BASIC ASSESSMENT REPORT

Basic Assessment for the Proposed Construction of Electrical Grid Infrastructure to support the Rietrug Wind Energy Facility (WEF), Northern and Western Cape Provinces (Rietrug WEF – Electrical Grid Infrastructure)

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

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

SAHRA Case ID: 10494
HWC Case No.: 17020607AS0207E

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: 031 242 2318
Email: RAbed@csir.co.za

On behalf of:

South Africa Mainstream Renewable Power Developments (Pty) Ltd

Dr Jayson Orton
ASHA Consulting (Pty) Ltd
6A Scarborough Road, Muizenberg, 7945
Tel: (021) 788 8425 | 083 272 3225
Email: jayson@asha-consulting.co.za

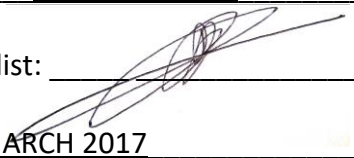
1st draft: 24 March 2017
Final report: 21 May 2017

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: 24 MARCH 2017

EXECUTIVE SUMMARY

1. Site Name

Electrical grid infrastructure to support the proposed Rietrug Wind Energy Facility (WEF)

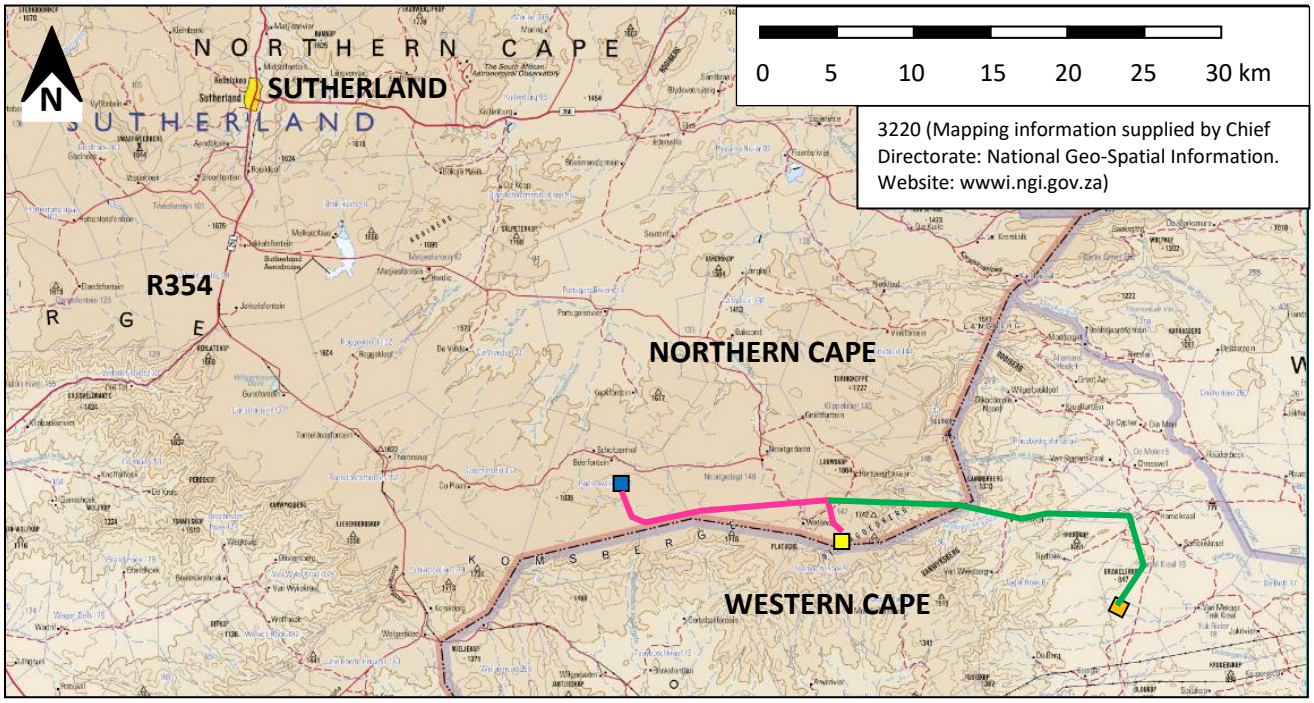
2. Location

The proposed power line would traverse the following properties (listed from west to east as for Alternative 2):

- 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, and Portion 7 of Hamelkraal 16.

The proposed distribution line would run from an on-site substation at S32° 37’ 16” E20° 54’ 30” to one of two proposed third party substations (i.e. the proposed collector hub and Eskom Nuwerust Substation) to the east, neither of which are part of the present assessment. The easternmost substation would be located at S32° 42’ 00” E21° 15' 32”. There are two alternatives of the third party substation and associated distribution line routing, with the first being confined to Northern Cape and the second extending further east into Western Cape.

3. Locality Plan



Map showing the location of the study area. Alternative 1 is shown in pink, while Alternative 2 follows the same alignment but extends along the green line to the east.

4. Description of Proposed Development

It is proposed to construct the following:

- An on-site substation in Northern Cape with an operations and maintenance building and a laydown area;
- A 132 kV distribution line extending from the on-site substation to a third party substation in Northern Cape (Alternative 1; about 17 km long) or Western Cape (Alternative 2, about 44 km long);
- A connection to the relevant third party substation; and
- A service road below the power line (the road deviates from the power line in one short section of Alternative 2).

It should be noted that there are three separate power line applications being conducted simultaneously. Should all three be approved and receive preferred bidder status then it is proposed to link them to one another as follows: a single line would be constructed from each of the proposed Sutherland 2 WEF and Rietrug WEF Substations to the proposed Sutherland WEF Substation with only a single line being constructed from the Sutherland WEF substation on to either of the Alternative 1 or 2 termini. Both alternatives for all three projects end at the same point in the east (the yellow and orange substations in Figure 1) but start in different places in the west.

5. Heritage Resources Identified

Archaeological remains are generally scarce but are found throughout the area. Very little Stone Age material was found with just two 'sites' being recorded: a kraal complex and a geometric rock art site. Isolated stone artefacts were remarkably rare. 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. Alternative 2 has more significant sites in close proximity to it but, because the alignment was devised by the present author to avoid these sites, significant impacts are not expected.

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.

Some graveyards and buildings are present in the area but 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 a proposed Renewable Energy Development Zone (REDZ) and it is noted that a new electrical layer is due to be added to this landscape in the very near future.

6. Anticipated Impacts on Heritage Resources

Both Alternative 1 and Alternative 2 have heritage sites within a few hundred metres of their alignments but direct impacts are not expected. However, a potentially sensitive part of Alternative 2 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 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 proposed REDZ the area is very likely to be devoted to renewable energy developments (some facilities are already scheduled for construction in 2017) 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 it is recommended that the proposed development be authorised. However, the following conditions should be incorporated into the Environmental Authorisation:

- Any areas not yet surveyed should be examined by both an archaeologist and a palaeontologist in order to identify any areas or sites that should be protected or mitigated prior to commencement of construction (this includes parts of the assessed alignments or any alterations made after completion of this report);
- 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 may not be widened towards the east and should preferably not be widened at all;
- 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, 21 May 2017
Archaeological specialist study: Dr Jayson Orton, ASHA Consulting (Pty) Ltd, 21 May 2017
Palaeontological specialist study: Dr John Almond, Natura Viva cc, May 2017

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.

***Lammerkraal*:** A small enclosure, often alongside or adjoining a larger one, in which lambs were penned separately from the adult sheep.

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

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

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, and Sections 3.2
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 Appendix 4
q) any other information requested by the competent authority.	n/a
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 on-site substation and electrical distribution line (and associated infrastructure) to support the proposed Rietrug Wind Energy Facility (WEF). The distribution line would run from a proposed on-site substation at S32° 37' 16" E20° 54' 30" to one of two proposed third party substations to the east (i.e. the proposed collector hub or Eskom Nuwerust Substation), neither of which are part of the present assessment. The easternmost third party substation would be located at S32° 42' 00" E21° 15' 32". There are two alternatives of the third party substation and associated distribution line routing, with the first being confined to Northern Cape and the second extending further east into Western Cape (Figure 1).

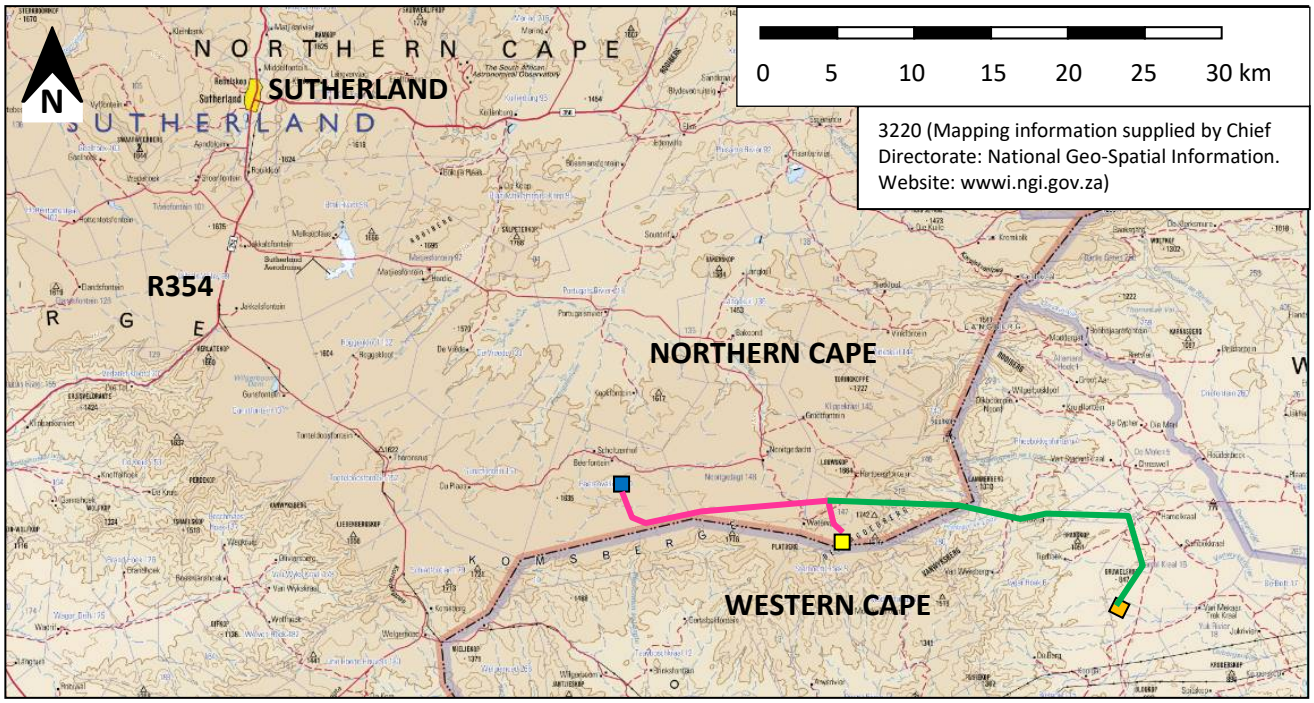


Figure 1: *Map showing the location of the study area. The blue square shows the proposed Rietrug on-site substation, while the pink line indicates the Alternative 1 distribution line route. The extension eastwards along the green line is Alternative 2. The yellow and orange squares respectively represent the Suurplaat and Nuwerust substation sites already examined in other impact assessments.*

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

- 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
- 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

The above farm portions apply to the proposed Alternative 2 routing of the distribution line and connection to the proposed Nuwerust Substation. Alternative 1 of the proposed distribution line will only be routed over the Remaining Extent of Beeren Valley 150, Remaining Extent of Nooitgedacht 148, and Remaining Extent of Hartbeesfontein 147, within the Northern Cape.

1.1. Project description

It is proposed to construct the following:

- An on-site substation in Northern Cape with an operations and maintenance building and a laydown area;
- A 132 kV distribution line extending from the on-site substation to a third party substation in Northern Cape (Alternative 1; about 17 km long) or Western Cape (Alternative 2, about 44 km long);
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It should be noted that there are three separate Electrical Grid Infrastructure applications being conducted simultaneously. Should all three be approved and receive preferred bidder status then it is proposed to link them to one another as follows: a single line would be constructed from each of the proposed Sutherland 2 WEF and Rietrug WEF Substations to the proposed Sutherland WEF Substation with only a single line being constructed from the Sutherland WEF substation on to either of the Alternative 1 or 2 termini. Both alternatives for all three projects end at the same point in the east (the yellow and orange substations in Figure 1) but start in different places in the west.

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) and compile a Heritage Impact Assessment (HIA) that would meet the requirements of the relevant heritage authorities in both Northern Cape and Western Cape.

On notifying the South African Heritage Resources Agency (SAHRA) of the proposed development, they requested an HIA that included archaeological and palaeontological studies. HWC responded to the NID with a request for an HIA that included specialist assessments of archaeological and palaeontological resources 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:

- Impacts to archaeological heritage resources
- Impacts to palaeontological heritage resources.

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, all heritage resources should be identified and assessed.

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 Cape and Northern Cape provinces 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 (NHRA) No. 25 of 1999 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.”

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 BAR. 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. METHODS

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.

3.2. Field survey

Five days were spent on site examining the alignments of four related projects in Northern Cape from 14 to 18 November 2016. This was in early summer but in this relatively dry and high altitude environment the season makes little difference to the degree of vegetation cover and hence the visibility of heritage resources. During this survey the majority of the Alternative 1 alignment was walked. Because Alternative 2 was only introduced for assessment after this fieldwork had been completed, a second trip of two days was carried out during which the eastern part of the Alternative 2 study area in Western Cape was surveyed. This was in mid-summer but, again, season made no difference. During the survey 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.

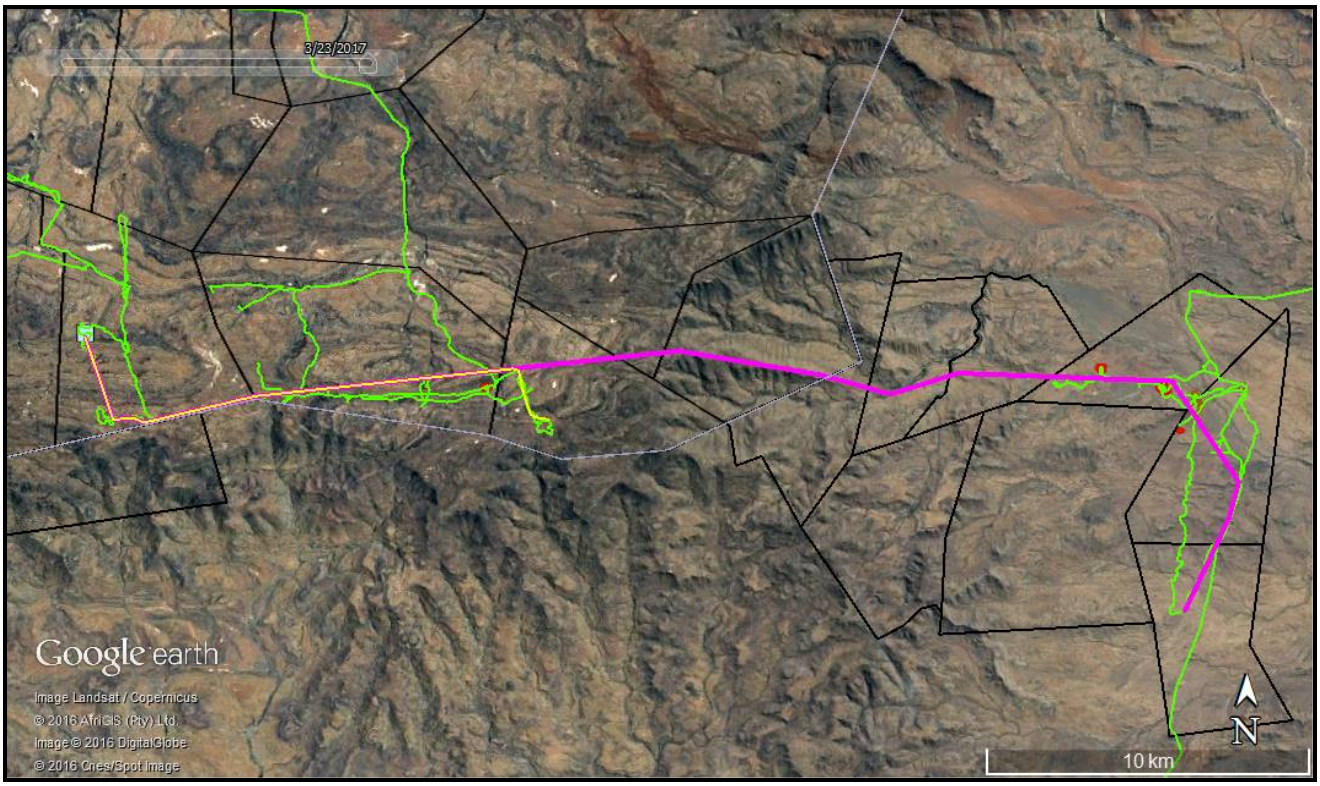


Figure 2: *Aerial view of the study area showing the proposed alignments (Alternative 1 in yellow, Alternative 2 in pink) and walk and drivepaths (green lines). Note that Alternative 1 was surveyed completely but the tracks are obscured by the power line alignments. The central portion of Alternative 2 was not surveyed.*

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 sections of Alternative 2 were not examined in the field:

- A 4.3 km long section above the escarpment was not examined because it was topographically uninteresting and remote and aerial photography suggested 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 could not be examined because the land owner did not provide consent for specialist site visits. Although much of this area is likely of very low sensitivity, the valley section may be more sensitive. This should not affect the outcome of the impact assessment because the eastern part of this route was designed by the present author based on an examination of aerial photography and the findings from the area that could be surveyed; and

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

- Two short sections of Alternative 2 in the far east were not examined because this alternative was proposed during the fieldwork and there was insufficient time to consider it fully. However, the amount of land seen, including two other proximate alternatives that were surveyed and screened out, 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.

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 entire region is used for livestock grazing, although one area to the west of the study area is a nature reserve. The study area lies within a proposed Renewable Energy Development Zone (REDZ) and many renewable energy facilities have been proposed in the area (Figure 3). Some are scheduled for construction during 2017.

