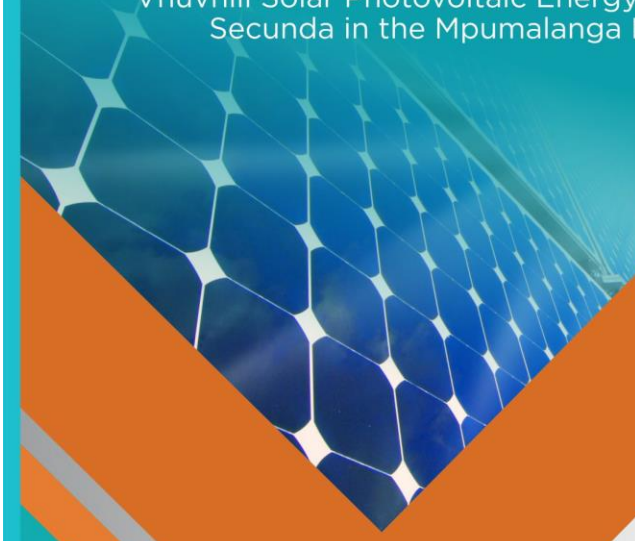
DRAFT BASIC ASSESSMENT REPORT

Proposed Development of a 132 kV Overhead Power Line and Supporting Infrastructure for the Proposed Vhuvhili Solar Photovoltaic Energy Facility, near Secunda in the Mpumalanga Province



APPENDIX D.3

Heritage Impact Assessment (Archaeology, Cultural Landscape and Palaeontology)

ENERTRAG

CSIR
Touching lives through innovation

HERITAGE IMPACT ASSESSMENT:

BASIC ASSESSMENT FOR A PROPOSED 132 kV OVERHEAD POWER LINE AND ASSOCIATED ELECTRICAL GRID INFRASTRUCTURE TO SUPPORT THE PROPOSED VHUVHILI SOLAR ENERGY FACILITY NEAR SECUNDA, MPUMALANGA

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

SAHRA Case No.: TBC

Report for:

CSIR – Environmental Management Services
P.O. Box 320, Stellenbosch, 7599
Email: MLevendal@csir.co.za

On behalf of:

Vhuvhili Solar RF (Pty) Ltd

Dr Jayson Orton
ASHA Consulting (Pty) Ltd
23 Dover Road, Muizenberg, 7945
Tel: (021) 788 1025 | 083 272 3225
Email: jayson@asha-consulting.co.za

Jaco van der Walt
Beyond Heritage
37 Olienhout Street, Modimolle, 0510
Tel: 082 373 8491
Email: jaco@heritageconsultants.co.za

1st draft: 03 October 2022
Final report: 04 November 2022

Specialist declaration

DocuSign Envelope ID: 8B30F46B-3838-4561-BBF4-155CFEDBE2E5

10.4 The Specialist

Note: Duplicate this section where there is more than one specialist.

I Jayson Orton, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

- in terms of the general requirement to be independent (tick which is applicable):

X	other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
	am not independent, but another EAP that is independent and meets the general requirements set out in Regulation 13 has been appointed to review my work (Note: a declaration by the review specialist must be submitted);

- have expertise in conducting specialist work as required, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- will ensure compliance with the EIA Regulations 2014;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;
- will take into account, to the extent possible, the matters listed in regulation 18 of the regulations when preparing the application and any report, plan or document relating to the application;
- will disclose to the proponent or applicant, registered interested and affected parties 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 or the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority (unless access to that information is protected by law, in which case I will indicate that such protected information exists and is only provided to the competent authority);
- declare that all the particulars furnished by me in this form are true and correct;
- am aware that it is an offence in terms of Regulation 48 to provide incorrect or misleading information and that a person convicted of such an offence is liable to the penalties as contemplated in section 49B(2) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist

ASHA Consulting (Pty) Ltd

Name of company

04 NOVEMBER 2022

Date

MPUMALANGA
THE PLACE OF THE RISING SUN

EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by ENERTRAG South Africa (the Project Proponent)to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of a power line and associated infrastructure intended to support the proposed Vhuvhili Photovoltaic Solar Energy Facility (SEF). The proposed 132 kV overhead power line will extend approximately 12 km from the proposed Vhuvhili SEF on-site substation to a switching station at the proposed Mukondeleli WEF site. The power line would start about 6 km southeast of Secunda (at S26° 33' 58.80" E29° 15' 49.11") and run to a point some 11 km south of Secunda (S26° 37' 24.57" E29° 11' 04.12"[1]), Mpumalanga. A 200 m wide corridor is considered in this assessment. The proposed Vhuvhili SEF and on-site substation are subject to a separate Scoping and Environmental Impact Assessment (S&EIA) process (NEAS: MPP/EIA/0001063/2022). The proposed Mukondeleli WEF and on-site switching station are also subject to a separate S&EIA process (NEAS: MPP/EIA/0001099/2022). It must be noted that this assessment only includes the power line, since the substations at either end will be included within the assessments of the respective Renewable Energy Facilities as noted above.

