the Koornplaats Member on the eastern flanks of Bakenkop, just south of the MTS site, Hamel Kraal Farm 16 (Loc. 019).

Figure 25. Wave-rippled upper surface of a Koornplaats Member crevasse-splay sandstone on Hamel Kraal Farm 16 (Loc. 025). The surface is associated with abundant invertebrate trace fossils (Fig. 62).

Figure 26. Package of closely-spaced, sheet-like channel sandstones of the Moordenaars Member building the upper edge of the Besemgoedberg Escarpment near Blouval, Farm 219.

Figure 27. Gentle hillslope exposure of purple-brown overbank siltstones within the upper part of the Moordenaars Member, Nooitgedagt Farm 148 (Loc. 540).

Figure 28. Exceptional concentration of pebble- to cobble-sized exotic clasts within fine-grained mudrocks of the Mordenaars Member, Nooitgedagt 148 (Loc. 540. See previous figure). These are among the largest clasts recorded within the Lower Beaufort Group in the SW Karoo, possibly transported by floating tree roots.

Figure 29. Excellent stream gulley exposures of blue-grey overbank mudrocks of the Moordenaars Member on Nooitgedagt Farm 148. Tabular packages of thin-bedded mudrocks were deposited on the distal floodplain, perhaps within playa lakes.

Figure 30. Well-developed palaeosol horizon marked by dense pale grey pedogenic calcrete concretions, Moordenaars Member, Tonteldoosfontein Farm 152 (Hammer = 30 cm). Such horizons are a primary focus for recording vertebrate fossil remains.

Figure 31. Downwasted Abrahamskraal Formation sandstones forming rubbly surface gravels south of Bruwelskop, Hamel Kraal 16 (Loc. 081).

Figure 32. Coarse stream gravels capped by sandy to silty alluvium exposed in the banks of the Brandleegte River west of Hamelkraal homestead.

Figure 33. Surface gravels dominated by coffee-brown ferruginous carbonate concretions weathering out of Koornplaats Member mudrocks, Hamel Kraal Farm 16 (Loc. 026).

3. PALAEONTOLOGICAL HERITAGE

The fossil record of the principal sedimentary rock units represented within the WEF electrical grid infrastructure and MTS study region has been reviewed in previous palaeontological assessment reports for the region by Almond (2010b, 2010c, 2011, 2015g, 2017). In this section of the Basic Assessment report only a short summary of earlier finds is given, plus a brief illustrated account of new fossil records made during the recent field-based assessment of the study area.

3.1. Fossil biotas of the Lower Beaufort Group (Adelaide Subgroup)

The overall palaeontological sensitivity of the Beaufort Group sediments is high to very high (Almond & Pether 2008, SAHRIS website). These continental sediments have yielded one of the richest fossil records of land-dwelling plants and animals of Permo-Triassic age anywhere in the world (MacRae 1999, Rubidge 2005, McCarthy & Rubidge 2005, Smith *et al.* 2012). Bones and teeth of Late Permian tetrapods have been collected in the western Great Karoo region since at least the 1820s and this area remains a major focus of palaeontological research in South Africa.

A chronological series of mappable fossil biozones or assemblage zones (AZ), defined mainly on their characteristic tetrapod faunas, has been established for the Main Karoo Basin of South Africa (Rubidge 1995, 2005, Van der Walt *et al.* 2010). Maps showing the distribution of the Beaufort Group assemblage zones within the Main Karoo Basin have been provided by Keyser and Smith (1979, Fig. 25 herein) and Rubidge (1995, 2005). A recently updated version is now available (Nicolas 2007, Van der Walt *et al.* 2010). The assemblage zone represented within the present study area is the Middle Permian ***Tapinocephalus* Assemblage Zone** (Theron 1983, Rubidge 1995).

The main categories of fossils recorded within the *Tapinocephalus* fossil biozone (Keyser & Smith 1977-78, Anderson & Anderson 1985, Smith & Keyser 1995a, MacRae 1999, Rubidge 2005, Nicolas 2007, Almond 2010a, Smith *et al.* 2012, Day 2013a, Day 2013b, Day *et al.* 2015b) include:

- isolated petrified bones as well as rare articulated skeletons of tetrapods (*i.e.* air-breathing terrestrial vertebrates) such as true **reptiles** (notably large herbivorous pareiasaurs like *Bradysaurus*, small insectivorous millerettids), rare pelycosaurs, and diverse **therapsids** or “mammal-like reptiles” (*e.g.* numerous genera of large-bodied dinocephalians, herbivorous dicynodonts, flesh-eating biarmosuchians, gorgonopsians and therocephalians) (Fig. 35);

- aquatic vertebrates such as large **temnospondyl amphibians** (*Rhinesuchus*, usually disarticulated), and **palaeoniscoid bony fish** (*Atherstonia*, *Namaichthys*, often represented by scattered scales rather than intact fish);

- freshwater **bivalves** (*Palaeomutela*);

- **trace fossils** such as worm, arthropod and tetrapod burrows and trackways, coprolites (fossil droppings) and plant stem or root casts;

- **vascular plant remains** (usually sparse and fragmentary), including leaves, twigs, roots and petrified woods ("*Dadoxylon*") of the *Glossopteris* Flora, especially glossopterid trees and arthrophytes (horsetail ferns).

In general, tetrapod fossil assemblages in the *Tapinocephalus* Assemblage Zone are dominated by a wide range of dinocephalian genera and small therocephalians *plus* pareiasaurs while relatively few dicynodonts can be expected (Day & Rubidge 2010, Jirah & Rubidge 2010 and references. therein). Vertebrate fossils in this zone are generally much rarer than seen in younger assemblage zones of the Lower Beaufort Group, with almost no fossils to be found in the lowermost beds (Loock *et al.* 1994) (Fig. 36).

Despite their comparative rarity, there has been a long history of productive fossil collection from the *Tapinocephalus* Assemblage Zone in the western and central Great Karoo area, as summarized by Rossouw and De Villiers (1952), Boonstra (1969) and Day (2013b). Numerous fossil sites recorded in the region are marked on the published 1: 250 000 Sutherland geology sheet 3220 (Fig. 19) but none of these sites lies within the present project footprint. According to the vertebrate fossil distribution map of Keyser and Smith (1977-78; Fig. 34) there is a paucity of known sites within the present study area. Vertebrate fossils found in the Sutherland sheet area are also listed by Kitching (1977) as well as Theron (1983). They include forms such as the pareiasaur *Bradysaurus*, tapinocephalid and titanosuchid dinocephalians *plus* rarer dicynodonts, gorgonopsians and therocephalians (*e.g.* pristerognathids, *Lycosuchus*) as well as land plant remains (*e.g.* arthrophyte stems and leaves). Numerous fossil sites were recorded along the eastern edge of the Moordenaarskaroo in the key biostratigraphic study of the Abrahamskraal Formation by Loock *et al.* (1994). A palaeontological heritage study was carried out by the author within the Abrahamskraal Formation of the Moordenaarskaroo and Koup regions to the south and southeast of the present study area (Almond 2010a). This fieldwork yielded locally abundant dinocephalian and other therapsid skeletal remains, large, cylindrical vertical burrows or plant stem casts, *Scoyenia* ichnofacies trace fossil assemblages and sphenophytes (horsetail ferns) associated with probable playa lake deposits, as well as locally abundant petrified wood. An earlier palaeontological field assessment of Mordenaars Member rocks on the outskirts of Sutherland by Almond (2005) yielded only transported plant remains (arthrophytes including *Phyllotheca*, glossopterid and other, more strap-shaped leaves, possible wood tool marks), sparse trace fossil assemblages of the damp-ground *Scoyenia* ichnofacies, and rare fragments of rolled bone. Reworked silicified wood from surface gravels, scattered, fragmentary plant remains associated with channel sandstones and rare disarticulated bones were reported by Almond (2011) from a Moordenaars Member study site *c*. 11 km south of Sutherland.

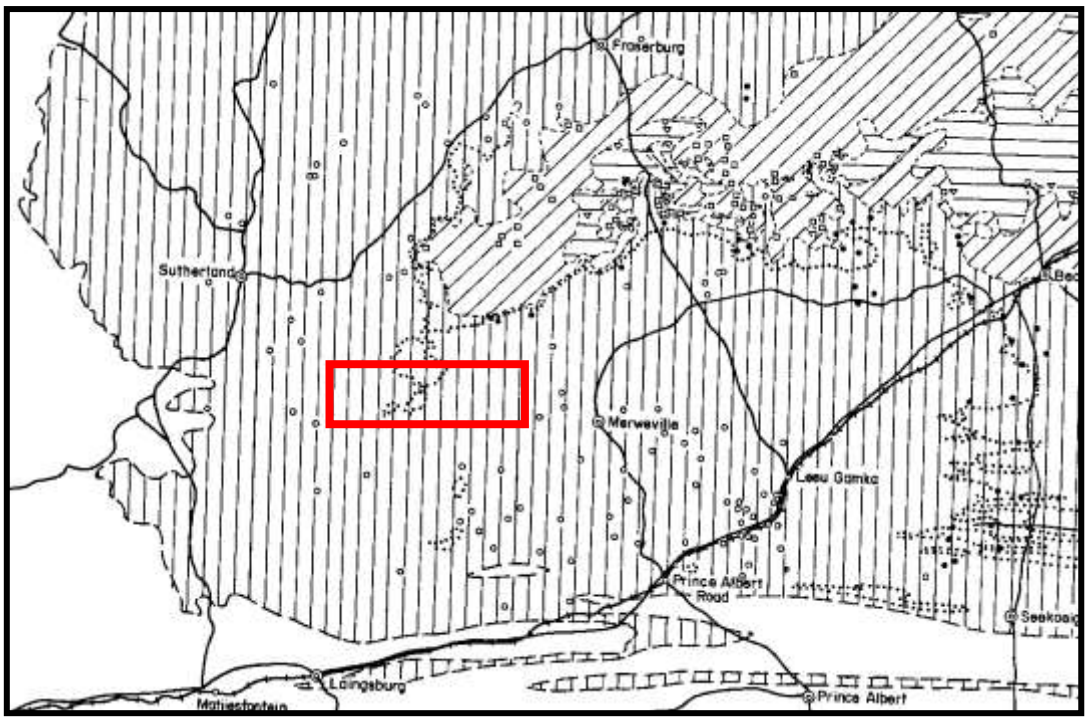


Figure 34. Distribution of vertebrate fossil localities within the Lower Beaufort Group in the south-western Karoo region (Map abstracted from Keyser & Smith 1977-78). Outcrop areas with a vertical lined ornament are assigned to the Middle Permian *Tapinocephalus* Assemblage Zone. Note the paucity of vertebrate fossil records from the lower part of the Abrahamskraal Formation in the WEF electrical grid infrastructure study area between Sutherland and Merweville (red rectangle). This probably reflects palaeontological neglect more than an absence of fossil material.

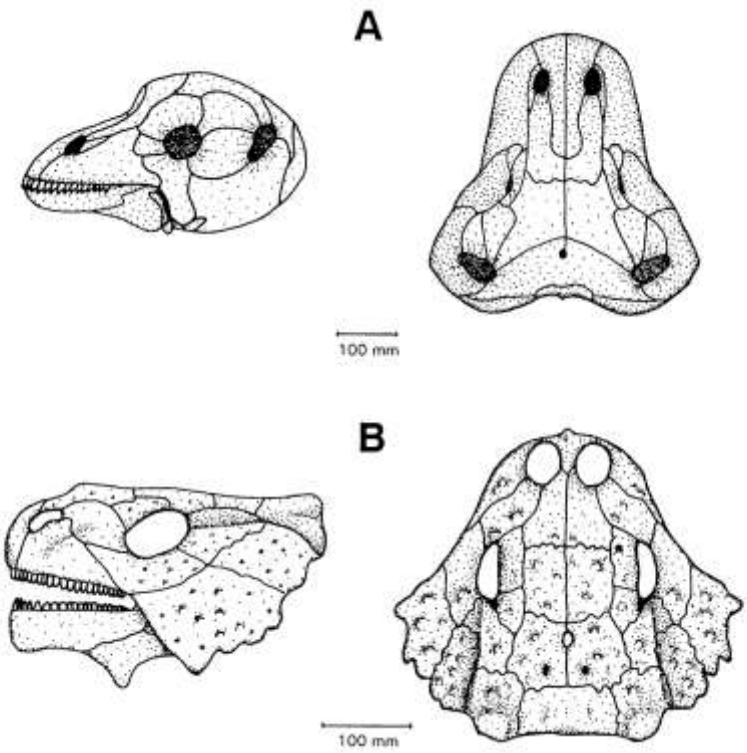


Figure 35. Skulls of two key large-bodied tetrapods of the *Tapinocephalus* Assemblage Zone: A – the dinocephalian therapsid *Tapinocephalus*; B – the pareiasaur *Bradysaurus* (From Smith & Keyser 1995b).

A recent palaeontological field assessment of the Gunstfontein WEF study area (Almond 2015g), situated just to the west of the present WEF electrical infrastructure study area, yielded the following records of fossil material from the Abrahamskraal Formation bedrocks. All these records are from the Moordenaars Member on the Roggeveld Plateau and are representative of the categories and preservation styles of expected and observed fossil material within the present study area:

- Rare transported fossil bone fragments and probable disarticulated bony fish scales preserved within ferruginised basal channel breccias;
- Low diversity trace fossil assemblages of the *Scoyenia* ichnofacies on sandstone sole surfaces as well as treptichnid-like serial probe burrows associated with high energy sheet-laminated sandstone facies;
- Sandstone casts of reedy plant stems – probably sphenophytes (“horsetails”) – within crevasse splay sandstones;
- Ferruginised or slightly dark-hued impressions of non-woody plant material, including occasional well-preserved, tongue-shaped glossopterid leaves showing midribs as well as indeterminate leaf and stem fragments, preserved within dark brown, impure sandstone facies;
- Local concentrations of indeterminate woody plant material preserved as ferruginised moulds in channel sandstones, often associated with basal breccio-conglomerates and / or *koffieklip*;

- Sparse to locally common, poorly- to well-preserved blocks of silicified wood, including portions of sizeable logs, occurring among surface sandstone rubble, downwasted surface gravels and sheetwash gravels. Much of this material has a pale yellowish to creamy, cherty, vuggy appearance with no obvious preservation of the original woody fabric and may represent wood that was silicified at a late stage of decomposition. However, some of the petrified wood fragments do show well-preserved xylem cells. While the petrified wood blocks recorded during the present study have not been observed *in situ*, it is inferred that they have been reworked from nearby channel sandstone bodies.

Fossil records made during the recent field assessment for the WEF electrical grid infrastructure projects are tabulated with brief notes in the Appendix 1. The sites are indicated with reference to the proposed powerline routes on the Google earth© satellite map in Figures 1 to 3. The fossils found belong for the most part to the same categories as those listed above for the adjoining Gunsfontein WEF study area. For the purposes of the present palaeontological heritage basic assessment study, the following additional points should suffice here.

Disarticulated fossil bones, mainly of large-bodied tetrapods such as pareiasaurs and dinocephalians, are found widely, but usually very sparsely, at surface within the Abrahamskraal Formation outcrop area. Some of the material has clearly weathered out of basal channel breccio-conglomerates where it may be associated with reworked fossil wood (Figs. 37 & 54). Most of the specimens observed are fragmentary, highly weathered, secondarily ferruginised and, in some cases, rounded by transport (Figs. 48 & 55). Sun-cracked surface textures are commonly seen. Without associated skull material they are difficult to identify and for the most part of limited scientific value; the very thick skull roof fragment seen in Figure 59 can be ascribed to a tapinocephalid dinocephalian. The notable scatter of robust post-cranial bones observed within sandstone scree on Portugals Rivier 218 (Figs. 41 to 43) may belong to one or more individuals. The partially embedded, articulated post-cranial skeleton of a large tetrapod at Loc. 535 (Beeren Valley Farm 150) (Figs. 38 & 39) is of heritage conservation significance but will not be impacted by the present electrical infrastructure project.

Basal channel breccias in the Koornplaats and Moordenaars Members may be locally rich in transported woody plant material (often preserved as ferruginized moulds; Fig. 60) as well as reworked tetrapod remains. The latter include disarticulated, rounded bones and isolated teeth (Figs. 56 and 57), most of which are unidentifiable. The extensive scatters of petrified logs (mostly, but not all, poorly-preserved) seen at surface on Hamel Kraal Farm 16 (Locs. 041-074, 015, 024; Figs. 49 to 53) and the scarce associated bone fragments have probably weathered out of a local channel sandstone within the Koornplaats Member. Nearby *koffiklip* lenses contain occasional reworked bone (Fig. 55). The largest fossil scatter lies 500 m southwest of the 132 kV powerline route and should not be directly impacted by the proposed development (Fig. 63).

Probable sandstone casts of tetrapod burrows were observed at several localities, but in several cases their interpretation as such is equivocal (*cf* Fig. 47). The best examples include a concentration of several gently inclined, subcylindrical tetrapod burrow casts (*c*. 15 cm wide) embedded in maroon overbank mudrocks that were observed within the

Karelskraal Member on Nooitgedagt 148 (Loc. 521). One of these burrows shows well-developed scratch marks on the ventrolateral surface (Fig. 37). These are among the youngest recorded tetrapod burrows within the Abrahamskraal Formation. They may well have been constructed by dicynodonts. Note that this stratigraphic horizon does not crop out within the 132 kV powerline study area itself. Other vertebrate traces of interest are dense arrays of subcylindrical sandstone casts of lungfish aestivation burrows (Loc. 512, Portugals Rivier 218) (Fig. 45). Similar vertical burrow assemblages have been recorded elsewhere in the SW Karoo at several localities and horizons within the Abrahamskraal Formation (*cf* Almond 2010a, Odendaal & Loock 2015).

The oblique, small-scale invertebrate burrow observed at Loc. 509 (Portugals Rivier 218; Fig. 44) is unusual in that the trace maker – possibly some sort of crustacean – had to burrow through a coarse, gravelly substrate. Other small-scale trace fossils observed include stem casts of reedy plants within sandstone beds and occasional low-diversity assemblages of straight to curving, cylindrical invertebrate burrows exposed at the surface or within channel sandstone bodies (Figs. 46 and 61); many of the latter can be assigned to the *Scoyenia* ichnofacies and are associated with wave-rippled crevasse splay sandstone bed tops (Figs. 25 & 62).

Occurrences of sandstone-hosted uranium ore bodies picked up by aerial surveys of the Sutherland sheet area are often associated with fossil plant material and *koffieklip* (Almond 2015g). Decomposition of rotting plant material embedded within channel sandstones often played a key role in the precipitation of uranium minerals (See detailed discussion in Cole & Vorster 1999, Cole & Wipplinger 2001). It is therefore possible that the uranium anomalies mapped close to the present WEF electrical grid infrastructure study area may be associated with fossil plants, though this particular point was *not* addressed during recent fieldwork. On palaeontological as well as economic geological and general geoscientific grounds it is therefore recommended that a 30 m - radius buffer zone be recognised around previously-identified uranium anomalies close to the powerline corridor that are mapped in Fig. 18 (GPS data for numbered anomalies are provided by Cole & Vorster 1999 and also given in Appendix 1).

3.2. Fossils within the superficial deposits

The diverse superficial deposits within the South African interior have been comparatively neglected in palaeontological terms. However, sediments associated with ancient drainage systems, springs and pans in particular may occasionally contain important fossil biotas, notably the bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises (*e.g.* Skead 1980, Klein 1984b, Brink, J.S. 1987, Bousman *et al.* 1988, Bender & Brink 1992, Brink *et al*. 1995, MacRae 1999, Meadows & Watkeys 1999, Churchill *et al*. 2000, Partridge & Scott 2000, Brink & Rossouw 2000, Rossouw 2006). Other late Caenozoic fossil biotas that may occur within these superficial deposits include non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (*e.g.* calcretised termitaria, coprolites, invertebrate burrows, rhizocretions), and plant material such as peats or palynomorphs (pollens) in organic-rich alluvial horizons (Scott 2000) and diatoms in pan sediments. In Quaternary deposits, fossil remains may be associated with human artefacts such as stone tools and are also of archaeological interest (*e.g.* Smith 1999 and references therein).

Ancient solution hollows within extensive calcrete hardpans may have acted as animal traps in the past. As with coastal and interior limestones, they might occasionally contain mammalian bones and teeth (perhaps associated with hyaena dens) or invertebrate remains such as snail shells.

Apart from the reworked Beaufort Group petrified wood and bones within alluvial and colluvial gravels described earlier, no fossils were observed within the various Late Caenozoic superficial deposits represented within the WEF electrical grid infrastructure study area during the recent field studies.

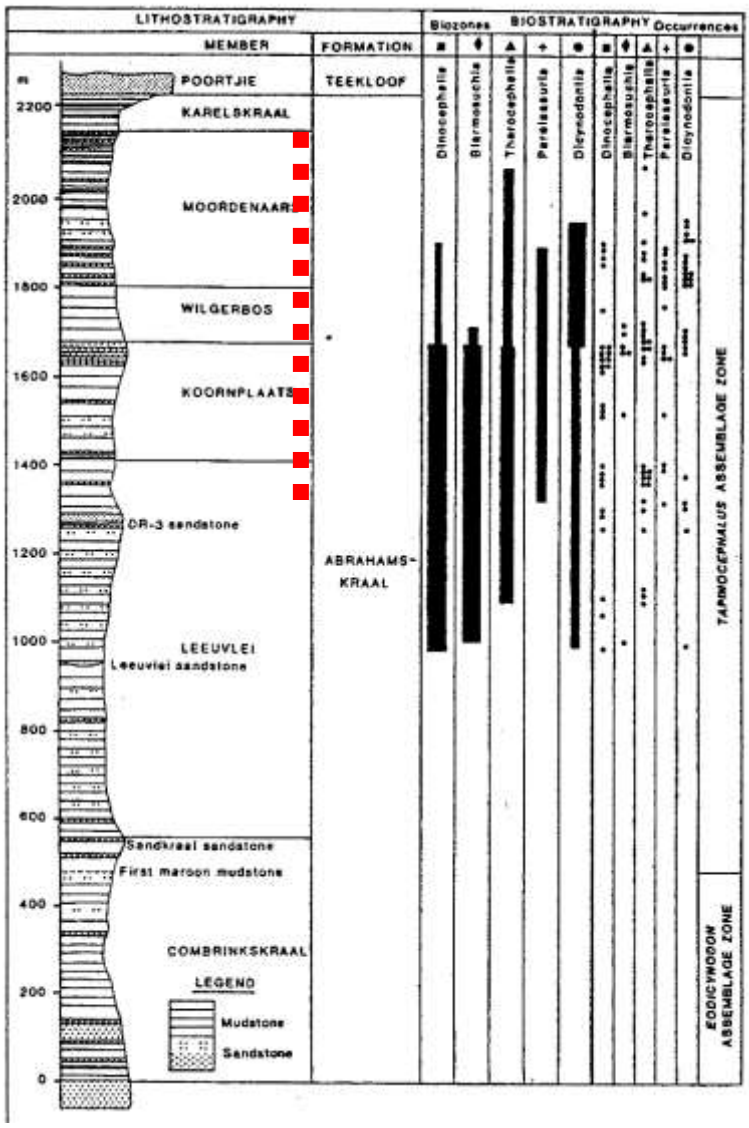


Figure 36. Chart showing the subdivision of the Abrahamskraal Formation in the western Karoo region with the stratigraphic distribution of the major fossil vertebrate groups (Loock *et al*. 1994). The WEF electrical grid infrastructure project area on the Roggeveld Plateau is largely underlain by sediments of the Moordenaars Member. Lower stratigraphic intervals are represented within the Besemgoedberg Escarpment zone and the low-lying Koup region to the east, including the MTS project area on Hamel Kraal Farm 16 (See red dotted line).

Figure 37. Gently-inclined, curved tetrapod burrow cast within the Kareslkraal Member (Scale *c*. 15 cm long), one of several in the area. Nooitgedagt 148 (Loc. 521). This is one of the youngest tetrapod burrows recorded from the Abrahamskraal Formation.

Figure 38. Partially-embedded, well-articulated postcranial skeleton of a large tetrapod, Beeren Valley 150 (Loc. 535) (Scale is *c*. 15 cm long). This specimen is of conservation value but lies well outside the present project footprint.

Figure 39. Detail of the articulated skeleton seen in the preceding figure showing the attachment of several ribs along the backbone.

Figure 40. Sizeable disarticulated bone, preserved in part as a mould, embedded within a calcrete-rich breccia at the base of a channel sandstone, Moordenaars Member, Portugalsrivier 218 (Loc. 509) (Scale in cm and mm).

Figure 41. Several highly-weathered, secondarily ferruginised pieces of tetrapod bone found among surface float, Portugals Rivier 218 (Loc. 545) (Scale in cm). The limb bone on the left shows superficial sun-cracking due to protracted pre-burial exposure.

Figure 42. Sandstone scree on Portugals Rivier 218 with numerous dispersed fossil bones that may have weathered out of the channel sandstone above. Several fossil bones have been collected together in one spot (arrow) (Loc. 546).

Figure 43. Close-up of large tetrapod bones (pareiasaur and / or dinocephalian) shown in the previous figure (Loc. 546) (Scale *c.* 15 cm long). They may belong to one or more individuals but are difficult to identify without associated cranial material.

Figure 44. Fossiliferous basal channel breccia penetrated by an inclined invertebrate burrow – possibly crustacean, Moordenaars Member, Portugalsrivier 218 (Loc. 509) (Scale in cm).

Figure 45. Road cutting through interbedded thin sandstones and overbank mudrocks of the Moordenaars Member showing several cylindrical lungfish burrow casts up to 10 cm in diameter (arrowed), Portugals Rivier 218 (Loc. 512).

Figure 46. Upper surface of a Moordenaars Member channel sandstone with ill-defined horizontal burrows, Beeren Valley 150 (Loc. 530) (Scale is 15 cm long).

Figure 47. Two closely-spaced, anomalous, sandstone-infilled structures (arrowed) embedded within overbank mudrocks – possibly tetrapod burrows, Moordenaars Member, Nooitgedagt 148 (Loc.555) (Hammer = 30 cm).

Figure 48. Isolated block of dense bone in surface float, probably from the Swaerskraal Member, Farm 219 (Loc. 030). Specimen is *c*. 8 cm in longest dimension.

Figure 49. Extensive surface scatter of sizeable blocks of petrified wood weathering out from the Koornplaats Member, Hamel Kraal Farm 16 (Loc. 041). This site is of conservation significance (See also satellite image in Fig. 49).

Figure 50. Block of well-preserved silicified log showing woody fabric and knots, Hamel Kraal Farm 16 (Same locality as preceding figure) (Scale in cm and mm).

Figure 51. Partially embedded, secondarily-ferruginised petrified log that is breaking up *in situ*, Hamel Kraal Farm 16 (Same locality as Fig. 40) (Scale is 15 cm long).

Figure 52. Blocks of poorly-preserved silicified wood dispersed among surface gravels on Hamel Kraal Farm 16 (Loc. 015) (Scale = 15 cm). This material has probably been reworked from Koornplaats Member channel sandstones in the region.

Figure 53. Close-up of typical block of petrified wood (*c*. 15 cm across) from the Koornplaats Member outcrop area showing abundant cavities and poor preservation of woody fabric. The wood may have been extensively decomposed before diagenetic silicification.

Figure 54. Sizeable blocks of spongy fossil bone occurring as float in the vicinity of the petrified wood surface scatter seen in Fig. 40, Hamel Kraal 16 (Loc. 042) (Scale in cm and mm).

Figure 55. Rounded, reworked bone fragment embedded within ferruginised channel sandstone (*koffieklip*), Hamel Kraal Farm 16 (close to Loc. 041) (Bone is *c*. 1.5 cm wide).

Figure 56. Fragment of a large tusk (*c*. 2.5 cm across, circular in cross-section) – probably therapsid - that has weathered out of a basal channel breccia in the Koornplaats Member, Bruwelskop, Hamel Kraal Farm 16 (Loc. 079).

Figure 57. Fragmentary postcranial tetrapod bones weathering out of a Koornplaats Member basal channel breccia on Hamel Kraal Farm 16 (Loc. 005) (Scale in cm).