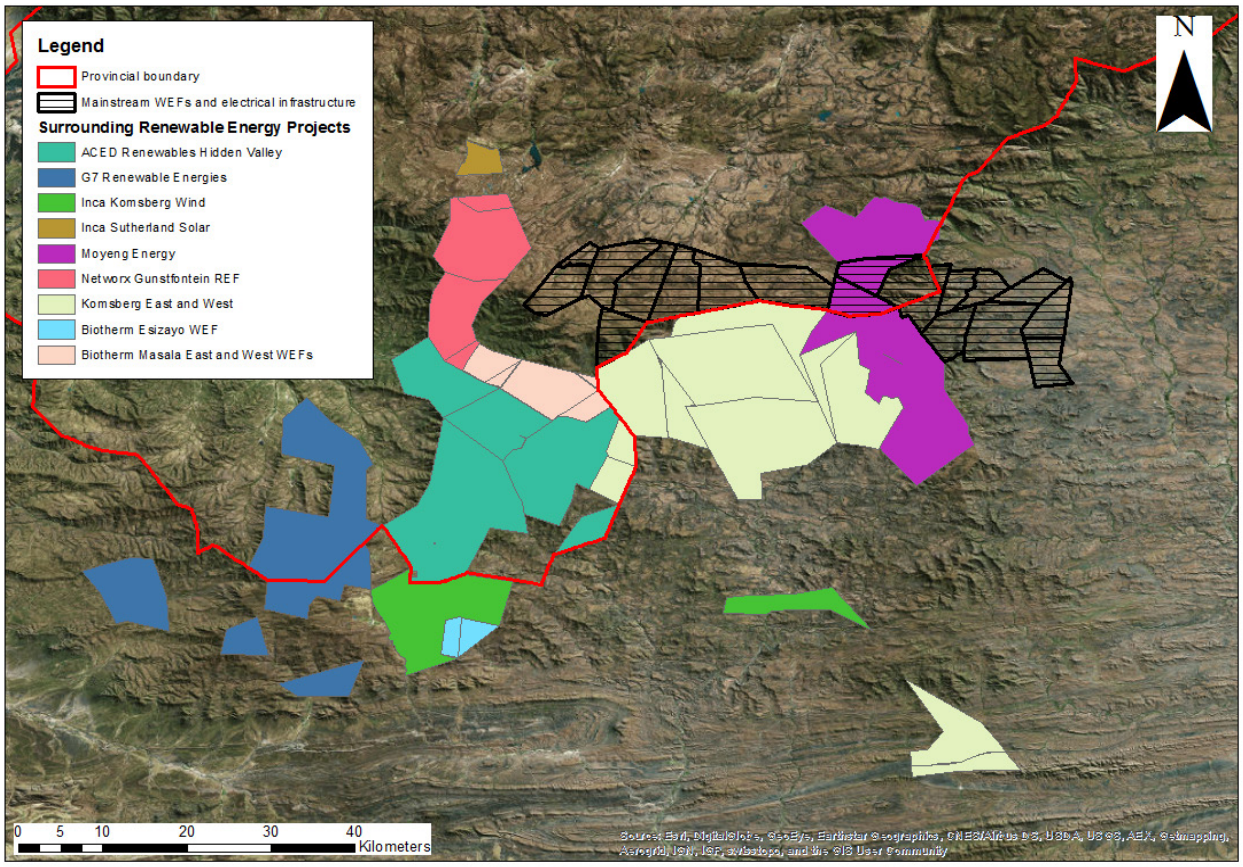


Figure 3: *Map of farm portions affected by proposed renewable energy facilities in the broader study area.*

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 (e.g. Figure 4). Although the terrain is often very rocky, the rocks tend to be flat (Figure 5). Small ridges do protrude in places though, especially along the north-facing slopes in the eastern part of the Alternative 1 study area (Figure 6). 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 7). Although the rock is largely quite solid sandstone, there are places where dark shale bands occur which are eroding heavily (Figure 8). 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 4: *View towards the south over an agricultural field in the western part of the study area (1.6 km northeast of the proposed Rietrug on-site substation location).*

Figure 5: *Flat rock slabs in the central part of the Northern Cape section.*

Figure 6: *A low rocky ridge in the central part of the Northern Cape section.*

Figure 7: *View up a river valley in the central part of the Northern Cape section showing the denser bush in the actual stream bed.*

Figure 8: *Weathering and eroding shale band in the side of a small river channel near the eastern end of Alternative 1.*

The easternmost part of the study area that lies within Western Cape was mildly undulating with very minor stream beds but was much less rocky than the escarpment area (Figure 9). Low scarps occurred in places with the largest of these being in the region of 20-25 m high (Figure 10). The bulk of the visible bedrock was highly weathered shale but the remains of more resistant rocks were often lying on the surface as gravel (Figure 11). In a few places there were small broken cliffs (1-3 m high). Fine gravel tended to be widespread on the surface.

Figure 9: *View towards the south in the far eastern part of the study area. A small drainage line is marked by denser vegetation.*

Figure 10: *View towards the southeast from the top of a small rocky scarp with a river bed visible in the distance.*

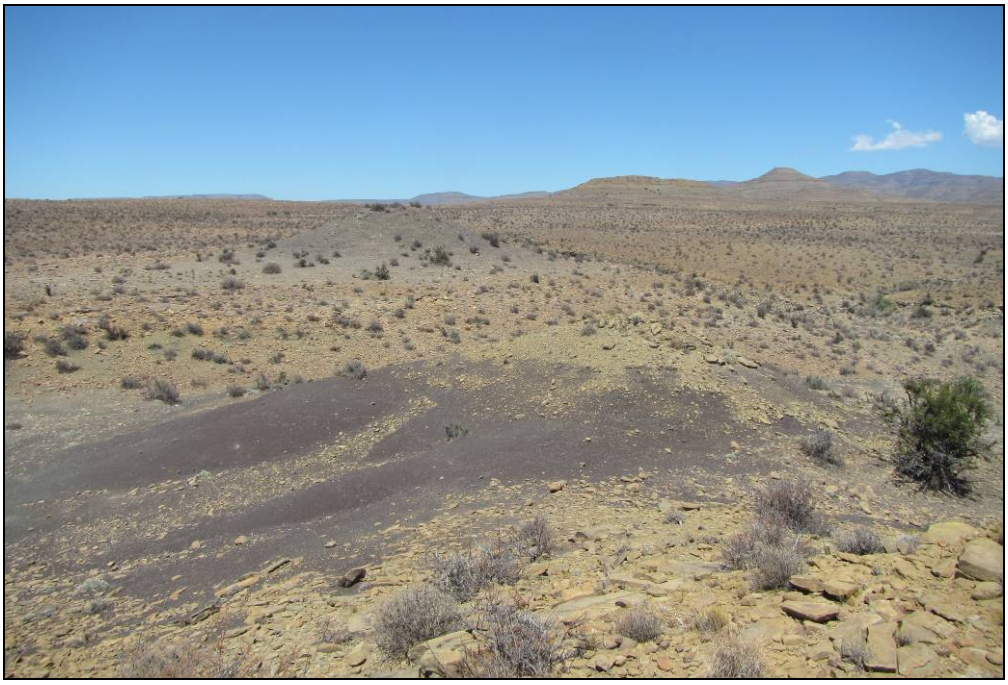


Figure 11: *View towards the southwest along a low rocky ridge in the eastern part of the study area showing the dark-coloured weathering shale overlain by the remnants of more resistant pale orange-coloured sandstone.*

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.

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 are known from the 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 an excellent example has also been reported from the southern edge of Sutherland (Hart 2005). This example was a complex of 13 interlocking enclosures. A number of other examples were found, largely on top of the escarpment, in an area to the south of the present study area. Some had stone artefacts, red burnished, thin-walled pottery, and ostrich egg shell 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). These 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 are largely early 18th to late 19th century in age and reflect the material remains of domestic life on the early frontier farms.

5.2. Built environment and historical archaeology

Various types of built 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:

- Various boundary markers, cairns and beacons (e.g. Hart *et al.* 2010; Orton & Halkett 2011). They may have been built when the original farm surveys took place in the 19th century;
- Military structures occur in places, most notably on Jakkalsvalley, the farm through which the subject road passes at its western end (Orton & Halkett 2011). Many of these are ruined and would technically be archaeological sites;
- Farm houses, outbuildings and farm workers dwellings occur widely, sometimes built from dressed stone; and
- Dry stone *kraals* and boundary walls.

Hart *et al.* (2010) and Halkett & Webley (2011) recorded numerous graveyards, generally associated with homesteads and with abandoned settlements. Ruins are quite numerous and range from ruined farm complexes to stock posts, historic kraals and boundary walls.

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.

Table 1: *List of heritage resources recorded during the field survey. Grades follow the system in use for each province as relevant. Note that the finds for the entire study area for all three projects are listed for the sake of completeness. Some sites are located quite far from the proposed alignments.*

Waypoint	Co-ordinates	Description	Grade	Cultural significance
NORTHERN CAPE				
501	S32 36 49.1 E20 44 51.2	Stone walling.	GP A	Medium
502	S32 36 47.8 E20 44 52.9	Stone walling with a small enclosure built onto it.		
503	S32 36 47.0 E20 44 56.7	Stone walling.		
504	S32 36 44.0 E20 45 01.0	Stone walling.		
505	S32 36 39.6 E20 45 03.6	Stone walling.		
506	S32 36 38.0 E20 45 02.9	Small cottage. No doubt older than 60 years originally but has been renovated.	GP B	Low-Medium
507	S32 36 29.6 E20 45 03.2	Stone walling.		
508	S32 36 28.1 E20 45 02.2	Stone walling.		
509	S32 36 23.8 E20 45 03.2	Very large round historical kraal on a slope up against a rock outcrop.	GP A	Medium
510	S32 36 28.9 E20 44 59.1	Stone walling.		
511	S32 36 22.0 E20 45 06.1	There are a variety of remnant stone features in	GP C	Low

Waypoint	Co-ordinates	Description	Grade	Cultural significance
		this area but too little left to tell what any of them were.		
512	S32 36 02.2 E20 45 09.2	Two small stone structures, one rectangular, the other very small and circular. Also a small dump of bone, blue and white glass, white ceramics and coarse porcelain.	GP B	Low-medium
513	S32 35 58.9 E20 45 13.5	Small stone feature built up against a free-standing boulder. There are glass and ceramic fragments scattered about, especially to the north.	GP B	Low-medium
514	S32 35 45.4 E20 45 29.1	Tiny stone feature of 1 m by 2 m on a small scarp edge.	GP C	Very low
515	S32 34 53.2 E20 47 13.7	Isolated grooved lower grindstone found face up on the alluvial flood plain of a river.	---	---
516	S32 34 38.2 E20 48 26.5	Very ephemeral stone enclosure of about 7 m by 10 m. There is doubt as to whether it is anthropogenic or natural.	GP C	Very low
517	S32 34 40.5 E20 47 45.5	Isolated white refined earthenware fragment.	---	---
518	S32 34 47.4 E20 47 20.7	Large stone boundary cairn. Located alongside the current boundary fence.	GP A	Medium
519	S32 36 10.7 E20 45 11.2	Isolated old tin can. Manufacturer named as “Poulton & Noel”. A record in the Evanion Catalogue (n.d.) shows the company to have been a manufacturer of preserved foods during the 1880s.	---	---
566	S32 36 27.1 E20 45 13.1	Stone walling against rock outcrop. Likely historical.	GP C	Low
567	S32 36 26.5 E20 45 13.8	Stone walling against rock outcrop. Likely historical.	GP C	Low
568	S32 36 26.7 E20 45 13.4	Stone walling against rock outcrop. Likely historical.	GP C	Low
569	S32 34 44.2 E20 53 17.4	Stone ‘cairn’. Not neatly made but just a pile of stones.	GP C	Low
570	S32 34 15.3 E20 50 51.8	Extensive scatter of ostrich eggshell on the edge of a flat-topped koppie.	GP C	Low
571	S32 34 15.2 E20 50 50.5	Smaller scatter of ostrich eggshell on the edge of a flat-topped koppie.	GP C	Low
572	S32 34 15.0 E20 50 49.9	Isolated old tin.	---	---
573	S32 36 04.0 E20 54 19.4	Graveyard in the middle of agricultural lands. May not have been recorded by Halkett and Webley (2010). It is located well away from the proposed power line but is close to a current farm road.	III A	High
520	S32 36 06.2 E20 44 54.3	Large stone cairn located about 20 m from the road.	GP B	Low-Medium
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

Waypoint	Co-ordinates	Description	Grade	Cultural significance
525	S32 38 24.3 E21 02 37.4	Two historical kraals, one rectangular and one circular.	GP B	Low-Medium
526	S32 38 37.3 E21 03 06.4	Tiny stone feature on a rocky ridge. Also a stone beacon (just a few stones on a boulder) nearby.	GP C	Low
527	S32 38 22.5 E21 02 28.7	Stone house ruin. The occupants had at some point tried to rescue the walls from caving in by building extra walling up on the outside. The inside has also started bulging and no doubt this lead to the people moving out and removing all wooden joinery for use elsewhere.	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
574	S32 37 22.1 E20 54 33.7	Isolated tea cup fragment.	---	---
575	S32 37 40.0 E20 54 39.3	Small piled stone structure of about 1.5 m by 3 m built along the edge of a small scarp. Probably related to other stone structures further east along the same scarp and recorded by Halkett & Webley (2010).	GP C	Low
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.	---	---
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

Waypoint	Co-ordinates	Description	Grade	Cultural significance
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
WESTERN CAPE				
483	S32 39 59.5 E21 15 21.2	A small cottage lies some 700 m to the west of the alignment. It was not visited but a photograph reveals it to be a vernacular cottage with external hearth and chimney stack.	IIIB	Low-medium
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.	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
490	S32 38 11.6 E21 16 54.1	Graveyard with five deceased and what seem to be three empty graves. Deaths in 1954, 1958, 1979, 1995, 1996.	IIIA	High
491	S32 38 10.9 E21 16 29.5	A few isolated historical artefacts in this area. Two ceramics likely from the same vessel and located 20-30 m apart, a piece of glass and a tin. Also a stone flake here.	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
496	S32 38 08.1 E21 16 59.9	Farm house and barn on Hamelkraal 16/6. Probably early-mid-20th century.	IIIB	Low-medium
		Waypoints 497-508 are all part of a single historical farm complex, while the track marked by 509-512 is no doubt directly related to it. The entire complex is graded as a whole.		
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		

Waypoint	Co-ordinates	Description	Grade	Cultural significance
		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 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	IIIC	Low
610	S32 38 07.4 E21 15 30.6			
611	S32 38 06.4 E21 15 34.2			

Waypoint	Co-ordinates	Description	Grade	Cultural significance
612	S32 38 05.9 E21 15 36.8	512. It appears from aerial photography to continue towards the north east.		
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.		
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

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 two lower grindstones. Both of the latter were found close to streams with one of them being very large and featuring a prominent groove indicative of extensive use (Figure 12). Another lightly used grindstone was found in an ephemeral pan to the southeast of the escarpment. 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 two days of survey there.

Only two significant Stone Age sites were found. The first 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 13 to 16 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 17).

Figure 12: *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 13: *View of a large enclosure on the east side of the rock outcrop.*

Figure 14: *A very small enclosure on the northeast side of the rock outcrop.*

Figure 15: *Two enclosures, one very large, on the north-western side of the outcrop.*

Figure 16: *An enclosure on the top of the rock outcrop.*

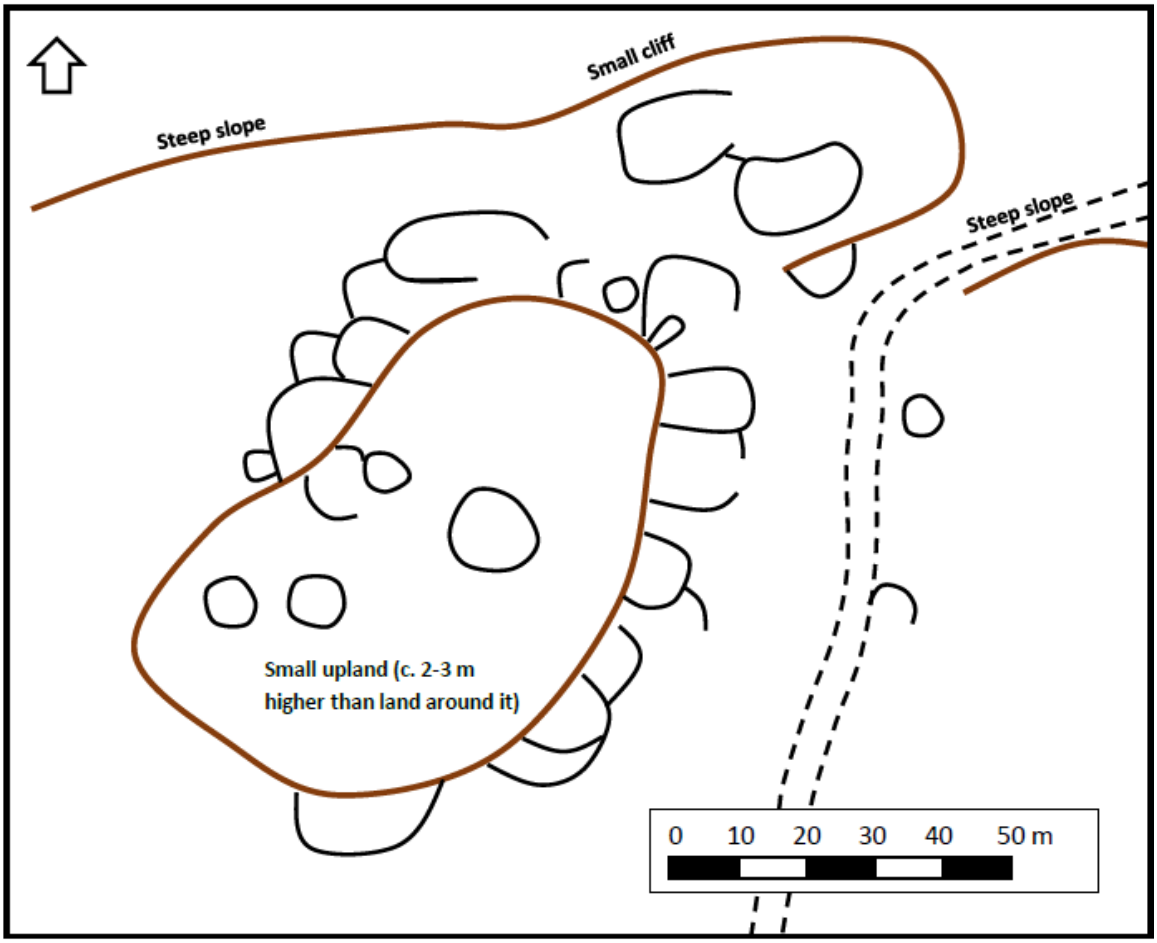


Figure 17: *Plan of the kraal complex at waypoint 546 showing topographic features in brown and stone walling in black. The double dashed lines indicate the position of the current access road which takes advantage of a break in the scarp.*

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 a historical 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 18).

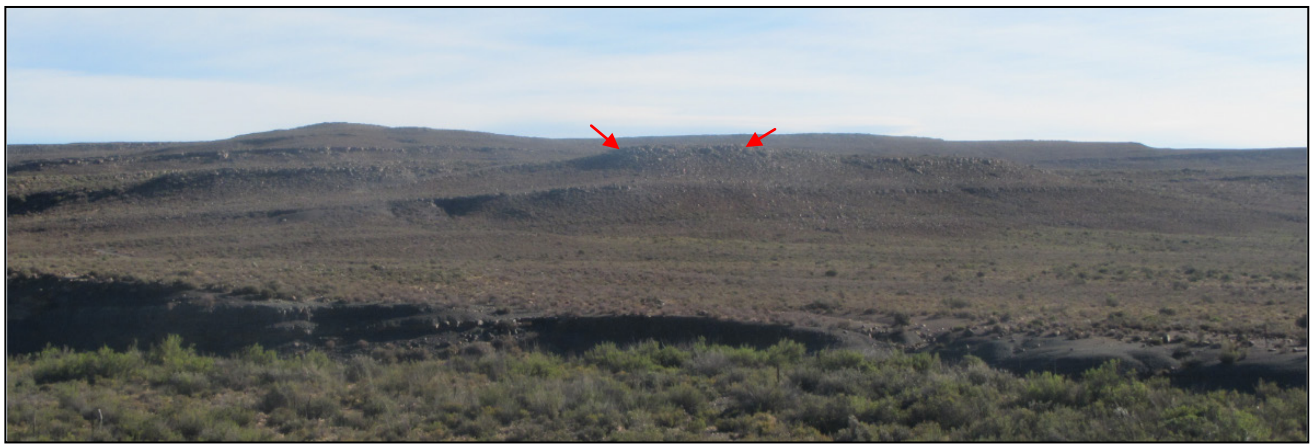


Figure 18: *View towards the south showing the location of the Stone Age kraal complex. The skyline in the background is the crest of the escarpment.*

The second important Stone Age site was a small rock art site. Because the imagery is comprised of a series of finger-painted red lines, it would be classed as a geometric rock art site (Figure 19). 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 river bed and has neither a flat base that would allow occupation nor an overhang that would offer shelter from the elements (Figure 19). This was one of the sites that resulted in the abandonment of one of the surveyed alternatives.