The study area is a largely flat agricultural landscape with some areas cultivated and some left as grazing pastures. Notably, the very large Sasol facility occurs a few kilometres to the north and various coal mines are present in the surrounding landscape. Surveys were carried out in the vicinity of the end points for adjoining renewable energy facilities and part of the corridor was driven through, but some areas remain unsurveyed.

The archaeological remains of an old farmstead were seen in one place outside the corridors but no archaeology is yet known from within the corridors. Two graveyards were found, one each within the Alternative 3 and 4 corridors. These are the main concern for the project, but, despite their 50 m buffers being wholly within the corridors, there should be enough space within the corridors for these features to be avoided by at least 50 m. Although built heritage does occur in the landscape, none of these sites lie close to the corridors. The only other concern is the cultural landscape, but it has already been compromised by the Sasol facility just to the north of the study area and, in the surrounding area, coal mines (effectively adding an industrial layer). As such, the proposed project will make a relatively small contribution to landscape impacts. The impact significance after mitigation is summarised in the table that follows.

Phase	**Overall Impact Significance**
Construction	Low
Operational	Very low
Decommissioning	Very low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very low
Cumulative - Operational	Very low
Cumulative - Decommissioning	Very low

It is recommended that the proposed power line should be authorised, but subject to the following conditions which should be incorporated into the Environmental Authorisation:

[1] These co-ordinates represent the furthest northeast and southwest end points of the various alternatives.

- The graves in the Alternative 3 (waypoint 179) and Alternative 4 (waypoint 182) corridors must be avoided and protected if either of these corridors are used. The power line and associated service track must be located at least 50 m from the graves.
- If Alternatives 3 or 4 are used then, before construction starts, the relevant graveyard must be fenced with a farm-style wire fence with a pedestrian gate to facilitate public access. The fence must be placed a minimum of 5 m away from all graves.
- A pre-construction survey of the final alignment must be carried out once the design is completed so as to determine whether there are any further areas requiring intervention.
- If any archaeological 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. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Iron Age: Period post-dating about AD 200 and occurring in Eastern South Africa and featuring farming communities who practised iron smelting. It is split into the Early Iron Age (AD 200 to AD 900), the Middle Iron Age (AD 900 to AD 1300) and the Late Iron Age (AD 1300 to AD 1840.

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

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

CDNGI: Chief Directorate: National Geo-Spatial Information

CSIR: Council for Scientific and Industrial Research

CRM: Cultural Resources Management

DARDLEA: Mpumalanga Department of Environmental Affairs

EA: Environmental Authorisation

ECO: Environmental Control Officer

EGI: Electricity Grid Infrastructure

EIA: Environmental Impact Assessment

EMPr: Environmental Management Programme

ESA: Early Stone Age

GPS: global positioning system

GP: General Protection

HIA: Heritage Impact Assessment

LSA: Later Stone Age

MSA: Middle Stone Age

MPHRA: Mpumalanga Provincial Heritage Resources Authority

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

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

PPP: Public Participation Process

PV: Photovoltaic

REDZ: Renewable Energy Development Zone

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

SEF: Solar Energy Facility

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 8.6, 8.4 & 8.8
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;	Sections 1.1.3 & 5; Figure 14
g) an identification of any areas to be avoided, including buffers;	Section 12
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 12
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.6
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 5 Section 12
k) any mitigation measures for inclusion in the EMPr;	Sections 8 & 11
l) any conditions for inclusion in the environmental authorisation;	Section 13
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity and activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Sections 12.1 & 13
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Three land owners were asked about heritage resources on their land.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not Applicable
q) any other information requested by the competent authority.	Not Applicable
2. Where a government notice gazetted by the Minister provides for any protocol of minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Part A of the Assessment Protocols published in Government Notice No. 320 on 20 March 2020 is applicable (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed). See Appendix 3.