Figure 58. Weathered and reworked postcranial bone fragments of one or more large-bodied tetrapods found among surface gravels close to the 132 kV transmission line route on Hamel Kraal Farm 16 (Loc. 024) (Scale in cm).

Figure 59. Fragment of the highly-thickened bony cranium of a tapinocephalid dinocephalian found among float, Hamel Kraal Farm 16 (Loc. 027) (Scale in cm).

Figure 60. Ferruginised mould of transported woody debris preserved within a channel breccia, Koornplaats Member, Bruwelskop, Hamel Kraal Farm 16 (Loc. 079) (Scale in cm and mm).

Figure 61. Blocks of dark-patinated channel sandstone (*koffieklip*) showing prominent-weathering intrastratal horizontal burrows, Hamel Kraal Farm 16 (Loc. 084) (Hammer = 30 cm). These rocks show a superficial resemblance to dolerite.

Figure 62. Abundant low-diversity invertebrate trace fossils and sandy desiccation crack infills associated with a wave-rippled crevasse splay sandstone surface, Hamel Kraal Farm 16 (Loc. 25) (*cf* Fig. **) (Scale in cm).

4. ASSESSMENT OF IMPACTS

Given the rather uniform geology and sparse, largely unpredictable distribution of recorded or anticipated palaeontological resources within the Sutherland WEF electrical grid infrastructure and MTS substation study areas (Section 3), this impact assessment applies equally to entire electrical infrastructure footprint (Figs. 1 to 3).

All South African fossil heritage is protected by law (South African Heritage Resources Act, 1999) and fossils may not be collected, damaged or disturbed without a permit from the relevant Provincial Heritage Resources Agencies (in this case Heritage Western Cape and SAHRA) (See Section 1.2). The construction phase of the proposed substation, 132 kV powerline and 400 kV powerline will entail extensive surface clearance (notably for service roads, pylon footings, laydown areas, MTS substation) as well as excavations into the superficial sediment cover and underlying bedrocks (*e.g. for* pylon footings, service roads). The development may adversely affect potential fossil heritage within the study area by destroying, damaging, disturbing or permanently sealing-in fossils preserved at or beneath the surface of the ground that are then no longer available for scientific research or other public good.

The planning, operational and de-commissioning phases of the electrical grid infrastructure are very unlikely to involve further adverse impacts on local palaeontological heritage and are therefore not separately assessed here.

4.1. Impact assessment for the construction phase

This assessment (See Table 1) refers to impacts on fossil heritage preserved at or beneath the ground surface within the footprint of the proposed MTS substation and associated 132 kV and 400 kV powerlines during the construction phase, mainly due to surface clearance and excavation activities. It is noted that surface clearance for lengthy service roads associated with new powerlines is likely to have greater impact on fossil heritage than the intermittent, shallow excavations for small pylon footings. Such impacts on fossil heritage are *site specific* (limited to the development footprint) and are generally *direct*, *negative* and of *permanent* duration (non-reversible). While fossils of some sort (including microfossils, invertebrate trace fossils and plant debris) are of widespread occurrence within the project area, *unique or scientifically-important (conservation-worthy) fossils* are very scarce and unpredictably distributed here, even where bedrock exposure levels are locally high. Only one highly-sensitive “no-go” area was identified within the electrical grid infrastructure study area and this lies outside the proposed development footprint (Figure 63). It is concluded that impacts on scientifically important palaeontological heritage resources are *unlikely* and of *slight consequence* since (1) significant fossil sites are unlikely to be affected, given the small development footprint and rarity of scientifically-important fossils and (2) in many cases these impacts can be mitigated. The overall impact significance during the construction phase of the substation and powerline infrastructure, including the powerline service road, *without mitigation* is rated as LOW in terms of palaeontological heritage resources. Should the proposed mitigation measures outlined in Section 5 below be fully implemented, the impact significance would be very low. However, residual negative impacts such as the inevitable loss of fossil heritage would be partially offset by an improved understanding of Karoo fossil heritage which is considered a *positive* impact.

There are no objections on palaeontological heritage grounds to authorisation of the proposed electrical grid infrastructure and MTS substation developments. Confidence levels for this assessment are rated as only *medium*. This is due to the necessarily superficial coverage of the recent field assessment and the absence of field-based palaeontological assessments for the relevant WEF projects.

The impact assessment for the **No-Go Option** considers future impacts on local fossil heritage that are likely to occur in the absence of the WEF powerline and MTS substation development, using the present status of fossil heritage in the area as a baseline. Destruction of near-surface or surface fossil material by natural bedrock weathering and erosion will be partially counterbalanced by on-going exposure of fresh fossil material by erosion. Improvements in our understanding of palaeontology of the area (a possible positive impact) will depend on whether or not field-based academic or impact studies are carried out here, which is inherently unpredictable (There is an on-going research project on the palaeontology of the SW Karoo by Wits University).

Table 1: Assessment of anticipated direct impacts on palaeontological heritage resources for the proposed Sutherland WEF electrical grid infrastructure, including the MTS substation, 132 kV and 400 kV powerlines as well as the associated service road (construction phase).

Aspect/Activity	**Surface clearance & bedrock excavations during construction phase**
Type of impact	Direct (negative)
Potential Impact	Disturbance / damage or destruction of fossils at or beneath the ground surface
Impact Significance (Pre-Mitigation)	LOW
Mitigation Required	1. Safeguarding of any chance fossil finds (preferably *in situ*) during the construction phase by the responsible ECO, followed by reporting of finds to Heritage Western Cape / SAHRA. 2. Recording and judicious sampling of significant chance fossil finds by a qualified palaeontologist 3. Curation of fossil material within an approved repository (museum / university fossil collection) and 4. Submission of a Phase 2 palaeontological heritage report to HWC / SAHRA by a qualified palaeontologist.
Impact Significance (Post-Mitigation)	VERY LOW

4.2. Assessment of cumulative impacts (construction phase)

In the current absence of field-based palaeontological heritage assessments for the relevant Sutherland, Sutherland 2 and Rietrug WEFs (These studies have been requested in the pre-construction phase by SAHRA, Interim Comment of 5 July 2016; Case ID 9622) as well as the separate Moyeng Energy Suurplaat WEF, it is not yet feasible to meaningfully assess cumulative palaeontological impacts for the associated electrical grid infrastructure. Among available palaeontological impact studies for other developments proposed for the region, the most relevant are those on the Roggeveld Plateau for Jakhals Valley solar project (Almond 2011) and the Gunsfontein WEF (Almond 2015g), both located to the south of Sutherland and west of the present study area. The Gamma-Omega 765 kV powerline study by Almond (2012a) considers fossil heritage in the Koup region to the west of Merweville. There are numerous further WEF projects proposed for the Klein-Roggeveld region, below the great escarpment and south of the present study area, but for the most part these concern rocks and fossil assemblages that are older than those encountered in the present study area; exceptions include the Maralla East and Maralla West WEFs (Almond 2015h, 2015i) as well as the Komsberg West and Komsberg East WEFs (Almond 2015j, 2015k).

In all the strictly *relevant* field-based palaeontological studies in the Klein-Roggeveld and Roggeveld Plateau regions the palaeontological sensitivity of the project area and the palaeontological heritage impact significance for the developments concerned has been rated as low. In all cases it was concluded by the author that, despite the undoubted occurrence of scientifically-important fossil remains (notably fossil vertebrates, vertebrate trackways and burrows, petrified wood), the overall impact significance of the proposed developments was low because the probability of significant impacts on *scientifically important, unique or rare fossils* was slight. While fossils do indeed occur within some of the formations present, they tend to be sparse – especially as far as fossil vertebrates are concerned - while the great majority represent common forms that occur widely within the outcrop areas of the rock units concerned. It is concluded that – pending the outcome of outstanding palaeontological field-based studies for the Moyeng Energy Suurplaat WEF and original Mainstream Sutherland WEF (now split into the Sutherland, Sutherland 2 and Rietrug WEFs) - the cumulative impact significance of the proposed new MTS substation and associated electrical grid infrastructure developments in the context of other regional projects is likely to be *low* (*negative*). This is the case *provided that* the proposed monitoring and mitigation recommendations made for all these various projects are followed through. Unavoidable residual negative impacts may be partially offset by the improved understanding of Karoo palaeontology resulting from appropriate professional mitigation. This is regarded as a *positive* impact for Karoo palaeontological heritage. However, *without* mitigation the magnitude of cumulative (negative, direct) impacts of such a large number of WEFs and associated powerlines affecting the same (albeit sparsely) fossiliferous rock successions would be significantly higher and probable. The cumulative impact significance without mitigation is accordingly assessed provisionally as *medium* (Table 2).

Table 2: Cumulative impacts on palaeontological heritage: summary assessment table (construction phase)

Aspect/Activity	**Surface clearance & bedrock excavations during construction phase**
Type of impact	Direct (negative)
Potential Impact	Disturbance / damage or destruction of fossils at or beneath the ground surface
Impact Significance (Pre-Mitigation)	MEDIUM
Mitigation Required	1. Safeguarding of any chance fossil finds (preferably *in situ*) during the construction phase by the responsible ECO, followed by reporting of finds to Heritage Western Cape / SAHRA. 2. Recording and judicious sampling of significant chance fossil finds by a qualified palaeontologist 3. Curation of fossil material within an approved repository (museum / university fossil collection) and 4. Submission of a Phase 2 palaeontological heritage report to HWC / SAHRA by a qualified palaeontologist.
Impact Significance (Post-Mitigation)	LOW

5. MITIGATION AND MANAGEMENT MEASURES

Given the scarcity of scientifically-important, unique fossil heritage recorded within the electrical grid connection and MTS study area, no further specialist palaeontological studies or mitigation are recommended here, pending the potential discovery of significant new fossils before or during the construction phase.

The following specific and general palaeontological mitigation measures apply to the *construction phase* of the electrical infrastructure development (See Table 3):

- Monitoring of all surface clearance and substantial excavations (>1 m deep) by the ECO for fossil material (*e.g.* bones, teeth, fossil wood) on an on-going basis during the construction phase.

- Safeguarding of chance fossil finds (preferably *in situ*) during the construction phase by the responsible ECO, followed by reporting of finds to Heritage Western Cape / SAHRA.

- Recording and judicious sampling of significant chance fossil finds by a qualified palaeontologist, together with pertinent contextual data (stratigraphy, sedimentology, taphonomy) (Phase 2 mitigation).

- Curation of fossil material within an approved repository (museum / university fossil collection) and submission of a Phase 2 palaeontological heritage report to HWC / SAHRA by a qualified palaeontologist.

Mitigation of significant chance fossil finds reported by the ECO would involve the recording, sampling and / or collection of fossil material and associated geological data by a professional palaeontologist during the construction phase of the development (See Appendix 2). The palaeontologist concerned with potential mitigation work (Phase 2) would need a valid fossil collection permit from the relevant heritage management authority, *i.e.* Heritage Western Cape (W. Cape) or SAHRA (N. Cape), and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological fieldwork and reporting should meet the minimum standards outlined by HWC (2016) and SAHRA (2013).

Significant further impacts on palaeontological heritage resources are not anticipated during the operational, decommissioning and rehabilitation phases of the proposed Sutherland WEF Electrical Grid Infrastructure, so no further mitigation or management measures in this respect are proposed here.

These monitoring and mitigation requirements should be incorporated into the EMPr for the proposed MTS substation and electrical grid infrastructure project and also included as conditions for authorisation of the development.

Figure 63. Google earth satellite image of part of Farm Hamel Kraal 16 showing the location of an extensive surface scatter of petrified wood *plus* occasional bone fragments either side of a farm track (Locs. 041- 074). The yellow polygon outlines a *c*. 30-m wide peripheral buffer zone around the fossil scatter. The black line *c*. 500 m to the northeast shows the 132 kV transmission line route.

Table 3: Management Plan for the Construction Phase (Including pre- and post-construction activities): Palaeontological Heritage

Impact	Mitigation/Management Objectives	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
A. CONSTRUCTION PHASE					
A.1. PALAEONTOLOGICAL HRITAGE IMPACTS					
Disturbance, damage or destruction of fossils preserved at or below the ground surface during construction activities - especially ground clearance (e.g. for service roads) and substantial excavations (e.g. pylon footings)	Protection of known sensitive fossil sites from disturbance. Safeguarding, recording and sampling of significant new chance fossil finds. Improved palaeontological database for the SW Karoo region.	1. Safeguarding of any chance fossil finds (preferably *in situ*) during the construction phase by the responsible ECO, followed by reporting of finds to Heritage Western Cape / SAHRA. 2. Recording and judicious sampling of significant chance fossil finds by a qualified palaeontologist, together with pertinent contextual data (stratigraphy, sedimentology, taphonomy) (Phase 2 mitigation). 3. Curation of fossil material within an approved repository (museum / university fossil collection) and submission of a Phase 2 palaeontological heritage report to HWC / SAHRA by a qualified palaeontologist.	Monitoring of all surface clearance and substantial excavations (>1 m deep) for fossil material (*e.g.* bones, teeth, fossil wood). Reporting of significant chance fossil finds to the relevant heritage management authority (HWC / SAHRA) and permit application.	On-going during construction Following fossil finds	ECO ECO and qualified Palaeontologist (appointed by the Project Developer)

6. ACKNOWLEDGEMENTS

Ms Rohaida Abed as well as Ms Surina Laurie of the CSIR – Environmental Management Services offices in Durban and Stellenbosch are both thanked for providing a constant, and sometimes overwhelming, stream of background information for this project as well as for managing the various stages of the fieldwork and report preparation. I am grateful to Dr Jayson Orton of ASHA Consulting (Pty) Ltd, Cape Town, for advice on heritage management issues during the course of project and for incorporating the palaeontological data into a meaningful Heritage Impact Assessment. Logistical back-up as well as assistance in the field *plus* companionship from Ms Madelon Tusenius is, as ever, very much appreciated.

7. REFERENCES

ALMOND, J.E. 2005. Palaeontological scoping report: Proposed golf estate, Sutherland, Northern Cape, 10 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010a. Eskom Gamma-Omega 765kV transmission line: Phase 2 palaeontological impact assessment. Sector 1, Tanqua Karoo to Omega Substation (Western and Northern Cape Provinces), 95 pp + Appendix. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010b. Palaeontological impact assessment: desktop study – Proposed Suurplaat wind energy facility near Sutherland, Western Cape, 33 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2010c. Proposed Mainstream wind farm to the southeast of Sutherland, Northern Cape and Western Cape Provinces. Palaeontological impact assessment: pre-scoping desktop study, 19 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2011. Proposed photovoltaic solar energy facility on the farm Jakhals Valley (RE/99) near Sutherland, Karoo Hoogland Municipality, Northern Cape Province. Palaeontological specialist study: combined desktop and field assessment, 34 pp. Natura Viva cc, Cape Town.

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 expansion of the existing Komsberg 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. 2015b. 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. 2015c. 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. 2015g. 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.

ALMOND, J.E. 2015h. Komsberg East Wind Energy Facility near Sutherland, Laingsburg District, Western Cape. Palaeontological scoping assessment: combined desktop and field-based study, 51 pp. Natura Viva cc, Cape Town.

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

ALMOND, J.E. 2016j. Maralla West Wind Energy Facility near Sutherland, Sutherland Magisterial District, Northern Cape: palaeontological heritage assessment, 51 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2016k. Maralla East Wind Energy Facility near Sutherland, Sutherland & Laingsburg Magisterial Districts, Northern & Western Cape: palaeontological heritage assessment 64 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2017. Proposed Construction of Electrical Grid Infrastructure to support the Rietrug Wind Energy Facility, Northern and Western Cape Provinces. Palaeontological heritage: desktop & field-based basic assessment, 64 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Western Cape. Interim SAHRA technical report, 20 pp. Natura Viva cc., Cape Town.

ANDERSON, J.M. & ANDERSON, H.M. 1985. Palaeoflora of southern Africa. Prodromus of South African megafloras, Devonian to Lower Cretaceous, 423 pp. Botanical Research Institute, Pretoria & Balkema, Rotterdam.

ATAYMAN, S., RUBIDGE, B.S. & ABDALA, F. 2009. Taxonomic re-evaluation of tapinocephalid dinocephalians. Palaeontologia africana 44, 87-90.

BAMFORD, M. 1999. Permo-Triassic fossil woods from the South African Karoo Basin. Palaeontologia africana 35, 25-40.

BENDER, P.A. 2004. Late Permian actinopterygian (palaeoniscid) fishes from the Beaufort Group, South Africa: biostratigraphic and biogeographic implications. Council for Geoscience Bulletin 135, 84 pp.

BENDER, P.A. & BRINK, J.S. 1992. A preliminary report on new large mammal fossil finds from the Cornelia-Uitzoek site. South African Journal of Science 88: 512-515.

BOONSTRA, L.D. 1969. The fauna of the Tapinocephalus Zone (Beaufort Beds of the Karoo). Annals of the South African Museum 56: 1-73.

BOTHA-BRINK, J. & MODESTO, S.P. 2007. A mixed-age classed “pelycosaur” aggregation from South Africa: earliest evidence of parental care in amniotes? Proceedings of the Royal Society of London (B) 274, 2829-2834.

BOUSMAN, C.B. *et al.* 1988. Palaeoenvironmental implications of Late Pleistocene and Holocene valley fills in Blydefontein Basin, Noupoort, C.P., South Africa. Palaeoecology of Africa 19: 43-67.

BRINK, J.S. 1987. The archaeozoology of Florisbad, Orange Free State. Memoirs van die Nasionale Museum 24, 151 pp.

BRINK, J.S. et al. 1995. A new find of *Megalotragus priscus* (Alcephalini, Bovidae) from the Central Karoo, South Africa. Palaeontologia africana 32: 17-22.

BRINK, J.S. & ROSSOUW, L. 2000. New trial excavations at the Cornelia-Uitzoek type locality. Navorsinge van die Nasionale Museum Bloemfontein 16, 141-156.

BROOM, R. 1909. On the occurrence of water-worn pebbles in the Lower Beaufort shales. Transactions of the Geological Society of South Africa 14, 84-86.

CHURCHILL, S.E. et al. 2000. Erfkroon: a new Florisian fossil locality from fluvial contexts in the western Free State, South Africa. South African Journal of Science 96: 161-163.

COLE, D.I., SMITH, R.M.H. & WICKENS, H. DE V. 1990. Basin-plain to fluvio-lacustrine deposits in the Permian Ecca and Lower Beaufort Groups of the Karoo Sequence. Guidebook Geocongress '90, Geological Society of South Africa, PO2, 1-83.

COLE, D.I., NEVELING, J., HATTINGH, J., CHEVALLIER, L.P., REDDERING, J.S.V. & BENDER, P.A. 2004. The geology of the Middelburg area. Explanation to 1: 250 000 geology Sheet 3124 Middelburg, 44 pp. Council for Geoscience, Pretoria.

COLE, D. & SMITH, R. 2008. Fluvial architecture of the Late Permian Beaufort Group deposits, S.W. Karoo Basin: point bars, crevasse splays, palaeosols, vertebrate fossils and uranium. Field Excursion FT02 guidebook, AAPG International Conference, Cape Town October 2008, 110 pp.

COLE, D.I. & VORSTER, C.J. 1999. The metallogeny of the Sutherland area, 41 pp. Council for Geoscience, Pretoria.

COLE, D.I. AND WIPPLINGER, P.E. 2001, Sedimentology and molybdenum potential of the Beaufort Group in the main Karoo Basin, South Africa, Council for Geoscience Memoir, South Africa 80, 225 pp.

DAY 2013a. Middle Permian continental biodiversity changes as reflected in the Beaufort Group of South Africa: a bio- and lithostratigraphic review of the *Eodicynodon*, *Tapinocephalus* and *Pristerognathus* assemblage zones. Unpublished PhD thesis, University of the Watwatersrand, Johannesburg, 387 pp plus appendices.

DAY, M. 2013b. Charting the fossils of the Great Karoo: a history of tetrapod biostratigraphy in the Lower Beaufort Group, South Africa. Palaeontologia Africana 48, 41-47.

DAY, M. & RUBIDGE, B. 2010. Middle Permian continental biodiversity changes as reflected in the Beaufort group of South Africa: An initial review of the *Tapinocephalus* and *Pristerognathus* assemblage zones. Proceedings of the 16th conference of the Palaeontological Society of Southern Africa, Howick, August 5-8, 2010, pp. 22-23.

DAY, M., RUBIDGE, B., ALMOND, J. & JIRAH, S. 2013. Biostratigraphic correlation in the Karoo: the case of the Middle Permian parareptile *Eunotosaurus*. South African Journal of Science 109, 1-4.

DAY, M.O. & RUBIDGE, B.S. 2014. A brief lithostratigraphic review of the Abrahamskraal and Koonap formations of the Beaufort group, South Africa: towards a basin-wide

stratigraphic scheme for the Middle Permian Karoo. Journal of African Earth Sciences 100, 227-242.

DAY, M.O., GÜVEN, S., ABDALA, F., JIRAH, S., RUBIDGE, B. & ALMOND, J. 2015b. Youngest dinocephalian fossils extend the *Tapinocephalus* Zone, Karoo Basin, South Africa Research Letter, South African Journal of Science 111, 5 pp.

DAY M.O., RAMEZANI J, BOWRING S.A., SADLER P.M., ERWIN D.H., ABDALA F. & RUBIDGE B.S. 2015a. When and how did the terrestrial mid-Permian mass extinction occur? Evidence from the tetrapod record of the Karoo Basin, South Africa. Proceedings of the Royal Society B282: 20150834. http://dx.doi.org/10.1098/rspb.2015.0834.

DE WET, J.J. 1975. Carbonatites and related rocks at Salpetre Kop, Sutherland, Cape Province. Annals of the University of Stellenbosch Series A1 (Geology) 1, 193-232.

DUNCAN, A.R. & MARSH, J.S. 2006. The Karoo Igneous Province. Pp. 501-520 in Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

ERWIN, D.H. 2006. Extinction. How life on Earth nearly ended 250 million years ago, 296 pp. Princeton University Press, Princeton.

JIRAH, S. & RUBIDGE, B.S. 2010. Sedimentological, palaeontological and stratigraphic analysis of the Abrahamskraal Formation (Beaufort Group) in an area south of Merweville, South Africa. Proceedings of the 16th conference of the Palaeontological Society of Southern Africa, Howick, August 5-8, 2010, pp. 46-47.

JIRAH, S. & RUBIDGE, B.S. 2014. Refined stratigraphy of the Middle Permian Abrahamskraal Formation (Beaufort Group) in the southern Karoo Basin. Journal of African Earth Sciences 100, 121–135.

JOHNSON, M.R. & KEYSER, A.W. 1979. The geology of the Beaufort West area. Explanation of geological Sheet 3222, 14 pp. Council for Geoscience, Pretoria.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

JORDAAN, M.J. 1990. Basin analysis of the Beaufort Group in the western part of the Karoo Basin. Unpublished PhD thesis, University of the Orange Free State, Bloemfontein, 271 pp.

KEYSER, A.W. & SMITH, R.M.H. 1977-78. Vertebrate biozonation of the Beaufort Group with special reference to the Western Karoo Basin. Annals of the Geological Survey of South Africa 12: 1-36.

KITCHING, J.W. 1977. The distribution of the Karroo vertebrate fauna, with special reference to certain genera and the bearing of this distribution on the zoning of the Beaufort beds. Memoirs of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, No. 1, 133 pp (incl. 15 pls).

KLEIN, R. 1980. Environmental and ecological implications of large mammals from Upper Pleistocene and Holocene sites in southern Africa. Annals of the South African Museum 81, 223-283.

KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) Southern African prehistory and paleoenvironments, pp 107-146. Balkema, Rotterdam.

LE ROUX, J.P. 1985. Palaeochannels and uranium mineralization in the main Karoo Basin of South Africa. Unpublished PhD thesis, University of Port Elizabeth, 250 pp.

LOOCK, J.C., BRYNARD, H.J., HEARD, R.G., KITCHING, J.W. & RUBIDGE, B.S. 1994. The stratigraphy of the Lower Beaufort Group in an area north of Laingsburg, South Africa. Journal of African Earth Sciences 18: 185-195.

LUCAS, D.G. 2009. Global Middle Permian reptile mass extinction: the dinocephalian extinction event. Geological Society of America Abstracts with Programs 41, No. 7, p. 360.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa, 305 pp. The Geological Society of South Africa, Johannesburg.

McCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

MEADOWS, M.E. & WATKEYS, M.K. 1999. Palaeoenvironments. In: Dean, W.R.J. & Milton, S.J. (Eds.) The karoo. Ecological patterns and processes, pp. 27-41. Cambridge University Press, Cambridge.

MILLER, D. 2011. Roggeveld Wind Farm: palaeontology study, 7 pp. Appendix to Archaeological, Heritage and Paleontological Specialist Report prepared by ACO Associates, St James.

NICOLAS, M.V. 2007. Tetrapod diversity through the Permo-Triassic Beaufort Group (Karoo Supergroup) of South Africa. Unpublished PhD thesis, University of Witwatersrand, Johannesburg.

ODENDAAL, A.I. AND LOOCK, J.C. 2015. Lungfish burrows in the lower Beaufort Group in the south-western part of the Karoo Basin. Origin and Evolution of The Cape Mountains and Karoo Basin “Imbizo”, 25-27 November 2015, NMMU, poster.

PARTRIDGE, T.C. & MAUD, R.R. 1987. Geomorphic evolution of southern Africa since the Mesozoic. South African Journal of Geology 90: 179-208.

PARTRIDGE, T.C. & SCOTT, L. 2000. Lakes and Pans. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.145-161. Oxford University Press, Oxford.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

PARTRIDGE, T.C. & SCOTT, L. 2000. Lakes and pans. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.145-161. Oxford University Press, Oxford.

RETALLACK, G.J., METZGER, C.A., GREAVER, T., HOPE JAHREN, A., SMITH, R.M.H. & SHELDON, N.D. 2006. Middle – Late Permian mass extinction on land. GSA Bulletin 118, 1398-1411.

ROSSOUW, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust Farm, Central Free State, South Africa. Navorsinge van die Nasionale Museum Bloemfontein 22, 145-162.

ROSSOUW, P.J. & DE VILLIERS, J. 1952. Die geologie van die gebied Merweville, Kaapprovinsie. Explanation to 1: 125 000 geology sheet 198 Merweville, 63 pp. Council for Geoscience, Pretoria.

RUBIDGE, B.S. (Ed.) 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1., 46 pp. Council for Geoscience, Pretoria.

RUBIDGE, B.S. 2005. Re-uniting lost continents – fossil reptiles from the ancient Karoo and their wanderlust. 27th Du Toit Memorial Lecture. South African Journal of Geology 108, 135-172.

RUBIDGE, B.S., ERWIN, D.H., RAMEZANI, J., BOWRING, S.A. & DE KLERK, W.J. 2010. The first radiometric dates for the Beaufort Group, Karoo Supergroup of South Africa. Proceedings of the 16th conference of the Palaeontological Society of Southern Africa, Howick, August 5-8, 2010, pp. 82-83.

RUBIDGE, B.S., ERWIN, D.H., RAMEZANI, J., BOWRING, S.A. & DE KLERK, W.J. 2013. High-precision temporal calibration of Late Permian vertebrate biostratigraphy: U-Pb zircon constraints from the Karoo Supergroup, South Africa. Geology published online 4 January 2013. doi: 10.1130/G33622.1.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SCOTT, L. 2000. Pollen. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp.339-35. Oxford University Press, Oxford.

SEILACHER, A. 2007. Trace fossil analysis, xiii + 226pp. Springer Verlag, Berlin.

SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

SKEAD, C.J. 1980. Historical mammal incidence in the Cape Province. Volume 1: The Western and Northern Cape, 903pp. Department of Nature and Environmental Conservation, Cape Town.

SMITH, R.M.H. 1979. The sedimentology and taphonomy of flood-plain deposits of the Lower Beaufort (Adelaide Subgroup) strata near Beaufort West, Cape Province. Annals of the Geological Survey of South Africa 12, 37-68.

SMITH, R.M.H. 1980. The lithology, sedimentology and taphonomy of flood-plain deposits of the Lower Beaufort (Adelaide Subgroup) strata near Beaufort West. Transactions of the Geological Society of South Africa 83, 399-413.