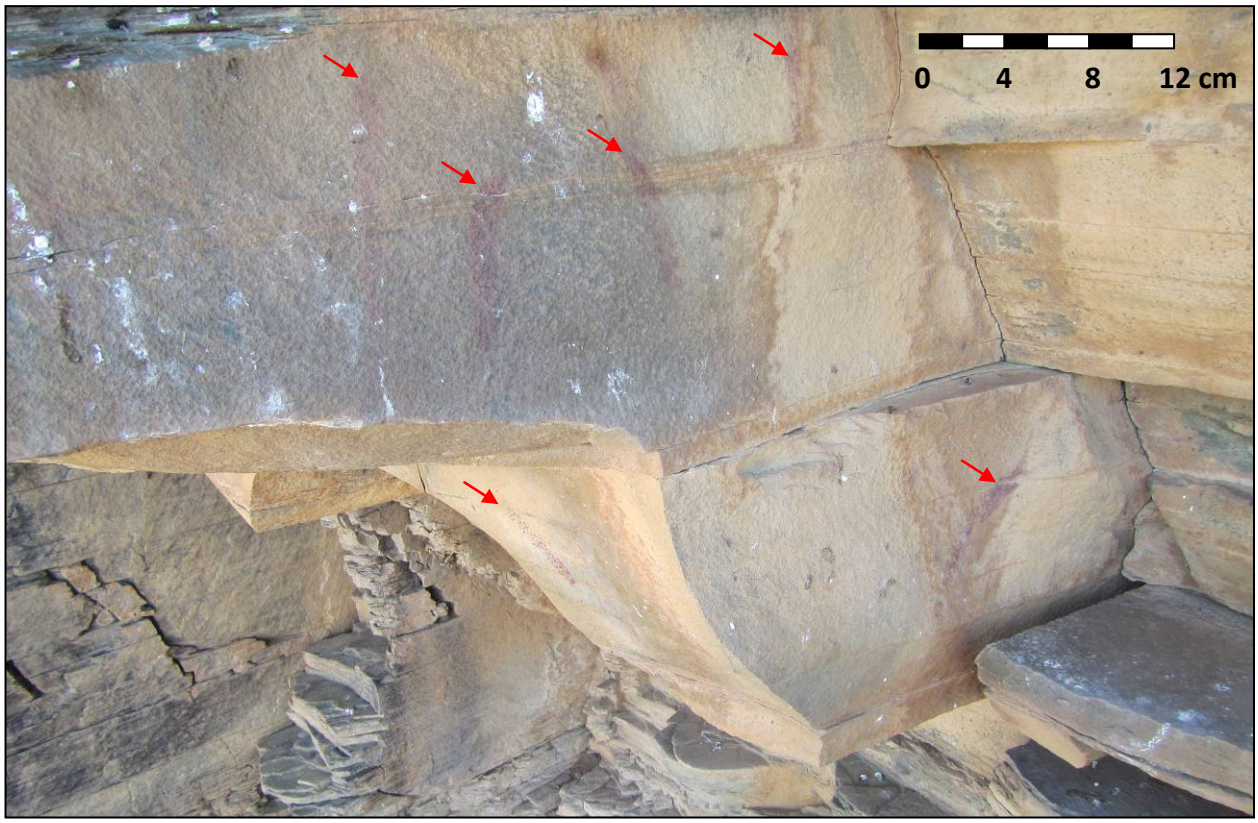


Figure 19: *View of the main painted area with the upper end of each finger smear identified by red arrows. Two further smears lie out of view to the right.*

Figure 20: *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.*

Historical archaeological features were numerous and found virtually throughout the study area in varying densities. These varied from small, isolated stone features like cairns, to small ruined structures, larger ruined structures and entire complexes of ruined structures and features. Figures 21 and 22 show examples of stone cairns, one very large and formal and no doubt a boundary marker, the other simply a pile of stones of indeterminate function. Even more ephemeral than this small cairn was a tiny 'dam' created by placing a single line of stones across a flat area where it was recognised that water would accumulate with only a minor modification (Figure 23). This was no doubt done to provide a place where rainwater could accumulate and allow livestock to drink.

Figure 21: *The large stone boundary marker at waypoint 518.*

Figure 22: *A small, loosely-packed stone cairn at waypoint 613.*

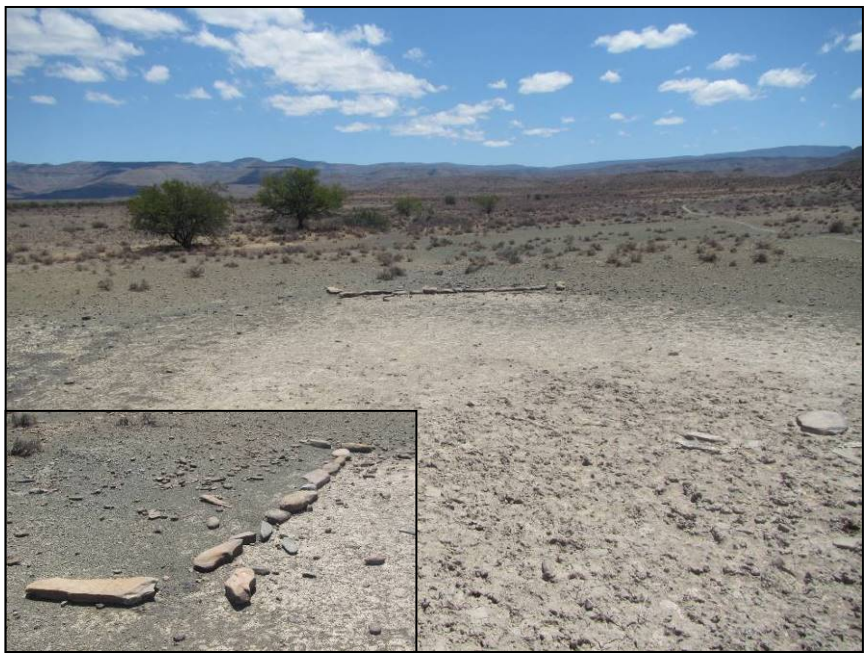


Figure 23: *A small 'dam' at waypoint 485. The inset shows the single line of stones forming the 'wall'.*

A number of small, usually isolated and very low structures were found. These may well relate to shepherds constructing small shelters for themselves. One of them (Figure 24) was built up against a low (*c.* 1 m high) cliff line that formed the southern edge of a small rocky ridge. Although it stood on its own, the desktop study revealed that Halkett and Webley (2011) had documented further structures some 175 m away to the east along the same cliff line. They listed their find as "Probably shepherd's hut adjacent to lammerkraal, which is adjacent to larger kraal (2x1m; 2x1m; 5x4m). Glass, metal, bullet casings, bone." Interestingly they found a few artefacts suggesting a domestic function for the site. Some 2 km to the south of these enclosures was a small, isolated stone structure that, although tumbled, retained enough integrity to see that it had been packed in the traditional historical style (Figure 25). Three fragments of bone, one of them burnt, were found there.

Figure 24: *A small stone-walled structure built on a low rock ridge against a small 'cliff' at waypoint 575.The 'cliff' is on the left.*

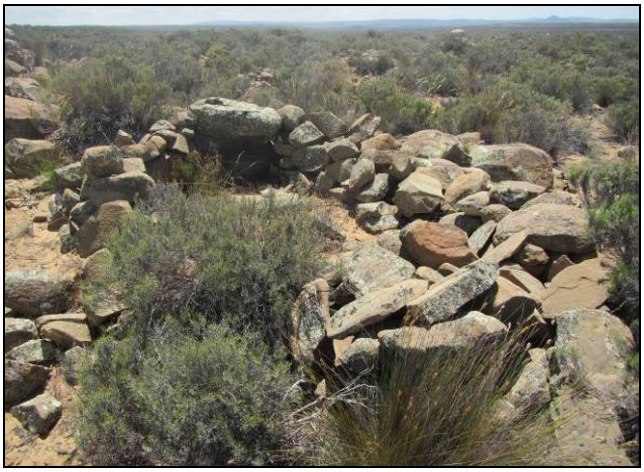


Figure 25: *A small oval structure standing in the open away from any landscape features at waypoint 576.*

Only slightly more formalised was a pair of structures located close to a small dam on high ground near the edge of the escarpment (Figure 26). Somewhat more 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 27).

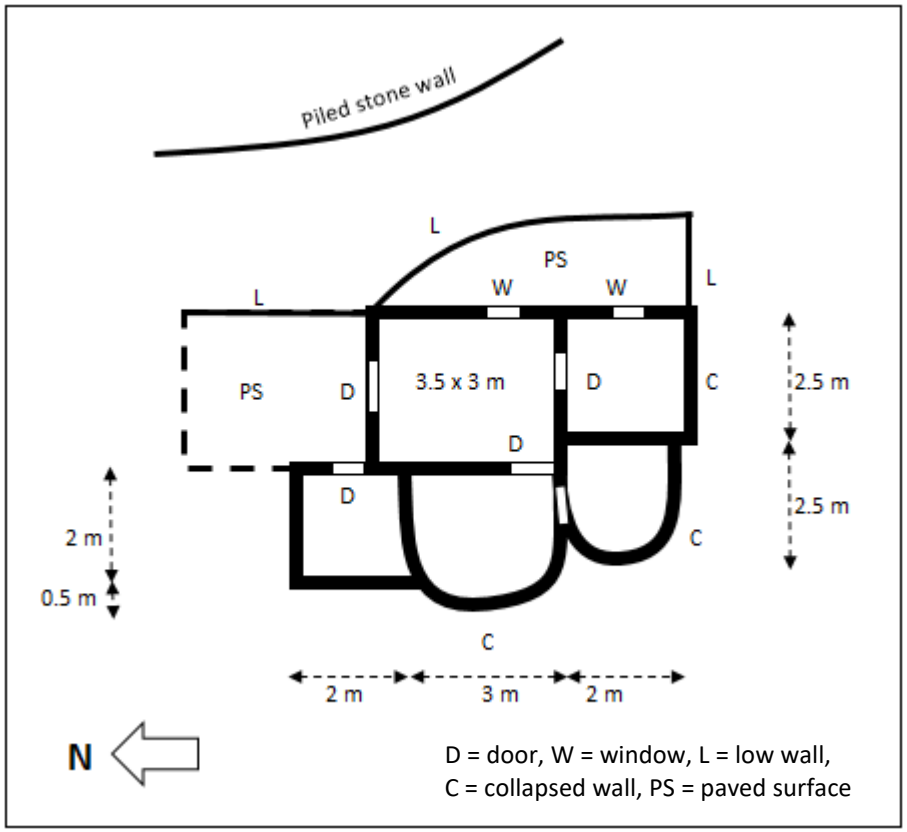
Figure 26: *The two small stone structures at waypoints 521 & 522.*

Figure 27: *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. 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 28 & 29). 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 structures 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 stop 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 present thinly 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 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.).



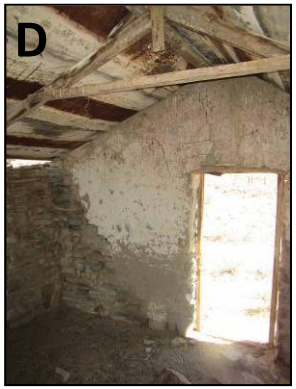


Figure 28: *Plan of the stone-walled house at waypoint 498 with (A) a view of the entrance and north-eastern corner, (B) View of the south-western corner of the site showing the curved walling, (C) the east-facing window in the central structure, and (D) the north-facing doorway in the central structure. Not to scale but approximate measurements are indicated.*

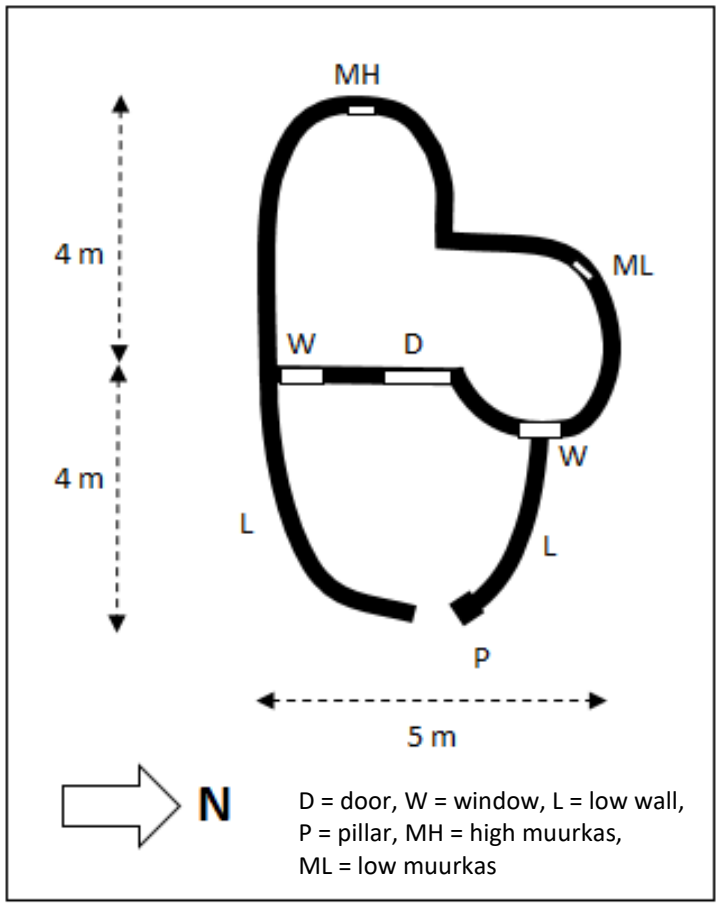


Figure 29: *Plan of the stone-walled house at waypoint 500 with (A) a view towards the west of the entrance, (B) a view towards the south of the northern lobe showing remaining roof 'beams', (C) a view of the high 'muurkas' in the western lobe and (D) a view of the east-facing window with wooden planks and sticks in the southern lobe. Not to scale but approximate measurements are indicated.*

Nearby above the stream was a fairly well-preserved threshing floor (Figure 30), 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 31).

Figure 30: *View towards the north of the threshing floor with the lobed structure (from Figure 29) visible in the background.*

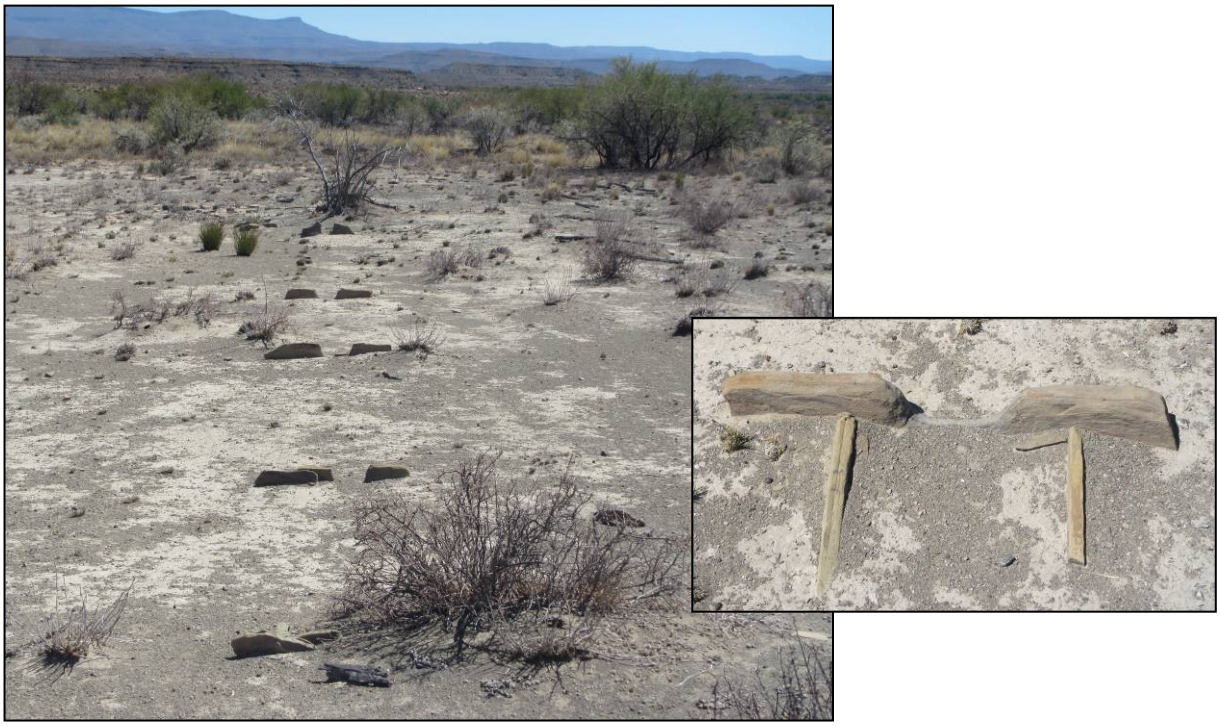


Figure 31: *A set of stones that may have held a pipe or similar.*

Further to the west lay a smaller complex, perhaps an outpost of the one just described. It had a single-roomed rectangular structure with similar 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), a stone-lined reservoir and a '*waterput'* (Figure 32).

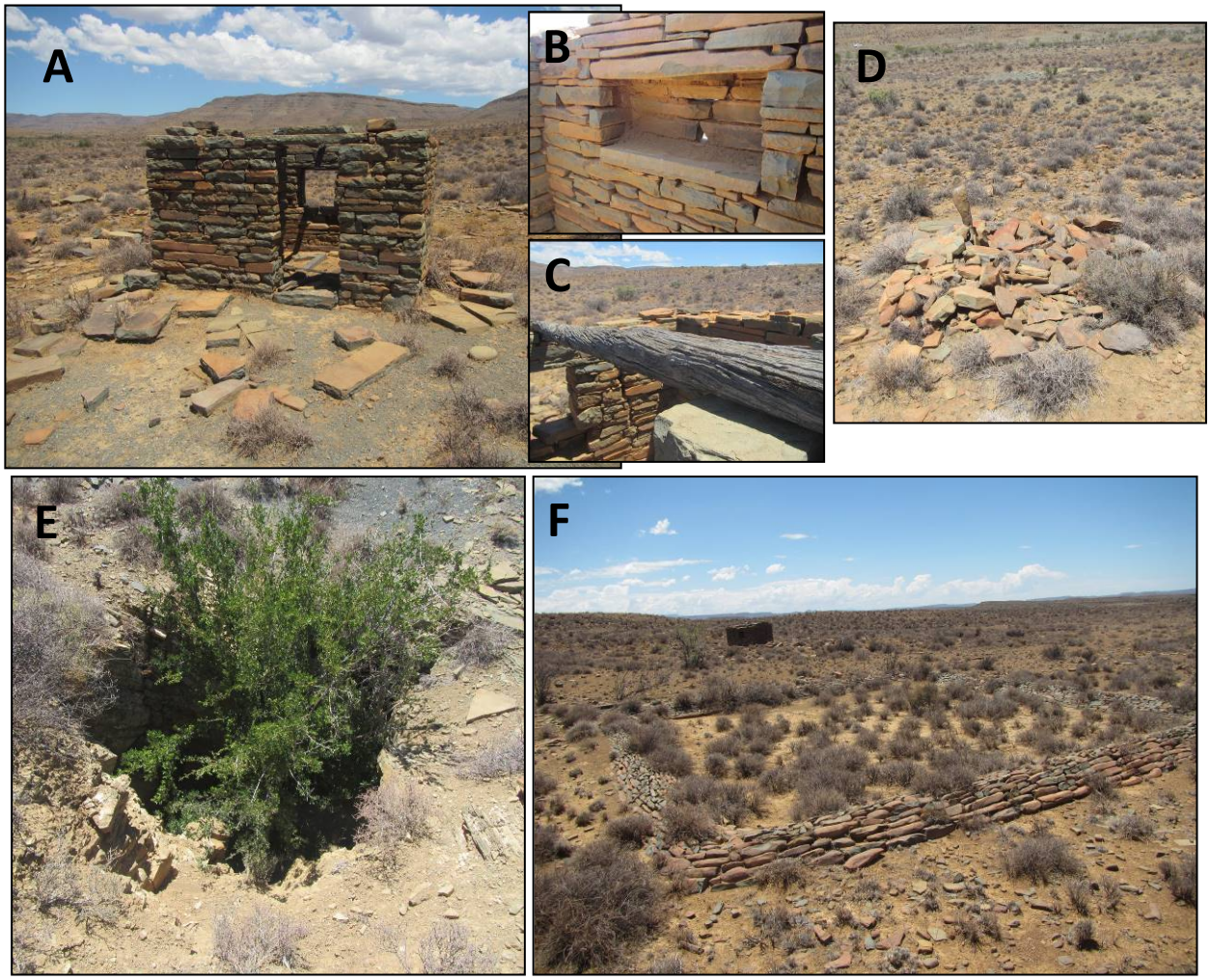


Figure 32: *The complex at waypoint 614; (A) shows the house, (B) a muurkas, (C) a roof beam, (D) the stone pile at waypoint 616, (E) the waterput at waypoint 617 and (F) the stone-lined reservoir.*

6.2. Palaeontology

A specialist palaeontological study was carried out by Dr John Almond (2017) and is included as Appendix 3 of the present report.