Contents

1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by ENERTRAG South Africa (the Project Proponent)to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed development of a power line and associated infrastructure intended to support the proposed Vhuvhili Photovoltaic Solar Energy Facility (SEF). The proposed 132 kV overhead power line will extend approximately 12 km from the proposed Vhuvhili SEF on-site substation to a switching station at the proposed Mukondeleli WEF site. The power line would start about 6 km southeast of Secunda (at S26° 33' 58.80" E29° 15' 49.11") and run to a point some 11 km south of Secunda (S26° 37' 24.57" E29° 11' 04.12"[2]), Mpumalanga (Figure 1). A 200 m wide corridor is considered in this assessment.

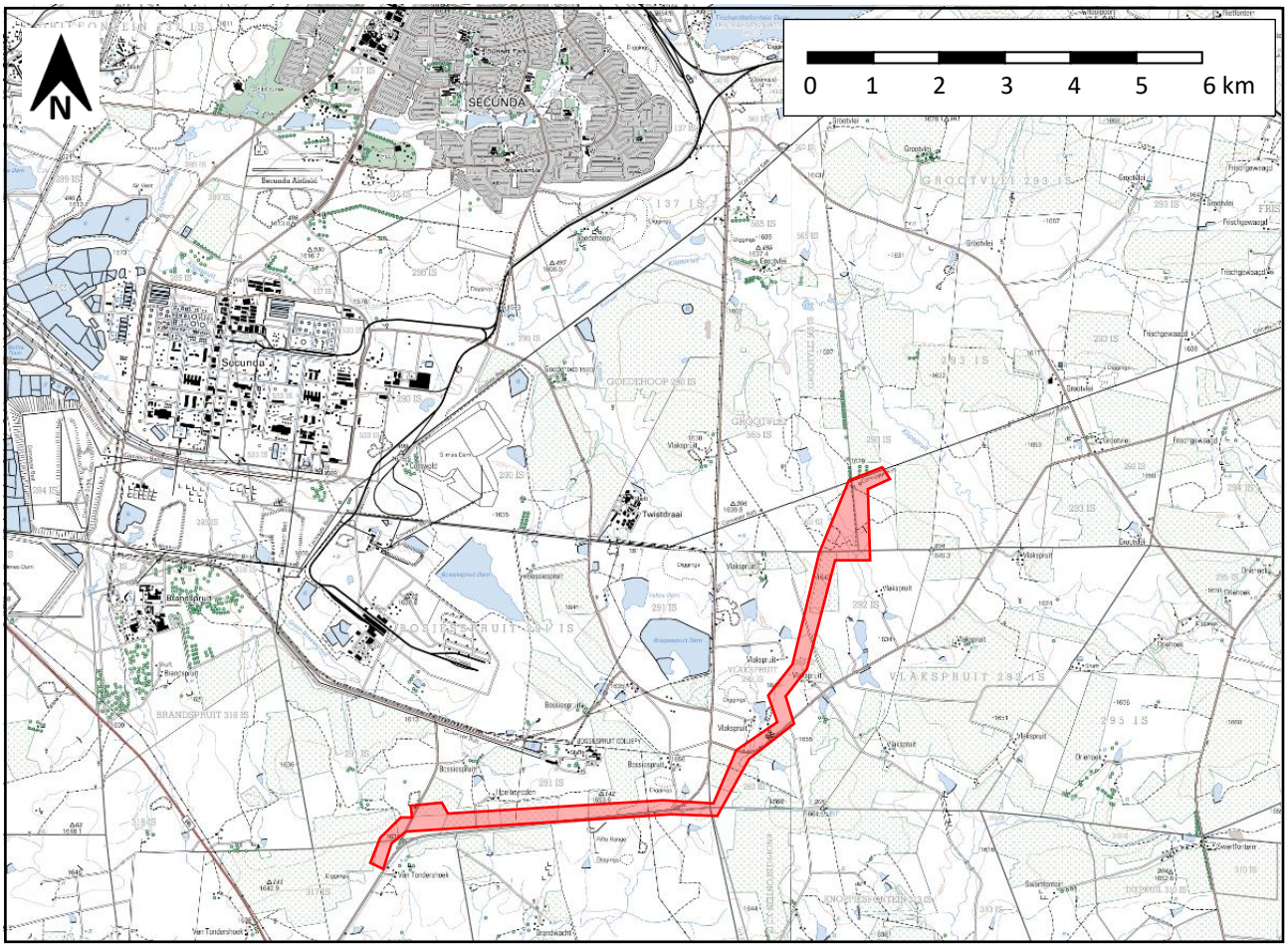


Figure 1: *Extract from 1:50 000 topographic map 2629CA&CB showing the location of the site (red shaded polygon encompasses the 200 m wide corridors of all alternatives). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

[2] These co-ordinates represent the furthest northeast and southwest end points of the various alternatives.