SMITH, R.M.H. 1986. Trace fossils of the ancient Karoo. Sagittarius 1 (3), 4-9.

SMITH, R.M.H. 1987a. Morphological and depositional history of exhumed Permian point bars in the southwestern Karoo, South Africa. Journal of Sedimentary Petrology 57, 19-29.

SMITH, R.M.H. 1987b. Helical burrow casts of therapsid origin from the Beaufort Group (Permian) of South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology 60, 155-170.

SMITH, R.M.H. 1988. Fossils for Africa. An introduction to the fossil wealth of the Nuweveld mountains near Beaufort West. Sagittarius 3, 4-9. SA Museum, Cape Town.

SMITH, R.M.H. 1989. Fossils in the Karoo – some important questions answered. Custos 17, 48-51.

SMITH, R.M.H. 1990. Alluvial paleosols and pedofacies sequences in the Permian Lower Beaufort of the southwestern Karoo Basin, South Africa. Journal of Sedimentary Petrology 60, 258-276.

SMITH, R.M.H. 1993a. Sedimentology and ichnology of floodplain paleosurfaces in the Beaufort Group (Late Permian), Karoo Sequence, South Africa. Palaios 8, 339-357.

SMITH, R.M.H. 1993b. Vertebrate taphonomy of Late Permian floodplain deposits in the southwestern Karoo Basin of South Africa. Palaios 8, 45-67.

SMITH, R.M.H. & KEYSER, A.W. 1995a. Biostratigraphy of the *Tapinocephalus* Assemblage Zone. Pp. 8-12 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1. Council for Geoscience, Pretoria.

SMITH, R.M.H. & KEYSER, A.W. 1995b. Biostratigraphy of the *Pristerognathus* Assemblage Zone. Pp. 13-17 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1. Council for Geoscience, Pretoria.

SMITH, R.M.H. & ALMOND, J.E. 1998. Late Permian continental trace assemblages from the Lower Beaufort Group (Karoo Supergroup), South Africa. Abstracts, Tercera Reunión Argentina de Icnologia, Mar del Plata, 1998, p. 29.

SMITH, R., RUBIDGE, B. & VAN DER WALT, M. 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. Chapter 2 pp. 30-62 in Chinsamy-Turan, A. (Ed.) Forerunners of mammals. Radiation, histology, biology. xv + 330 pp. Indiana University Press, Bloomington & Indianapolis.

STEAR, W.M. 1978. Sedimentary structures related to fluctuating hydrodynamic conditions in flood plain deposits of the Beaufort Group near Beaufort West, Cape. Transactions of the Geological Society of South Africa 81, 393-399.

STEAR, W.M. 1980a. The sedimentary environment of the Beaufort Group uranium province in the vicinity of Beaufort West, South Africa. Unpublished PhD thesis, University of Port Elizabeth, 188 pp.

STEAR, W.M. 1980b. Channel sandstone and bar morphology of the Beaufort Group uranium district near Beaufort West. Transactions of the Geological Society of South Africa 83: 391-398.

THERON, J.N. 1983. Die geologie van die gebied Sutherland. Explanation of 1: 250 000 geological Sheet 3220, 29 pp. Council for Geoscience, Pretoria.

TURNER, B.R. 1981. The occurrence, origin and stratigraphic significance of bone-bearing mudstone pellet conglomerates from the Beaufort Group in the Jansenville District, Cape Province, South Africa. Palaeontologia africana 24, 63-73.

VAN DER WALT, M., DAY, M., RUBIDGE, B., COOPER, A.K. & NETTERBERG, I. 2010. A new GIS-based biozone map of the Beaufort Group (Karoo Supergroup), South Africa. Palaeontologia Africana 45, 1-5.

VERWOERD, W.J. 1990. The Salpeterkop ring structure, Cape Province, South Africa. Tectonophysics 171, 275-285.

VERWOERD, W.J., VILJOEN, J.H.A. & VILJOEN, K.S. 1990. Olivine melilitites and associated intrusives of the southwestern Cape Province. Guidebook Geocongress '90, Geological Society of South Africa, PR3, 1-60.

WILSON, A., FLINT, S., PAYENBERG, T., TOHVER, E. & LANCI, L. 2014. Archiectural styles and sedimentology of the fluvial Lower Beaufort Group, Karoo Basin, South Africa. Journal of Sedimentary Research 84, 326-348.

QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest, Gauteng and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Specialist Declaration

I, Dr John Edward Almond, 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.

Name of Specialist: Dr John Edward Almond

Signature of the specialist:

Date: 18 July 2019

APPENDIX 1: SUTHERLAND WEF ELECTRICAL GRID INFRASTRUCTURE FOSSIL SITES & SELECTED GEO-SITES

All GPS readings were taken in the field using a hand-held Garmin GPSmap 60CSx instrument. The datum used is WGS 84. Land parcel names used in the table refer to those shown on the relevant 1: 50 000 topographical maps published by the Chief Directorate: National Geo-spatial Information, Mowbray. Fossil localities that were recorded during fieldwork are shown in relation to relevant major components of the proposed development footprint on the satellite image provided in Figure 1. Please note that this map does *not* show all fossils that are present at surface within the study area, and additional, unrecorded fossil occurrences (the majority) are to be expected at the surface or in the subsurface, where they may be impacted during the construction phase of the development. Areas on the map that do not contain known fossil sites are therefore not necessarily fossil-free or palaeontologically insensitive.

N.B. Fossil locality data is not for general release to the public (e.g. through publication on open access websites) for conservation reasons.

Loc. No.	GPS data	Comments
NEW FOSSIL SITES FROM SUTHERLAND ROAD & POWERLINE PROJECT Nov 2016- Feb 2017, June 2019		
001	S32° 38' 22.0" E21° 16' 01.9"	Farm De Molen. Small hillslope exposures (probably Koornplaats Member) of grey-green overbank mudrocks, fine-grained channel sandstones close to access road deviation. Metre-scale upward-coarsening packages capped by thin-bedded siltstones. Occasional horizons of small, pale grey palaeocalcrete concretions (well-developed palaesols).
002	S32° 38' 39.7" E21° 16' 02.2"	Farm Hamel Kraal. Sheetwash gravel-covered *vlaktes* and low exposures of crumbly, grey-green and purple-brown overbank mudrocks in foothills of low escarpment. Weathering-out horizons of irregular-shaped calcrete concretions. Local mantle of well-rounded corestones of downwasted, brownish, fine-grained channel sandstone.
003	S32° 38' 42.3" E21° 16' 03.1"	Farm Hamel Kraal. Streambed exposure of fine-grained crevasse-splay sandstone with upper bedding plane showing abundant small-scale invertebrate burrows (c. 5 mm diam.) – probably including *Scoyenia* – as well as stem casts of reedy plants (possibly equisetalean ferns), microbial mat textures. Probable Koornplaats Member. Proposed Field Rating IIIC.
004	S32° 38' 59.2" E21° 16' 30.5"	Farm Hamel Kraal. Crumbly, yellowish-brown, thin-bedded / flaggy to cross-bedded channel sandstones of the Koornplaats Member associated with well-developed lenses (50-100 cm thick) of well-cemented, rusty-brown weathering basal channel breccio-conglomerates. These predominantly of subrounded reworked calcrete clasts, ferruginous mudflakes.
005	S32° 39' 00.1" E21° 16' 30.4"	Farm Hamel Kraal. Fragments of post-cranial bones weathering-out of breccias in the Koornplaats Member which are also associated with rusty-brown ferruginous moulds of transported woody plant axes. Proposed Field Rating IIIC.
006	S32° 38' 59.0" E21° 16' 22.7"	Farm Hamel Kraal. Low hill exposures of crumbly, grey-green and purple-brown Koornplaats Member mudrocks capped by thin sandstones and basal breccias.
007	S32° 39' 00.1" E21° 16' 18.8"	Farm Hamel Kraal. Sheetwash gravels with occasional reworked blocks of vuggy silicified wood showing poorly-developed xylem structure – perhaps a result of pre-diagenetic decomposition. Proposed Field Rating IIIC.
009	S32° 39' 19.2" E21° 16' 45.0"	Farm Hamel Kraal. Greyish-patinated, blocky-weathering, medium-grained channel sandstone (probably Koornplaats Member but atypical, if so) weathering out as ridge in *veld*.
010	S32° 39' 42.6" E21° 16' 48.1"	Farm Hamel Kraal. Low scarp of Koornplaats Member grey-green and purple-brown overbank mudrocks with calcrete pedocretes, intervals of tabular, thin-bedded sandstones, succession capped by crumbly, flaggy, yellowish-brown sandstones. Local development of ferruginised basal channel breccias. Colluvial gravels of sandstone mantle most hillslopes.
011	S32° 40' 03.9" E21° 16' 44.3"	Farm Hamel Kraal. Footslopes of low hills of Koornplaats Member mudrocks with weathered-out, angular to subrounded clasts ferruginous carbonate concretions (*koffieklip*).

012	S32° 40' 06.2" E21° 16' 38.8"	Farm Hamel Kraal. Low hilly exposures of Koornplaats Member grey-green and purple-brown, massive to thin-bedded mudrocks with horizons of ferruginous carbonate / *kofffieklip*, pale grey-brown calcrete concretions. Scree slopes of well-rounded corestones of fine-grained channel sandstone.
013	S32° 40' 37.0" E21° 16' 32.7"	Farm Hamel Kraal. Low sandstone-capped scarp with good views southwestwards into grid connection study area. Extensive alluvial *vlaktes* traversed by shallow ephemeral streams and mantled by alluvial gravels.
014	S32° 40' 53.7" E21° 16' 25.2"	Farm Hamel Kraal. Road cutting exposure through medium-bedded, grey-green to purple-brown mudrocks of the Koornplaats Member with occasional horizons of pedogenic calcrete nodules.
015	S32° 41' 55.5" E21° 16' 09.4"	Farm Hamel Kraal. Surface gravels with local concentration of blocks of poorly-preserved, silicified and partially ferruginised wood, some showing recognisable woody fabric, others not (possibly due to pre-diagenetic decomposition). Proposed Field Rating IIIC.
016	S32° 41' 57.0" E21° 15' 43.5"	Farm Hamel Kraal. Alluvial *vlaktes* and low bedrock exposures east of MTS site traversed by shallow ephemeral streams with poorly-consolidated, alluvial gravels and sands. Lenses of *koffieklip* within mudrocks. Patches of sheetwash gravels with occasional reworked blocks of poorly-preserved silicified wood, fine-grained sandstone stone artefacts, calcrete concretions, vein quartz *etc*. Proposed Field Rating IIIC.
017	S32° 41' 56.2" E21° 15' 34.4"	Farm Hamel Kraal. Sparse blocks of poorly-preserved silicified wood in surface gravels. Apron of coarse sandstone colluvial gravels in foothills of Bakenkop. Proposed Field Rating IIIC.
018	S32° 41' 59.6" E21° 15' 25.3"	Farm Hamel Kraal. Sparse blocks of poorly-preserved silicified wood in surface gravels. Proposed Field Rating IIIC.
019	S32° 42' 00.9" E21° 15' 22.4"	Farm Hamel Kraal. Small, low hillslope exposures crumbly grey-green and purple-brown mudrocks of the Koornplaats Member. Apron of coarse, blocky, fine-grained sandstone colluvial gravels in foothills and slopes of Bakenkop. Several; packages of thin- to medium-bedded, crumbly, yellowish-brown channel sandstones, locally with erosive bases, basal channel breccio-conglomerates and *koffieklip* concretions, capping mudrock packages. Upland areas of MTS site dominated by Koornplaats channel sandstones as well as downwasted surface gravels of sandstone, *koffieklip* and vein quartz.
020	S32° 41' 55.8" E21° 15' 11.3"	Farm Hamel Kraal. Surface gravels with locally abundant angular clasts of vein quartz, some showing mineral lineation surfaces / slickensides.
021	S32° 41' 58.4" E21° 15' 11.4"	Farm Hamel Kraal. Upland viewpoint across MTS study area dominated by Koornplaats Member channel sandstones and sandstone colluvial rubble. Occasional small hillslope exposures of grey-green overbank mudrocks, crevasse-splay sandstones, especially on lower foot-slopes of Bakenkop..
022	S32° 41' 51.3" E21° 15' 25.0"	Farm Hamel Kraal. Alluvial gravels and sands on eastern foot of Bakenkop with sparse blocks of poorly-preserved petrified wood. Proposed Field Rating IIIC.
023	S32° 41' 51.6" E21° 15' 36.0"	Farm Hamel Kraal. Surface gravels east of MTS site with sparse blocks of silicified wood. Proposed Field Rating IIIC.
024	S32° 41' 51.8" E21° 15' 38.7"	Farm Hamel Kraal. Sheetwash surface gravels of sandstone, vein quartz with local concentrations of poorly-preserved, weathered and disarticulated postcranial bones of sizeable tetrapod(s) - possibly dinocephalian or pareisaur – as well as blocks of poorly-preserved petrified wood. Proposed Field Rating IIIC.
025	S32° 41' 53.1" E21° 16' 09.1"	Farm Hamel Kraal. Low hill capped by rusty-brown *koffieklip* breccias. Streambed exposure of wave-rippled sandstone palaeosurface with small-scale, low-diversity ichnoassemblages (epichnial furrows, narrow sinuous burrows), sandstone-infilled desiccation cracks. Proposed Field Rating IIIC.
026	S32° 43' 10.4" E21° 15' 33.2"	Farm Hamel Kraal. Low *koppies* of Koornplaats Member sandstones and mudrocks. Extensive *koffieklip* gravels on footslopes.
027	S32° 43' 09.3" E21° 15' 31.0"	Farm Hamel Kraal. Float block fragment of very thick bony skull roof of a tapinocephalid dinocephalian. Weathering-out calcrete palaeosols. Proposed Field Rating IIIC.
028	S32° 43' 56.2" E21° 15' 32.4"	Farm Hamel Kraal. Thick package of crumbly grey-green to purple-brown mudrocks – either within Koornplaats Member or possibly the overlying Swaerskraal Member.
493	S32° 29' 27.2" E20° 46' 38.0"	Farm Matjesfontein 92. Partial thin-boned skull roof, scapula and unidentified, worn postcranial bones in surface float (probably dinocephalian, possibly tapinocephalid). Note historical *Tapinocephalus* Assemblage Zone fossil locality marked around here on 1: 250 000 geology map Sutherland 3220. Proposed Field Rating IIIC.
494	S32° 29' 26.3" E20° 46' 38.5"	Farm Matjesfontein 92. End of very robust limb bone (dinocephalian / pareiasaur) – partially embedded in soil. Proposed Field Rating IIIC.

495	S32° 29' 29.2" E20° 46' 41.1"	Farm Matjesfontein 92. Highly weathered, worn postcranial bone fragment in float. Proposed Field Rating IIIC.
496	S32° 29' 29.8" E20° 46' 41.4"	Farm Matjesfontein 92. Cluster of several highly weathered, worn postcranial bone fragments in float. Proposed Field Rating IIIC.
502	S32° 30' 38.3" E20° 52' 28.5"	Farm Portugals Rivier 218. Dykes of well-exposed ferruginised pyroclastic breccia of the Sutherland Suite.
509	S32° 31' 04.4" E20° 54' 47.2"	Farm Portugals Rivier 218. Well-developed channel breccias containing several disarticulated and worn tetrapod postcranial bone fragments. Ferruginised oblique burrow (*c.* 5.5 cm wide) excavated through breccia bed. Proposed Field Rating IIIC.
512	S32° 31' 16.4" E20° 56' 11.0"	Farm Portugals Rivier 218. Horizon with numerous subvertical lungfish burrow casts excavated into maroon overbank mudrocks exposed in cutting on southern side of dust road. Proposed Field Rating IIIB.
513	S32° 31' 42.6" E20° 56' 51.9"	Farm Portugals Rivier 218. Blocks of greyish-purple wacke with assemblage of narrow vertical sand-infilled cylinders – probably casts of reedy plant stems (*e.g.* sphenophytes or "horsetails"). Proposed Field Rating IIIC.
515	S32° 32' 06.1" E20° 58' 03.4"	Farm Annex Bakoven 135/1. Flaggy sandstone blocks with plant stem casts, small invertebrate traces of the *Scoyenia* ichnofacies. Proposed Field Rating IIIC.
521	S32° 33' 48.5" E21° 00' 14.1"	Farm Nooigedagt 148. Karelskraal Member. Several large, gently inclined, subcylindrical tetrapod burrow casts (*c*. 15 cm wide) of sandstone embedded in maroon overbank mudrocks. The best example shows well-developed scratch marks on the ventrolateral surface. These are among the youngest recorded tetrapod burrows within the Abrahamskraal Formation and were possibly constructed by dicynodonts. Proposed Field Rating IIIB.
530	S32° 36' 32.6" E20° 52' 19.0"	Farm Beeren Valley 150. Bioturbated swaley channel sandstone palaeosurface with poorly-preserved horizontal burrows and other ill-defined traces. Proposed Field Rating IIIC.
532	S32° 36' 27.6" E20° 54' 24.5"	Farm Beeren Valley 150. Two isolated pieces of highly-weathered postcranial bones in surface float. Proposed Field Rating IIIC.
535	S32° 36' 36.9" E20° 55' 29.2"	Farm Beeren Valley 150. Articulated partial postcranial skeleton of a large tetrapod embedded in grey-green overbank mudrocks. This specimen is conservation-worthy and should be protected by a buffer zone of 30 m radius. Proposed Field Rating IIIB.
539	S32° 36' 53.5" E20° 57' 34.1"	Farm Nooigedagt 148. Disarticulated limb bone of large tetrapod embedded in maroon mudrocks, showing sun-dried surface texture. Proposed Field Rating IIIC.
540	S32° 36' 53.6" E20° 57' 33.9"	Farm Nooigedagt 148. Fragment of long bone in surface float. Discrete cluster of several pebble- to cobble-sized exotic clasts ("lonestones") embedded within maroon overbank mudrocks. The larger cobbles are of a greenish-grey igneous rock (possibly andesite) and are subrounded. They are among the largest exotic clasts recorded from the Lower Beaufort Group in the SW Karoo. The conglomeratic lens also contains weathered, dark-grey tillite-like material, suggesting a Dwyka Group provenance for the pebbles which may have been brought into the Mid Permian Karoo Basin by floating tree roots or ice floes.
545	S32° 33' 10.2" E20° 54' 13.0"	Farm Portugals Rivier 218. Several highly weathered postcranial bones in surface float, showing sun-cracked surface textures. Proposed Field Rating IIIB.
546	S32° 33' 11.2" E20° 54' 16.1"	Farm Portugals Rivier 218. Scatter of numerous disarticulated, weathered bones of a large tetrapod (dinocephalian / pareiasaur) among sandstone scree. Proposed Field Rating IIIB.
548	S32° 34' 35.1" E21° 00' 29.7"	Farm Nooigedagt 148. Kareskraal Member. *Possible* vertebrate burrow casts (*c*. 30 cm wide). Requires confirmation. Proposed Field Rating IIIC.
550	S32° 34' 40.0" E21° 00' 27.4"	Farm Nooigedagt 148. Partial disarticulated skull of small tetrapod with a boat-shaped lower jaw (probably dicynodont) embedded in pedocrete horizon. Proposed Field Rating IIIC.
555	S32° 38' 21.2" E20° 59' 33.7"	Farm Nooigedagt 148. Possible sandstone cast of vertebrate burrow (*c*. 15 cm wide) within maroon overbank mudrocks (requires confirmation). Proposed Field Rating IIIC.
556	S32° 37' 16.3" E20° 58' 47.9"	Farm Nooigedagt 148. Two highly-weathered post-cranial bones of a large tetrapod in surface float. Proposed Field Rating IIIC.
029	S32° 37' 27.8" E21° 05' 52.4"	Farm 219, escarpment edge nr Blouval. Several small bone fragments (possibly amphibian based on rugose surface texture) within mudflake-rich conglomerate horizon (sandstone float block). Proposed Field Rating IIIC.
030	S32° 37' 29.7" E21° 05' 53.3"	Farm 219, escarpment edge nr Blouval. Extensive hillslope and gulley exposure of blue-green, grey-green and purple-brown Abrahamskraal Fm mudrocks, thin crevasse splay sandstones. Well-developed palaeocalcrete pedogenic horizons

		(sl. ferruginised). Gypsum pseudomorphs and unidentified bone fragment in float. Proposed Field Rating IIIC.
031	S32° 37' 42.7" E21° 06' 34.7"	Farm 219, upper escarpment zone (Langpunt track). Hillslope exposure of grey-green mudrocks and flaggy sandstones – probably of Koornplaats Member. Isolated rolled bone fragment within thin mudflake breccia.
041	S32° 38' 51.9" E21° 15' 42.1"	Hamel Kraal 16, extensive surface scatter of large blocks of silicified wood and rare blocks of spongy bone on either side of farm track. Probably weathered out from base of local yellowish-brown channel sandstones (Koornplaats Member, Abrahamskraal Fm). and locally associated with *koffieklip* ferruginous carbonate concretionary lenses containing occasional rolled bone fragments. Wood preservation often poor, ferruginized, vuggy (possibly partially rotted before petrification) but some material shows well-preserved woody fabric (prominent seasonal growth lines). This site is conservation-worthy and should be protected by a 50-m wide buffer zone. Proposed Field Rating IIIB.
042	S32° 38' 53.7" E21° 15' 42.4"	Hamel Kraal 16, float blocks of robust fossil bone just south of fossil wood surface scatter. Proposed Field Rating IIIB.
043	S32° 38' 53.2" E21° 15' 41.3"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
044	S32° 38' 52.2" E21° 15' 41.3"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
045	S32° 38' 52.3" E21° 15' 41.4"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
046	S32° 38' 52.3" E21° 15' 41.5"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
047	S32° 38' 52.3" E21° 15' 41.5"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
048	S32° 38' 52.2" E21° 15' 41.6"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
049	S32° 38' 52.1" E21° 15' 41.7"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
050	S32° 38' 51.9" E21° 15' 41.7"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
051	S32° 38' 51.9" E21° 15' 41.7"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
052	S32° 38' 51.8" E21° 15' 41.6"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
053	S32° 38' 51.8" E21° 15' 41.6"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
054	S32° 38' 51.6" E21° 15' 41.7"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
055	S32° 38' 51.7" E21° 15' 41.8"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
056	S32° 38' 52.1" E21° 15' 42.1"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
057	S32° 38' 52.2" E21° 15' 42.1"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
058	S32° 38' 52.2" E21° 15' 42.1"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
059	S32° 38' 52.2" E21° 15' 42.2"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
060	S32° 38' 52.2" E21° 15' 42.2"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
061	S32° 38' 52.0" E21° 15' 42.3"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
062	S32° 38' 52.0" E21° 15' 42.4"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
063	S32° 38' 51.9" E21° 15' 42.5"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
064	S32° 38' 51.8" E21° 15' 42.6"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
065	S32° 38' 51.8" E21° 15' 42.6"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
066	S32° 38' 52.2" E21° 15' 43.5"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
067	S32° 38' 52.7"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field

	E21° 15' 43.4"	Rating IIIB.
068	S32° 38' 52.7" E21° 15' 43.3"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
069	S32° 38' 52.6" E21° 15' 43.1"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
070	S32° 38' 52.6" E21° 15' 43.1"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
071	S32° 38' 52.5" E21° 15' 43.1"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
072	S32° 38' 52.3" E21° 15' 42.8"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
073	S32° 38' 52.3" E21° 15' 42.7"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
074	S32° 38' 52.3" E21° 15' 42.6"	Petrified wood block within surface scatter on Hamel Kraal 16. Proposed Field Rating IIIB.
077	S32° 40' 19.8" E21° 15' 28.6"	Hamel Kraal 16, N side of Brewelskop. Tabular, flat-laminated sandstones with cylindrical casts of plant stems (probably sphenophytes / horsetails). Proposed Field Rating IIIC.
079	S32° 40' 23.1" E21° 15' 33.1"	Hamel Kraal 16, N side of Brewelskop. Well-developed (*c*. 50 cm) basal channel breccia packed with reworked calcrete nodules as well as abundant rusty-brown, ferruginized moulds of transported woody plant debris. Plant debris layers or lenses also present within overlying flaggy channel sandstones. Isolated large therapsid tusk (*c*. 25 mm diam.) in float has probably weathered out from basal breccias, or possibly from calcrete palaeosol within underlying mudocks. Proposed Field Rating IIIC.
081	S32° 40' 48.4" E21° 15' 53.6"	Hamel Kraal 16, south of Brewelskop. Isolated rounded bone fragment (*c*. 5 cm across) in float. Proposed Field Rating IIIC.
084	S32° 42' 41.8" E21° 15' 51.5"	Hamel Kraal 16. Unusually extensive development of lens of brown-weathering, ferruginous-patinated greyish channel sandstones either side of dust road and *c*. 1 km SE of proposed Eskom Nuwerust Substation. Dolerite-like sandstone corestones locally show fine internal lamination as well as low-diversity assemblages of prominent-weathering, intrastratal, subcylindrical invertebrate burrows (*c*. 1 cm wide). Proposed Field Rating IIIC.

Uranium anomalies on 1: 250 000 sheet Sutherland

Data abstracted from Cole & Vorster (1999) (See Fig. 18 in text).

U Anomaly	Farm	Co-ordinates
180	Gunstfontein 151	32 35 20 S, 20 48 01 E
181	Gunstfontein 151	32 35 07 S, 20 51 55 E
183	Beerenvalley 150	32 35 59 S, 20 55 29 E
187	Beerenvalley 150	32 37 48 S, 20 55 08 E 32 37 43 S, 20 54 50 S

CHANCE FOSSIL FINDS PROCEDURE: Electrical grid infrastructure to support the authorised Rietrug, Sutherland and Sutherland 2 Wind Energy Facilities, Northern and Western Cape Provinces		
Province & region:	Northern Cape, Sutherland & Laingsburg Districts	
Responsible Heritage Resources Agency	**SAHRA**, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za **HWC**, Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za	
Rock unit(s)	Abrahamskraal Formation (Lower Beaufort Group, Karoo Supergroup) Late Caenozoic alluvium along water courses and calcrete hardpans	
Potential fossils	Petrified wood and other plant remains, skeletal remains of tetrapods (*e.g.* therapsids), trace fossils of invertebrates and vertebrate burrows in Abrahamskraal Formation bedrocks . Bones, teeth and horn cores of mammals, freshwater molluscs, calcretised termitaria and other trace fossils in older alluvium.	
ECO protocol	1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (*N.B.* safety first!), safeguard site with security tape / fence / sand bags if necessary.	
	2. Record key data while fossil remains are still *in situ:* • Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo • Context – describe position of fossils within stratigraphy (rock layering), depth below surface • Photograph fossil(s) *in situ* with scale, from different angles, including images showing context (*e.g.* rock layering)	
	3. If feasible to leave fossils *in situ*: • Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation • Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency for work to resume	3. If *not* feasible to leave fossils *in situ* (emergency procedure only): • *Carefully* remove fossils, as far as possible still enclosed within the original sedimentary matrix (*e.g.* entire block of fossiliferous rock) • Photograph fossils against a plain, level background, with scale • Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags • Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist • Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
	4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.	
	5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority	
Specialist palaeontologist	Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.	

BASIC ASSESSMENT REPORT

Basic Assessment for the Proposed Construction and Operation of Electrical Grid Infrastructure to support the Sutherland, Sutherland 2 and Rietrug Wind Energy Facilities (WEFs), Northern and Western Cape Provinces

APPENDIX D.5: Avifauna Assessment

BIRD IMPACT ASSESSMENT STUDY:

Basic Assessment for the proposed construction of electrical infrastructure to support three proposed wind energy facilities, near Sutherland, in the Northern and Western Cape Provinces

Report prepared for:

CSIR – Environmental Management Services
P O Box 320
Stellenbosch
7599
South Africa

Report prepared by:

AFRIMAGE Photography (Pty) Ltd t/a:
Chris van Rooyen Consulting
VAT#: 4580238113
email: vanrooyen.chris@gmail.com
Tel: +27 (0)82 4549570 cell

Version 1: June 2019
Version 2: September 2019

Specialist Expertise

Curriculum vitae: Chris van Rooyen

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	LLB
Nationality	:	South African
Years of experience	:	22 years

Key Experience

Chris van Rooyen has twenty two years' experience in the assessment of avifaunal interactions with industrial infrastructure. He was employed by the Endangered Wildlife Trust as head of the Eskom-EWT Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has consulted in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. He also has extensive project management experience and he has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author and/or co-author of 17 conference papers, co-author of two book chapters, several research reports and the current best practice guidelines for avifaunal monitoring at wind farm sites. He has completed around 130 power line assessments; and has to date been employed as specialist avifaunal consultant on more than 50 renewable energy generation projects. He has also conducted numerous risk assessments on existing power lines infrastructure. He also works outside the electricity industry and he has done a wide range of bird impact assessment studies associated with various residential and industrial developments. He serves on the Birds and Wind Energy Specialist Group which was formed in 2011 to serve as a liaison body between the ornithological community and the wind industry.