Almond (2017:1) 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 (2017) 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 is covered by a large amount of superficial sediment.

6.3. Graves

No isolated graves were seen during the survey. However, several graveyards are present in the general area. One was found to lie within an agricultural field close to an access road for the original Alternative 1 alignment (Figure 33), while another was within the path of one of the routes previously considered for Alternative 2. No graves were found close to the currently assessed alignments.

Figure 33: *An old graveyard with simple stone headstone at waypoint 573.*

Figure 34: *A formally laid-out family graveyard in the far eastern part of the study area at waypoint 490.*

6.4. Built environment

A number of farm buildings were seen in the general vicinity of the study area, generally while driving in to the proposed alignments, but all lie well away from the proposed routes. The only structures near enough to be worth reporting are a farm complex close to the third-party Suurplaat

Substation (630 m from the eastern end of the Alternative 1 power line route; Figure 35) and a small vernacular cottage 700 m from the route near the eastern end of Alternative 2 (Figure 36). Neither will be meaningfully impacted due to the distances involved.

Figure 35: *Farmhouse near waypoint 527.*

Figure 36: *Small cottage at waypoint 483.*

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 views (Figures 37 and 38). 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 proliferation of small historic stone features across the landscape is 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.

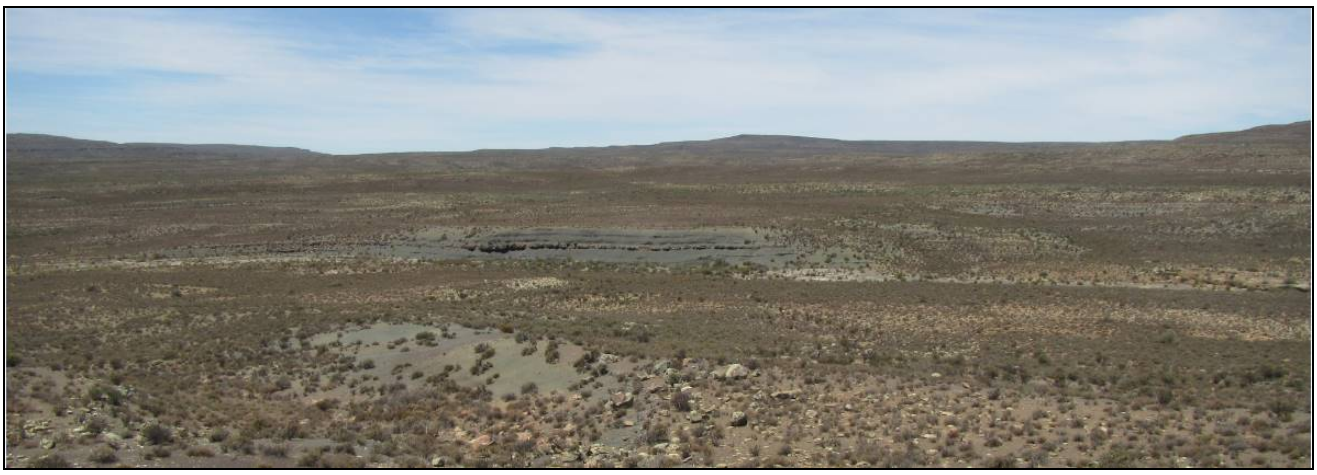


Figure 37: *View towards the northeast in the central part of the Alternative 1 area exemplifying the landscape above the escarpment with its undulating topography and lack of prominent mountains.*

Figure 38: *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 with the prominent mountains of the escarpment in the far distance.*

It is pertinent to note, however, that this landscape can no longer be regarded as pristine because the present study area falls within a proposed REDZ and many other renewable energy facilities have been proposed here, some of them due for construction shortly. This will mean that wind turbines and power lines (should they receive authorisation) will comprise a new layer on this landscape, the strongest layer yet.

6.6. Summary of heritage indicators

Archaeological remains are generally scarce but are found throughout the area. Very little Stone Age material was found with just two 'sites' being recorded: a kraal complex (waypoint 546) and a geometric rock art site (waypoint 492). Isolated stone artefacts were remarkably rare. The vast majority of archaeological remains found were historical and ranged from a ruined farm complex to small, isolated ruined structures (one of which lies within the proposed Sutherland substation development envelope) and isolated individual artefacts. The eastern part of Alternative 2 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.

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.

Some graveyards and buildings are present in the area but 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 a proposed REDZ and it is noted that a new electrical layer is due to be added to this landscape in the very near future.

6.7. 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 but there are a few more important sites in the study area that could be rated as worthy of a IIIA grading (both systems).

Graves are deemed to have high cultural significance for their social value.

The two structures located within 1 km of the proposed powerline have moderate significance for their architectural and possibly social values. They are likely worthy of a 'IIIB' grading in terms of the HWC system (the SAHRA system is not intended to be used on buildings).

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 would be worthy of a 'IIIA' grading (in the HWC system). However, considering the renewable energy facilities planned for construction in the area this grading would likely need to be reduced in areas within easy sight of these facilities. It should still not drop below 'IIIB' however (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 and apply equally to both Alternative 1 and Alternative 2. The nature and significance of impacts – based on known sites – is likely to be the same except that a few more sites may be affected by Alternative 2 because it is longer.

Only impacts to archaeology, palaeontology and the cultural landscape are specifically assessed. This is because impacts to graves and buildings are not expected to occur. 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. Direct Impacts

7.1.1. Construction Phase

Potential impact to archaeological resources

Direct impacts to archaeological resources may occur when construction vehicles move through the area 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, the impact significance is regarded as being **low** 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 been found to date within the project footprint). The farm road passing through the kraal complex (waypoint 546) may not be widened towards the east and preferably should not be widened at all. 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**.

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 distribution of palaeontological resources (significant or otherwise) and the fact that none were located 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). Those sections of the final alignment that have not been surveyed should be subjected to a pre-construction walk-down survey to locate any fossils that need to be avoided or mitigated. Because of the low likelihood of finding fossils, the impact significance with mitigation is likely to also be **very low**.

Potential impacts to the cultural landscape
The cultural landscape will be impacted through the presence of incompatible structures (the proposed power line and its pylons) and the construction vehicles in the rural landscape. Because the area is within a proposed REDZ and many other renewable energy facilities and power lines are proposed (some are due for construction in 2017), the impact significance is assessed as being **low** without the implementation of mitigation measures. 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 where the road would be visible from longer distances. This is mainly applicable to the scarp within the Alternative 2 alignment – the detour route around the east side of the scarp must be used there. Mitigation measures will not alter the impact significance which remains **low** after mitigation.

7.1.2. Operation Phase

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 and public 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**.

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 and public road (note that for this reason the palaeontological specialist study did not specifically address the operation phase). 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**.

Potential impacts to the cultural landscape
The cultural landscape will be impacted through the presence of incompatible structures (the proposed power line and its pylons) in the rural landscape. Because the area is within a proposed REDZ and many other renewable energy facilities and power lines are proposed (some are due for construction in 2017), the impact significance is assessed as being **low** without the implementation of

mitigation measures. No mitigation measures are suggested for this phase and the impact significance remains **low**.

7.1.3. Decommissioning Phase

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 and public 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**.

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 and public road (note that for this reason the palaeontological specialist study did not specifically address the decommissioning phase). 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**.

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, the impact significance is assessed as being **very low** without the implementation of mitigation measures. The only mitigation measure is to ensure that rehabilitation is effective and that no landscape scarring remains visible from long distances. The impact significance will remain **very low**.

7.1.4. 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**.

Potential impact to palaeontological resources
Direct impacts to palaeontological resources are the same as the construction phase impacts except that they may occur over a larger area. Despite the very sparse distribution of palaeontological resources (significant or otherwise), there is still 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 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). Those sections of the final alignment that have not been surveyed should be subjected to a pre-construction walk-down survey to locate any fossils that need to be avoided or mitigated. 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**.

Potential impacts to the cultural landscape

The cultural landscape will be impacted through the presence of incompatible structures (the proposed power line and its pylons) and the construction vehicles in the rural landscape. Because the area is within a proposed REDZ and many other renewable energy facilities and power lines are proposed (some are due for construction in 2017), the impact significance is assessed as being **low** without the implementation of mitigation measures. In addition, the proposed power line would make a fairly small contribution to the overall visual impact to the landscape. Mitigation measures for the power line are generally impossible because one cannot hide them but a measure applicable to the proposed service road is to avoid steep slopes where the road would be visible from longer distances. This is mainly applicable to the scarp within the Alternative 2 alignment – the detour route around the east side of the scarp must be used there. Because the power line would likely be seen against a backdrop of other similar structures, the impact significance will be **very low** after mitigation.

7.2. Indirect Impacts

Indirect impacts could occur in two ways:

1. During construction there could be unintended impacts either through, for example, vehicles deviating from the permitted route or from construction personnel ignorantly damaging heritage sites in proximity of the power line; or
2. Contextual impacts could occur because of the existence of incompatible structures (power lines and pylons) in the rural landscape which spoil the immediate context of a heritage site.

The first type of impact is generally unlikely to happen because there are very few heritage sites within close enough proximity to the alignments. Rock art sites are usually the most vulnerable to human damage, often in the form of graffiti, but in this instance the chances of anyone finding the site are virtually zero, despite its proximity to the study area. Rock art is also sensitive to contextual impacts but in this case the painted panels face away from the power line and the site would be completely unaffected. The two sensitive historical ruins lie some 310 m (waypoint 614) and 150 m (waypoint 498) from the proposed alignments and will need to be marked as no-go areas.

Because of the very low probability of indirect impacts occurring, the significance of all such impacts will be very low, and certainly lower than the significance of the potential direct impacts listed above.

Table 2: *Impact assessment summary table – Construction Phase direct impacts.*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	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 PHASE													
Construction of proposed powerlines, substation and service road	**Destruction of archaeological remains**	Negative	Site	Permanent	Moderate	Very likely	Non-reversible	High	• Avoid and protect sites if possible. • Farm road through kraal complex may not be widened to the east. • Walk down of unsurveyed areas. • Record significant sites in footprint.	Low	Very low	5	Medium
	Destruction of palaeontological material	Negative	Site	Permanent	Slight	Unlikely	Non-reversible	Moderate	• Avoid and protect fossils if possible. • Walk down of unsurveyed areas. • 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	• Avoid creating roads up steep slopes. • Follow suggested service road detour on Alternative 2.	Low	Low	4	High

Table 3: *Impact assessment summary table – Operation Phase direct impacts.*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	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)		
OPERATION PHASE													
Existence and maintenance of powerlines, substation and service road	**Destruction of archaeological remains**	Negative	Site	Permanent	Slight	Extremely unlikely	Non-reversible	High	• 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	• Stay on service road at all times.	Very low	Very low	5	High
	Alteration of the cultural landscape	Negative	Local	Long term	Moderate	Very likely	High	Moderate	• None feasible.	Low	Low	4	High

Table 4: *Impact assessment summary table – Decommissioning Phase direct impacts.*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	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)		
DECOMMISSIONING PHASE													
Removal of power lines and substation and rehabilitation of service road	**Destruction of archaeological remains**	Negative	Site	Permanent	Slight	Extremely unlikely	Non-reversible	High	• 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	• Stay on service road at all times.	Very low	Very low	5	High
	Alteration of the cultural landscape	Negative	Local	Short term	Slight	Very likely	High	Moderate	• 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 impacts (Construction Phase)*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	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)		
CUMULATIVE IMPACTS													
Construction of proposed powerlines, substation and service road	**Destruction of archaeological remains**	Negative	Local	Permanent	Moderate	Very likely	Non-reversible	High	• Avoid and protect sites if possible. • Record significant sites in footprint.	Low	Very low	5	Medium
	Destruction of palaeontological material	Negative	Local	Permanent	Substantial	Unlikely	Non-reversible	Moderate	• Avoid and protect fossils if possible. • Walk down of unsurveyed areas. • Monitoring by ECO and rescue of isolated finds.	Moderate	Very low	5	Medium
	Alteration of the cultural landscape	Negative	Local	Long term	Moderate	Very likely	High	Moderate	• Avoid creating roads up steep slopes. • Follow suggested service road detour on Alternative 2.	Low	Very low	5	High

8. LEGISLATIVE AND PERMIT REQUIREMENTS

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

In Northern Cape (applicable to both Alternatives):

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 (applicable to Alternative 2 only):

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

A limitation of this assessment was the inability to access certain portions of land. This will need to be rectified in the pre-construction phase.

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

- Ensure that all areas not already surveyed as part of this assessment are examined by both an archaeologist and a palaeontologist 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 assessed routes as well as to any alterations to the routing 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;
- The farm road passing through the kraal complex (waypoint 546) may not be widened towards the east and should preferably not be widened at all;
- Significant palaeontological and archaeological sites (especially the two ruined complexes around waypoints 498 and 614) 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). There is one fossil site (a scatter of petrified wood) some 500 m from Alternative 2 and a number of archaeological sites along both alternatives (Figures 39 to 41);

- 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): 575, 576, 524, 546, 527, 614, 498 (whole complex included), 492 and the palaeontological site identified in Almond 2017 (see Appendix 3 of this report).

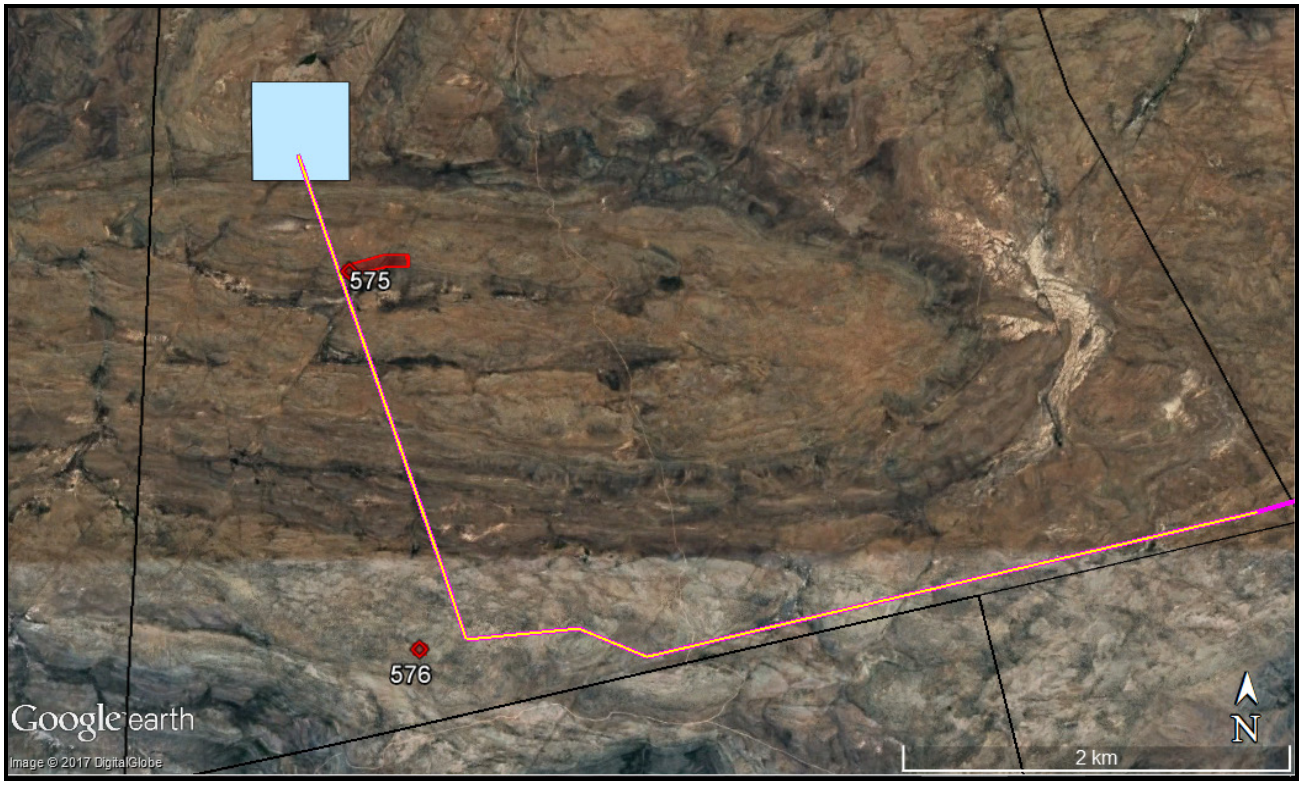


Figure 39: *Two archaeological sites (red shaded polygons) that should be avoided at the western end of the study area. Note that the northern one includes waypoints recorded by Halkett & Webley (2011), while the southern one lies within the development envelope for the proposed Sutherland on-site substation (assessed in a separate report, at waypoint 576).*

Figure 40: *Three archaeological sites that should be avoided near the eastern end of Alternative 1.*

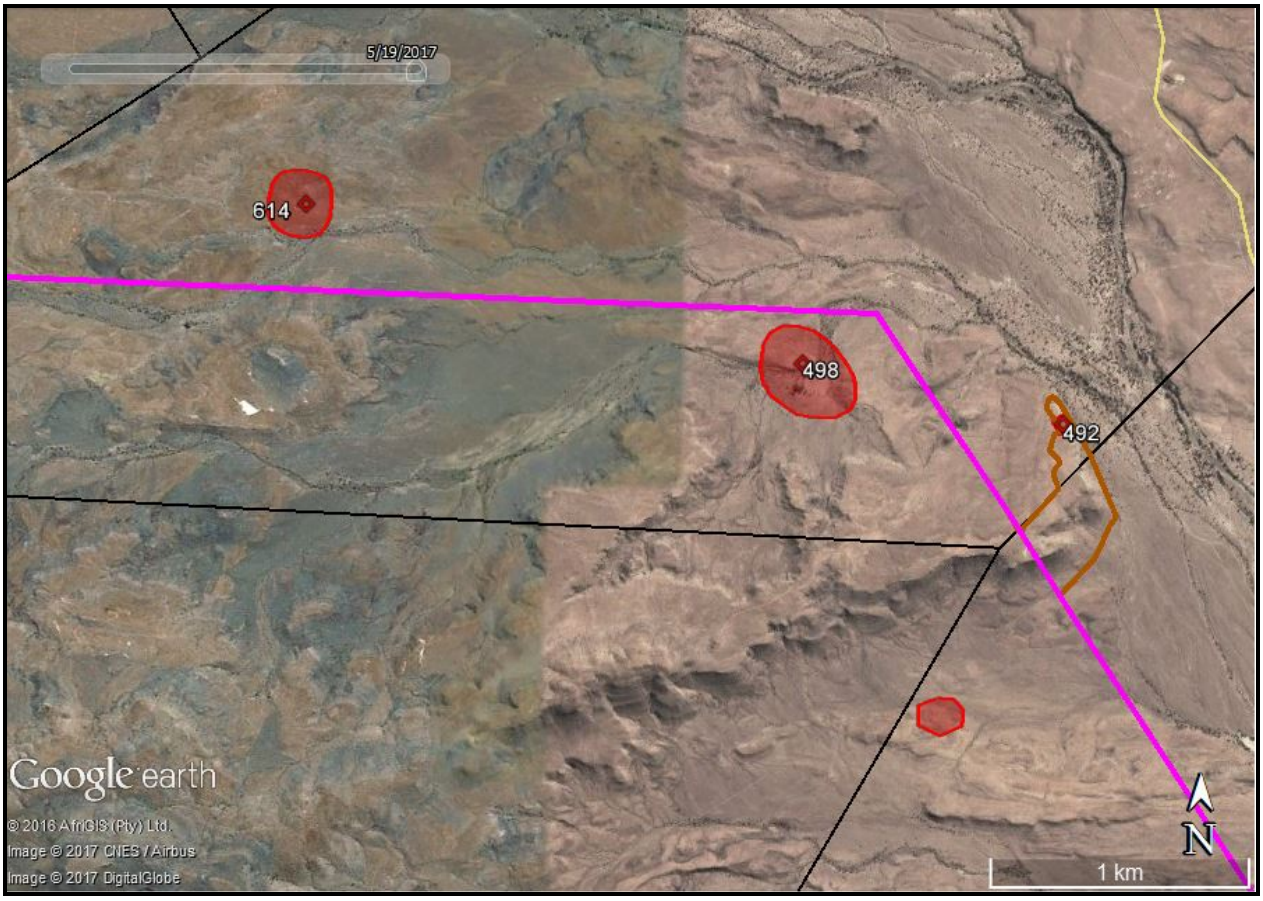


Figure 41: *Three archaeological sites and one palaeontological site (red shaded polygons) that must be avoided in the north-eastern part of Alternative 2. The palaeontological site is the southernmost polygon. The brown line shows the route that must be followed by the service road in that area.*

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 small 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.

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, however, requires that the relevant municipality within the Western Cape Province be requested to provide comment on the HIA – there are no heritage conservation organisation registered in the area. The report was thus sent to the Laingsburg Municipality by email for comment. They responded on 27 June 2017 that they had no further comments to add. All email communications were submitted digitally with this application but the response email was as follows:

FW: HIAs for comment

From "Winnie Miles" <wmiles@laingsburg.gov.za> 08:08:14 AM
to jayson@asha-consulting.co.za and copy to spieterse@laingsburg.gov.za

You replied to this message on 27 June 2017 08:10:30 AM.

Good day mr Orton

Telephonic conversations and e-mails received in this regard refer.

Herewith we'd like to inform that Laingsburg Municipality do not have any issues regarding this matter.

We hope you'll find this in order.

Thank you

W Miles
Secretary

12. CONCLUSIONS

This assessment has found that the broader study area around the proposed power line routes and associated electrical infrastructure does contain some significant heritage resources. These

include archaeological sites (mostly historical), palaeontological occurrences, graveyards and historical structures. Alternative 1 does not have any heritage sites on its alignment. Because the eastern part of Alternative 2 was routed by the heritage specialist especially to avoid significant heritage sites, it too should not impact on anything significant. However, a part of this route that is potentially sensitive 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 (at waypoint 546) 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 a proposed REDZ the area is very likely to be devoted to renewable energy developments (some facilities are already scheduled for construction in 2017) and the proposed power line and associated electrical infrastructure would thus not be out of place.

Neither Alternative has any fatal flaws but Alternative 1 is preferred because its alignment is shorter and therefore it passes close to fewer heritage sites. 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 low significance before mitigation and very low significance after mitigation.

13. RECOMMENDATIONS

Because there are unlikely to be significant impacts to heritage resources it is recommended that the proposed development be authorised. However, the following conditions should be incorporated into the Environmental Authorisation:

- Any areas not yet surveyed should be examined by both an archaeologist and a palaeontologist in order to identify any areas or sites that should be protected or mitigated prior to commencement of construction (this includes parts of the assessed alignments or any alterations made after completion of this report);
- 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 may not be widened towards the east and should preferably not be widened at all;
- 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.

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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:

<u>Phase 1 surveys and impact assessments:</u>

- 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)

<u>Phase 2 mitigation and research excavations:</u>

- 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

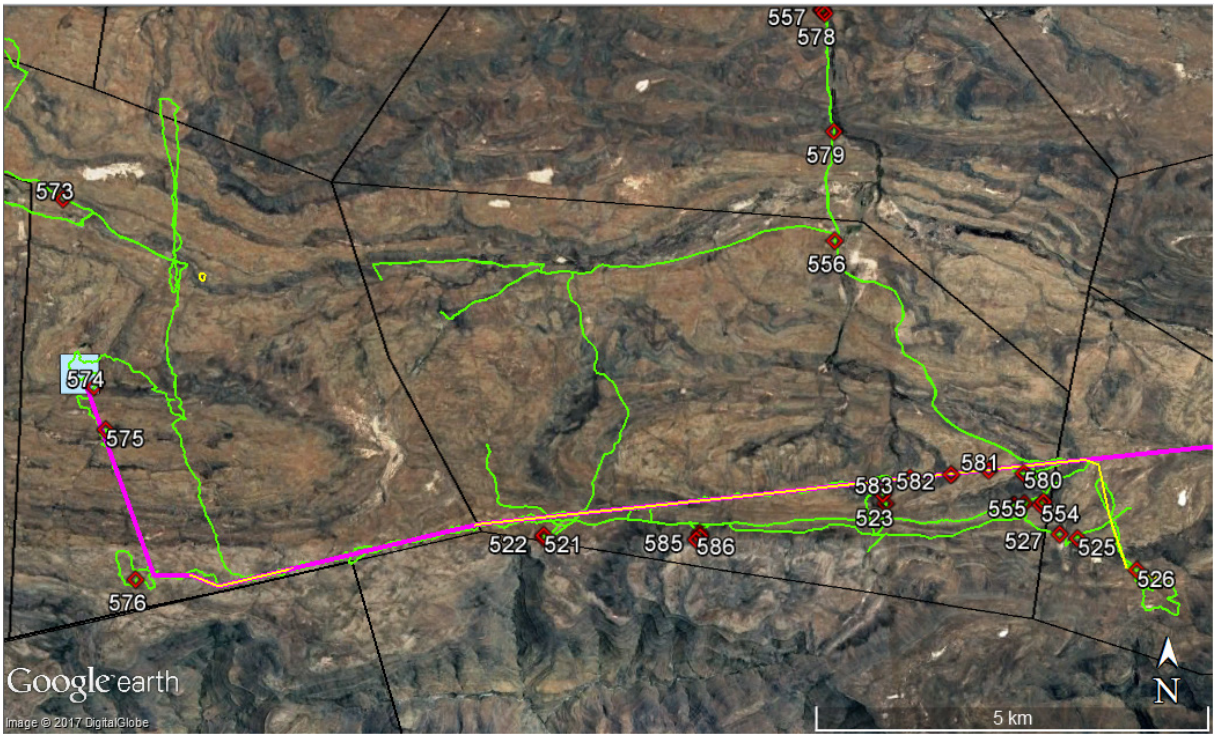

Figure A2.1: *Aerial view of the western part of the study area showing the recorded waypoints along Alternative 1. The yellow/pink line indicates the power line routing and the red numbered symbols are waypoints. The green lines are survey tracks.*

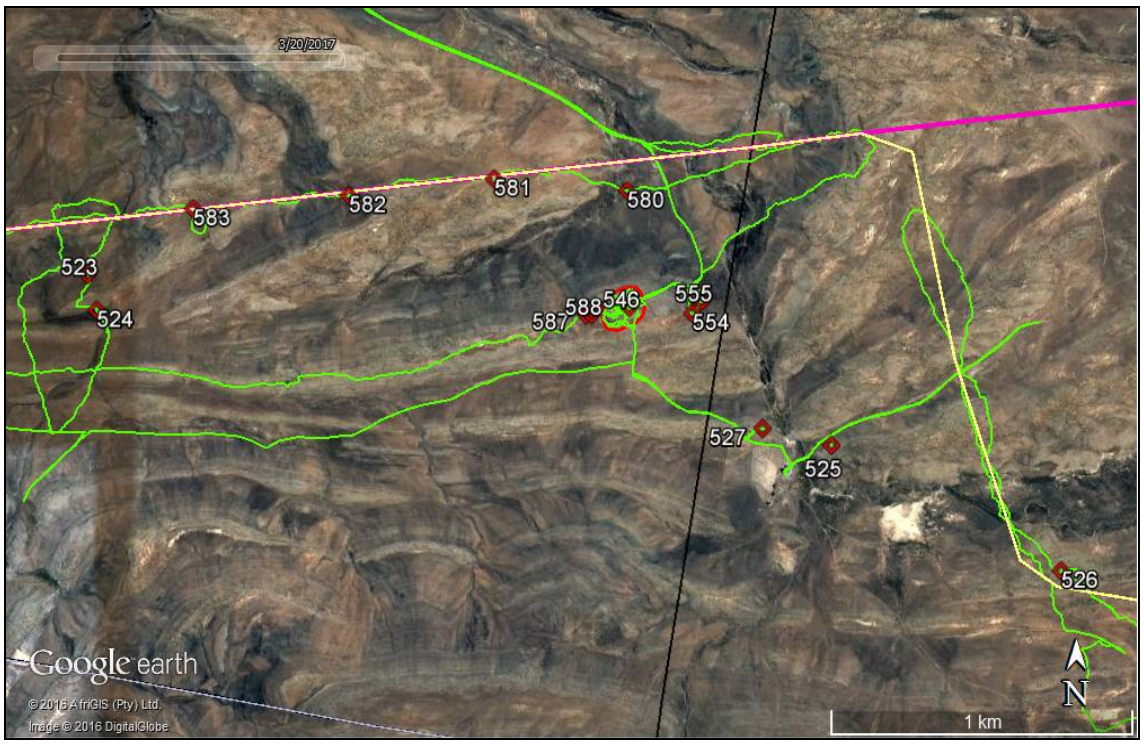

Figure A2.2: *Aerial view of the eastern part of Alternative 1. The yellow/pink line indicates the power line routing and the red numbered symbols are waypoints. The green lines are survey tracks.*

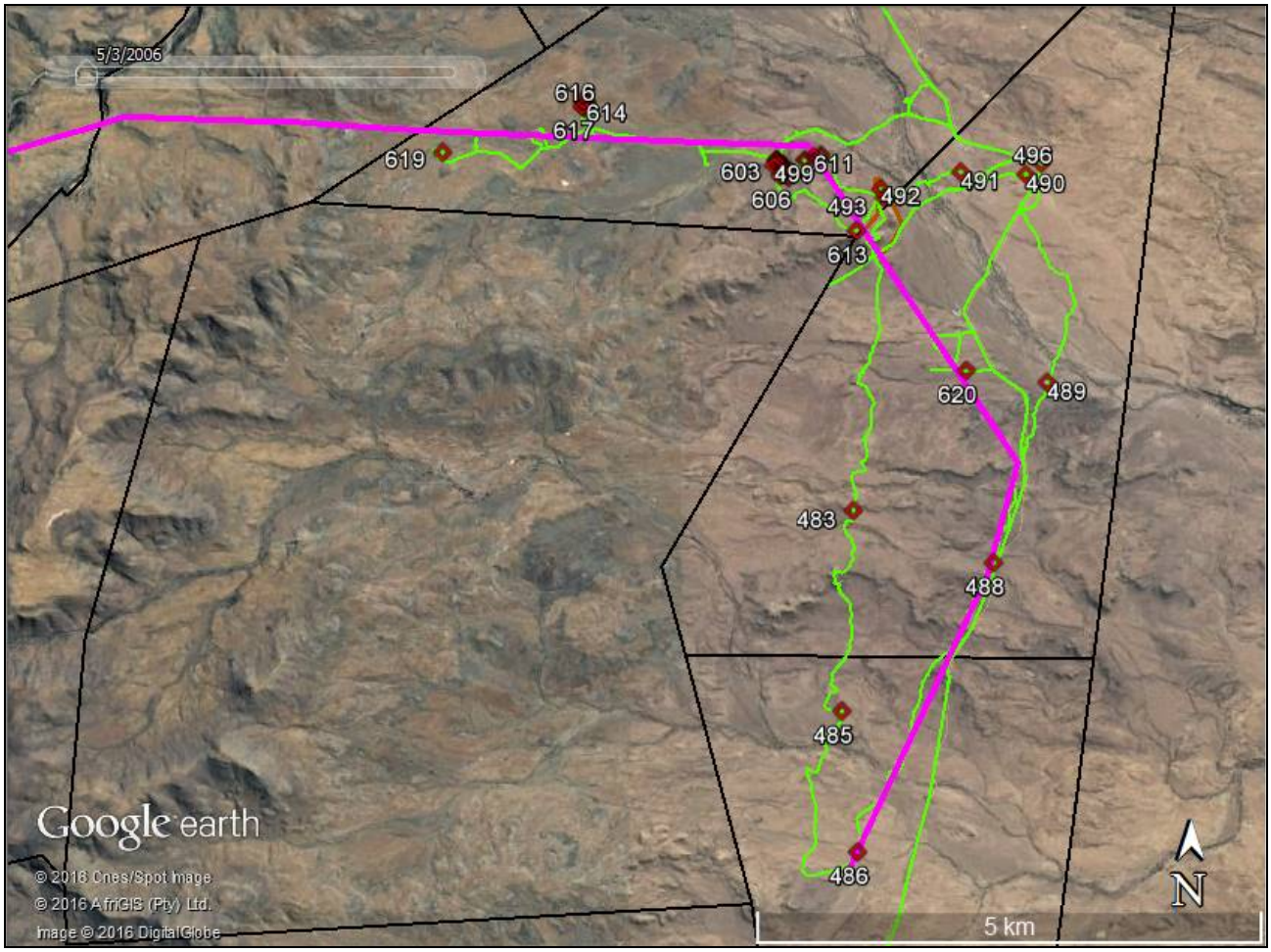

Figure A2.3: *Aerial view of the eastern part of Alternative 2. The pink line indicates the power line routing and the red numbered symbols are waypoints. The green lines are survey tracks.*

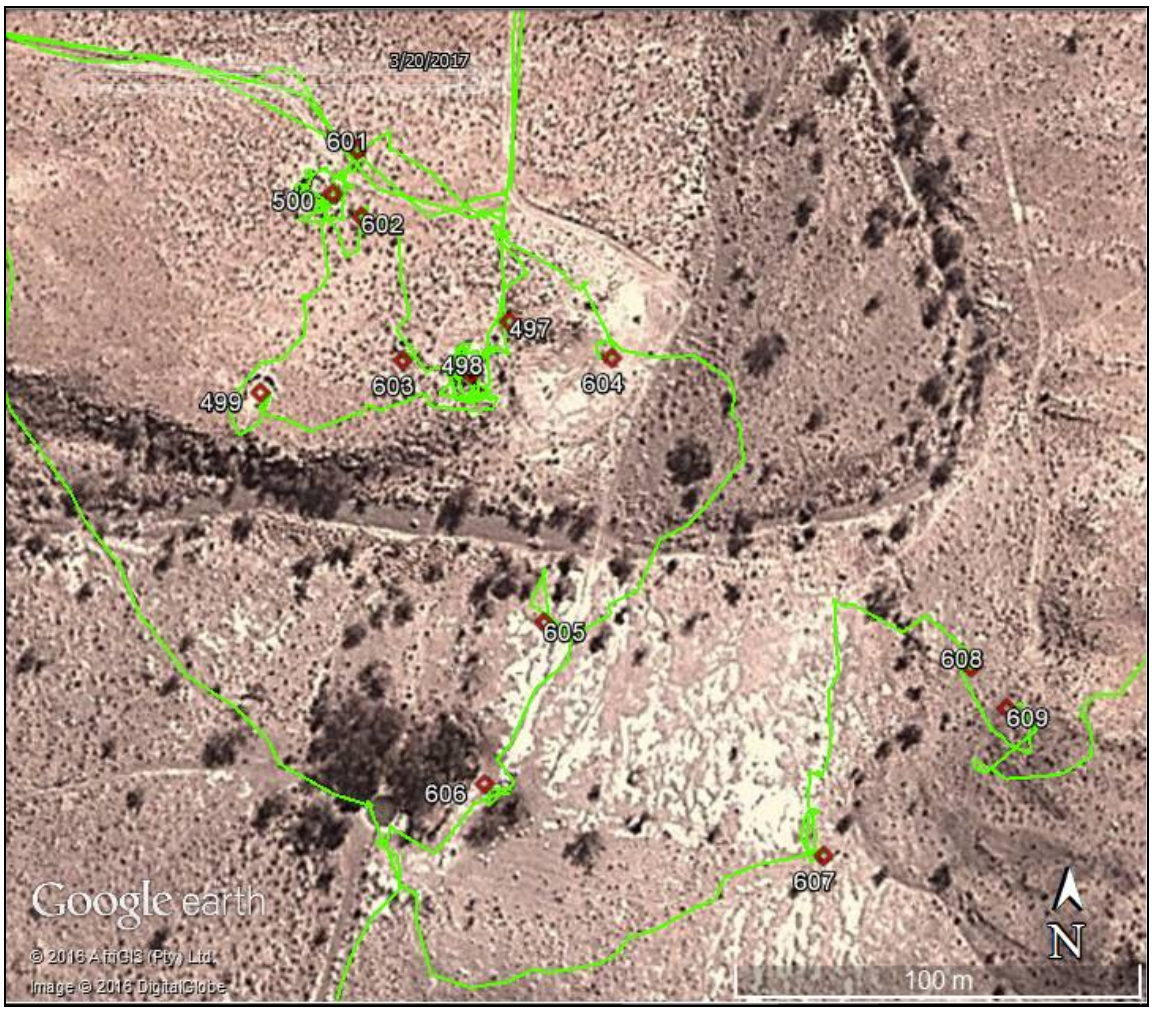

Figure A2.4: *Aerial view of the historic farm complex around waypoint 498.*

Figure A2.5: *Aerial view of the historic farm outpost around waypoint 614.*

APPENDIX 3 – Palaeontological study

Proposed Construction of Electrical Grid Infrastructure to support the Rietrug Wind Energy Facility, Northern and Western Cape Provinces

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Cape Town 8010, RSA
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February 2017 (and updated in May 2017)

EXECUTIVE SUMMARY

South Africa Mainstream Renewable Power Developments (Pty) Ltd are proposing to connect the authorised Rietrug Wind Energy Facility (WEF), situated some 35 km southeast of Sutherland, to the national grid. The proposed electrical grid infrastructure spans the boundary between the Western and Northern Cape Provinces and will comprise an on-site substation (including an operations and maintenance building as well as laydown areas) on the farm Beeren Valley 150, a new 132 kV distribution line from the on-site substation to the third party substation together with a service road beneath the powerline. Two distribution line route options are currently being considered. Alternative 1 would connect the proposed Rietrug on-site substation with the proposed Suurplaat On-site Substation on Farm Hartebeeste Fontein 147 while Alternative 2 would connect the Rietrug on-site substation to the Nuwerust Substation on Farm Hamelkraal 16 (Fig. 1).

The electrical grid connection study area extends from the Roggeveld Plateau eastwards into the western Koup region at the foot of the Besemgoedberg Escarpment, 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 six-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 scatter, most of these fossil occurrences are of limited palaeontological value and lie well away from the electrical infrastructure footprint (Fig. 1) and do not warrant mitigation. No significant fossil remains were recorded at the proposed on-site substation and third-party substation sites. The overall palaeontological sensitivity of the electrical grid infrastructure study area is rated as low.

Pending a proposed pre-construction palaeontological walk-down of those sectors of the finally chosen powerline route that have yet to be assessed in the field (See Fig. 1), the impact significance of the construction phase of the proposed electrical grid infrastructure for the Rietrug WEF is assessed as VERY 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. This assessment applies equally to the various substation sites and alternative powerline routes currently under consideration. Significant further impacts during the operational and de-commissioning phases of the electrical grid infrastructure are not anticipated. There are no preferences on palaeontological heritage grounds for any particular layout among the various substation and powerline route options under consideration. 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 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 Rietrug WEF 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 on-site substation (including the laydown area and operation and maintenance (O&M) Building), 132 kV powerline, service road and connection to a third-party substation. Pending the potential discovery of substantial new fossil remains during the proposed pre-construction walk-down of unstudied powerline sectors or during the construction phase itself, no specialist palaeontological mitigation is recommended for this project.