Professional affiliations

I work under the supervision of and in association with Albert Froneman (MSc Conservation Biology) (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003.

Curriculum vitae: Albert Froneman

Profession/Specialisation	:	Avifaunal Specialist
Highest Qualification	:	MSc (Conservation Biology)
Nationality	:	South African
Years of experience	:	20 years

Key Qualifications

Albert Froneman (Pr.Sci.Nat) has more than 20 years' experience in the management of avifaunal interactions with industrial infrastructure. He holds a M.Sc. degree in Conservation Biology from the University of Cape Town. He managed the Airports Company South Africa (ACSA) – Endangered Wildlife Trust Strategic Partnership from 1999 to 2008 which has been internationally recognized for its achievements in addressing airport wildlife hazards in an environmentally sensitive manner at ACSA's airports across South Africa. Albert is recognized worldwide as an expert in the field of bird hazard management on airports and has worked in South Africa, Swaziland, Botswana, Namibia, Kenya, Israel, and the USA. He has served as the vice chairman of the International Bird Strike Committee and has presented various papers at international conferences and workshops. At present, he is consulting to ACSA with wildlife hazard management on all their airports. He also an accomplished specialist ornithological consultant outside the aviation industry and has completed a wide range of bird impact assessment studies. He has co-authored many avifaunal specialist studies

and pre-construction monitoring reports for proposed renewable energy developments across South Africa. He also has vast experience in using Geographic Information Systems to analyse and interpret avifaunal data spatially and derive meaningful conclusions. Since 2009 Albert has been a registered Professional Natural Scientist (Registration Number 400177/09) with The South African Council for Natural Scientific Professions, specialising in Zoological Science.

Specialist Declaration

I, Chris van Rooyen, 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 not, 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 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.

Name of Specialist: Chris van Rooyen

Signature of the specialist: _____

Date: 17 June 2019

Executive Summary

The project applicant is proposing the development of a 132kV sub-transmission line, a major transmission substation and 400kV transmission line within the Renewable Energy Development Zone (REDZ): 2 Komsberg. The 132kV line routing proposed as part of this application has been previously assessed as part of the proposed construction of the electrical grid infrastructure for the Sutherland Wind Energy Facility (14/12/16/3/3/1/1816), Rietrug Wind Energy Facility (14/12/16/3/3/1/1815) and Sutherland 2 Wind Energy Facility (14/12/16/3/3/1/1814/AM1). These projects received Environmental Authorisation in February 2018.

The proposed project components will have the following potential impacts on avifauna:

- Displacement due to habitat transformation in the footprint of the proposed transmission substation;
- Displacement due to the construction of the proposed transmission substation, service road and 132kV and 400kV powerlines;
- Electrocution in the transmission substation yard; and
- Mortality due to collision with the earthwire of the proposed 132kV and 400kV powerlines.

Displacement due to habitat transformation

Habitat transformation has an impact on birds breeding, foraging and roosting in or in close proximity of the proposed transmission substation, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce this impact as the total permanent transformation of the natural habitat within the construction footprint of the proposed transmission substation yard is unavoidable. However, due to the nature of the vegetation, and judged by the existing transmission lines, very little if any vegetation clearing will be required in the powerline servitudes. The habitat in the study area is very uniform from a bird impact perspective, therefore the loss of habitat for Red Data species due to direct habitat transformation associated with the construction of the proposed transmission substation is likely to be fairly minimal. **The impact significance is assessed to be Low, both before and after mitigation**. The species most likely to be directly affected by this impact would be small, non-Red Data species. Suggested mitigation measures are restricting footprint to the absolute minimum, no off-road driving, maximum use of existing roads, measures to control dust, restricted access to the rest of the property, and rehabilitation of all areas disturbed.

Displacement due to disturbance

Apart from direct habitat destruction, construction activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle. Large terrestrial species, including Red Data Ludwig's Bustard, Karoo Korhaan and Southern Black Korhaan, are most likely to be affected by displacement due to disturbance. The ground-nesting Black Harrier and cliff nesting Jackal Buzzard could also potentially be vulnerable to this impact, but the habitat in the study area is not ideal for the former species from a breeding perspective. **The impact is assessed to be Moderate before mitigation, and Low after mitigation**. Suggested mitigation measures are restricting footprint to the absolute minimum, no off-road driving, maximum use of existing roads, measures to control noise, restricted access to the rest of the property, training the ECO to identify

Red Data nests during construction, and a pre-construction walk-through by the avifaunal specialist to identify and Red Data nests coupled with the timing of the construction if need be.

Electrocution

In the case of the proposed powerlines, no electrocution risk is envisaged because the proposed design of the 132kV and 400kV powerlines will not pose an electrocution threat to any of the priority species which are likely to occur at the site. Electrocutions within the proposed transmission substation yard are possible, but should not affect the more sensitive Red Data bird species, as these species are unlikely to use the infrastructure within the substation yards for perching or roosting. Suggested mitigation measures are reactive mitigation in the substation if electrocutions are recorded. **The risk is assessed to be Very Low, both before and after mitigation.**

Collisions

The most likely Red Data candidates for collision mortality on the proposed powerlines are Ludwig's Bustards, Karoo Korhaan and Southern Black Korhaan in natural habitat, and Greater Flamingo near dams. Non-Red Data waterbirds could also be at risk near dams and where the line crosses drainage lines (see Table 2 for a list of species that could be at risk). Martial and Verreaux's Eagle might also be at risk, especially at surface water when they descend to bath and drink. Suggested mitigation measures are a walk-through by the avifaunal specialist of the final alignment to identify sections that require mitigation, the fitting of BFDs on those pre-identified sections and quarterly line inspections by the avifaunal specialist to record collision-related mortality. **The risk is assessed to be High, but it can be reduced to Moderate through the application of mitigation measures.**

Cumulative impacts

Large raptor species, particularly Verreaux's Eagle and Martial Eagle, are potentially most at risk as far as cumulative impacts of renewable energy projects in the 50km radius around the proposed development is concerned. However, the project should not materially threaten these species. The concern from a powerline interaction perspective is more for large terrestrial species, particularly Ludwig's Bustard, which is highly susceptible to powerline collisions. The proposed project will add an additional approximately 41km of HV line to the existing HV network in the area. Several hundred kilometres of HV line already exists within this area, and several more are planned should the renewable energy projects all be built. **The overall cumulative impact of the proposed project, when viewed with the existing impacts on avifauna, is assessed to be Moderate, and is likely remain at that level after mitigation.**

The table below provides a summary of the respective significance ratings, and an average overall rating before and after mitigation.

Overall impact significance rating

Impact	**Rating pre-mitigation**	**Rating post-mitigation**
Displacement due to habitat transformation	Low (4)	Low (4)
Displacement due to disturbance	Moderate (3)	Low (4)
Electrocution	Very Low (5)	Very Low (5)
Collisions	High (2)	Moderate (3)
Cumulative impacts	Moderate (3)	Moderate (3)
Average:	**Moderate to Low (3.4)**	**Low to Moderate (3.8)**

Final Specialist Statement and Authorisation Recommendation

The overall potential impact on priority avifauna for the construction phase is assessed to be of **Moderate to Low significance before mitigation measures, and Low after the implementation of mitigation measures.** For the decommissioning phase, the overall potential impact on priority avifauna is assessed with a **Moderate significance before the implementation of mitigation and a Low significance after the implementation of mitigation measures**. For the operational phase, the overall potential impact on priority avifauna is assessed with a **Very Low to High significance without the implementation of mitigation measures; and Very Low to Moderate significance with the implementation of mitigation measures**. Cumulative impacts are assessed with a **Moderate significance both with and without mitigation measures**. In terms of an average, the pre-mitigation significance of all potential impacts identified in this specialist study is assessed as **Moderate to Low**, leaning more towards Moderate (i.e. average of 3.4, as shown in Table 9 above) and the post-mitigation significance is assessed as Low to Moderate, leaning more towards Low (i.e. average of 3.8, as shown in Table 9 above). It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the EMPr (APPENDIX 3) are strictly implemented.

Contents

List of Figures

List of Tables

List of Abbreviations

EIA	Environmental Impact Assessment
BA	Basic Assessment
DEA	Department of Environmental Affairs
WEF	Wind Energy Facility
I&APs	Interested and affected parties
IBA	Important Bird Area
BLSA	BirdLife South Africa
EWT	Endangered Wildlife Trust
SABAP 2	Southern African Bird Atlas Project 2
BFD	Bird Flight Diverters

Glossary

Definitions	
Study area	The area comprising a 2km radius around the proposed powerline alternative alignments
Priority species	Powerline sensitive and Red Data avifauna which could potentially occur in the study area
Pentad Grid	A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude

COMPLIANCE WITH THE APPENDIX 6 OF THE 2014 EIA REGULATIONS (AS AMENDED)

Requirements of Appendix 6 – GN R326 (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;	Preliminary Section of this report
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Preliminary Section of this report
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 1.3 and Section 2.1
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 4, 5 and 6 and Appendix 2
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1 and Section 2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 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 alternatives;	Section 4
g) an identification of any areas to be avoided, including buffers;	Section 4
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 4
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 5
k) any mitigation measures for inclusion in the EMPr;	Section 6
l) any conditions for inclusion in the environmental authorisation;	Section 11
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity and 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;	Sections 10 and 11
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 2
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	No comments received so far

Requirements of Appendix 6 – GN R326 (7 April 2017)	Addressed in the Specialist Report
q) any other information requested by the competent authority.	Not applicable
2. Where a government notice gazetted by the Minister provides for any protocol of minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Not Applicable

BIRD IMPACT ASSESSMENT STUDY

1. Introduction and Methodology

The project applicant is proposing the development of a 132kV sub-transmission line, a major transmission substation and 400kV transmission line within the Renewable Energy Development Zone (REDZ): 2 Komsberg. The 132kV line routing proposed as part of this application has been previously assessed as part of the proposed construction of the electrical grid infrastructure for the Sutherland Wind Energy Facility (14/12/16/3/3/1/1816), Rietrug Wind Energy Facility (14/12/16/3/3/1/1815) and Sutherland 2 Wind Energy Facility (14/12/16/3/3/1/1814/AM1). These projects received Environmental Authorisation in February 2018. Within the authorisations, the alternative line routing "1" was submitted as the preferred routing and subsequently approved.

Project components

- Major Transmission Substation (400 m x 400 m)
- Overhead 132 kV line ˜ 41 km (this line has been assessed as part of a previous Basic Assessment Process) and referred to in the reports as "Alternative 2"
- 400 kV ~ 4 km overhead transmission line connecting to an existing Eskom line
- Service roads will be constructed below the lines (jeep track)

Farm portions affected

- Northern Cape Farm Portions
  - Remaining Extent of Hartebeeste Fontein Farm 147
  - Remaining Extent of Nooitgedacht Farm 148
  - Remaining Extent of Beeren Valley Farm 150
  - Portion 1 of Farm 219
  - Remaining Extent of Farm 219

- Western Cape Farm Portions
  - Farm 280
  - Portion 1 of Rheebokkenfontein Farm 4
  - Portion 2 of Rheebokkenfontein Farm 4
  - Portion 2 of Farm De Molen 5
  - Portion 6 of Farm Hamelkraal 16
  - Portion 7 of Farm Hamelkraal 16
  - Remaining Extent of Spitskop Farm 20

The 132 kV line routing proposed as part of this application was considered as alternative line routing "2" as part of the assessments undertaken in 2017/2018. The line routing did not include any environmental fatal flaws and is a technical feasible option to enable the evacuation of the electricity generated by the abovementioned Wind Energy Facilities into the National Grid.

1.1. Scope, Purpose and Objectives of this Specialist Report

The objectives of the report are to investigate the potential impacts of the proposed 132kV sub-transmission line, a major transmission substation and 400kV transmission line on avifauna in order to assess whether the project is fatally flawed from an avifaunal impact perspective and, if not, what mitigation measures should be implemented to reduce the potential impacts.

1.2. Terms of Reference

The terms of reference for this impact assessment report are as follows:

- Describe the affected environment from an avifaunal perspective;
- Discuss gaps in baseline data and other limitations;
- List and describe the expected impacts;
- Assess and evaluate the potential impacts;
- Recommend mitigation measures to reduce the impact of the expected impacts; and
- Provide a reasoned opinion as to whether the proposed development should proceed or not.

1.3. Assessment Details

Type of Specialist Investigation	Bird Impact Assessment Study: Wind Energy facilities
Date of Specialist Site Investigation	12-months pre-construction monitoring programme conducted over four seasons in 2015/2016 for the proposed Sutherland, Sutherland 2 and Rietrug WEFs. The electrical infrastructure proposed as part of this application aims to provide support to the WEFs by enabling the evacuation of the electricity generated by these WEFs into the national grid.
Season	All four seasons
Relevance of Season	All four seasons are important from an avifaunal perspective

Type of Specialist Investigation	Field investigation
Date of Specialist Site Investigation	27 April 2019
Season	End of rainy season
Relevance of Season	The investigation was done when there was plenty of water in the environment, which is important for bird abundance and variety in an arid environment.

2. Approach and Methodology

2.1. Information Sources

The following information sources were used in compiling the report:

- Bird distribution data of the Southern African Bird Atlas Project 2 (SABAP 2) was obtained (http://sabap2.adu.org.za/), in order to ascertain which species are likely to occur in the pentads where the proposed infrastructure will be located. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. In order to get a more representative impression of the birdlife, a consolidated data set was obtained for the 20 pentads which overlap substantially with the proposed infrastructure. A total of 67 full protocol lists, and 33 ad hoc protocol lists have been completed to date for the 21 pentads where the study area is located. Lists surveys lasting a minimum of two hours each are designated as full protocol lists, while ad hoc protocol lists are surveys which did not last a minimum of two hours, but still yielded valuable data. In addition, 1 402 incidental sightings were recorded within this period. The SABAP2 data was therefore regarded as a reliable snapshot of the avifauna, especially when supplemented by actual data collected during pre-construction surveys and through general knowledge of the area.
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).

- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2019.1) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- The BirdLife South Africa (BLSA) was consulted on Important Bird Areas of Southern Africa for information on relevant Important Bird Areas (IBAs) (Marnewick *et al*. 2015).
- Satellite imagery from Google Earth was used in order to view the broader area on a landscape level and to help identify bird habitat on the ground.
- Information on bird diversity and abundance at the proposed Sutherland, Sutherland 2 and Rietrug WEF development sites were obtained through a 12-months monitoring programme. These three WEFs were assessed as part of a separate Environmental Impact Assessment (EIA) Process, which received Environmental Authorisation (EA) on 22 February 2012, an amended EA on 6 October 2015 and separate amended EAs in November 2016. Data was collected through transect counts, incidental sightings, inspection of potential focal points and the recording of flight behaviour from vantage points. In addition, extensive nest searches were conducted. This data was used as a supplementary source of information on the variety and abundance of avifauna in the study area.
- Information on existing raptor nests were obtained from avifaunal specialists Dr. Andrew Jenkins (Avisense Consulting) and Andrew Pearson (Arcus), as well as from the staff of the Komsberg Nature Reserve. Various landowners were also interviewed to obtain information on nests and roosting sites in the greater area. Dedicated nest searches were repeated by Eric Hermann in June 2019.
- A site visit to the proposed 400kV line, substation site and part of the 132kV alignment was conducted on 27 April 2019.

2.2. Assumptions, Knowledge Gaps and Limitations

The following assumptions and limitations apply:

- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances. However, power line and substation impacts can be predicted with a fair amount of certainty, based on a robust body of research stretching back over thirty years (see References in Section 12).
- The precautionary principle was applied throughout. The World Charter for Nature, which was adopted by the United Nations (UN) General Assembly in 1982, was the first international endorsement of the precautionary principle (http://www.unep.org). The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.”
- The core study area was defined as a 2km buffer zone around the proposed powerlines and substation.
- Priority species were defined as species vulnerable to collisions with and electrocutions on the proposed electrical infrastructure.
- Cumulative impacts were assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50-70km radius around the proposed

development. The existing and proposed developments that were taken into consideration for cumulative impacts include:

- Gunstfontein Wind Energy Project
- Sutherland WEF
- Sutherland 2 WEF
- Rietrug WEF
- Maralla East Wind Energy Project
- Maralla West Wind Energy Project
- Esizayo Wind Energy Project
- Hidden Valley Wind Energy Project
- Proposed Photovoltaic (PV) Solar Energy Facility on a site south of Sutherland
- Suurplaat WEF
- Komsberg East and West WEF
- Sutherland 2 and Rietrug Electricity Grid Infrastructure Projects

2.3. Consultation Processes Undertaken

As noted above, information on existing raptor nests were obtained from avifaunal specialists Dr. Andrew Jenkins (Avisense Consulting) and Andrew Pearson (Arcus), as well as from the staff of the Komsberg Nature Reserve. Various landowners were also interviewed to obtain information on nests and roosting sites in the greater area.

3. Description of Project Aspects relevant to Avifaunal Impacts

The following project aspects are relevant from a bird impact assessment perspective:

- Major Transmission Substation (400 m x 400 m);
- Overhead 132kV line of approximately 41km;
- 400 kV ~ 4 km overhead transmission line connecting to an existing Eskom line;

See Figures 1 and 2 below for a map indicating the location and lay-out of the proposed infrastructure.

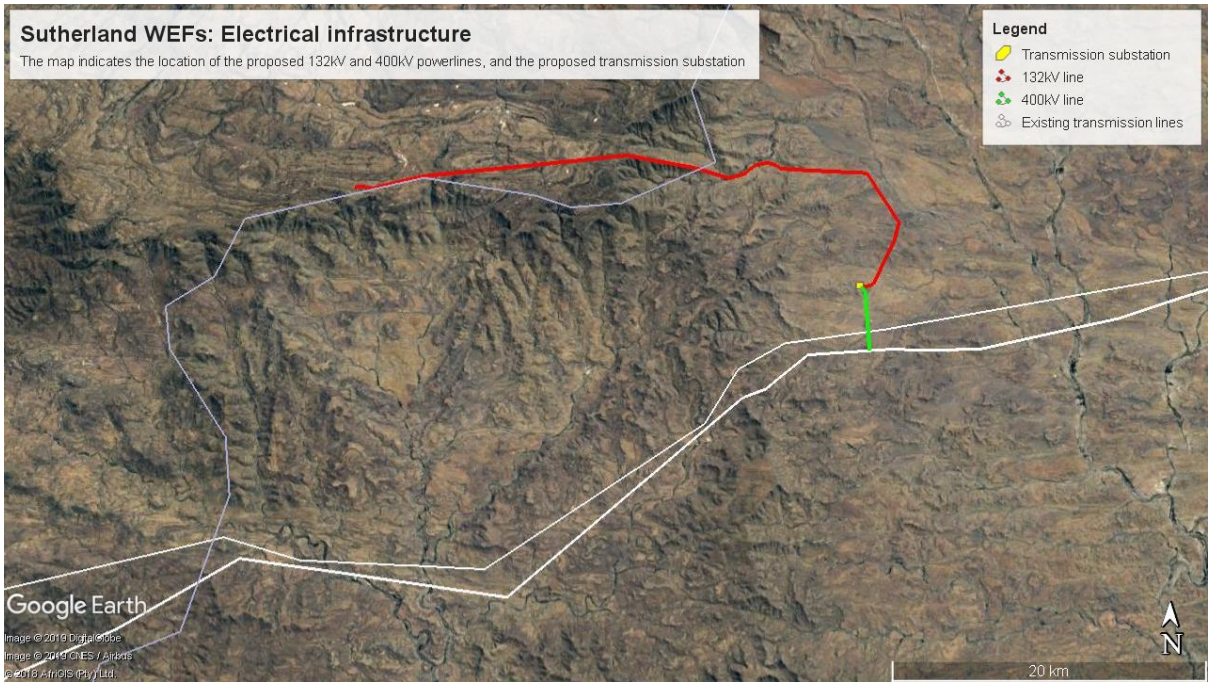


Figure 1: Layout of the proposed infrastructure

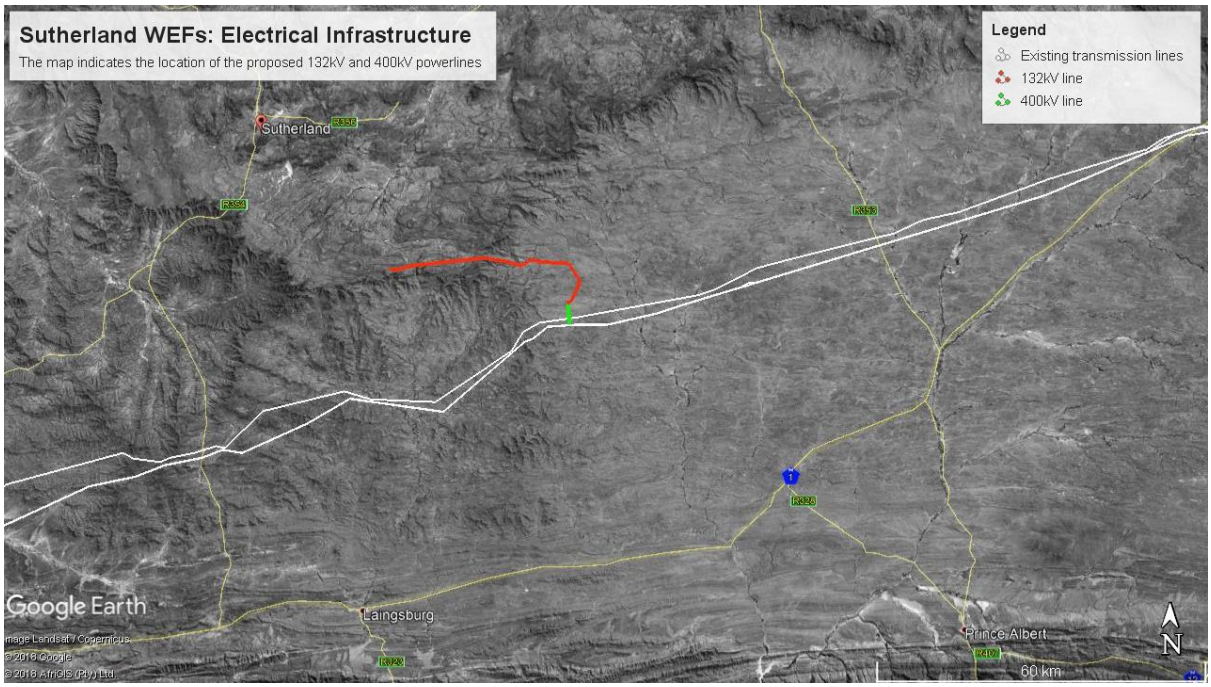


Figure 2: The location of the proposed infrastructure

4. Description of the Receiving Environment

4.1. Baseline Environmental Description

The proposed development is located at the junction of the Fynbos and Nama Karoo biomes (Mucina & Rutherford 2006). The study area is primarily situated on a plateau at an altitude of between 1600 and 1700 meters above sea-level and partially straddles the escarpment of the Klein-Roggeveld and Komsberg mountain ranges, but also extends eastwards onto the plains below the plateau. The dominant vegetation types on the plateau are Roggeveld Shale Renosterveld and Central Mountain Shale Renosterveld (Mucina & Rutherford 2006). Roggeveld Shale Renosterveld vegetation type occurs on undulating, plateau landscapes with low hills and broad shallow valleys, supporting mainly

moderately tall schrublands dominated by renosterbos, with rich geophytic flora in the wetter and rocky habitats. Central Mountain Shale Renosterveld is found on slopes and broad ridges of low mountains and escarpments. It consists of tall shrubland dominated by renosterbos and large suites of mainly non-succulent karoo shrubs with a rich geophytic flora in the undergrowth or in more open, wetter or rocky habitats. The dominant vegetation type on the plains below the plateau is Gamka Karoo which consists of dwarf spiny shrubland dominated by Karoo dwarf shrubs (e.g. *Chrysocoma ciliata, Eriocephalus ericoides*) with rare low trees (e.g. *Euclea undulata*). Dense stands of drought-resistant grasses (*Stipagrostis, Aristida*) cover (especially after abundant rains) broad sandy bottomlands. Stands of alien trees, mostly Eucalyptus, are present at farm steads.

The climate is quite severe, with about 170 mm of rain per annum, falling mostly in winter, with mean winter minimum and summer maximum temperatures of 0˚C and 29˚C respectively (Mucina & Rutherford 2006). The study area is bisected by several ephemeral drainage lines. There are also several artificial impoundments in the study area as well as a number of natural, flat depressions which hold water after good rains, as was the case in April 2019 when the field visit was conducted. The principal land-use is sheep farming. Three transmission lines run south of the study area, namely the Droërivier Kappa 2 400kV, Gamma Kappa 1 765kV and the Droërivier Kappa 1 400kV.

Refer to Figures 3 to 6 for representative examples of the habitat in the study area.

Figure 3: Typical renosterveld vegetation in the study area on the plateau above the Komsberg mountains.

Figure 4: A example Gamka Karoo at the site of the proposed transmission substation.

Figure 5: An ephemeral drainage line on the plains below the plateau.

Figure 6: An ephemeral waterbody near the proposed 400kV line.

A total of 159 bird species could potentially occur in the study area. Of these, 38 are classified as powerline priority species. Of these, eight are classified as locally threatened (Taylor *et al*. 2015). Table 1 below lists the priority species that could potentially occur in the study area, as well as the potential impact on the species in the study area.

Table 1: Priority (Red Data) species potentially occurring in the study area. VU = Vulnerable, EN = Endangered, NT = Near-threatened, LC = Least Concern.