A 30-m wide buffer zone is proposed to safeguard the petrified wood surface scatter on Hamel Kraal 16 (Locs. 041-074, Figs. 1 & 48) during the construction phase.

The Environmental Control Officer (ECO) responsible for the Rietrug 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, laydown areas, 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); and
- 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 electrical grid infrastructure in order to connect the authorised Rietrug Wind Energy Facility (WEF), situated some 35 km southeast of Sutherland, to the national grid. The proposed electrical grid infrastructure spans the boundary between the Western and Northern Cape Provinces and will comprise the following main components (See satellite map Fig. 1):

- On-site substation (including an O&M building as well as laydown areas) to be situated on the farm Beeren Valley 150/Remaining Extent.
- 132 kV distribution line from the proposed on-site substation to the third party substation, as well as a connection to the third party substation. Two options for the third party substation are under consideration: the proposed 132 kV Suurplaat On-site Substation to be located on Farm Hartebeeste Fontein 147 and the proposed 400 kV Eskom Main Transmission Substation (Eskom Nuwerust Substation, for which a separate Environmental Impact Assessment (EIA) process is being undertaken) to be located on Farm Hamelkraal 16. Two distribution line route options are currently being considered (See Fig. 1). Alternative 1 would connect the on-site substation with the Suurplaat On-site Substation while Alternative 2 would connect the on-site substation to the Nuwerust Substation.
- Service road below the powerline (4-6 m wide).

The purpose of the present report is to provide a palaeontological heritage Basic Assessment of the proposed electrical grid infrastructure for the Rietrug WEF. This report has been commissioned on behalf of the developer by the CSIR – Environmental Management Services, Durban (Contact details: Ms Rohaida Abed, CSIR. PO Box 17001, Congella, Durban 4013. Tel: 031 242 2300. Fax: 031 261 2509. E-mail: RAbed@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 8425. Cell: 083 272 3225. E-mail: jayson@asha-consulting.co.za).

Both of the alternative third party substations form part of the Moyeng Energy (Pty) Ltd Suurplaat WEF that has already received environmental authorisation. It is noted here that both the Suurplaat WEF as well as the original Mainstream Sutherland WEF (now split into the Sutherland, Sutherland 2 and Rietrug WEFs) 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 Rietrug WEF electrical grid infrastructure study area near Sutherland 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) 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.

Due to access issues during fieldwork, it was not possible to assess certain portions of the powerline route alternatives including the area near Novavita farmstead on farm Rheebokkenfontein 4 (See yellow dashed rectangle in Fig. 1). Depending on the powerline route finally selected, a pre-construction palaeontological field survey of the relevant unstudied area is therefore recommended here.

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.

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). These last reports notably include field-based assessments for the separate Gunsfontein WEF (Almond 2015g) as well as pre-scoping desktop assessments for the Mainstream Sutherland WEF (Almond 2010c) and Suurplaat WEF (Almond 2010b).

4. A 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.

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 the Appendix.

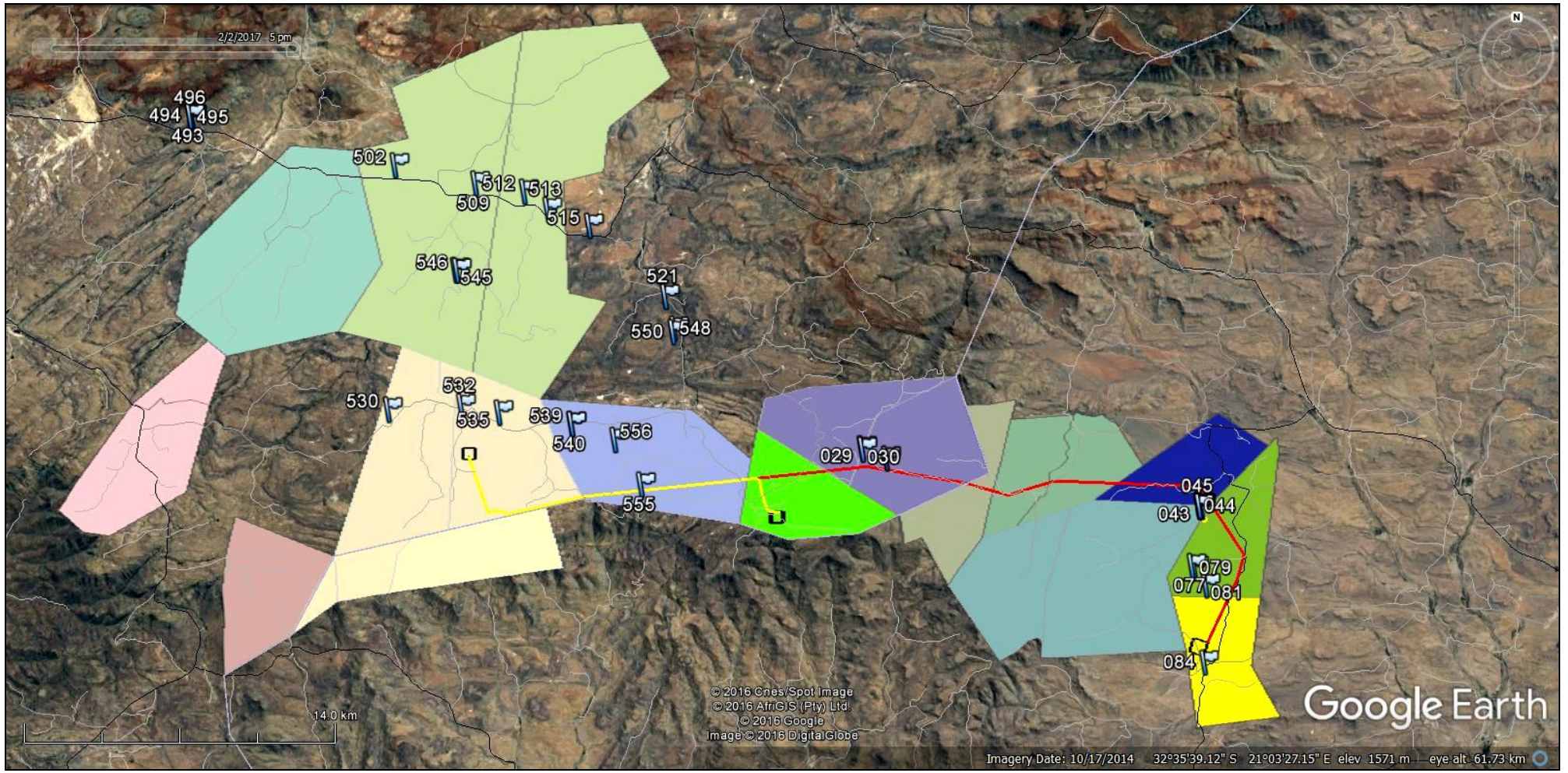
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Figure 1 (previous page). Google earth© satellite image of the Rietrug WEF Electrical Grid Infrastructure study area showing powerline route Alternative 1 (yellow) and Alternative 2 (red). Numbered flags represent recorded fossil sites (See Appendix for GPS data and short descriptions). Note that no fossil sites were recorded within the substation site study areas. The majority of the recorded fossil sites are of low palaeontological heritage significance and do not require mitigation. The only exceptions lying close to or within the alternative 132 kV powerline routes are Locs. 044-045 (surface scatter of fossil wood, bones) that are indicated by the red arrow. A 30 m-wide buffer zone is proposed for this site cluster (See Fig. 48 for more detail). The powerline sector within the yellow dashed rectangle has not yet been assessed in the field due to access issues. Depending on the powerline route finally selected, a pre-construction palaeontological field survey of the unsurveyed areas is therefore recommended here. A short deviation between the Alternative 2 powerline and its service road on Farm Hamel Kraal 16 (pea-green polygon in the far east) is not shown here and is likewise of very low palaeontological heritage significance.

Figure 2. Flat-lying, sandy terrain with no bedrock exposure in the development area for the proposed Sutherland 2 on-site substation (which is the subject of a separate Basic Assessment Process), Portion 1 of Tonteldoosfontein Farm 152.

Figure 3. Abrahamskraal Formation bedrocks exposed along a shallow incised drainage line on Gunstfontein 151 with Salpeterkop in the distance to the north.

Figure 4. 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 5. 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 6. Typical rubble-strewn terrain underlain by thick Abrahamskraal Formation channel sandstones on the Roggeveld Plateau, Hartebeeste Fontein Farm 147.

Figure 7. Laterally extensive, tabular channel sandstones of the Moordenaars Member (Abrahamskraal Formation) weathering out as narrow *kranzes* on the slopes of Louwskop, Farm 219.

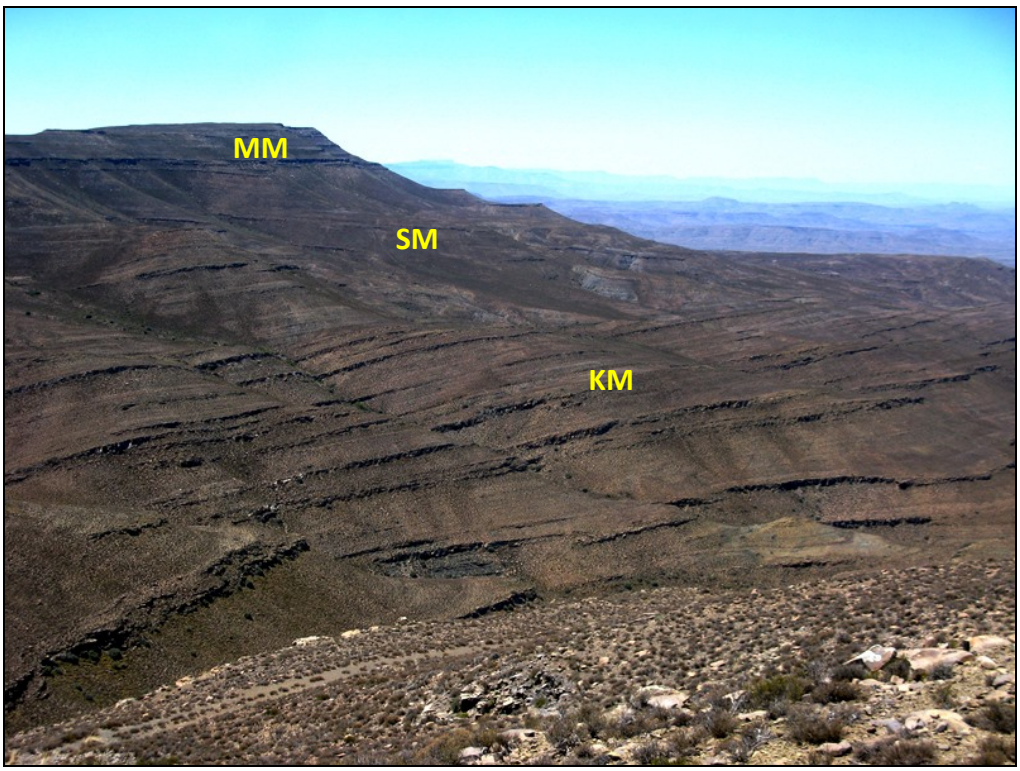

Figure 8. View north-eastwards along the upper part of the Besemgoedberg Escarpment close to Blouval (Farm 219). The sandstone-rich Moordenaars Member (MM, along ridge crest) is separated from the Koornplaats Member (KM, closely-spaced lower sandstones) by a sandstone-poor zone, the Swaerskraal Member (SM).

Figure 9. 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 10. Typical exposure of grey-green overbank mudrocks and yellowish channel sandstones of the Koornplaats Member at Brewelskop (Hamelkraal Farm 16), western Koup region.

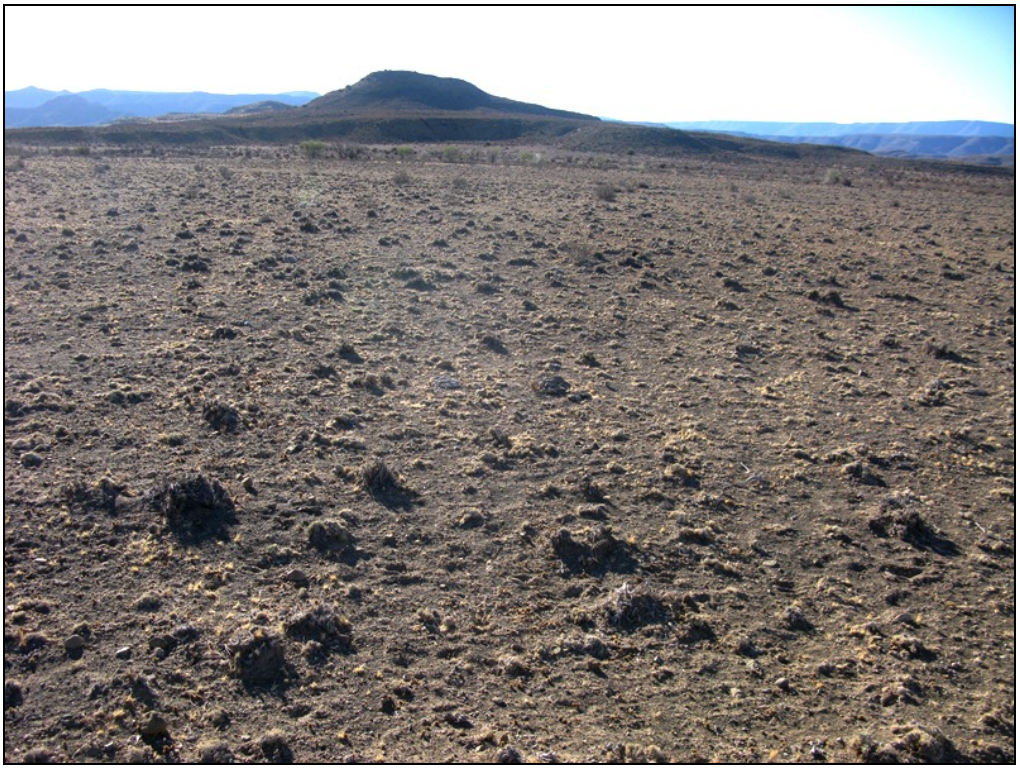

Figure 11. Flat terrain mantled by alluvial sands and silts to the SE of Bakenkop, Hamelkraal Farm 16. This is the development area for the proposed Nuwerust Substation (This will be subject to a separate EIA process).

2. GEOLOGICAL CONTEXT

The combined study area for the Rietrug WEF powerlines and associated substations comprises a narrow, west-east trending band of semi-arid Karoo terrain some 50 km long (W-E) and *c*. 15 km wide (N-S), spanning the boundary between the Northern and Western Cape (Fig. 1). The western 30 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. 2 to 7). 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. 8 & 9). 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.) and Brewelskop (850 m amsl) (Figs. 10 & 11). This comparatively low-lying region (*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. 14) 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. 13). 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. 14). In the Sutherland area to the north of the Rietrug 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 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. 12). 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** (Fig. 7) (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 (Figs. 8 to 10). 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. 8). 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. 9).

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. 7 & 18). 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).

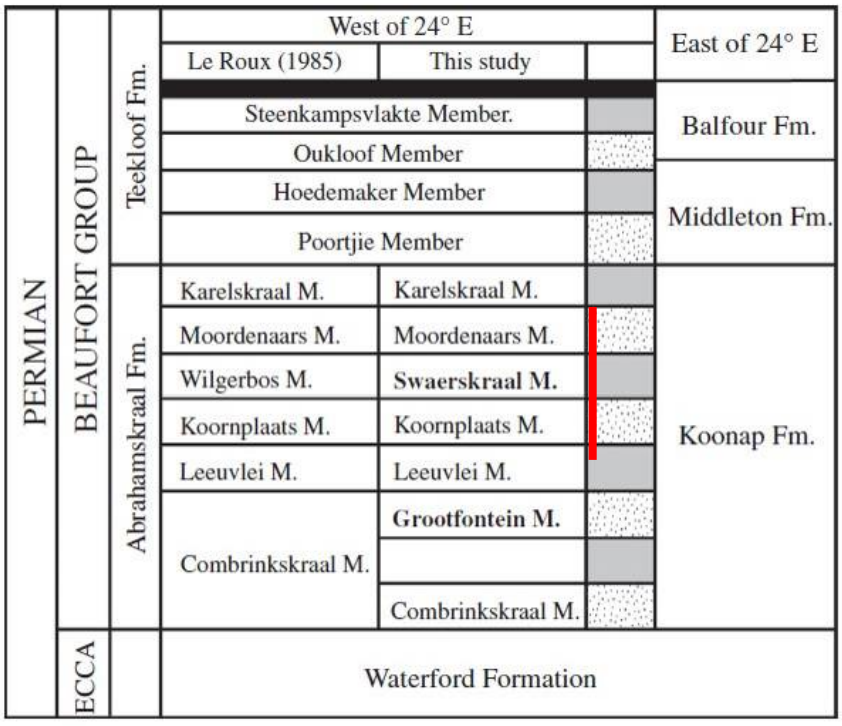

Figure 12. Revised stratigraphic subdivision of the Abrahamskraal Formation of Day and Rubidge (2014). The red bar indicates members that are represented within the Rietrug WEF powerline study area. Mudrock-dominated units are indicated in grey and sandstone packages by stippling.

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. 14). 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 15 to 22. Selected unconsolidated superficial deposits overlying these bedrocks are shown in Figures 23 and 24. 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 km southeast of the proposed Nuwerust Substation (Loc. 084). 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* Figs. 17 & 47).
- 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. 20) 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 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 but not within the proposed 132 kV powerline route and on-site substation sites. They are situated on the farms Gunstfontein 151 and Beeren Valley 150 (Fig. 13). Co-ordinates for these anomalies are given in the sheet explanation by Cole and Vorster (1999). 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). 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 Gunstfontein WEF). While significant palaeontological impacts are unlikely, as a precautionary measure, it is suggested that these sites are protected by a 30 m – radius buffer zone during the construction phase.

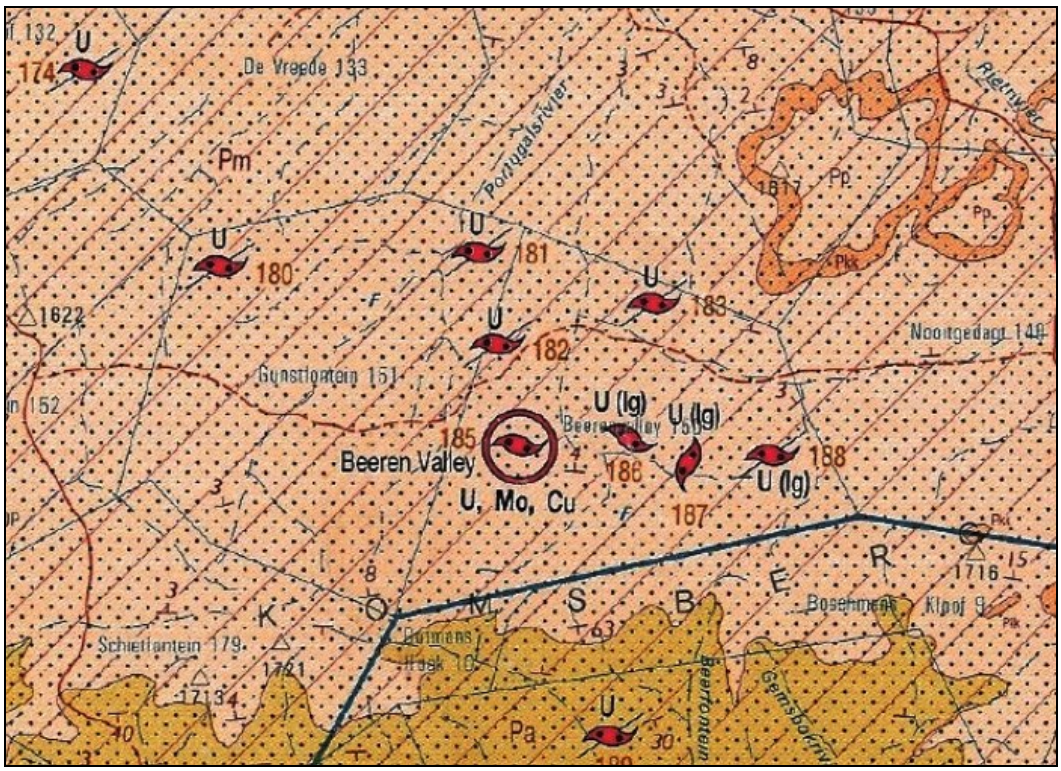

Figure 13. Extract from the 1: 250 000 Sutherland metallogenic map showing several uranium anomalies mapped on the farms Gunsfontein 151 and Beeren Valley 150 (red symbols) (Council for Geoscience, Pretoria). Anomalies 180, 181, 183 and 187 lie close to the proposed electrical grid infrastructure for the Sutherland, Sutherland 2 and Rietrug WEFs. 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. Palaeontological impacts at these sites due to the proposed electrical infrastructure development are considered unlikely.

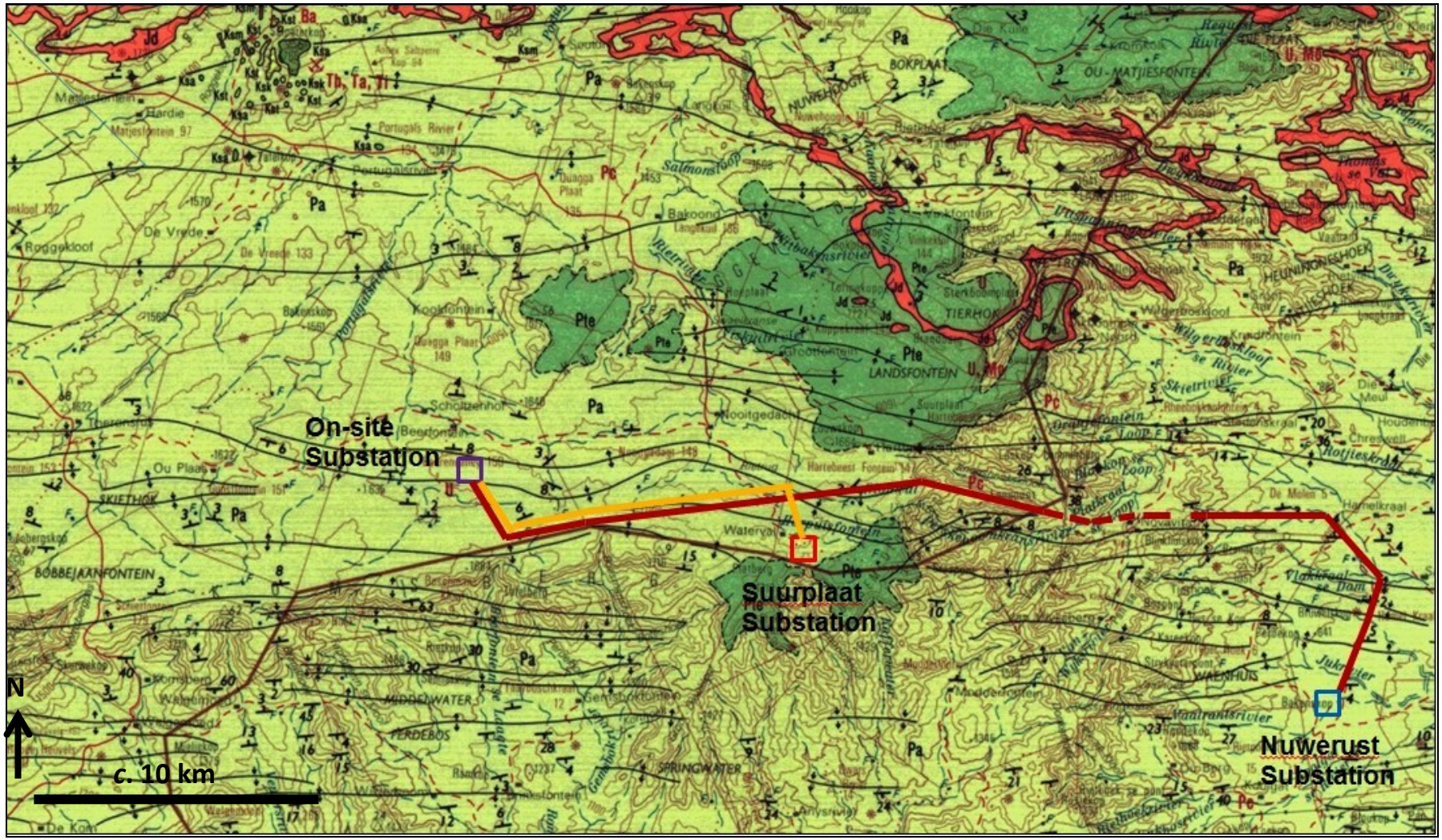

Figure 14. Extract from 1: 250 000 geological sheet 3220 Sutherland (Council for Geoscience, Pretoria) showing the *approximate* footprint of the proposed Electrical Grid Infrastructure for the Rietrug WEF. The two alternative 132 kV powerline route options are shown in yellow (Alternative 1) and brown (Alternative 2). Note that the alternatives follow the same route up until a point on Farm Hartebeeste Fontein 147 where it separates towards the proposed Suurplaat Substation (Alternative 1) and the Eskom Nuwerust Substation (Alternative 2). Dashed portions of the powerlines have not been assessed in the field and require a pre-construction palaeontological walkdown if they are finally chosen.

Figure 15. 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 16. Well-developed ferruginised basal channel breccia within the Koornplaats Member, Brewelskop, 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. 31, 35 and 45).

Figure 17. Unusually thick and extensive *koffieklip* lens (sandstone secondarily mineralised with iron and manganese minerals) within a channel sandstone of the Koornplaats Member, *c*. 1 km SE of the proposed Nuwerust Substation.

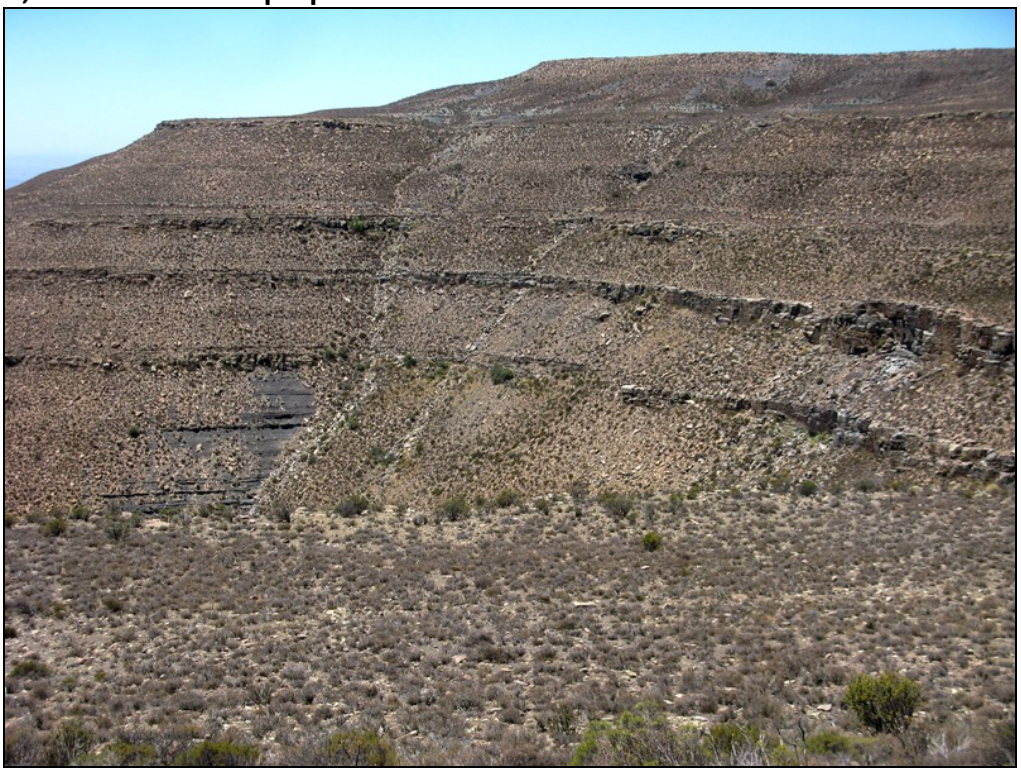

Figure 18. Package of closely-spaced, sheet-like channel sandstones of the Moordenaars Member building the upper edge of the Besemgoedberg Escarpment near Blouval, Farm 219.

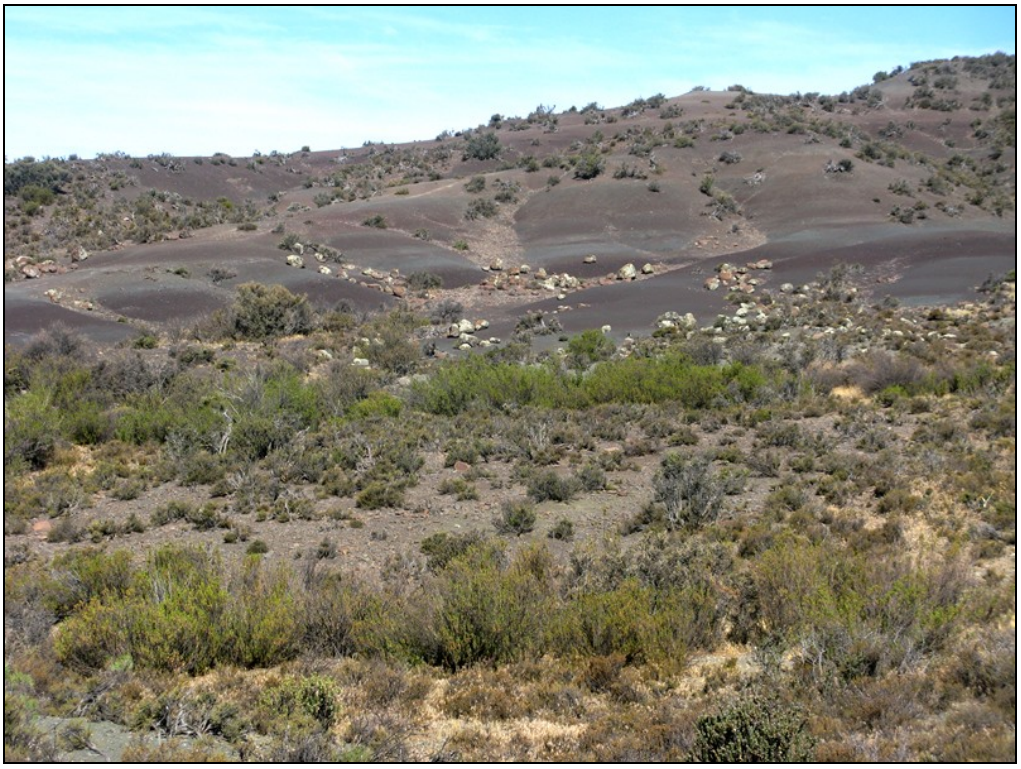

Figure 19. Gentle hillslope exposure of purple-brown overbank siltstones within the upper part of the Moordenaars Member, Nooitgedagt Farm 148 (Loc. 540).

Figure 20. 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 21. 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 22. 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 23. Downwasted Abrahamskraal Formation sandstones forming rubbly surface gravels south of Brewelskop, Hamel Kraal 16 (Loc. 081).

Figure 24. Coarse stream gravels capped by sandy to silty alluvium exposed in the banks of the Brandleegte River west of Hamelkraal homestead.

3. PALAEONTOLOGICAL HERITAGE

The fossil record of the principal sedimentary rock units represented within the Rietrug WEF electrical grid infrastructure study region has been reviewed in previous palaeontological assessment reports for the region by Almond (2010b, 2010c, 2011, 2015g). 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* (Fig. 25), 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. 26);

- 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. 27).

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. 14) but none of these sites lies within the alternative powerline routes. According to the vertebrate fossil distribution map of Keyser and Smith (1977-78; Fig. 25) 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.

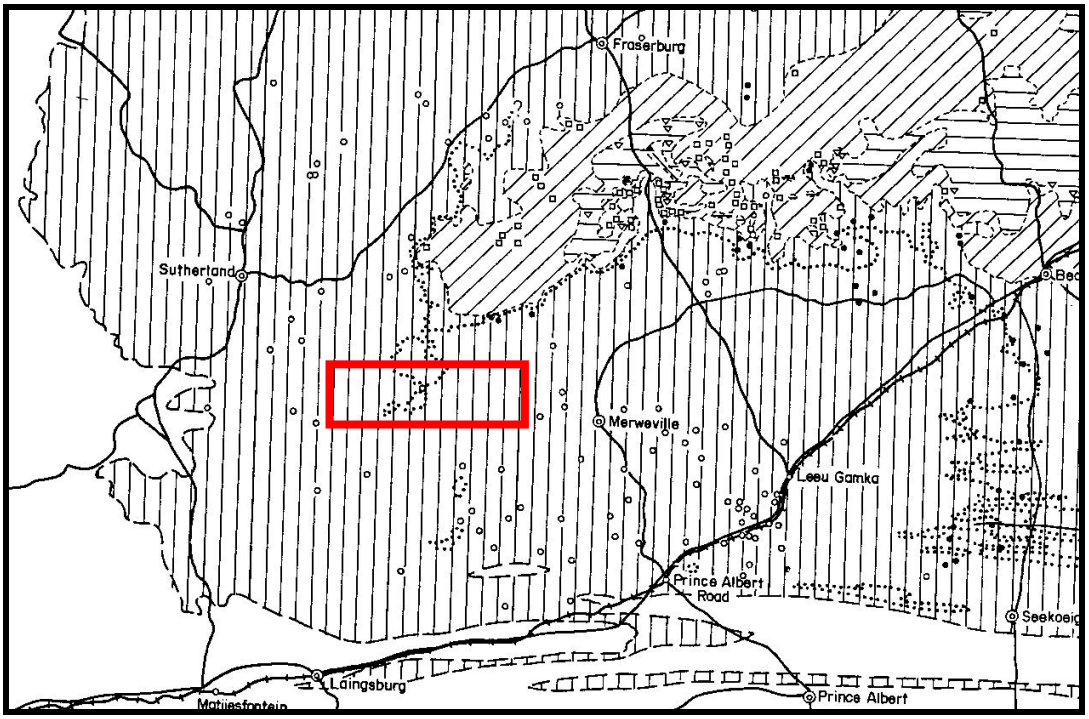

Figure 25. Distribution of vertebrate fossil localities within the Lower Beaufort Group in the south-western Karoo region (Map abstracted from Keyser & Smith 1977-78). Outcrop areas with a vertical lined ornament are assigned to the Middle Permian *Tapinocephalus* Assemblage Zone. Note the paucity of vertebrate fossil records from the lower part of the Abrahamskraal Formation in the Rietrug WEF electrical grid infrastructure study area between Sutherland and Merweville (red rectangle). This probably reflects palaeontological neglect more than an absence of fossil material.

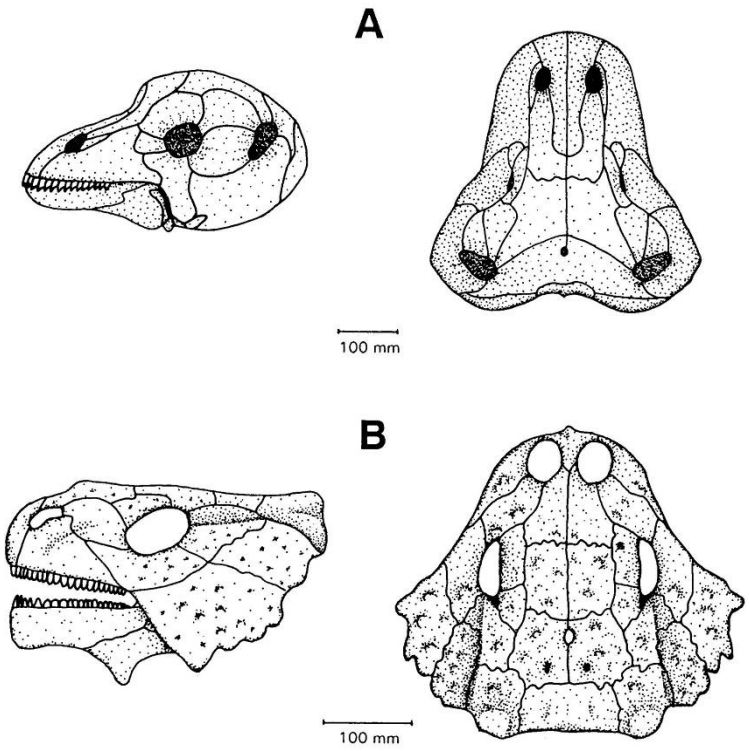

Figure 26. Skulls of two key large-bodied tetrapods of the *Tapinocephalus* Assemblage Zone: A – the dinocephalian therapsid *Tapinocephalus*; B – the pareiasaur *Bradysaurus* (From Smith & Keyser 1995b).

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 plants 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 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.

Fossil records made during the present field assessment for the Rietrug WEF electrical grid infrastructure projects are tabulated with brief notes in the Appendix. The sites are indicated with reference to the alternative powerline routes under consideration on the Google earth© satellite map in Figure 1. 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. Most of the specimens observed are fragmentary, highly weathered, secondarily ferruginised and, in some cases, rounded by transport (Figs. 32 & 39). 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 notable scatter of robust post-cranial bones observed within sandstone scree on Portugals Rivier 218 (Figs. 33 & 34) 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. 29 & 30) 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. 48) as well as reworked tetrapod remains. The latter include disarticulated, rounded bones and isolated teeth (Figs. 33 and 45), most of which are unidentifiable. The extensive scatter of petrified logs (mostly, but not all, poorly-preserved) seen at surface on Hamel Kraal Farm 16 (Locs. 041-074; Figs. 40 to 43) 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. 44). This fossil scatter lies 500 m southwest of powerline route Alternative 2 and should be protected by a 30-m wide peripheral buffer zone (Fig. 48).

Probable sandstone casts of tetrapod burrows were observed at several localities, but in several cases their interpretation as such is equivocal (*cf* Fig. 38). 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. 28). 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. 36). 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. 35) 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. 37 and 47).

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 various 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 and significant impacts here are considered to be unlikely. 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. 13.

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.

No fossils were observed within the various Late Caenozoic superficial deposits represented within the Rietrug WEF electrical grid infrastructure study area during the present field study.