Species	Taxonmic name	Powerline priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Renosterveld	Gamka Karoo	Surface water	Alien trees	Cliffs	Powerlines	Collisions	Displacement - disturbance	Displacement - habitat loss	Electrocution (substations)
African Black Duck	*Anas sparsa*	x	8.82									x				x			
African Sacred Ibis	*Threskiornis aethiopicus*	x	4.41									x				x			
African Spoonbill	*Platalea alba*	x	2.94									x				x			
Black Harrier	*Circus maurus*	x	2.94	EN	EN	Near endemic	Endemic		x	x		x					x		
Black Stork	*Ciconia nigra*	x	1.47	LC	VU				x			x		x		x			
Black-chested Snake Eagle	*Circaetus pectoralis*	x	1.47						x	x	x	x	x		x	x			
Black-headed Heron	*Ardea melanocephala*	x	4.41						x			x	x			x			
Black-shouldered Kite	*Elanus caeruleus*	x	1.47							x	x		x						
Booted Eagle	*Aquila pennatus*	x	11.76						x	x	x	x	x	x		x			
Cape Crow	*Corvus capensis*	x	0.00						x	x	x		x						x
Cape Eagle-Owl	*Bubo capensis*	x	0.00						x	x				x		x			
Cape Shoveler	*Anas smithii*	x	11.76				Near-endemic		x			x				x			
Cape Teal	*Anas capensis*	x	5.88						x			x				x			
Common (Steppe) Buzzard	*Buteo vulpinus*	x	1.47							x	x	x	x		x	x			x
Egyptian Goose	*Alopochen aegyptiacus*	x	32.35						x			x			x	x			x
Glossy Ibis	*Plegadis falcinellus*	x	0.00						x			x	x			x			
Greater Flamingo	*Phoenicopterus ruber*	x	0.00	LC	NT				x			x				x			
Grey Heron	*Ardea cinerea*	x	4.41						x			x	x			x			
Hadeda Ibis	*Bostrychia hagedash*	x	29.41						x	x	x	x	x		x				x
Hamerkop	*Scopus umbretta*	x	2.94									x		x					
Jackal Buzzard	*Buteo rufofuscus*	x	38.24			Near endemic	Endemic		x	x	x	x	x	x	x	x	x	x	x
Karoo Korhaan	*Eupodotis vigorsii*	x	41.18	LC	NT		Endemic		x		x					x			
Lanner Falcon	*Falco biarmicus*	x	0.00						x	x	x	x	x	x	x	x	x		x
Little Grebe	*Tachybaptus ruficollis*	x	5.88									x				x			
Ludwig's Bustard	*Neotis ludwigii*	x	11.76	EN	EN		Near-endemic		x		x					x			

Species	Taxonmic name	Powerline priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys	Renosterveld	Gamka Karoo	Surface water	Alien trees	Cliffs	Powerlines	Collisions	Displacement - disturbance	Displacement - habitat loss	Electrocution (substations)
Martial Eagle	*Polemaetus bellicosus*	x	14.71	VU	EN				x	x	x	x	x		x	x	x		
Pale Chanting Goshawk	*Melierax canorus*	x	36.76				Near-endemic			x	x	x	x		x				x
Species	**Taxonmic name**	**Powerline priority species**	**SABAP2 Average reporting rate: full protocol**	**Red Data status: International**	**Red Data status: Regional**	**Endemic - South Africa**	**Endemic - Southern Africa**	**Possibility of occurrence**	**Recorded during surveys**	**Renosterveld**	**Gamka Karoo**	**Surface water**	**Alien trees**	**Cliffs**	**Powerlines**	**Collisions**	**Displacement - disturbance**	**Displacement - habitat loss**	**Electrocution (substations)**
Peregrine Falcon	*Falco peregrinus*	x	0.00						x				x	x	x	x			
Pied Crow	*Corvus albus*	x	38.24						x	x	x	x	x		x				x
Red-billed Teal	*Anas erythrorhyncha*	x	5.88						x			x							
Red-knobbed Coot	*Fulica cristata*	x	4.41									x				x			
South African Shelduck	*Tadorna cana*	x	27.94				Endemic		x			x				x			
Southern Black Korhaan	*Afrotis afra*	x	7.35	VU	VU	Endemic	Endemic		x	x						x			
Spotted Eagle-Owl	*Bubo africanus*	x	4.41						x	x	x		x		x				x
Spur-winged Goose	*Plectropterus gambensis*	x	2.94						x			x				x			
Verreaux's' Eagle	*Aquila verreauxii*	x	16.18	LC	VU				x	x		x	x	x	x	x	x		x
White-necked Raven	*Corvus albicollis*	x	58.82						x	x			x	x	x	x	x		x
Yellow-billed Duck	*Anas undulata*	x	14.71						x			x				x			

Refer to APPENDIX 1 for a list of all species that could potentially occur in the study area.

4.2. Identification of Environmental Sensitivities

The following environmental sensitivities have been identified in the study area from an avifaunal perspective (see Figure 7 below):

- No-go areas: These are areas in close proximity to known active Verreaux's Eagle and Jackal Buzzard nests, where the construction of the proposed powerline and associated infrastructure will constitute a disturbance risk. **No such areas will be impacted by the proposed alignment**.
- High sensitivity: Included are areas within 300m of small waterbodies, and within 500m of large waterbodies (both artificial dams and natural pans), where the proposed powerline will constitute a collision risk. These areas should ideally be avoided, or if this is not possible, there should be adequate mitigation implemented to reduce the risks materially (see Section 7 for a discussion of proposed mitigation measures). Red Data species that could be impacted through collisions with the proposed powerline due to being attracted to the surface water include Greater Flamingo, Black Stork and raptors such as Martial Eagle and Verreaux's Eagle. Many non-Red Data powerline sensitive species could also be attracted to surface water and be at risk of collisions e.g. various species of raptors, ducks, herons, grebes and waders. Ephemeral drainage lines and their immediate environments are also included in this category. When these ephemeral drainage lines contain water, they serve as flyways for waterbirds, and may temporarily attract Red Data species such as Black Stork, while standing pools of water could attract raptors for purposes of drinking and bathing, e.g. Red Data Martial Eagle and Verreaux's Eagle as well as non-Red Data raptors. These areas should likewise ideally be avoided, or if this is not possible, there should be adequate mitigation implemented to reduce the risks materially, e.g. marking with anti-collision devices.
- Medium sensitivity: The entire study area can be classified as medium-sensitive. The area is largely untransformed, and the natural habitat supports a number of Red Data powerline sensitive species, notably Ludwig's Bustard and Karoo Korhaan. Ludwig's Bustard in particular is known to be highly susceptible to powerline collisions.

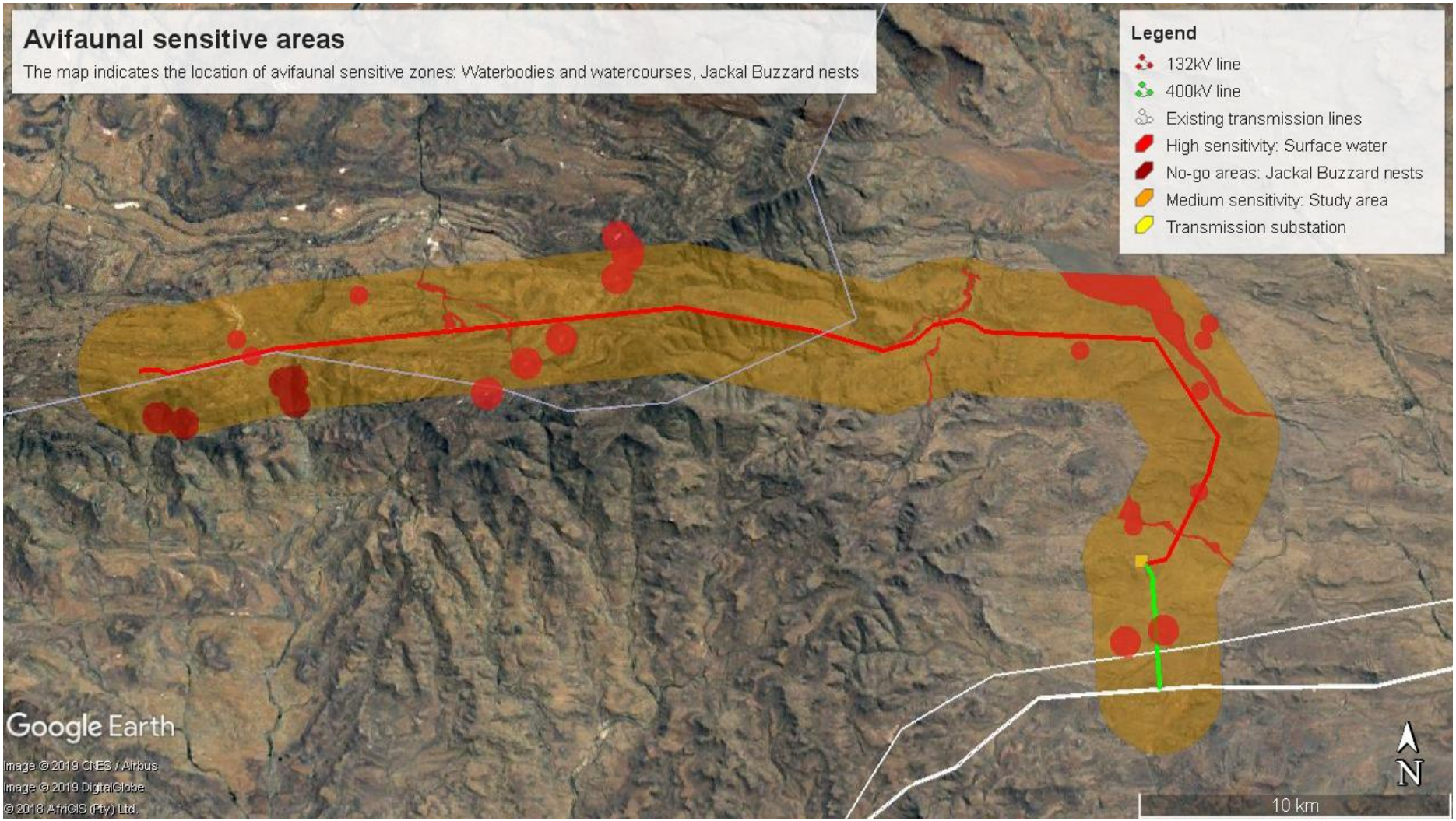


Figure 7: Sensitive areas from an avifaunal impact perspective

5. Issues, Risks and Impacts

The potential impacts identified are as follows:

5.1 Construction Phase

- Potential impact 1: Displacement of priority avifauna due to disturbance associated with the construction of the proposed powerlines, service road and transmission substation.
- Potential impact 2: Displacement of priority avifauna due to habitat transformation associated with the construction of the transmission substation.

5.2 Operational Phase

- Potential impact 3: Mortality of priority avifauna due to collisions with the earth wire of the proposed 132kV and 400kV powerlines.
- Potential impact 4: Electrocution of priority avifauna in the transmission substation yard.

5.3 Decommissioning Phase

- Potential impact 5: Displacement of priority avifauna due to disturbance associated with the decommissioning of the proposed powerline, service road and transmission substation.

5.4 Cumulative Impacts

- Cumulative impact 1: Displacement of priority avifauna due to disturbance associated with the construction of the proposed powerlines, service road and transmission substation in conjunction with existing and future similar projects.
- Cumulative impact 2: Displacement of priority avifauna due to habitat transformation associated with the construction of the transmission substation in conjunction with existing and future similar projects.
- Cumulative impact 3: Mortality of priority avifauna due to collisions with the earth wire of the proposed 132kV and 400kV lines
- Cumulative impact 4: Electrocutions in the transmission substation yard in conjunction with existing and future similar projects.

6. Impact Assessment

6.1 General

Negative impacts on avifauna by electricity infrastructure generally take two main forms namely electrocution and collisions (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs & Ledger 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Van Rooyen 2004; Jenkins *et al*. 2010). Displacement due to habitat destruction and disturbance associated with the construction of the electricity infrastructure is another impact that could potentially impact on avifauna.

6.2 Electrocutions

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (Van Rooyen 2004). The electrocution risk is largely determined by the pole/tower design. In the case of the proposed powerlines, no electrocution risk is envisaged because the proposed design of the 132kV line, namely the steel monopole, and the 400kV transmission towers, will not pose an electrocution threat to any of the priority species which

are likely to occur at the site. Electrocutions within the proposed transmission substation yard are possible, but should not affect the more sensitive Red Data bird species, as these species are unlikely to use the infrastructure within the substation yard for perching or roosting.

6.3 Collisions

Collisions are the biggest threat posed by transmission lines to birds in southern Africa (Van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds, and to a lesser extent, vultures. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with transmission lines (Van Rooyen 2004, Anderson 2001). In a recent PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with transmission lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini et al. 2005, Jenkins et al. 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the lower-resolution, and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin et al. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown et al. 1987, Henderson et al. 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown et al. 1987, APLIC 2012).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins et al. 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown et al. 1987, Faanes 1987, Alonso et al. 1994a, Bevanger 1994)."

From incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are generally susceptible to power line collisions in South Africa (see Figure 8 below).

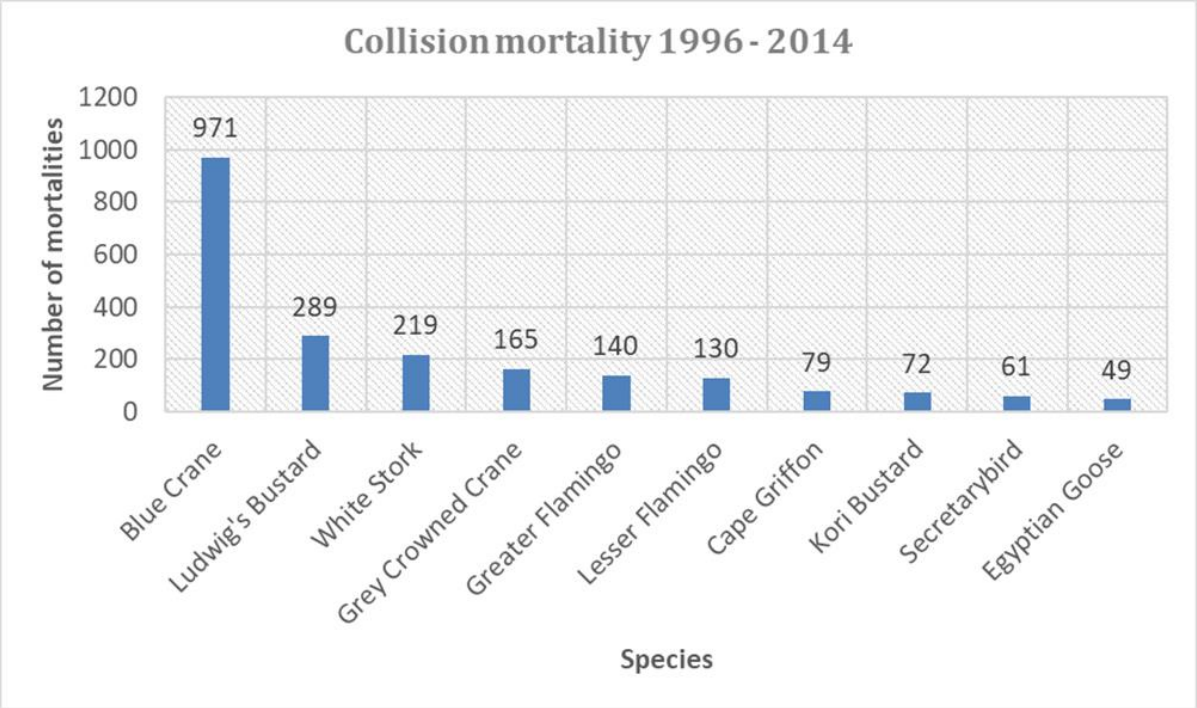


Figure 8: The top 10 collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/Endangered Wildlife Trust Strategic Partnership central incident register 1996 - 2014 (EWT unpublished data)

Power line collisions are generally accepted as a key threat to bustards (Raab *et al*. 2009; Raab *et al*. 2010; Jenkins & Smallie 2009; Barrientos *et al*. 2012, Shaw 2013). In a recent study, carcass surveys were performed under high voltage transmission lines in the Karoo for two years, and low voltage distribution lines for one year (Shaw 2013). Ludwig's Bustard was the most common collision victim (69% of carcasses), with bustards generally comprising 87% of mortalities recovered. Total annual mortality was estimated at 41% of the Ludwig's Bustard population, with Kori Bustards also dying in large numbers (at least 14% of the South African population killed in the Karoo alone). Karoo Korhaan was also recorded, but to a much lesser extent than Ludwig's Bustard. The reasons for the relatively low collision risk of this species probably include their smaller size (and hence greater agility in flight) as well as their more sedentary lifestyles, as local birds are familiar with their territory and are less likely to collide with power lines (Shaw 2013).

Several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is key to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes *Anthropoides paradiseus* and White Storks *Ciconia ciconia*. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and

below the binocular fields in the forward facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35°, respectively, are sufficient to render the birds blind in the direction of travel; in storks, head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (A*ccipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to power line collisions.

Despite doubts about the efficacy of line marking to reduce the collision risk for bustards (Jenkins *et al*. 2010; Martin *et al.* 2010), there are numerous studies which prove that marking a line with PVC spiral type Bird Flight Diverters (BFDs) generally reduce mortality rates (e.g. Bernardino *et al.* 2018; Sporer *et al.* 2013, Barrientos *et al*. 2011; Jenkins *et al*. 2010; Alonso & Alonso 1999; Koops & De Jong 1982), including to some extent for bustards (Barrientos *et al*. 2012; Hoogstad 2015 pers.comm). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. Barrientos *et al.* (2011) reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease of 55–94% in bird mortalities. Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5m, whereas using the same devices at 10m intervals only reduces the mortality by 57%. Barrientos *et al*. (2012) found that larger BFDs were more effective in reducing Great Bustard collisions than smaller ones. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al*. 2010).

The most likely Red Data candidates for collision mortality on the proposed powerline are Ludwig's Bustards, Karoo Korhaan and Southern Black Korhaan in natural habitat, and Greater Flamingo near dams. Non-Red Data waterbirds could also be at risk near dams and where the line crosses drainage lines (see Table 1 for a list of species that could be at risk). Martial and Verreaux's Eagle might also be at risk, especially at surface water when they descend to bath and drink.

6.4 Displacement due to habitat destruction and disturbance

During the construction of power lines, service roads (jeep track) and substations, habitat destruction/transformation inevitably takes place. The construction activities will constitute the following:

- Site clearance and preparation:
- Construction of the infrastructure (i.e. the transmission substation, powerlines and service road);
- Transportation of personnel, construction material and equipment to the site, and personnel away from the site;
- Removal of vegetation for the proposed substation and stockpiling of topsoil and cleared vegetation;
- Excavations for infrastructure;

These activities could impact on birds breeding, foraging and roosting in or in close proximity of the proposed transmission substation through **transformation of habitat**, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the substation yard is unavoidable. Fortunately, due to the nature of the vegetation, and judged by the existing powerlines, very little if any vegetation clearing will be required in the powerline servitudes. The habitat in the study area is very uniform from a bird impact perspective; therefore the loss of habitat for Red Data species due to direct habitat transformation associated with the construction of the proposed substation is likely to be fairly minimal. The species most likely to be directly affected by this impact would be small, non-Red Data species.

Apart from direct habitat destruction, the above-mentioned activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle, although in practice that can admittedly be very challenging to implement. Large terrestrial species namely Ludwig's Bustard, Karoo Korhaan and Southern Black Korhaan are most likely to be affected by displacement due to disturbance. The ground-nesting Black Harrier and cliff-nesting Jackal Buzzard could also potentially be vulnerable to this impact, but the habitat in the study area is not ideal for the former species from a breeding perspective. The cliff-nesting Verreaux's Eagle will not be affected as no known nests are within the impact zone of the proposed developments.

6.5 Cumulative impacts (all phases)

The cluster of renewable energy project applications currently registered with the Department of Environmental Affairs (DEA) within a 50km radius around the proposed development are listed in APPENDIX 2 of this report, together with a map indicating their locality relative to the proposed development. Possible impacts by renewable energy projects on birds within this area are temporary displacement due to disturbance associated with the construction of the facilities and associated infrastructure, collisions with solar panels and wind turbines, permanent displacement due to habitat transformation, entrapment in perimeter fences, collisions with the associated power lines, and electrocutions in substation yards.

Large raptor species, particularly Verreaux's Eagle and Martial Eagle, are potentially most at risk as far as cumulative impacts of the cluster of renewable energy projects in the 50km radius around the proposed development is concerned. However, the proposed development should not materially threaten these species. The concern from a powerline interaction perspective is more for large terrestrial species, particularly Ludwig's Bustard, which is highly susceptible to powerline collisions. The proposed development will add an additional ˜41km of HV line to the existing HV network in the area. Several hundred kilometres of HV line already exists within this area, and several more are planned should the renewable energy projects all be built. The overall cumulative impact of the proposed development, when viewed with the existing impacts on avifauna, is assessed to be of moderate significance. It could be reduced to some extent with mitigation, but will remain at a moderate level.

6.6 Potential Impacts during the Construction Phase

6.6.1. Displacement of priority avifauna due to habitat transformation

Aspect/Activity	The clearing of vegetation in the proposed transmission substation yard
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Displacement of priority species due to permanent habitat transformation
Status	Negative
Mitigation Required	A site-specific Construction Environmental Management Programme (CEMPr) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction and degradation of habitat. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr should specifically include the following: • The minimum footprint areas for infrastructure should be used wherever possible, including road widths and lengths; • No off-road driving; • Maximum use of existing roads; • Measures to control dust; • Restricted access to the rest of the property; and • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.
Impact Significance (Pre-Mitigation)	Low (Level 4)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	None to date

6.6.2. Displacement due to Disturbance

Aspect/Activity	Construction activities
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Displacement of priority species, particularly Red Data species, due to disturbance
Status	Negative
Mitigation Required	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: • No off-road driving; • Maximum use of existing roads; • Measures to control noise; • Restricted access to the rest of the property; • The appointed Environmental Control Officer (ECO) must be trained by an avifaunal specialist to identify the potential priority species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of especially Red Data species, and such efforts may include the training of construction staff to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed; and • Prior to construction, an avifaunal specialist should conduct a site walk through, covering the final service road and power line routes, to identify any nests/breeding/roosting activity of priority species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	None to date

6.7 Potential Impacts during the Operational Phase

6.7.1. Electrocution of priority avifauna

Aspect/Activity	The transmission of electricity generated from the proposed three Mainstream WEFs
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Electrocution of priority species in the transmission substation
Status	Negative
Mitigation Required	• The hardware within the proposed transmission substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site specific mitigation be applied reactively. This is an acceptable approach because priority avifauna, especially Red Data species, is unlikely to frequent the substation and be electrocuted.
Impact Significance (Pre-Mitigation)	Very low (Level 5)
Impact Significance (Post-Mitigation)	Very low (Level 5)
I&AP Concern	None to date

6.7.2. Mortality of priority avifauna due to collisions

Aspect/Activity	The transmission of electricity generated from the proposed three Mainstream WEFs
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Mortality of priority avifauna due to collisions with the earthwire of the proposed powerlines
Status	Negative
Mitigation Required	• An avifaunal specialist must conduct a site walk through of final pylon positions prior to construction to determine if, and where, BFDs are required. • Install BFDs as per the instructions of the specialist following the site walk through, which may include the need for modified BFDs fitted with solar powered LED lights on certain spans. • The operational monitoring programme must include regular monitoring (i.e. quarterly) of the powerlines for collision mortalities.
Impact Significance (Pre-Mitigation)	High (Level 2)
Impact Significance (Post-Mitigation)	Moderate (Level 3)
I&AP Concern	None to date

6.8 Potential Impacts during the Decommissioning Phase

6.8.1. Displacement of priority avifauna due to disturbance

Aspect/Activity	Removal of the proposed infrastructure during decommissioning
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Displacement of priority species, especially Red Data species, due to disturbance
Status	Negative
Mitigation Required	• A site-specific Decommissioning EMPr (DEMPr) must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the DEMPr and should apply good environmental practice during decommissioning. • Following decommissioning, rehabilitation of all areas disturbed must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.
Impact Significance (Pre-Mitigation)	Moderate (Level 3)
Impact Significance (Post-Mitigation)	Low (Level 4)
I&AP Concern	None to date

6.9 Cumulative Impacts

Aspect/Activity	The incremental impact of the proposed transmission, service road and powerlines on priority avifauna added to the impacts of other past, present or reasonably foreseeable future activities.
Type of Impact (i.e. Impact Status)	Cumulative
Potential Impact	Temporary displacement of priority avifauna due to disturbance associated with the construction of the proposed transmission substation, service road and powerlines; permanent displacement of priority avifauna due to habitat transformation associated with the construction of the proposed powerlines, service road and transmission substation, and mortality of priority avifauna due to collisions with the powerline, and electrocutions in the substation yard.
Status	Negative
Mitigation Required	• • Please refer to all the proposed mitigation measures as listed in the preceding tables in Section 6 for all the impacts and all the phases.
Impact Significance (Pre-Mitigation)	Moderate risk (Level 3)
Impact Significance (Post-Mitigation)	Moderate risk (Level 3)
I&AP Concern	None to date

6.10 No-go option

The no-go option will result in no additional impacts on avifauna and will result in the ecological status quo being maintained (as described in Section 4 of this report).

7. Impact Assessment Tables

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Tables 2 to 5 below.

Table 2: Impact Assessment Summary Table for the Construction Phase

Construction Phase													
Direct Impacts													
Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance Without Mitigation	Significance With Mitigation	Ranking of Residual Impact/ Risk	Confidence Level
The clearing of vegetation for the proposed transmission substation yard	Displacement of priority species, especially Red Data species due to permanent habitat transformation	Negative	Site Specific	Long term	Extreme	Very unlikely	High reversibility	Replaceable	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction and degradation of habitat. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr should specifically include the following: • The minimum footprint areas for infrastructure should be used wherever possible, including road widths and lengths; • No off-road driving; • Maximum use of existing roads; • Measures to control dust; • Restricted access to the rest of the property; • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.	Low risk (4)	Low risk (4)	Low risk (4)	High
Construction of the proposed transmission substation, service road and powerline	Displacement of priority species, especially Red Data species, due to disturbance	Negative	Site	Short term	Substantial	Likely	Highly reversible	Replaceable	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: • No off-road driving; • Maximum use of existing roads; • Measures to control noise; • Restricted access to the rest of the property; • The appointed ECO must be trained by an avifaunal specialist to identify the potential priority species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of especially Red Data species, and such efforts may include the training of construction staff to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g.	Moderate risk (3)	Low risk (4)	Low Risk (4)	High

									if a nest site is found), construction activities within 500m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed. • Prior to construction, an avifaunal specialist should conduct a site walk through, covering the final service road and power line routes, to identify any nests/breeding/roosting activity of priority species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.				

Table 3: Impact Assessment Summary Table for the Operational Phase

Operational Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
The transmission of electricity generated by the three proposed Mainstream WEFs	Electrocution of Red Data avifauna in the transmission substation	Negative	Local	Long term	Severe	Extremely unlikely	High	Replace able	• The hardware within the proposed transmission substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site specific mitigation be applied reactively. This is an acceptable approach because Red Data avifauna is unlikely to frequent the substation and be electrocuted.	Very low risk (5)	Very low risk (5)	Very low risk (5)	High
The transmission of electricity generated by the three proposed Mainstream WEFs	Mortality of priority avifauna due to collisions with the earthwire of the proposed powerlines	Negative	Local	Long term	Severe	Likely	High	Replace able	• An avifaunal specialist must conduct a site walk through of final pylon positions prior to construction to determine if, and where, BFDs are required. • Install BFDs as per the instructions of the specialist following the site walk through, which may include the need for modified BFDs fitted with solar powered LED lights on certain spans. • The operational monitoring programme must include regular (quarterly) monitoring of the grid connection power line for collision mortalities.	High risk (2)	Moderate risk (3)	Moderate risk (3)	High

Table 4: Impact Assessment Summary Table for the Decommissioning Phase

Decommissioning Phase													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation/ Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
Removal of the infrastructure	Displacement of priority species, especially Red Data species, due to disturbance	Negative	Site Spe cific	Short term	Substantial	Likely	Highly reversible	Replace able	• A site-specific DEMPr must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the DEMPr and should apply good environmental practice during decommissioning. • Following decommissioning, rehabilitation of all areas disturbed must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.	Moderate risk (3)	Low risk (4)	Low risk (4)	Medium

Table 5: Cumulative Impact Assessment Summary Table

Cumulative Impacts (Construction, Operational and Decommissioning Phases)													
Direct Impacts													
Aspect/ Impact Pathway	**Nature of Potential Impact/ Risk**	**Status**	**Spatial Extent**	**Duration**	**Consequence**	**Probability**	**Reversibility of Impact**	**Irreplaceability**	**Potential Mitigation Measures**	**Significance of Impact and Risk**		**Ranking of Residual Impact/ Risk**	**Confidence Level**
										Without Mitigation / Management	**With Mitigation/ Management (Residual Impact/ Risk)**		
The incremental impact of the proposed transmission substation, service road and powerlines on priority avifauna added to the impacts of other past, present or reasonably foreseeable future activities.	Temporary displacement of priority avifauna, especially Red Data avifauna, due to disturbance associated with the construction of the proposed transmission substation, service road and powerlines; permanent displacement of Red Data avifauna due to habitat transformation associated with the construction of the proposed transmission substation; and mortality of Red Data avifauna due to collisions with the powerline, and electrocutions in the substation yard.	Negative	Local	Long term	Substantial	Very likely	High	Replaceable	• Please refer to all the proposed mitigation measures as listed in the impact tables in Section 6 for all impacts in all the phases.	Moderate risk (3)	Moderate risk (3)	Moderate risk (3)	Low

7.1 Impact Assessment Summary

Table 6 below provides an indication of the overall impact significance with the implementation of mitigation measures for the various phases.

Table 6: Overall Impact Significance (Post Mitigation)

Phase	**Overall Impact Significance**
Construction	Low (Level 4)
Operational	Very Low (Level 5) to Moderate (Level 3)
Decommissioning	Low (Level 4)
Nature of Impact	**Overall Impact Significance**
Cumulative	Moderate (Level 3)

8. Legislative and Permit Requirements

8.1 Legislative Framework

There is no legislation pertaining specifically to the impact of wind facilities and associated electrical infrastructure on avifauna. There are best practice guidelines available which were compiled under the auspices of Birdlife South Africa (BLSA) and the Endangered Wildlife Trust (EWT) i.e. *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.* These guidelines have been updated on several occasions, with the latest version released in 2015.

8.1.1 Agreements and conventions

Table 7 below lists international agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna[1].

Convention name	Description	Geographic scope
African-Eurasian Waterbird Agreement (AEWA)	The Agreement on the Conservation of AEWA is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range.	Regional
Convention on Biological Diversity (CBD), Nairobi, 1992	The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: The conservation of biological diversity; The sustainable use of the components of biological diversity; and The fair and equitable sharing of the benefits arising out of the utilization of genetic resources.	Global
Convention on the Conservation of Migratory Species of Wild Animals,	As an environmental treaty under the aegis of the UNEP, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which	Global

[1] (BirdLife International (2016) Country profile: South Africa. Available from: http://www.birdlife.org/datazone/country/south_africa. Checked: 2016-04-02).

Convention name	Description	Geographic scope
(CMS), Bonn, 1979	migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range.	
Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Global
Ramsar Convention on Wetlands of International Importance, Ramsar, 1971	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.	Global
Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia	The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate.	Regional

8.1.2 National legislation

8.1.2.1 Constitution of the Republic of South Africa, 1996

The Constitution of the Republic of South Africa provides in the Bill of Rights that: Everyone has the right –

(a) to an environment that is not harmful to their health or well-being; and
(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that –
  (i) prevent pollution and ecological degradation;
  (ii) promote conservation; and
  (iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

8.1.2.2 The National Environmental Management Act 107 of 1998

The National Environmental Management Act 107 of 1998 (as amended) (NEMA) creates the legislative framework for environmental protection in South Africa, and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated.

NEMA also provides that a wide variety of listed developmental activities (via the promulgation of the EIA Regulations (2014, as amended), which may significantly affect the environment, may be performed only after an EIA has been done and authorisation has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

8.1.2.3 The National Environmental Management: Biodiversity Act 10 of 2004 and the Threatened or Protected Species Regulations, February 2007

The most prominent statute containing provisions directly aimed at the conservation of birds is the National Environmental Management: Biodiversity Act (Act 10 of 2004, as amended) read with the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations). Chapter 1 sets out the objectives of the Act, and they are aligned with the objectives of the Convention on Biological Diversity, which are the conservation of biodiversity, the sustainable use of its components, and the fair and equitable sharing of the benefits of the use of genetic resources. The Act also gives effect to CITES, the Ramsar Convention, and the Bonn Convention on Migratory Species of Wild Animals (as noted in Table 7 above). The State is endowed with the trusteeship of biodiversity and has the responsibility to manage, conserve and sustain the biodiversity of South Africa.

9. Environmental Management Programme Inputs

Refer to APPENDIX 3 for the EMPr inputs. Below in Table 8 is a summary of the key monitoring recommendations contained in the EMPr specifically pertaining to avifauna. It is important to note that a comprehensive EMPr is included in the BA Report, which includes input from all specialists in this regard.

Table 7: Key monitoring requirements contained in the EMPr

Monitoring requirement	Frequency	Responsibility
• Avifaunal specialist must conduct a quarterly walk-through of the powerlines to assess the level of collision mortality of avifauna. Prior to construction, an avifaunal specialist should conduct a site walk through, covering the final service road and power line route, to identify any nests/breeding/roosting activity of priority species, as well as any additional sensitive habitats	Quarterly Once before construction commences	Avifaunal specialist

10. Conclusion and Recommendations

The proposed project will have the following potential impacts on avifauna:

- Displacement due to habitat transformation in the footprint of the proposed transmission substation;
- Displacement due to the construction of the proposed transmission substation, service road and 132kV and 400kV powerlines;
- Electrocution in the transmission substation yard; and
- Mortality due to collision with the earthwire of the proposed 132kV and 400kV powerlines.

10.1 Displacement due to habitat transformation

Habitat transformation has an impact on birds breeding, foraging and roosting in or in close proximity of the proposed transmission substation, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce this impact as the total permanent transformation of the natural habitat within the construction footprint of the proposed, transmission substation yard is unavoidable. However, due to the nature of the vegetation, and judged by the existing transmission lines, very little if any vegetation clearing will be required in the powerline

servitudes. The habitat in the study area is very uniform from a bird impact perspective, therefore the loss of habitat for Red Data species due to direct habitat transformation associated with the construction of the proposed transmission substation is likely to be fairly minimal. **The impact significance is assessed to be Low, both before and after mitigation**. The species most likely to be directly affected by this impact would be small, non-Red Data species. Suggested mitigation measures are restricting footprint to the absolute minimum, no off-road driving, maximum use of existing roads, measures to control dust, restricted access to the rest of the property, and rehabilitation of all areas disturbed.

10.2 Displacement due to disturbance

Apart from direct habitat destruction, construction activities also impact on birds through disturbance; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity to breeding locations could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. A potential mitigation measure is the timeous identification of nests and the timing of the construction activities to avoid disturbance during a critical phase of the breeding cycle. Large terrestrial species, including Red Data Ludwig's Bustard, Karoo Korhaan and Southern Black Korhaan, are most likely to be affected by displacement due to disturbance. The ground-nesting Black Harrier and cliff nesting Jackal Buzzard could also potentially be vulnerable to this impact, but the habitat in the study area is not ideal for the former species from a breeding perspective. **The impact is assessed to be Moderate before mitigation, and Low after mitigation**. Suggested mitigation measures are restricting footprint to the absolute minimum, no off-road driving, maximum use of existing roads, measures to control noise, restricted access to the rest of the property, training the ECO to identify Red Data nests during construction, and a pre-construction walk-through by the avifaunal specialist to identify and Red Data nests coupled with the timing of the construction if need be.

10.3 Electrocution

In the case of the proposed powerlines, no electrocution risk is envisaged because the proposed design of the 132kV and 400kV powerlines will not pose an electrocution threat to any of the priority species which are likely to occur at the site. Electrocutions within the proposed transmission substation yard are possible, but should not affect the more sensitive Red Data bird species, as these species are unlikely to use the infrastructure within the substation yards for perching or roosting. Suggested mitigation measures are reactive mitigation in the substation if electrocutions are recorded. **The risk is assessed to be Very Low, both before and after mitigation.**

10.4 Collisions

The most likely Red Data candidates for collision mortality on the proposed powerlines are Ludwig's Bustards, Karoo Korhaan and Southern Black Korhaan in natural habitat, and Greater Flamingo near dams. Non-Red Data waterbirds could also be at risk near dams and where the line crosses drainage lines (see Table 1 for a list of species that could be at risk). Martial and Verreaux's Eagle might also be at risk, especially at surface water when they descend to bath and drink. Suggested mitigation measures are a walk-through by the avifaunal specialist of the final alignment to identify sections that require mitigation, the fitting of BFDs on those pre-identified sections and quarterly line inspections by the avifaunal specialist to record collision-related mortality. **The risk is assessed to be High, but it can be reduced to Moderate through the application of mitigation measures.**

10.5 Cumulative impacts

Large raptor species, particularly Verreaux's Eagle and Martial Eagle, are potentially most at risk as far as cumulative impacts of renewable energy projects in the 50km radius around the proposed development is concerned. However, the project should not materially threaten these species. The concern from a powerline interaction perspective is more for large terrestrial species, particularly Ludwig's Bustard, which is highly susceptible to powerline collisions. The proposed project will add an additional ˜41km of HV line to the existing HV network in the area. Several hundred kilometres of HV line already exists within this area, and several more are planned should the renewable energy projects all be built. **The overall cumulative impact of the proposed project, when viewed with the existing impacts on avifauna, is assessed to be Moderate, and is likely remain at that level after mitigation.**

Table 9 below provides a summary of the respective significance ratings, and an average overall rating before and after mitigation.

Table 8: Overall impact significance rating

Impact	Rating pre-mitigation	Rating post-mitigation
Displacement due to habitat transformation	Low (4)	Low (4)
Displacement due to disturbance	Moderate (3)	Low (4)
Electrocution	Very Low (5)	Very Low (5)
Collisions	High (2)	Moderate (3)
Cumulative impacts	Moderate (3)	Moderate (3)
Average:	**Moderate to Low (3.4)**	**Low to Moderate (3.8)**

11. Final Specialist Statement and Authorisation Recommendation

The overall potential impact on priority avifauna for the construction phase is assessed to be of **Moderate to Low significance before mitigation measures, and Low after the implementation of mitigation measures.** For the decommissioning phase, the overall potential impact on priority avifauna is assessed with a **Moderate significance before the implementation of mitigation and a Low significance after the implementation of mitigation measures**. For the operational phase, the overall potential impact on priority avifauna is assessed with a **Very Low to High significance without the implementation of mitigation measures; and Very Low to Moderate significance with the implementation of mitigation measures**. Cumulative impacts are assessed with a **Moderate significance both with and without mitigation measures**. In terms of <u>an average</u>, the <u>pre-mitigation significance</u> of all potential impacts identified in this specialist study is assessed as **Moderate to Low**, leaning more towards Moderate (i.e. average of 3.4, as shown in Table 9 above) and the post-mitigation significance is assessed as Low to Moderate, leaning more towards Low (i.e. average of 3.8, as shown in Table 9 above). It is therefore recommended that the activity is authorised, on condition that the proposed mitigation measures as detailed in the EMPr (APPENDIX 3) are strictly implemented.

11.1. EA Condition Recommendations

The proposed mitigation measures are detailed in the EMPr (APPENDIX 3)

12. References

- ALLAN, D.G. 1994. The abundance and movements of Ludwig's Bustard *Neotis ludwigii*. *Ostrich* 65: 95-105
- ANDERSON, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.
- ANIMAL DEMOGRAPHY UNIT. The southern African Bird Atlas Project 2. University of Cape Town. http://sabap2.adu.org.za.
- AVIAN POWER LINE INTERACTION COMMITTEE (APLIC). 2012. *Mitigating Bird Collisions with Power Lines: The State of the Art in 2012*. Edison Electric Institute. Washington D.C.
- BARRIENTOS R, PONCE C, PALACIN C, MARTÍN CA, MARTÍN B, ET AL. 2012. Wire marking results in a small but significant reduction in avian mortality at power lines: A BACI Designed Study. PLoS ONE 7(3): e32569. doi:10.1371/journal.pone.0032569.
- BARRIENTOS, R., ALONSO, J.C., PONCE, C., PALACÍN, C. 2011. Meta-Analysis of the effectiveness of marked wire in reducing avian collisions with power lines. Conservation Biology 25: 893-903.
- BEAULAURIER, D.L. 1981. Mitigation of bird collisions with transmission lines. Bonneville Power Administration. U.S. Dept. of Energy.
- BERNARDINO, J., BEVANGER, K., BARRIENTOS, R., DWYER, J.F. MARQUES, A.T., MARTINS, R.C., SHAW, J.M., SILVA, J.P., MOREIRA, F. 2018. Bird collisions with power lines: State of the art and priority areas for research. https://doi.org/10.1016/j.biocon.2018.02.029. Biological Conservation 222 (2018) 1 – 13.
- ENDANGERED WILDLIFE TRUST. 2014. Unpublished data from the EWT Central Incident Register for powerline incidents.
- HOBBS, J.C.A. & LEDGER J.A. 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. *Proceedings of the Third International Conference on Environmental Quality and Ecosystem Stability*. Israel, June 1986.
- HOBBS, J.C.A. & LEDGER J.A. 1986b. Power lines, Birdlife and the Golden Mean. *Fauna and Flora,* 44:23-27.
- HOOGSTAD, C. Email communication from the manager of the Eskom-EWT Strategic Partnership to the author on 25 June 2015.
- HOCKEY P.A.R., DEAN W.R.J., AND RYAN P.G. 2005. Robert's Birds of Southern Africa, seventh edition. Trustees of the John Voelcker Bird Book Fund, Cape Town.
- JENKINS, A., DE GOEDE, J.H. & VAN ROOYEN, C.S. 2006. Improving the products of the Eskom Electric Eagle Project. Unpublished report to Eskom. Endangered Wildife Trust.
- JENKINS, A. & SMALLIE, J. 2009. Terminal velocity: the end of the line for Ludwig's Bustard? Africa Birds and Birding. Vol 14, No 2.
- JENKINS, A.R., SMALLIE, J.J. & DIAMOND, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. *Bird Conservation International* 20: 263-278.
- KOOPS, F.B.J. & DE JONG, J. 1982. Vermindering van draadslachtoffers door markering van hoogspanningsleidingen in de omgeving van Heerenveen. Electrotechniek 60 (12): 641 – 646.
- KRUGER, R. & VAN ROOYEN, C.S. 1998. Evaluating the risk that existing power lines pose to large raptors by using risk assessment methodology: The Molopo Case Study. *Proceedings of the 5th World Conference on Birds of Prey and Owls*. August 4-8,1998. Midrand, South Africa.

- KRUGER, R. 1999. *Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa*. Bloemfontein (South Africa): University of the Orange Free State. (M. Phil. Mini-thesis)
- LEDGER, J. 1983. *Guidelines for Dealing with Bird Problems of Transmission Lines and Towers.* Eskom Test and Research Division. (Technical Note TRR/N83/005).
- LEDGER, J.A. & ANNEGARN H.J. 1981. Electrocution Hazards to the Cape Vulture (*Gyps coprotheres*) in South Africa. *Biological Conservation* 20:15-24.
- LEDGER, J.A. 1984. Engineering Solutions to the Problem of Vulture Electrocutions on Electricity Towers. *The Certificated Engineer*, 57:92-95.
- LEDGER, J.A., J.C.A. HOBBS & SMITH T.V. 1992. Avian Interactions with Utility Structures: Southern African Experiences. *Proceedings of the International Workshop on Avian Interactions with Utility Structures*. Miami (Florida), Sept. 13-15, 1992. Electric Power Research Institute.
- MARNEWICK, M.D., RETIEF E.F., THERON N.T., WRIGHT D.R., ANDERSON T.A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.
- MARTIN, G.R., SHAW, J.M. 2010. Bird collisions with power lines: Failing to see the way ahead?. Biol. Conserv. (2010), doi:10.1016/j.biocon.2010.07.014.
- MARTIN, G., SHAW, J., SMALLIE J. & DIAMOND, M. 2010. Bird's eye view – How birds see is key to avoiding power line collisions. Eskom Research Report. Report Nr: RES/RR/09/31613.
- MUCINA. L. & RUTHERFORD, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- SHAW, J.M. 2013. Power line collisions in the Karoo: Conserving Ludwig's Bustard. Unpublished PhD thesis. Percy FitzPatrick Institute of African Ornithology, Department of Biological Sciences, Faculty of Science University of Cape Town May 2013.
- SPORER, M.K., DWYER, J.F., GERBER, B.D, HARNESS, R.E, PANDEY, A.K. Marking Power Lines to Reduce Avian Collisions Near the Audubon National Wildlife Refuge, North Dakota. Wildlife Society Bulletin 37(4):796–804; 2013; DOI: 10.1002/wsb.329
- TAYLOR, M.R., PEACOCK, F., WANLESS, R.M. (eds.) 2015. The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.
- VAN ROOYEN, C.S. & LEDGER, J.A. 1999. *Birds and utility structures: Developments in southern Africa*. Pp 205-230, in Ferrer, M. & G.F.M. Janns. (eds.). *Birds and Power lines*. Quercus, Madrid (Spain). Pp 238.
- VAN ROOYEN, C.S. & TAYLOR, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina.
- VAN ROOYEN, C.S. 1998. Raptor mortality on power lines in South Africa. *Proceedings of the 5th World Conference on Birds of Prey and Owls*. Midrand (South Africa), Aug.4 – 8, 1998.
- VAN ROOYEN, C.S. 1999. An overview of the Eskom-EWT Strategic Partnership in South Africa. *EPRI Workshop on Avian Interactions with Utility Structures* Charleston (South Carolina), Dec. 2-3 1999.
- VAN ROOYEN, C.S. 2000. An overview of Vulture Electrocutions in South Africa. *Vulture News,* 43: 5-22. (Vulture Study Group, Johannesburg, South Africa).
- VAN ROOYEN, C.S. 2007. Eskom-EWT Strategic Partnership: Progress Report April-September 2007. Endangered Wildlife Trust, Johannesburg.
- VAN ROOYEN, C.S. VOSLOO, H.F. & R.E. HARNESS. 2002. Eliminating bird streamers as a cause of faulting on transmission lines in South Africa. *Proceedings of the IEEE 46th Rural Electric Power Conference.* Colorado Springs (Colorado), May. 2002.

- VERDOORN, G.H. 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132kV power lines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. *Proceedings of the 2nd International Conference on Raptors*: Urbino (Italy), Oct. 2-5, 1996.

APPENDIX 1: LIST OF SPECIES POTENTIALLY OCCURRING IN THE STUDY AREA

Species	Taxonmic name	Powerline priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys
Acacia Pied Barbet	*Tricholaema leucomelas*		10.29				Near-endemic		
African Black Duck	*Anas sparsa*	x	8.82						
African Black Swift	*Apus barbatus*		1.47						
African Hoopoe	*Upupa africana*		0.00						
African Pipit	*Anthus cinnamomeus*		16.18						x
African Red-eyed Bulbul	*Pycnonotus nigricans*		7.35				Near-endemic		
African Reed Warbler	*Acrocephalus baeticatus*		1.47						
African Rock Pipit	*Anthus crenatus*		5.88	LC	NT	Endemic (SA, Lesotho, Swaziland)	Endemic		
African Sacred Ibis	*Threskiornis aethiopicus*	x	4.41						
African Spoonbill	*Platalea alba*	x	2.94						
African StoneChat	*Saxicola torquatus*		5.88						
Alpine Swift	*Tachymarptis melba*		7.35						
Ant-eating Chat	*Myrmecocichla formicivora*		4.41				Endemic		
Barn Swallow	*Hirundo rustica*		27.94						x
Black Harrier	*Circus maurus*	x	2.94	EN	EN	Near endemic	Endemic		x
Black Stork	*Ciconia nigra*	x	1.47	LC	VU				x
Black-chested Snake Eagle	*Circaetus pectoralis*	x	1.47						x
Black-eared Sparrow-lark	*Eremopterix australis*		7.35			Near endemic	Endemic		x
Black-headed Canary	*Serinus alario*		33.82			Near endemic	Endemic		x
Black-headed Heron	*Ardea melanocephala*	x	4.41						x
Black-shouldered Kite	*Elanus caeruleus*	x	1.47						
Blacksmith Lapwing	*Vanellus armatus*		20.59						x
Black-winged Stilt	*Himantopus himantopus*		5.88						
Bokmakierie	*Telophorus zeylonus*		64.71				Near-endemic		x
Booted Eagle	*Aquila pennatus*	x	11.76						x
Brown-throated Martin	*Riparia paludicola*		5.88						
Cape Bulbul	*Pycnonotus capensis*		2.94			Endemic	Endemic		x
Cape Bunting	*Emberiza capensis*		75.00				Near-endemic		x
Cape Canary	*Serinus canicollis*		0.00				Endemic		
Cape Clapper Lark	*Mirafra apiata*		25.00			Near endemic	Endemic		x
Cape Crow	*Corvus capensis*	x	0.00						x
Cape Eagle-Owl	*Bubo capensis*	x	0.00						x
Cape Penduline-Tit	*Anthoscopus minutus*		0.00						
Cape Robin-Chat	*Cossypha caffra*		10.29						
Cape Rock Thrush	*Monticola rupestris*		1.47			Endemic (SA, Lesotho, Swaziland)	Endemic		
Cape Shoveler	*Anas smithii*	x	11.76				Near-endemic		x
Cape Siskin	*Crithagra totta*		1.47			Endemic	Endemic		
Cape Sparrow	*Passer melanurus*		41.18				Near-endemic		x

Species	Taxonmic name	Powerline priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys
Cape Spurfowl	*Pternistis capensis*		17.65			Near endemic	Endemic		x
Cape Sugarbird	*Promerops cafer*		1.47			Endemic	Endemic		
Cape Teal	*Anas capensis*	x	5.88						x
Cape Turtle Dove	*Streptopelia capicola*		47.06						x
Cape Wagtail	*Motacilla capensis*		38.24						x
Cape Weaver	*Ploceus capensis*		14.71			Near endemic	Endemic		
Cape White-eye	*Zosterops virens*		5.88			Near endemic	Endemic		
Capped Wheatear	*Oenanthe pileata*		0.00						x
Cardinal Woodpecker	*Dendropicos fuscescens*		2.94						
Chat Flycatcher	*Bradornis infuscatus*		5.88				Near-endemic		
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*		11.76				Near-endemic		
Cinnamon-breasted Bunting	*Emberiza tahapisi*		0.00						x
Common (Steppe) Buzzard	*Buteo vulpinus*	x	1.47						
Common Fiscal	*Lanius collaris*		39.71						x
Common Greenshank	*Tringa nebularia*		4.41						x
Common House Martin	*Delichon urbicum*		2.94						x
Common Moorhen	*Gallinula chloropus*		1.47						
Common Quail	*Coturnix coturnix*		2.94						
Common Starling	*Sturnus vulgaris*		8.82						x
Common Swift	*Apus apus*		5.88						x
Common Waxbill	*Estrilda astrild*		10.29						x
Crowned Lapwing	*Vanellus coronatus*		11.76						x
Diederik Cuckoo	*Chrysococcyx caprius*		1.47						
Dusky Sunbird	*Cinnyris fuscus*		10.29				Near-endemic		x
Egyptian Goose	*Alopochen aegyptiacus*	x	32.35						x
European Bee-eater	*Merops apiaster*		5.88						
European Roller	*Coracias garrulus*		2.94	LC	NT				x
Fairy Flycatcher	*Stenostira scita*		10.29			Near endemic	Endemic		x
Familiar Chat	*Cercomela familiaris*		25.00						x
Fiscal Flycatcher	*Sigelus silens*		2.94			Near endemic	Endemic		
Glossy Ibis	*Plegadis falcinellus*	x	0.00						x
Greater Flamingo	*Phoenicopterus ruber*	x	0.00	LC	NT				x
Greater Kestrel	*Falco rupicoloides*		1.47						
Greater Striped Swallow	*Hirundo cucullata*		29.41						x
Grey Heron	*Ardea cinerea*	x	4.41						x
Grey Penduline-Tit	*Anthoscopus minutus*		16.18				Near-endemic		
Grey Tit	*Parus afer*		19.12			Near endemic	Endemic		x
Grey-backed Cisticola	*Cisticola subruficapilla*		63.24				Near-endemic		x
Grey-backed Sparrow-lark	*Eremopterix verticalis*		1.47				Near-endemic		

Species	Taxonmic name	Powerline priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys
Grey-winged Francolin	*Scleroptila africanus*		19.12			Endemic (SA, Lesotho, Swaziland)	Endemic		x
Ground Woodpecker	*Geocolaptes olivaceus*		22.06			Endemic (SA, Lesotho, Swaziland)	Endemic		x
Hadeda Ibis	*Bostrychia hagedash*	x	29.41						x
Hamerkop	*Scopus umbretta*	x	2.94						
Helmeted Guineafowl	*Numida meleagris*		0.00						x
Horus Swift	*Apus horus*		2.94						x
House Sparrow	*Passer domesticus*		11.76						x
Jackal Buzzard	*Buteo rufofuscus*	x	38.24			Near endemic	Endemic		x
Karoo Chat	*Cercomela schlegelii*		39.71				Near-endemic		x
Karoo Eremomela	*Eremomela gregalis*		27.94			Near endemic	Endemic		x
Karoo Korhaan	*Eupodotis vigorsii*	x	41.18	LC	NT		Endemic		x
Karoo Lark	*Calendulauda albescens*		23.53			Near endemic	Endemic		x
Karoo Long-billed Lark	*Certhilauda subcoronata*		41.18				Endemic		x
Karoo Prinia	*Prinia maculosa*		48.53			Near endemic	Endemic		x
Karoo Scrub Robin	*Cercotrichas coryphoeus*		55.88				Endemic		x
Kittlitz's Plover	*Charadrius pecuarius*		4.41						x
Lanner Falcon	*Falco biarmicus*	x	0.00						x
Large-billed Lark	*Galerida magnirostris*		57.35			Near endemic	Endemic		x
Lark-like Bunting	*Emberiza impetuani*		44.12				Near-endemic		x
Laughing Dove	*Streptopelia senegalensis*		8.82						
Layard's Tit-Babbler	*Parisoma layardi*		20.59			Near endemic	Endemic		x
Lesser Swamp Warbler	*Acrocephalus gracilirostris*		1.47						
Levaillant's Cisticola	*Cisticola tinniens*		0.00						x
Little Grebe	*Tachybaptus ruficollis*	x	5.88						
Little Stint	*Calidris minuta*		0.00						x
Little Swift	*Apus affinis*		10.29						x
Long-billed crombec	*Sylvietta rufescens*		11.76						x
Long-billed Pipit	*Anthus similis*		0.00						
Ludwig's Bustard	*Neotis ludwigii*	x	11.76	EN	EN		Near-endemic		x
Malachite Kingfisher	*Alcedo cristata*		1.47						
Malachite Sunbird	*Nectarinia famosa*		16.18						x
Martial Eagle	*Polemaetus bellicosus*	x	14.71	VU	EN				x
Mountain Wheatear	*Oenanthe monticola*		52.94				Near-endemic		x
Namaqua Dove	*Oena capensis*		8.82						
Namaqua Sandgrouse	*Pterocles namaqua*		29.41				Near-endemic		x
Namaqua Warbler	*Phragmacia substriata*		8.82			Near endemic	Endemic		
Neddicky	*Cisticola fulvicapilla*		1.47						
Orange-breasted Sunbird	*Anthobaphes violacea*		1.47			Endemic	Endemic		

Species	Taxonmic name	Powerline priority species	SABAP2 Average reporting rate: full protocol	Red Data status: International	Red Data status: Regional	Endemic - South Africa	Endemic - Southern Africa	Possibility of occurrence	Recorded during surveys
Pale Chanting Goshawk	*Melierax canorus*	x	36.76				Near-endemic		
Pale-winged Starling	*Onychognathus nabouroup*		22.06				Near-endemic		
Peregrine Falcon	*Falco peregrinus*	x	0.00						x
Pied Avocet	*Recurvirostra avosetta*		5.88						x
Pied Crow	*Corvus albus*	x	38.24						x
Pied Starling	*Spreo bicolor*		30.88			Endemic (SA, Lesotho, Swaziland)	Endemic		x
Pririt Batis	*Batis pririt*		5.88				Near-endemic		
Red-billed Teal	*Anas erythrorhyncha*	x	5.88						x
Red-capped Lark	*Calandrella cinerea*		32.35						x
Red-eyed Dove	*Streptopelia semitorquata*		16.18						x
Red-faced Mousebird	*Urocolius indicus*		8.82						
Red-knobbed Coot	*Fulica cristata*	x	4.41						
Red-winged Starling	*Onychognathus morio*		4.41						x
Rock Kestrel	*Falco rupicolus*		45.59						x
Rock Martin	*Hirundo fuligula*		36.76						x
Rufous-cheeked Nightjar	*Caprimulgus rufigena*		1.47						
Rufous-eared Warbler	*Malcorus pectoralis*		44.12				Endemic		x
Sabota Lark	*Calendulauda sabota*		4.41				Near-endemic		
Sclater's Lark	*Spizocorys sclateri*		0.00						x
Sickle-winged Chat	*Cercomela sinuata*		54.41			Near endemic	Endemic		x
South African Shelduck	*Tadorna cana*	x	27.94				Endemic		x
Southern Black Korhaan	*Afrotis afra*	x	7.35	VU	VU	Endemic	Endemic		x
Southern Double-collared Sunbird	*Cinnyris chalybeus*		5.88			Near endemic	Endemic		x
Southern Grey-headed Sparrow	*Passer diffusus*		4.41						
Southern Masked Weaver	*Ploceus velatus*		25.00						x
Southern Red Bishop	*Euplectes orix*		2.94						
Speckled Pigeon	*Columba guinea*		38.24						x
Spike-heeled Lark	*Chersomanes albofasciata*		17.65				Near-endemic		x
Spotted Eagle-Owl	*Bubo africanus*	x	4.41						x
Spotted Thick-knee	*Burhinus capensis*		2.94						
Spur-winged Goose	*Plectropterus gambensis*	x	2.94						x
Streaky-headed Seedeater	*Crithagra gularis*		1.47						
Three-banded Plover	*Charadrius tricollaris*		29.41						x
Verreauxs' Eagle	*Aquila verreauxii*	x	16.18	LC	VU				x
White-backed Mousebird	*Colius colius*		8.82				Endemic		
White-breasted Cormorant	*Phalacrocorax carbo*		2.94						
White-necked Raven	*Corvus albicollis*	x	58.82						x
White-rumped Swift	*Apus caffer*		11.76						x
White-throated Canary	*Crithagra albogularis*		33.82				Near-endemic		x
White-throated Swallow	*Hirundo albigularis*		4.41						
Wood Sandpiper	*Tringa glareola*		0.00						x
Yellow Canary	*Crithagra flaviventris*		58.82				Near-endemic		x
Yellow-bellied Eremomela	*Eremomela icteropygialis*		19.12						x
Yellow-billed Duck	*Anas undulata*	x	14.71						x