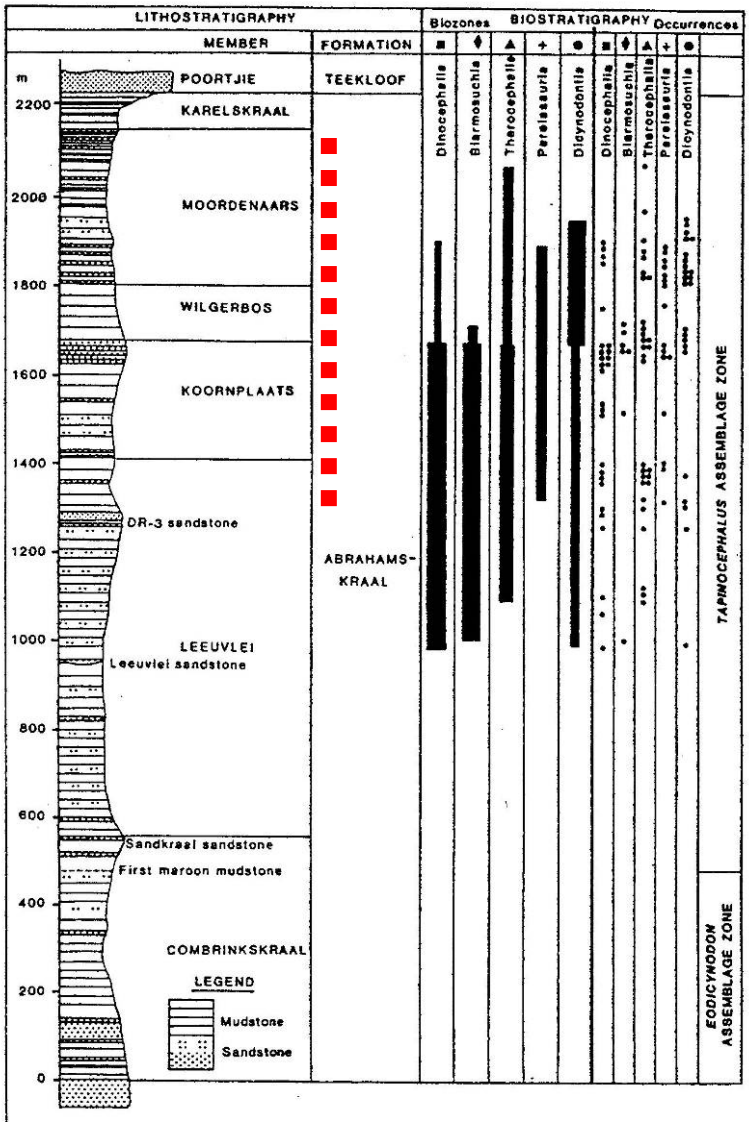

Figure 27. Chart showing the subdivision of the Abrahamskraal Formation in the western Karoo region with the stratigraphic distribution of the major fossil vertebrate groups (Loock *et al*. 1994). The Rietrug WEF electrical grid infrastructure project area on the Roggeveld Plateau is largely underlain by sediments of the Mordenaars Member. Lower stratigraphic intervals are represented within the Besemgoedberg Escarpment zone and the low-lying Koup region to the east (See red dotted line).

Figure 28. Gently-inclined, curved tetrapod burrow cast within the Kareslkraal Member (Scale *c*. 15 cm long). Nooitgedagt 148 (Loc. 521). This is one of the youngest tetrapod burrows recorded from the Abrahamskraal Formation.

Figure 29. 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 will not be impacted by the present BA project.

Figure 30. Detail of the articulated skeleton seen in the preceding figure showing the attachment of several ribs along the backbone.

Figure 31. 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).

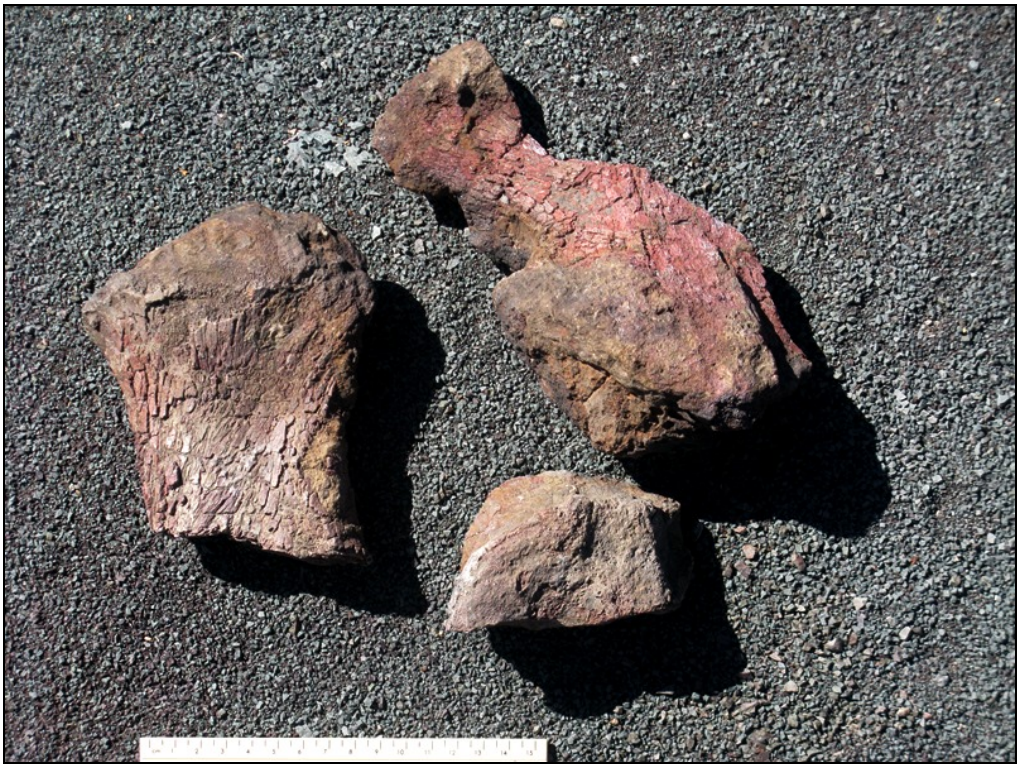

Figure 32. Several highly-weathered, secondarily ferruginised pieces of tetrapod bone found among surface float, Portugals Rivier 218 (Loc. 545) (Scale in cm). The limb bone on the left shows superficial sun-cracking due to protracted pre-burial exposure.

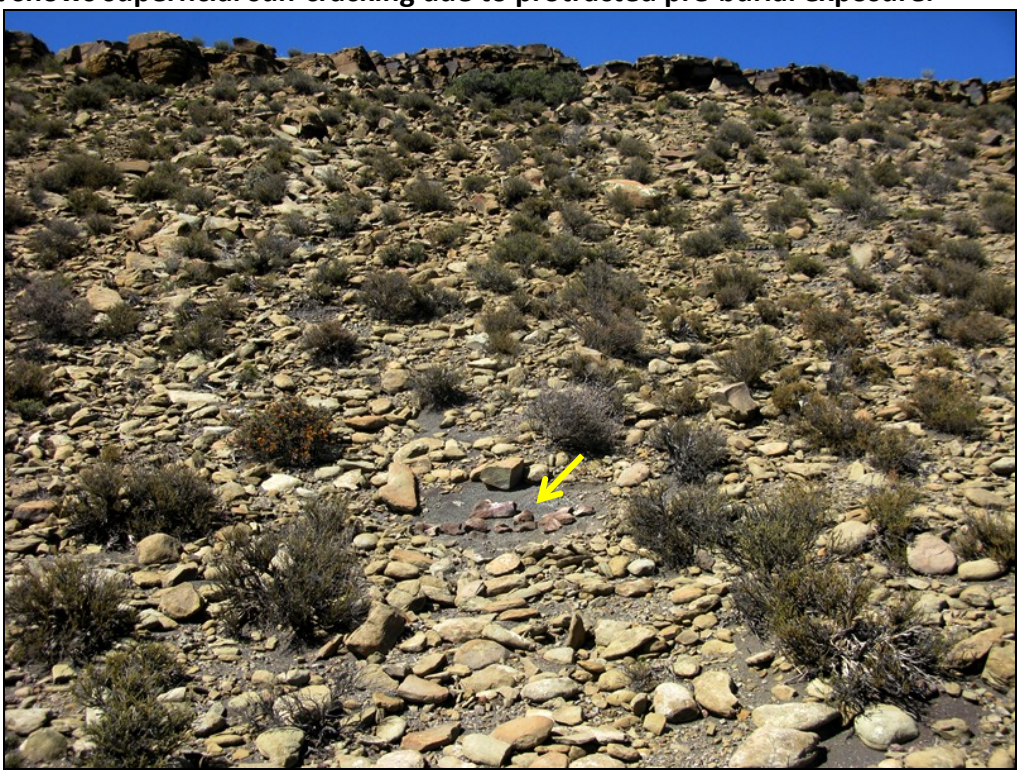

Figure 33. Sandstone scree on Portugals Rivier 218 with numerous dispersed fossil bones that may have weathered out of the channel sandstone above. Several fossil bones have been collected together in one spot (arrow) (Loc. 546).

Figure 34. Close-up of large tetrapod bones (pareiasaur 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 35. Fossiliferous basal channel breccia penetrated by an inclined invertebrate burrow – possibly crustacean, Moordenaars Member, Portugalsrivier 218 (Loc. 509) (Scale in cm).

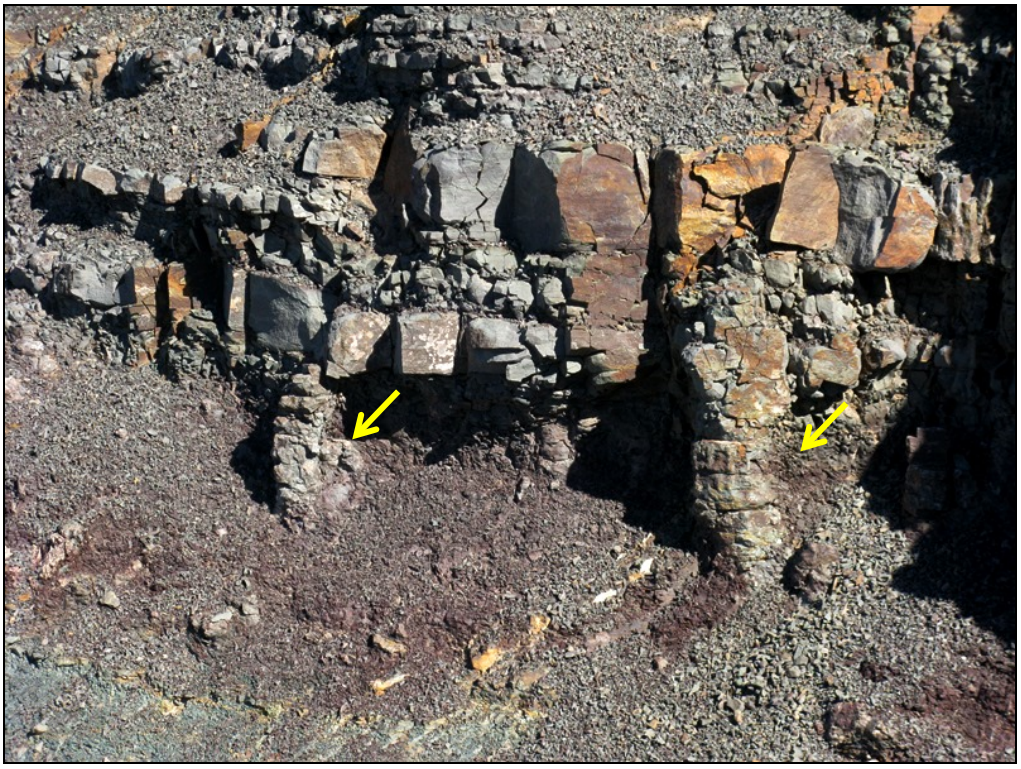

Figure 36. Road cutting through interbedded thin sandstones and overbank mudrocks of the Moordenaars Member showing several cylindrical lungfish burrow casts up to 10 cm in diameter (arrowed), Portugals Rivier 218 (Loc. 512).

Figure 37. Upper surface of a Moordenaars Member channel sandstone with ill-defined horizontal burrows, Beeren Valley 150 (Loc. 530) (Scale is 15 cm long).

Figure 38. 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 39. 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 40. 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. 48).

Figure 41. 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 42. 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 43. 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 44. 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 45. 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, Brewelskop, Hamel Kraal Farm 16 (Loc. 079).

Figure 46. Ferruginised mould of transported woody debris preserved within a channel breccia, Koornplaats Member, Brewelskop, Hamel Kraal Farm 16 (Loc. 079) (Scale in cm and mm).

Figure 47. 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.

4. ASSESSMENT OF IMPACTS

Given the rather uniform geology and sparse, largely unpredictable distribution of recorded or anticipated palaeontological resources within the Rietrug WEF electrical grid infrastructure study area (Section 3), this impact assessment applies equally to all the proposed on-site and third party substation sites as well as the alternative 132 kV powerline routes under consideration for the Rietrug WEF electrical grid infrastructure project (Fig. 1).

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 on-site substation and 132 kV powerline will entail extensive surface clearance (notably for service roads, pylon footings, laydown areas, O&M buildings) as well as excavations into the superficial sediment cover and underlying bedrocks (*e.g. for* pylon footings, building foundations, 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 on-site substation (including O&M building, laydown area) and associated 132 kV powerline 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 Rietrug WEF electrical grid infrastructure study area and this lies outside the proposed development footprint (Figure 48). 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 VERY LOW in terms of palaeontological heritage resources. Should the proposed mitigation measures outlined in Section 5 below be fully implemented, the impact

significance would remain 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 developments. The very low significance rating applies equally to both powerline route options under consideration (Alternatives 1 and 2) and there are no preferences on palaeontological grounds for any particular powerline connection to a third-party substation or particular powerline route option (The shortest route will obviously have the lowest impact, though this may be offset by a longer onward connection to the Eskom national grid).

Confidence levels for this assessment are rated as only *medium*. This is due to the necessarily superficial coverage of the recent field assessment, the failure to access several key sectors of the power line route options, 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 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 (below): Assessment of anticipated direct impacts on palaeontological heritage resources for the proposed Rietrug WEF electrical grid infrastructure, including an on-site substation (with laydown area and O&M Building) and associated 132 kV powerline and connection to a third party substation, as well as a service road below the powerline (construction phase). This assessment applies equally to both powerline route options (Alternatives 1 and 2) and both third-party substations under consideration.

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	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 PHASE													
Surface clearance for access roads, substations and laydown areas etc. Excavations for power line footings, O&M building	Disturbance, damage or destruction of scientifically important fossils at or beneath the ground surface.	Negative	Site specific	Permanent	Slight	Unlikely	Non-reversible	Moderate	• Safeguarding of identified sites of high palaeontological sensitivity by a 30-m wide buffer zone (i.e. extensive surface scatter of petrified wood *plus* occasional bone fragments either side of a farm track). • A *pre-construction* walk-down must be undertaken by a palaeontological specialist for any sectors of the 132 kV powerline route finally chosen that were not covered during the Basic Assessment Phase (Refer to the yellow dashed rectangle in Fig. 1). The resulting report will need to be submitted to and approved by the relevant heritage management authority. • Monitoring of all surface clearance and substantial (deeper than 1 m) excavations by the ECO for fossil material • Safeguarding of chance fossil finds by ECO • Reporting of chance fossil finds to Heritage Western Cape (HWC) / SAHRA • Recording and sampling of significant chance fossil finds by a qualified palaeontologist (Phase 2 mitigation) • Curation of fossil material within an approved repository (museum / university fossil collection)	Very low	Very low	5	Medium

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 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*.

5. MITIGATION AND MANAGEMENT MEASURES

A *pre-construction* walk-down by a palaeontological specialist is required for any sectors of the 132 kV powerline route finally chosen that were not covered during the Basic Assessment Phase (See yellow dashed rectangle in Fig. 1). The resulting report, together with any recommendations for mitigation or monitoring, will need to be approved by the relevant heritage management authority (SAHRA or HWC).

Given the scarcity of scientifically-important, unique fossil heritage recorded within the remainder of the Rietrug 2 WEF electrical grid connection 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 2):

- Safeguarding of identified sites of high palaeontological sensitivity by a 30-m wide buffer zone (See sites specified in Figs. 1 and 48).
- 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. 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 Rietrug 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 electrical grid infrastructure project and also included as conditions for authorisation of the development.

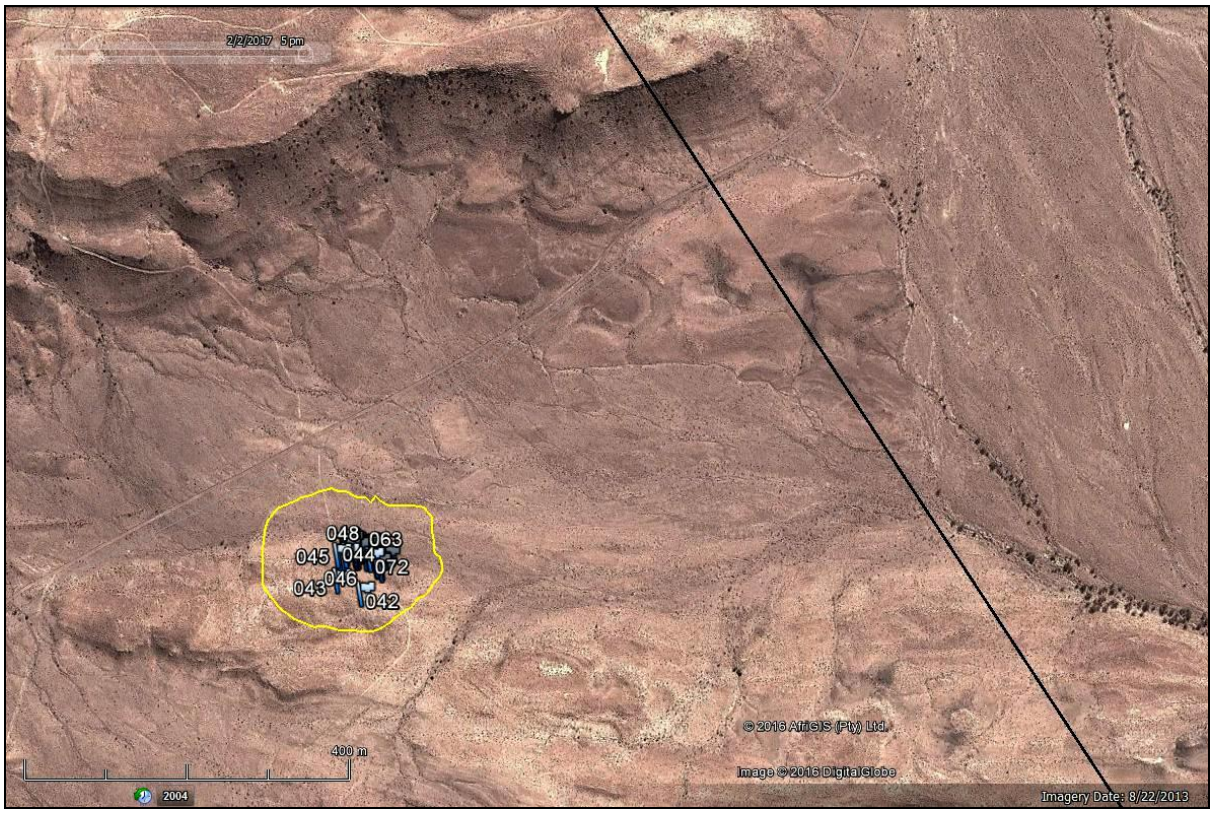

Figure 48. Google earth satellite image of part of Farm Hamel Kraal 16 showing the location of an extensive surface scatter of petrified wood *plus* occasional bone fragments either side of a farm track (Locs. 041- 074). The yellow polygon outlines a *c*. 30-m wide peripheral buffer zone around the fossil scatter. The black line *c*. 500 m to the northeast shows powerline Alternative 2.

Table 2 (below): Contributions to the EMPR for the proposed Rietrug WEF electrical grid infrastructure, including an on-site substation and associated 132 kV powerline and connection to a third party substation, as well as a service road below the powerline (pre-construction and construction phase activities).

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***
Aspect: Palaeontological Heritage					
Disturbance, damage or destruction of fossils preserved at or below the ground surface during construction activities (especially ground clearance and substantial excavations)	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. Pre-construction palaeontological walk down of un-surveyed sectors of the finally selected powerline route. 2. Safeguarding of identified sites of high palaeontological sensitivity by a 30-m wide buffer zone during construction (See sites specified in Figs. 1 and 48). 3. 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. 4. Recording and judicious sampling of significant chance fossil finds by a qualified palaeontologist, together with pertinent contextual data (stratigraphy, sedimentology, taphonomy) (Phase 2 mitigation). 5. 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.	Palaeontologist to undertake field study of areas not surveyed in original assessment. 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.	Once-off prior to construction. On-going during construction During fossil finds	Qualified Palaeontologist (appointed by the Project Developer) ECO ECO and qualified Palaeontologist (appointed by the Project Developer)

6. ACKNOWLEDGEMENTS

Ms Rohaida Abed of the CSIR – Environmental Management Services, Durban, is 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.

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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: 20 February 2017

APPENDIX: 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.