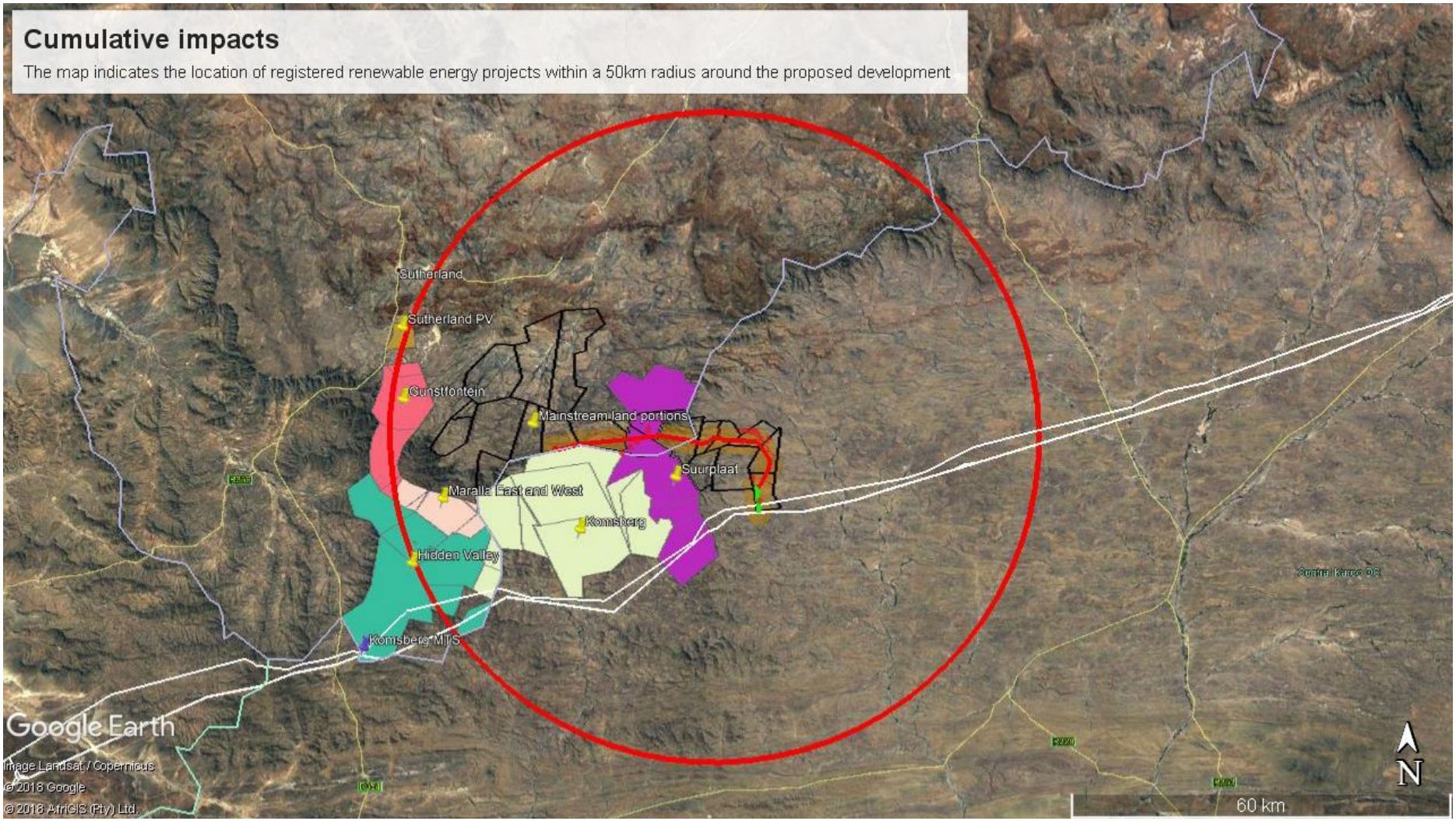
APPENDIX 2: LIST OF RENEWABLE ENERGY PROJECTS WITHIN A 50KM RADIUS AROUND THE PROPOSED PROJECT						
Proposed Development Name	**DEA Reference**	**Current EA Status**	**Proponent**	**Extent**	**Proposed Capacity**	**Proposed Mitigation Measures for avifaunal impacts as detailed in the relevant specialist reports**
Proposed 280 MW Gunstfontein Wind Energy Project	14/12/16/3/3/2/395	S&EIR	Networx Eolos Renewables (Pty) Ltd	12 000	280 MW	Pre-construction monitoring Delineation of suitable buffer zones Post-construction monitoring
Proposed development of renewable energy facility at 3 x Mainstream wind farm sites, Western and Northern Cape.	12/12/20/1782/AM1 12/12/20/1782/1 12/12/20/1782/2 12/12/20/1782/3	S&EIR	Mainstream Power Sutherland	28 600	420 MW	Delineation of no-go zones and pre-construction monitoring. On-site demarcation of 'no-go' areas identified during pre-construction monitoring must be undertaken to minimise disturbance impacts associated with the construction of the facility. Schedule maintenance activities to avoid disturbances in sensitive areas (identified through operational monitoring). Carefully monitoring the local avifauna pre- and post-construction monitoring must be undertaken. Excluding development from within 500 m of the edge of the escarpment along its entire

APPENDIX 2: LIST OF RENEWABLE ENERGY PROJECTS WITHIN A 50KM RADIUS AROUND THE PROPOSED PROJECT						
						length through the development area to reduce collision risk, primarily for slope soaring raptors.
Proposed Hidden Valley Wind Energy Facility, Northern Cape	12/12/20/2370/2	S&EIR	Hidden Valley Wind- African Clean Energy Developments (Pty) Ltd	9 530	150 MW	Implement exclusion zones In high sensitivity zones Implement post-construction monitoring Curtailment of turbines if need be Nest searches Control of staff and equipment to prevent disturbance
Proposed Hidden Valley Wind Energy Facility, Northern Cape	12/12/20/2370/3	S&EIR	Hidden Valley Wind- African Clean Energy Developments (Pty) Ltd	9 180	150 MW	Implement exclusion zones In high sensitivity zones Implement post-construction monitoring Curtailment of turbines if need be Nest searches Control of staff and equipment to prevent disturbance
Proposed Hidden Valley Wind Energy Facility, Northern Cape	12/12/20/2370/1	S&EIR	Hidden Valley Wind- African Clean Energy Developments (Pty) Ltd	16 620	150MW	Implement exclusion zones In high sensitivity zones Implement post-construction

APPENDIX 2: LIST OF RENEWABLE ENERGY PROJECTS WITHIN A 50KM RADIUS AROUND THE PROPOSED PROJECT						
						monitoring Curtailment of turbines if need be Nest searches Control of staff and equipment to prevent disturbance
Proposed Hidden Valley wind energy facility, Northern Cape	12/12/20/2370	S&EIR	Hidden Valley Wind- African Clean Energy Developments (Pty) Ltd		650 MW	Implement exclusion zones In high sensitivity zones Implement post-construction monitoring Curtailment of turbines if need be Nest searches Control of staff and equipment to prevent disturbance
Proposed establishment of the Suurplaat wind energy facility and associated infrastructure on a site near Sutherland, Western Cape and Northern Cape.	12/12/20/1583	S&EIR	Moyeng Energy (Pty) Ltd	28 600	120 MW	All construction and maintenance activities should be carried out according to generally accepted environmental best practice. No permanent lights to be used on the turbines, only red strobe lights. Location of turbines in the high sensitivity zones to be guided by the results of the pre-construction programme. Powerline walk-down to be conducted to identify spans for

APPENDIX 2: LIST OF RENEWABLE ENERGY PROJECTS WITHIN A 50KM RADIUS AROUND THE PROPOSED PROJECT						
						marking with Bird Flight Diverters.
Proposed development of renewable energy facility at Komsberg East and West near Sutherland	14/12/16/3/3/1/1562 14/12/16/3/3/1/1561	S&EIR	Komsberg Wind Farms (Pty) Ltd	25 600	550 MW	Implement exclusion zones in high sensitivity areas Implement operational phase monitoring Use bird-friendly powerline designs Mark powerlines with BFDs Implement construction phase monitoring of raptor nests
Maralla East & West Wind Facilities (grid connection)	14/12/16/3/3/2/962	S&EIR	Biotherm	9 157	250MW	• Measures to control noise and dust should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum as far as practical. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned. • Prior to construction commencing, an inspection should be performed by the avifaunal specialist to record

						any large raptor nests on the existing Droërivier-Muldersvlei 1 400kV line that could be impacted by the construction of the proposed powerline • Should any nests be recorded, it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist, and the Environmental Control Officer. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain when and where breeding priority raptors could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle, once it has been established that a particular nest is active. • A walk-through must be conducted by the avifaunal specialist after final pole positions have been determined, to demarcate sections of line that will need to be mitigated with Bird Flight Diverters.


Cumulative impacts
The map indicates the location of registered renewable energy projects within a 50km radius around the proposed development
Sutherland
Sutherland PV
Gunstfontein
Mainstream land portions
Suurplaat
Maralle East and West
Komsberg
Hidden Valley
Komsberg MTS
Google Earth
Image Landsat / Copernicus
© 2018 Google
© 2018 AfriGIS (Pty) Ltd.
60 km
N

APPENDIX 3: ENVIRONMENTAL MANAGEMENT PROGRAMME

Management Plan for the Construction Phase (Including pre- and post-construction activities)

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Displacement of Red Data species due to permanent habitat transformation					
The clearing of vegetation in the proposed transmission substation yard	Prevent unnecessary impacts on the surrounding environment by ensuring that contractors are aware of the requirements of the site-specific Construction Environmental Management Programme (CEMPr).	A site-specific CEMPr must be implemented, which gives an appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction and degradation of habitat. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr should specifically include the following: 1. The minimum footprint areas for infrastructure should be used wherever possible, including road widths and lengths; 2. No off-road driving; 3. Maximum use of existing roads; 4. Measures to control dust; 5. Restricted access to the rest of the property; 6. Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that the construction area and footprint is kept to a minimum. Carry out regular site inspections to verify the limits of the construction area to ensure unnecessary disturbance is avoided. 3. Ensure that construction personnel are made aware of the impacts relating to off-road driving. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 4. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 5. Monitor the implementation of dust control mechanisms via site inspections and record and report non-	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly 6. Weekly 7. Once-off prior to the completion of construction. 8. Monthly during the construction phase.	1. ECO 2. ECO 3. ECO 4. ECO 5. ECO 6. ECO 7. ECO, Project Developer (Mainstream), and Rehabilitation Specialist, 8. ECO and Construction Manager or Contractor

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			compliance. 6. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance. 7. Appointment of Rehabilitation Specialist to develop a Habitat Restoration Plan and ensure that it is approved by auditing the final and signed report acceptance. 8. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance.		
Displacement of Red Data species due to disturbance					
Construction of the transmission substation, service road and powerline	Prevent unnecessary displacement of Red Data avifauna by ensuring that contractors are aware of the requirements of the CEMPr.	A site-specific CEMPr must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMPr and should apply good environmental practice during construction. The CEMPr must specifically include the following: 1. No off-road driving; 2. Maximum use of existing roads; 3. Measures to control noise; 4. Restricted access to the rest of the property; 5. The appointed ECO must be trained by an avifaunal specialist to identify the potential priority species as well as the signs that	1. Implementation of the CEMPr. Oversee activities to ensure that the CEMPr is implemented and enforced via site audits and inspections. Report and record any non-compliance. 2. Ensure that construction personnel are made aware of the impacts relating to off-road driving. Construction access roads must be demarcated clearly. Undertake site inspections to verify. 3. Construction access roads must be	1. On a daily basis 2. Weekly 3. Weekly 4. Weekly 5. Weekly 6. Once-off before construction commences, for a three-day period. 7. Weekly 8. Once-off and ensure all new construction personnel are trained in this regard. 9. Throughout construction when breeding sites are found.	1. ECO 2. ECO 3. ECO 4. ECO 5. ECO 6. Project Developer (Mainstream), Avifauna Specialist and ECO 7. ECO 8. ECO 9. Project Developer (Mainstream), Avifauna Specialist and ECO 10. Project Developer (Mainstream), Avifauna Specialist and ECO

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
		indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed. 6. Prior to construction, an avifaunal specialist should conduct a site walk through, covering the final road and power line routes, to identify any nests/breeding/roosting activity of priority species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.	demarcated clearly. Undertake site inspections to verify. 4. Monitor the implementation of noise control mechanisms via site inspections and record and report non-compliance. 5. Ensure that the construction area is demarcated clearly and that construction personnel are made aware of these demarcations. Monitor via site inspections and report non-compliance. 6. Appoint an Avifauna Specialist prior to the construction phase to train and guide the ECO in identify potential priority species and signs for potential breeding. 7. ECO to undertake site visits and audits to find breeding sites. 8. ECO to provide training and information sessions to the construction personnel to identify Red Data species. Conduct regular audits of attendance registers for training. 9. Ensure that construction activities are stopped within 500 m of any breeding sites of Red Data species. Ensure that an Avifaunal Specialist is contacted	10. Once-off before the start of construction activities	

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
			immediately for further assessment. Conduct audits to verify the placement of the buffer area and verify if the Avifaunal Specialist has been appointed. 10. Appointment of Avifaunal Specialist to conduct a site walk through of the final road and power line routes. Record and report any non-compliance.		

Management Plan for the Operational Phase

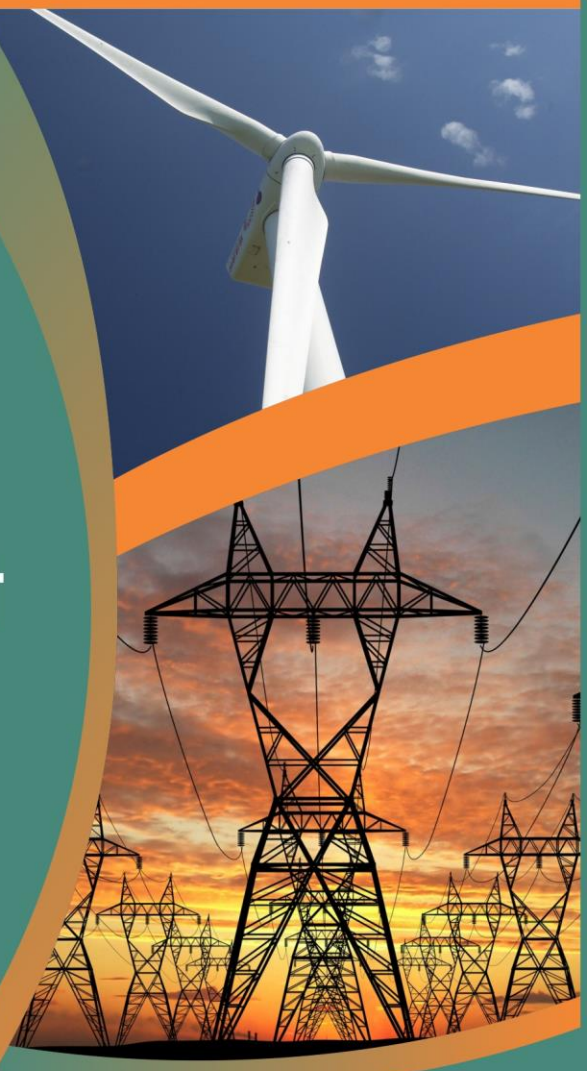
Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Electrocution of Red Data avifauna in the transmission substation					
The transmission of electricity generated by the proposed three Mainstream WEFs	Ensure effective reactive mitigation if need be in the proposed transmission substation yard if Red Data species are electrocuted.	The hardware within the proposed transmission substation yard is too complex to warrant any mitigation for electrocution at this stage. It is recommended that if on-going impacts are recorded once operational, site specific mitigation be applied reactively. If any electrocutions of Red Data avifauna are reported in the proposed transmission substation yard, the avifaunal specialist must be notified for an inspection of the problem and advice on how the problem can be resolved, if at all, through appropriate mitigation.	1. Avifaunal specialist to be appointed to conduct on-site investigation. 2. Environmental Manager to record impacts of electrocution of Red Data avifauna at the proposed transmission substation and ensure that reactive site specific mitigation is implemented if required. Record and report any non-compliance.	As and when required.	Avifaunal Specialist, Project Developer (Mainstream) and Environmental Manager
Mortality of priority avifauna due to collisions with the earthwire of the proposed powerline					
The transmission of electricity generated from the proposed three Mainstream WEFs	Mortality of priority avifauna due to collisions with the earthwire of the proposed powerline.	The operational monitoring programme must include regular monitoring of the grid connection power line for collision mortalities.	1. Avifaunal specialist to be appointed and must conduct a quarterly walk-through of the grid connection. 2. Environmental Manager to verify appointment of specialist and monitor the frequency of monitoring by auditing signed reports and minutes of meetings.	Quarterly	Avifaunal specialist and Facility Manager

Management Plan for the Decommissioning Phase

Impact	Mitigation/Management Objectives and Outcomes	Mitigation/Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Displacement of Red Data species due to disturbance					
Removal of the infrastructure	Prevent unnecessary displacement of Red Data avifauna by ensuring that contractors are aware of the requirements of the site-specific Decommissioning Environmental Management Programme (DEMPr).	1. A site-specific DEMPr must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the DEMPr and should apply good environmental practice during decommissioning. 2. Following decommissioning, rehabilitation of all areas disturbed (e.g. temporary access tracks) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist and implemented accordingly.	1. Implementation of DEMPr and oversee activities to ensure that the DEMPr is implemented and enforced, via site audits and inspections. Record and report any non-compliance. 2. Appointment of Rehabilitation Specialist to develop a Habitat Restoration Plan and ensure that it is approved by auditing the final and signed report acceptance. 3. Monitor rehabilitation via site audits and site inspections to ensure compliance. Record and report any non-compliance.	1. On a daily basis 2. Once-off prior to the completion of decommissioning. 3. Monthly during the decommissioning phase.	1. ECO 2. Project Developer (Mainstream) and Rehabilitation Specialist and ECO 3. ECO, Construction Manager or Contractor

BASIC ASSESSMENT REPORT

Basic Assessment for the Proposed Construction and Operation of Electrical Grid Infrastructure to support the Sutherland, Sutherland 2 and Rietrug Wind Energy Facilities (WEFs), Northern and Western Cape Provinces



APPENDIX D.6: Agriculture Impact Assessment

Johann Lanz
Soil Scientist (Pri.Sci.Nat.)
Reg. no. 400268/12

Cell: 082 927 9018
e-mail: johann@johannlanz.co.za

1A Wolfe Street
Wynberg
7800
Cape Town
South Africa

AGRICULTURAL IMPACT ASSESSMENT FOR DEVELOPMENT OF ELECTRICAL GRID INFRASTRUCTURE NEAR SUTHERLAND IN THE NORTHERN AND WESTERN CAPE PROVINCES

BASIC ASSESSMENT REPORT

Report by
Johann Lanz
for
CSIR – Environmental Management Services
PO Box 320
Stellenbosch
7600

Version 1: 19 June 2019
Version 2: September 2019

Johann Lanz
Professional profile

Education

• M.Sc. (Environmental Geochemistry)	University of Cape Town	1996 - June 1997
• B.Sc. Agriculture (Soil Science, Chemistry)	University of Stellenbosch	1992 - 1995
• BA (English, Environmental & Geographical Science)	University of Cape Town	1989 - 1991
• Matric Exemption	Wynberg Boy's High School	1983

Professional work experience

I am registered as a Professional Natural Scientist (Pri.Sci.Nat.) in the field of soil science, registration number 400268/12, and am a member of the Soil Science Society of South Africa.

- **Soil Science Consultant** **Self employed** **2002 - present**

  I run a soil science consulting business, servicing clients in both the environmental and agricultural industries. Typical consulting projects involve:
- Soil specialist study inputs to EIA's, SEA's and EMPR's. These have focused on impact assessments and rehabilitation on agricultural land, rehabilitation and re-vegetation of mining and industrially disturbed and contaminated soils, as well as more general aspects of soil resource management. Recent clients include: CSIR; SRK Consulting; Aurecon; Mainstream Renewable Power; SiVEST; Savannah Environmental; Subsolar; Red Cap Investments; MBB Consulting Engineers; Enviroworks; Sharples Environmental Services; Haw & Inglis; BioTherm Energy; Tiptrans.
- Soil resource evaluations and mapping for agricultural land use planning and management. Recent clients include: Cederberg Wines; Unit for Technical Assistance - Western Cape Department of Agriculture; Wedderwill Estate; Goedgedacht Olives; Zewenwacht Wine Estate, Lourensford Fruit Company; Kaarsten Boerdery; Thelema Mountain Vineyards; Rudera Wines; Flagstone Wines; Solms Delta Wines; Dornier Wines.

- **Soil Science Consultant** **Agricultural Consultors International (Tinie du Preez)** **1998 - end 2001**

  Responsible for providing all aspects of a soil science technical consulting service directly to clients in the wine, fruit and environmental industries all over South Africa, and in Chile, South America.

- **Contracting Soil Scientist** **De Beers Namaqualand Mines** **July 1997 - Jan 1998**

  Completed a contract to make recommendations on soil rehabilitation and re-vegetation of mined areas.

Publications

- Lanz, J. 2012. Soil health: sustaining Stellenbosch's roots. In: M Swilling, B Sebitosi & R Loots (eds). *Sustainable Stellenbosch: opening dialogues*. Stellenbosch: SunMedia.
- Lanz, J. 2010. Soil health indicators: physical and chemical. *South African Fruit Journal*, April / May 2010 issue.
- Lanz, J. 2009. Soil health constraints. *South African Fruit Journal*, August / September 2009 issue.
- Lanz, J. 2009. Soil carbon research. *AgriProbe*, Department of Agriculture.
- Lanz, J. 2005. Special Report: Soils and wine quality. *Wineland Magazine.*

I am a reviewing scientist for the *South African Journal of Plant and Soil*.

Specialist Declaration

I, Johann Lanz, 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 company: Johann Lanz – Soil Scientist

Professional Registration (including number): SACNASP Reg. no. 400268/12

Date: 19 June 2019

Table of Contents

List of Figures

List of Tables

EXECUTIVE SUMMARY

The proposed Grid Connection Infrastructure will be located on land zoned and used for agriculture (grazing). South Africa has very limited arable land and it is therefore critical to ensure that development does not lead to an inappropriate loss of land that may be valuable for cultivation. This assessment has found that the proposed development is on land which is of extremely low agricultural potential and is totally unsuitable for cultivation. Furthermore, the agricultural impact of grid infrastructure in this environment is negligible.

The key findings of this study are:

- Soils of the proposed development site are dominated by shallow soils on underlying rock that are of the Mispah and Glenrosa soil forms.
- The major limitation to agriculture is the extremely limited climatic moisture availability.
- As a result of this limitation, the study area is totally unsuitable for cultivation and agricultural land use is limited to low density grazing.
- The proposed development footprint is classified with low land capability evaluation values of between 1 and 7.
- There are no agriculturally sensitive areas and no parts of the site need to be avoided by the development.
- The proposed Grid Connection Infrastructure has negligible impact on agriculture in such an environment because all agricultural activities that are viable in this environment (grazing) can continue completely unhindered underneath transmission lines. Furthermore the actual footprint of disturbance of the infrastructure constitutes only a negligible proportion of the available land surface area.
- The only possible impact of the development was identified as:
    - Very minimal soil and land degradation caused by construction excavation and vehicle passage.
- The impact was assessed as having very low significance after mitigation.
- Cumulative impact is also assessed as very low, predominantly because of the negligible impact of transmission lines on grazing, and the low agricultural potential of the area.
- The recommended mitigation measure is for implementation of an effective system of storm water run-off control, where necessary.
- Due to the low agricultural potential of the site, and the consequent very low, negative agricultural impact, there are no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.
- There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation.
- The overall significance of the impact on agriculture for the construction, operation and decommissioning phase is assessed as very low.

1 INTRODUCTION

1.1 Scope and objectives

This report presents the Soil and Agricultural Impact Assessment undertaken by Johann Lanz (an independent consultant), appointment by the CSIR, as part of the Basic Assessment (BA) Process for the proposed construction and operation of electrical grid infrastructure near Sutherland (see Figure 1).

The objectives of the study are to identify and assess all potential impacts of the proposed development on agricultural resources including soils and agricultural production potential, and to provide recommended mitigation measures, monitoring requirements, and rehabilitation guidelines for all identified potential impacts.

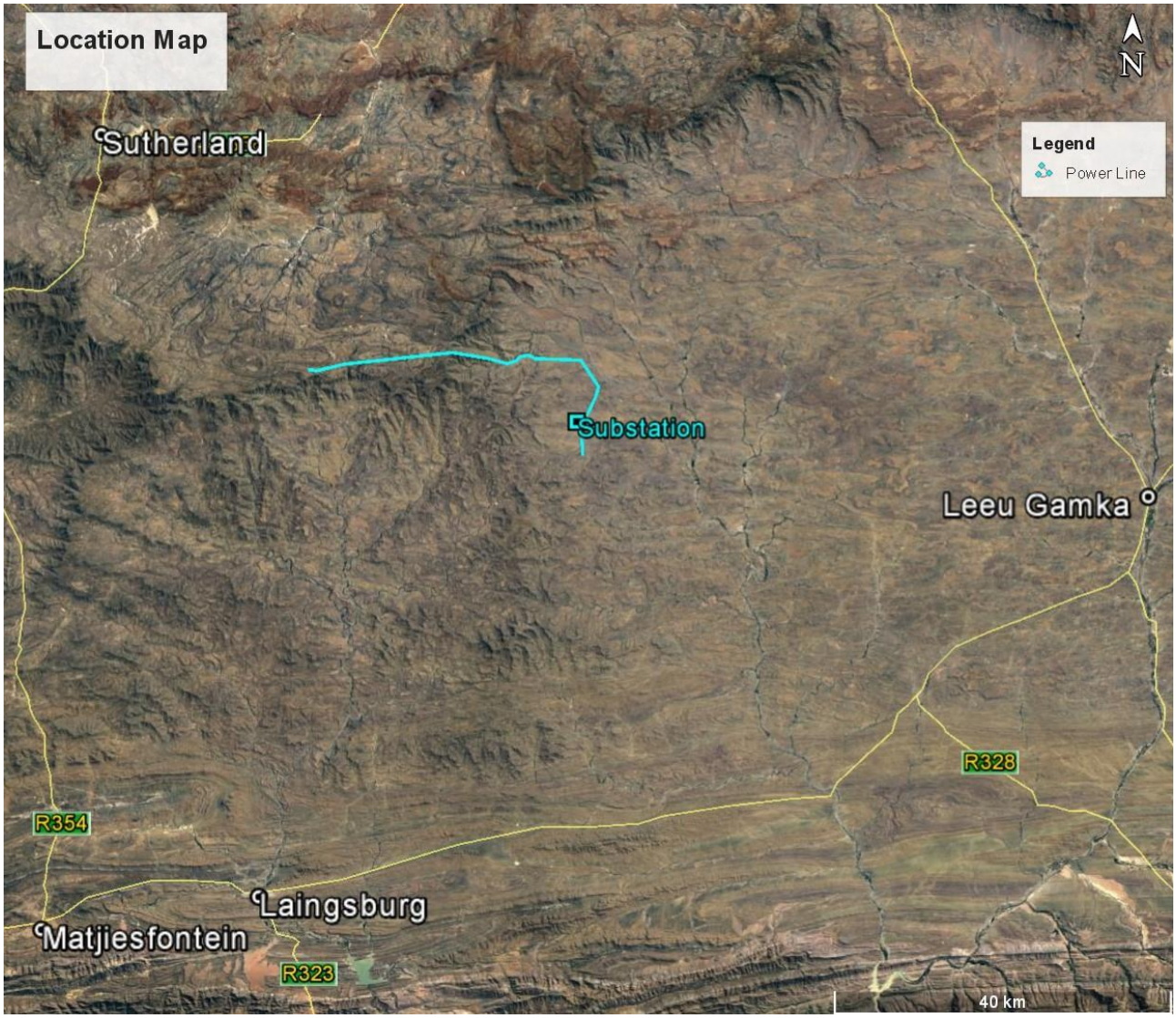


Figure 1: Location of proposed power line and Major Transmission Substation, south east of Sutherland.

1.2 Terms of Reference

The following terms of reference apply to this study:

- Adhere to the requirements of specialist studies in terms of Appendix 6 of the NEMA EIA Regulations (2014), as amended.
- Assess the potential impacts of the proposed development and its associated infrastructure by assessing the impacts during the construction, operational and decommissioning phases.
- Assess Cumulative impacts from other EGI projects located within a 50 km radius of the proposed development.
- Use the Impact Assessment Methodology as provided by the CSIR.
- Propose mitigation measures to address possible negative effects and to enhance positive impacts to increase the benefits derived from the project.
- Assess the project alternatives and the no-go alternative.
- Provide a recommendation as to whether the project must receive Environmental Authorisation or not and Identify any aspects which are conditional to the findings of the assessment which are to be included as conditions of the Environmental Authorisation.

Specific ToR:

- Describe the existing environment in terms of soils, geology, land-use and agricultural potential. Significant soils and agricultural features or disturbances should be identified, as well as sensitive features and receptors within the project area. The description must include surrounding agricultural land uses and activities, to convey the local agricultural context.
- Describe and map soil types (soil forms), soil characteristics (soil depth, soil colour, limiting factors, and clay content of the top and sub soil layers), and degradation and erodibility of soils etc. to the extent necessary to inform this assessment.
- Varying sensitivities of the soils and agricultural potential must be mapped and highlighted.
- The assessment is to be based on existing information, findings of the Wind & Solar PV SEA (CSIR, 2015), and professional experience and field work conducted by the specialist, as considered necessary and in accordance with relevant legislated requirements.
- Identify and assess the potential impacts of the proposed development on soils and agriculture, including impacts of associated infrastructure, such as the buildings, fencing etc.
- Identify any protocols, legal and permit requirements relating to soil and agricultural potential impacts that are relevant to this project and the implications thereof.

- The report needs to fulfil the terms of reference for an agricultural study as set out in the National Department of Agriculture's document, Regulations for the evaluation and review of applications pertaining to renewable energy on agricultural land, dated September 2011, with an appropriate level of detail for the agricultural suitability and soil variation on site (which may therefore be less than the standardised level of detail stipulated in the above regulations).

Table 1: Compliance with the Appendix 6 of the 2014 EIA Regulations (as Amended)

Requirements of Appendix 6 – GN R326 EIA Regulations 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;	Title page CV following Title page
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Following CV
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(ca) an indication of the quality and age of base data used for the specialist report;	Section 2.1
(cb) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5.4
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 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 4.7 & Figure 3
g) an identification of any areas to be avoided, including buffers;	Section 4.7
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 3; no agricultural environmental sensitivities identified
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 5
k) any mitigation measures for inclusion in the EMPr;	Section 8
l) any conditions for inclusion in the environmental authorisation;	Section 9
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 8
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (ja) 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 9 Section 8 Section 8
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable

2 APPROACH AND METHODOLOGY

The soil investigation applied an appropriate level of detail for the agricultural suitability on site and for the level of impact of the proposed development on agricultural land. A detailed soil survey, as per the requirement in the above DAFF document (see Section

1.2), is only appropriate for a significant footprint of impact on arable land. It has little relevance to an assessment of agricultural potential in this environment, where the agricultural limitations are overwhelmingly climatic, terrain is rugged, soil conditions are generally poor, and cultivation potential is non-existent. In such an environment, even where soils suitable for cultivation may occur, they cannot be cultivated because of the aridity and terrain constraints. Conducting a soil assessment at the stipulated level of detail would be very time consuming and add no value to the assessment. It makes absolutely no sense to conduct a soil survey for the purposes of this assessment. A field investigation was therefore not considered necessary. The assessment was based on a desktop analysis of existing soil and agricultural potential data and other data for the site, which is considered entirely adequate for a thorough assessment of all the agricultural impacts of the proposed development.

The potential impacts identified in this specialist study were assessed based on the criteria and methodology common to the whole impact assessment. The ratings of impacts were based on the specialist's knowledge and experience of the field conditions of the environment in which the proposed development is located, and of the impact of disturbances on that agricultural environment.

2.1 Sources of information

The following sources of information were used:

1. Soil data was sourced from the land type data set, of the Department of Agriculture, Forestry and Fisheries. This data set originates from the land type survey that was conducted from the 1970's until 2002. It is the most reliable and comprehensive national database of soil information in South Africa and although the data was collected some time ago, it is still entirely relevant as the soil characteristics included in the land type data do not change within time scales of hundreds of years.
2. Land capability data was sourced from the 2017 National land capability evaluation raster data layer produced by the Department of Agriculture, Forestry and Fisheries, Pretoria.
3. Rainfall and temperature data were sourced from The World Bank Climate Change Knowledge Portal, dated 2015.
4. Grazing capacity data was sourced from the 2018 Department of Agriculture, Forestry and Fisheries long-term grazing capacity map for South Africa, available on Cape Farm Mapper.
5. Satellite imagery of the site and surrounds was sourced from Google Earth.
6. The Strategic Environmental Assessment for wind and solar photovoltaic development in South Africa (DEA, 2015) was also consulted in terms of its sensitivity analysis of the area.

2.2 Assumptions and Limitations

The following assumptions were used in this specialist study:

- The study assumes that water for irrigation is not available across the site. This is based on the assumption that a long history of farming experience in an area will result in the exploitation of viable water sources if they exist, and none have been exploited in this area.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are illustrated in Appendix A.

The following limitation was identified in this study:

- The assessment rating of impacts is not an absolute measure. It is based on the subjective considerations and experience of the specialist, but is done with due regard and as accurately as possible within these constraints.

There are no other specific limitations or knowledge gaps relevant to this study.

3 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO AGRICULTURAL IMPACTS

The project applicant is proposing the development of a 132 kV transmission line, a major transmission substation and 400 kV line within the Renewable Energy Development Zone (REDZ): 2 Komsberg. The 132 kV line routing proposed as part of this application has been previously assessed as part of the proposed construction of the electrical grid infrastructure for the Sutherland Wind Energy Facility (14/12/16/3/3/1/1816), Rietrug Wind Energy Facility (14/12/16/3/3/1/1815) and Sutherland 2 Wind Energy Facility (14/12/16/3/3/1/1814/AM1). These projects received Environmental Authorisation in February 2018. Within the authorisations, the alternative line routing “1” was submitted as the preferred routing and subsequently approved.

The 132 kV line routing proposed as part of this application was considered as alternative line routing “2”. The line routing did not include any environmental fatal flaws and is a technical feasible option to enable the evacuation of the electricity generated by the above mentioned Wind Energy Facilities into the National Grid.

Project components

- Major Transmission Substation (400 m x 400 m)
- Overhead 132 kV line ˜ 41 km (this line has been assessed as part of a previous Basic Assessment Process) and referred to in the reports as “Alternative 2”
- 400 kV ~ 4 km overhead transmission line connecting to an existing Eskom line
- Service roads will be constructed below the lines (jeep track)

4 BASELINE ASSESSMENT OF THE SOILS AND AGRICULTURAL CAPABILITY

This section is organised in sub headings based on the requirements of an agricultural study as detailed in section 1.2 of this report. A satellite image map of the project layout is shown in Figure 3.

4.1 Climate and water availability

The area has a very low average rainfall of between 130 and 210 mm per annum (Schulze, 2009). The average monthly rainfall distribution for the middle of the proposed transmission line is shown in Figure 2. The low rainfall is a very significant agricultural constraint that seriously limits the level of agricultural production (including grazing) which is possible. There are no dams across the project area.

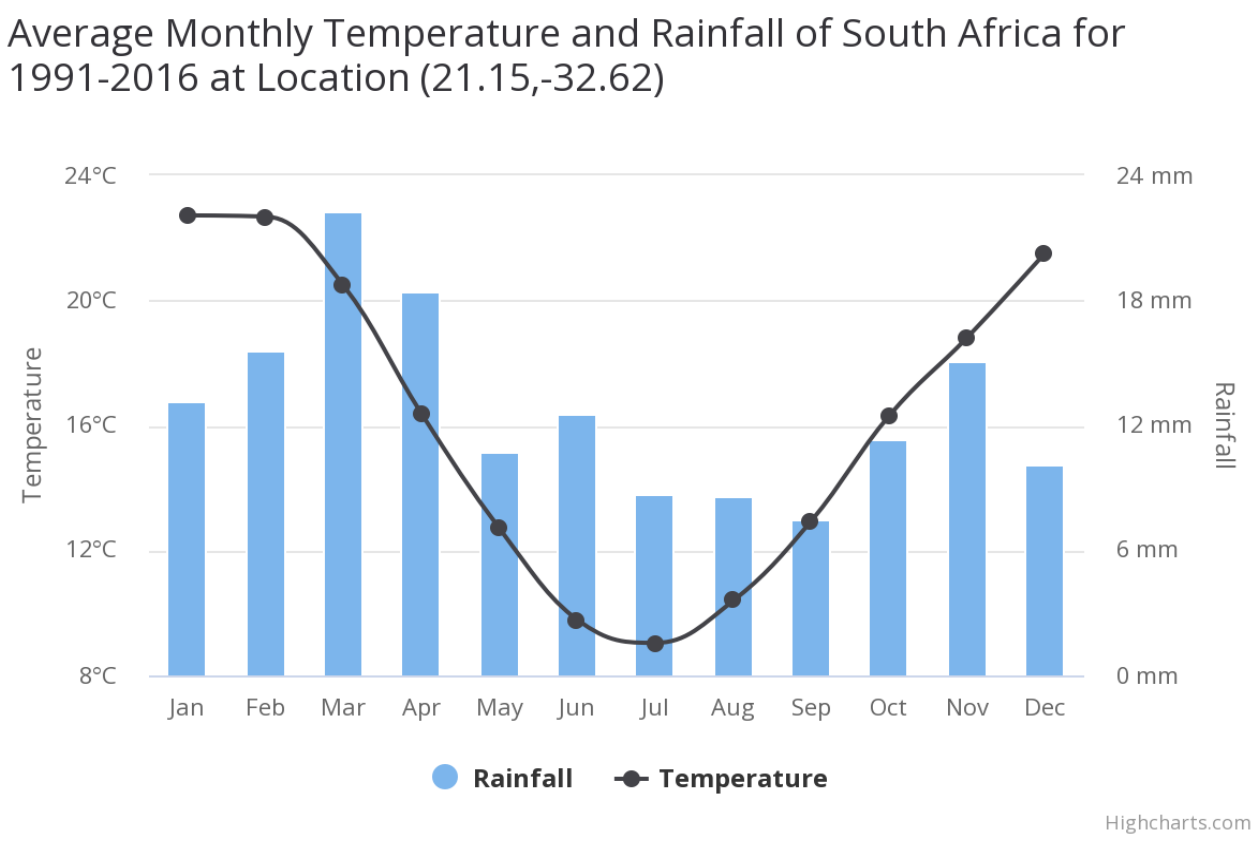


Figure 1: Climate data from the middle of the project area.

Figure 2: Satellite image map of proposed project layout.

4.2 Terrain, topography and drainage

The proposed line runs along the plateau at the edge of the escarpment at an altitude of around 1,600 metres and then drops off the escarpment through very broken terrain to the plains below at an altitude of around 780 metres. There is a wide range of slopes across the broken terrain. There are several non-perennial water courses, typical of arid areas, in the valleys.

The underlying geology of the project area is mudstone, siltstone and sandstone of the Beaufort Group, Karoo Supergroup.

4.3 Soils

The land type classification is a nationwide survey that groups areas of similar soil, terrain and climatic conditions into different land types. The proposed line crosses several very similar Fc and Ib land types that are dominated by rock outcrops and shallow Mispah and Glenrosa soil forms on underlying rock.

4.4 Agricultural capability

Land capability is defined as the combination of soil, climate and terrain suitability factors for supporting rainfed agricultural production. It is an indication of what level and type of agricultural production can sustainably be achieved on any land. The higher land capability classes are suitable as arable land for the production of cultivated crops, while the lower suitability classes are only suitable as non-arable grazing land, or at the lowest extreme, not even suitable for grazing. In 2017 DAFF released updated and refined land capability mapping across the whole of South Africa. This has greatly improved the accuracy of the land capability rating for any particular piece of land anywhere in the country. The new land capability mapping divides land capability into 15 different categories with 1 being the lowest and 15 being the highest. Values of below 8 are generally not suitable for production of cultivated crops. Detail of this land capability scale is shown in Table 2.

The proposed line crosses land classified with land capability evaluation values of 1 – 7. The land capability is limited by the very low climatic moisture availability, the rugged terrain, and the shallow, rocky soils.

Table 2: Details of the 2017 Land Capability classification for South Africa.

Land capability evaluation value	Description
1	Very Low
2	
3	Very Low to Low
4	
5	Low
6	Low to Moderate
7	
8	Moderate
9	Moderate to High
10	
11	High
12	High to Very High
13	
14	Very High
15	

4.5 Land use and development on and surrounding the site

The project is located in a sheep and game farming area and there is no other agricultural activity or infrastructure within the project area.

4.6 Possible land use options for the site

Due to the climate, terrain and soil limitations, the land is considered unsuitable for any agricultural purposes other than low intensity grazing.

4.7 Agricultural sensitivity

Agricultural sensitivity is a direct function of the capability of the land for agricultural production. This is because a negative impact on land of higher agricultural capability is more detrimental to agriculture than the same impact on land of low agricultural capability. A general assessment of agricultural sensitivity, in terms of loss of agricultural land in South Africa, considers arable land that can support viable production of cultivated crops, to have high sensitivity. This is because there is a scarcity of such land in South Africa, in terms of how much is required for food security. However, there is not a scarcity in the country of land that is only suitable as grazing land and such land is therefore not considered to have high agricultural sensitivity.

In terms of the sensitivity categories used in the REDZ sensitivity analysis, this site was assessed as low sensitivity (DEA, 2015).

Agricultural sensitivity of a particular development is also a function of the severity of the impact which that development poses to agriculture. In the case of transmission lines, the impact is negligible (see impact assessment section). This even further reduces the agricultural sensitivity of the study area for the proposed development.

The entire study area has extremely low agricultural potential and therefore very low agricultural sensitivity to development and consequent loss of agricultural land use. Agricultural potential and conditions are also very uniform across the site, and the choice of placement of facility infrastructure therefore has negligible influence on the significance of agricultural impacts. From an agricultural point of view, no parts of the site need to be avoided by the proposed development and no buffers are required.

5 IDENTIFICATION AND ASSESSMENT OF IMPACTS ON AGRICULTURE

The focus and defining question of an agricultural impact assessment is to determine to what extent a proposed development will compromise (negative impacts) or enhance (positive impacts) current and/or future agricultural production. The significance of an impact is therefore a direct function of the degree to which that impact will affect current or future agricultural production. If there will be no impact on production, then there is no agricultural impact. Impacts that degrade the agricultural resource base pose a threat to production and therefore are within the scope of an agricultural impact assessment. Lifestyle impacts on the resident farming community, for example visual impacts, do not necessarily impact agricultural production and, if they do not, are not relevant to and within the scope of an agricultural impact assessment. Such impacts are better addressed within the impact assessments of other disciplines included in the EIA process.

Transmission lines do not really impact the agriculture of the study area because the actual footprint of disturbance is negligible and all agricultural activities that are viable in this environment (grazing) can continue completely unhindered underneath transmission lines. The only possible source of impact from the power line is minimal disturbance to the land during construction and decommissioning.

The substation has a 400 x 400 metre (16 hectare) footprint. While this theoretically will lead to a loss of this land for agriculture, 16 hectares in the context of the agricultural environment of extremely low density grazing on farms which are typically thousands of hectares large is entirely insignificant and therefore does not warrant an assessment.

The following impacts are identified for the different phases of the development and described in table format below.

5.1 Construction phase

5.1.1 Minimal soil and land degradation (erosion and topsoil loss) as a result of land disturbance.

Aspect / Activity	**Construction disturbance and excavation and vehicle passage.**
Type of impact	Direct
Potential Impact	Land surface disturbance including vegetation removal, vehicle passage and excavation may lead to erosion. Because of the slopes, the aridity and the shallow soils, erosion risk is high.
Impact Significance (Pre-mitigation)	Low
Mitigation Required	Implement an effective system of storm water run-off control, where it is required. It would only be required where land disturbance could potentially lead to run-off accumulation that might then lead to down slope erosion. The system should control water movement by means of bunds and ditches, so that it safely disperses and disseminates any run-off accumulation into the veld.
Impact Significance (Post-Mitigation)	Very low

5.2 Operational phase

There is zero impact during the operational phase.

5.3 Decommissioning phase

5.3.1 Minimal soil and land degradation (erosion and topsoil loss) as a result of land disturbance.

Aspect / Activity	**Decommissioning disturbance and excavation and vehicle passage.**
Type of impact	Direct
Potential Impact	Land surface disturbance including vegetation removal, vehicle passage and excavation may lead to erosion. Because of the slopes, the aridity and the shallow soils, erosion risk is high.
Impact Significance (Pre-mitigation)	Low
Mitigation	Implement an effective system of storm water run-off control, where it is

Aspect / Activity	Decommissioning disturbance and excavation and vehicle passage.
Required	required. It would only be required where land disturbance could potentially lead to run-off accumulation that might then lead to down slope erosion. The system should control water movement by means of bunds and ditches, so that it safely disperses and disseminates any run-off accumulation into the veld.
Impact Significance (Post-Mitigation)	Very low

5.4 Cumulative impacts

The cumulative impact of a development is the impact that development will have when its impact is added to the incremental impacts of other past, present or reasonably foreseeable future activities that will affect the same environment. The most important concept related to a cumulative impact is that of an acceptable level of change to an environment. A cumulative impact only becomes relevant when the impact of the proposed development will lead directly to the sum of impacts of all developments causing an acceptable level of change to be exceeded in the surrounding area. If the impact of the development being assessed does not cause that level to be exceeded, then the cumulative impact associated with that development is not significant.

The potential cumulative agricultural impact of importance is a regional loss or degradation of agricultural land. The defining question for assessing the cumulative agricultural impact is this:

> *What level of loss of agricultural land use is acceptable in the area, and will the loss associated with the proposed electrical transmission lines cause that level in the area to be exceeded?*

DEA requires compliance with a specified methodology for the assessment of cumulative impacts. This is positive in that it ensures engagement with the important issue of cumulative impacts. However, the required compliance has some limitations and can, in my opinion, result in an over-focus on methodological compliance, while missing the more important task of answering the above defining question more broadly.

The first limitation with DEA's required methodology is that it restricts the cumulative impacts to similar developments, so in this case to renewable energy developments. In order to accurately answer the defining question above, all developments, regardless of their type and similarity, should be taken into account, because all will contribute to exceeding the acceptable level of change.

The second problem with the requirement, is that it restricts surrounding developments to those within an absolutely defined distance, in this case 50 km. Again this does not allow for accurately answering the defining question. To achieve this, the distance used for cumulative impact assessment should be discipline dependent. A different distance is likely to apply for agricultural impact than for economic impact or botanical impact. And a different distance should be used in different environments, for example in high potential agricultural environments versus very low potential agricultural environments.

Given the above, this assessment focuses more on effectively addressing the defining question above than getting distracted by methodological compliance for its own sake. It does this by considering cumulative impacts more broadly. This includes considering a wider area than the 50 km radius, and considering the likelihood of pressure from other types of developments as well.

There are 9 renewable energy projects, with their associated transmission lines, within 50 km of the proposed site (that need to be considered in terms of the DEA requirements). These are mapped in Appendix A.

All of these projects have the same agricultural impacts in a very similar agricultural environment. The cumulative impact is likely to be well within an acceptable limit in terms of loss of low potential agricultural land, of which there is no scarcity in the country. This is particularly so when considered within the context of the following point:

- In order for South Africa to achieve its renewable energy generation goals, agriculturally zoned land will need to be used for renewable energy generation. It is far more preferable to incur a cumulative loss of agricultural land in a region such as the one being assessed, which has no cultivation potential, and low grazing capacity, than to lose agricultural land that has a higher potential, and that is much scarcer, to renewable energy development elsewhere in the country. The limits of acceptable agricultural land loss are therefore far higher in this region than in regions with higher agricultural potential.

It should also be noted that there are few land uses, other than renewable energy, that are competing for agricultural land use in this area. The cumulative impact from developments, other than renewable energy, is therefore low.

Due to all of the considerations discussed above, the cumulative impact of loss of agricultural land use is assessed as having low significance. In terms of cumulative impact, therefore, the development can be authorised.

Aspect / Activity	Occupation of and impact to the land by the project infrastructure of multiple developments
Type of impact	Direct
Potential Impact	Cumulative impacts are likely to occur as a result of the regional impact on agricultural land because of other developments on agricultural land in the region. Because the land is of such low agricultural potential, the cumulative loss of agricultural resources is of very low significance.
Status	Negative
Impact Significance (Pre-mitigation)	Very low
Mitigation Required	There is no additional mitigation required for cumulative impacts, other than what has already been recommended for the project above.
Impact Significance (Post-Mitigation)	Very low

6 IMPACT ASSESSMENT TABLES

The fact that the footprint of disturbance affects such a small proportion of the surface area influences the assessment of probability of an impact. If an impact such as erosion is likely to occur in only a few isolated spots within the larger project area, then its probability of occurring is assessed in the tables as lower, because the probability of it impacting a significant area is low.

Table 3: Impact assessment summary table

Impact pathway	Nature of potential impact/risk	Mitigation	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Ranking of impact/ risk	Confidence level
	SOIL AND AGRICULTURE														
	CONSTRUCTION PHASE														
	Direct impacts														
Land disturbance	Soil erosion and degradation	Without mitigation	Negative	Site	Medium term	Moderate	Very unlikely	Moderate	Low	Low	No	Yes	Implement an effective system of storm water run-off control.	5	High
		With mitigation	Negative	Site	Medium term	Slight	Extremely unlikely	Moderate	Low	Very low					
	DECOMMISSIONING PHASE														
	Direct impacts														
Land disturbance	Soil erosion and degradation	Without mitigation	Negative	Site	Medium term	Moderate	Very unlikely	Moderate	Low	Low	No	Yes	Maintain an effective system of storm water run-off control.	5	High
		With mitigation	Negative	Site	Medium term	Slight	Extremely unlikely	Moderate	Low	Very low					

Table 4: Impact assessment summary table - Cumulative impacts

Impact pathway	Nature of potential impact/risk	Mitigation	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Ranking of impact/ risk	Confidence level
	SOIL AND AGRICULTURE														
	CUMULATIVE IMPACTS														
	Direct impacts														
Occupation of and disturbance to agricultural land	Loss of agricultural land	Without mitigation	Negative	Regional	Long term	Slight	Very unlikely	Moderate	Low	Very low	No	No		5	High

7 LEGISLATIVE AND PERMIT REQUIREMENTS

Power lines require the registration of a servitude for each farm portion crossed. In terms of the Subdivision of Agricultural Land Act (Act 70 of 1970) (SALA), the registration of a power line servitude requires written consent of the Minister if the following two conditions apply:

1. if the servitude width exceeds 15 metres; and
2. if Eskom is not the applicant for the servitude.

If one or both of these conditions do not apply, then no agricultural consent is required. Eskom is currently exempt from agricultural consent for power line servitudes.

Rehabilitation after disturbance to agricultural land is managed by the Conservation of Agricultural Resources Act (Act 43 of 1983) (CARA). No application is required in terms of CARA. The EIA process covers the required aspects of this.

8 ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The environmental management programme inputs for the protection of soil resources are presented in the tables below for each phase of the development.

Table 5: Management plan for the planning and design phase

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Design an effective system of storm water run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion.	Ensure that the storm water run-off control is included in the engineering design.	Once-off during the design phase.	Holder of the EA

Table 6: Management plan for the construction phase

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Implement an effective system of storm water run-off control, where it is required - that is at any points where run-off water might accumulate. The system must effectively collect and safely disseminate any run-off water from all hardened surfaces and it must prevent any potential down slope erosion.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Monthly	Environmental Control Officer (ECO)

Table 7: Management plan for the operational phase

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Aspect: Protection of soil resources					
Erosion	That existence of hard surfaces causes no erosion on or downstream of the site.	Maintain the storm water run-off control system. Monitor erosion and remedy the storm water control system in the event of any erosion occurring.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Bi-annually	Facility Environmental Manager

Table 8: Management plan for the decommissioning phase

Impact	Mitigation / management objectives and outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Aspect: Protection of soil resources					
Erosion	That disturbance and existence of hard surfaces causes no erosion on or downstream of the site.	Maintain the storm water run-off control system. Monitor erosion and remedy the storm water control system in the event of any erosion occurring.	Undertake a periodic site inspection to verify and inspect the effectiveness and integrity of the storm water run-off control system and to specifically record the occurrence of any erosion on site or downstream. Corrective action must be implemented to the run-off control system in the event of any erosion occurring.	Monthly	Environmental Control Officer (ECO)

9 CONCLUSIONS

The proposed development is on land of limited agricultural potential that is only viable for grazing. Transmission lines do not really impact the agriculture of the study area because all agricultural activities that are viable in this environment (grazing) can continue completely unhindered underneath transmission lines. The small size of the substation within the agricultural context means that the loss of the substation footprint is entirely insignificant as an agricultural impact. The only possible source of impact is minimal disturbance to the land resulting in minimal degradation during construction and decommissioning. All potential agricultural impacts including cumulative impacts are assessed as very low.

There are no agriculturally sensitive areas that need to be avoided by the development.

Due to the low agricultural potential of the site, and the important fact that transmission lines have such little impact on agriculture, as well as the minimal impact of the substation in this agricultural environment, the impact of the development is assessed as very low. There are therefore no restrictions relating to agriculture which preclude authorisation of the proposed development and therefore, from an agricultural impact point of view, the development should be authorised.

There are no conditions resulting from this assessment that need to be included in the Environmental Authorisation.

10 REFERENCES

Cape Farm Mapper. Available at: https://gis.elsenburg.com/apps/cfm/

Department of Agriculture, Forestry and Fisheries, 2017. National land capability evaluation raster data layer, 2017. Pretoria.

Department of Agriculture, Forestry and Fisheries, 2002. National land type inventories data set. Pretoria.

DEA, 2015. Strategic Environmental Assessment for wind and solar photovoltaic development in South Africa. CSIR Report Number CSIR: CSIR/CAS/EMS/ER/2015/001/B. Stellenbosch.

Schulze, R.E. 2009. SA Atlas of Climatology and Agrohydrology, available on Cape Farm Mapper. Available at: https://gis.elsenburg.com/apps/cfm/

Soil Classification Working Group. 1991. Soil classification: a taxonomic system for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

The World Bank Climate Change Knowledge Portal available at https://climateknowledgeportal.worldbank.org/country/south-africa/climate-data-historical

11 APPENDIX A

Map of Renewable Energy Projects considered for the cumulative impact assessment.