The farm portions that have been evaluated and which have been traversed by the assessed 200 m corridor[3] are as follows (listed from northeast to southwest):

- Farm Grootvlei No. 293, Portion 20
- Farm Grootvlei 584, Remaining Extent (RE)
- Farm Vlakspruit No. 292, RE
- Farm Vlakspruit No. 292, Portion 13
- Farm Vlakspruit 292, Portion 14
- Farm Vlakspruit 292, Portion 15
- Farm Vlakspruit 292, Portion 19
- Farm Vlakspruit 292, Portion 3
- Farm Vlakspruit 292, Portion 2
- Farm Vlakspruit 292, Portion 16
- Farm Vlakspruit 292, Portion 18
- Farm Knoppiesfontein 313, RE
- Farm Knoppies 314, RE
- Farm Brandwacht 316, Portion 3
- Farm Brandwacht 316, Portion 7
- Farm Brandwacht 316, Portion 6
- Farm Brandwacht 316, Portion 8
- Farm Brandwacht 316, Portion 9
- Farm Bosjesspruit 291, Portion 6
- Farm Bosjesspruit 291, Portion 13
- Farm Bosjesspruit 291, Portion 11
- Farm Bosjesspruit 291, Portion 10
- Farm Van Tondershoek 317, Portion 2
- Farm Van Tondershoek 317, Portion 12

1.1. The proposed project

1.1.1. Project description

Vhuvhili Solar RF (Pty) Ltd is proposing the construction of a 132 kV power line of approximately 12 km to feed electricity from the on-site substation hub at the proposed Vhuvhili SEF to the switching station at the proposed Mukondeleli Wind Energy Facility (WEF). The Project Applicant provided four power line routing alternatives that are linked to the locality of the Vhuvhili SEF on-site substation infrastructure as the starting point of the proposed power line, and the Mukondeleli WEF switching station infrastructure as the end point of the proposed power line. The proposed Vhuvhili SEF and on-site substation are subject to a separate Scoping and Environmental Impact Assessment (S&EIA) process (NEAS: MPP/EIA/0001063/2022). The proposed Mukondeleli WEF and on-site switching station are also subject to a separate S&EIA process (NEAS: MPP/EIA/0001099/2022). It must be

[3] Note that the power line itself would be on fewer properties once the final alignment has been selected.

noted that this assessment only includes the power line, since the substations at either end will be included within the assessments of the respective Renewable Energy Facilities as noted above.

The proposed power line will be supported by monopole or steel lattice pylons, or a combination of both where required. The choice of pylon type will depend on topography and corridor alignment (i.e. whether the pylons will be placed along straight sections or bends). In general, monopole-type pylons are used for transmission lines with shorter spans, whereas steel lattice-type pylons are only used where long spans (>500m) across valleys and rivers are required. Most span lengths are estimated to range between 200 m and 300 m. The exact specifications of the proposed pylon components will be determined during the detailed engineering phase and the information provided below (Table 1) is seen as the worst-case scenario.

The power line will be constructed within a 200 m wide Electrical Grid Infrastructure (EGI) corridor. Underground power lines are not feasible because of technical losses involved with large lengths of underground cables and high costs. Maintenance is also easier on suspended power lines in comparison to underground cables, and terrestrial disturbance is far greater with underground cables.

The proposed EGI corridor can be accessed via the D619 gravel road to the west of the northern portion of the corridor and via the tarred D823 road along the southern portion of the corridor. The D823 connects the site with the R546, an arterial route that connects to the N17 National Road north of the proposed project.

The current width of the D823 and D619 roads is approximately 5 m. It is proposed that these existing roads will be upgraded and widened to a maximum width of 10 m. The widening and upgrading of the existing roads are being assessed as part of the separate S&EIA process which is currently being undertaken for the proposed Vhuvhili SEF.

Service roads will also be constructed below the power lines for maintenance purposes. The service roads are expected to be composed of gravel and extend approximately 5 m wide. Exact specifications of the widening, length and upgrading of the farm gravel roads will be confirmed during the detailed design phase.

The key technical details for the Vhuvhili power line and associated EGI are provided in Table 1.

Table 1: *Description of the project components for the proposed 132 kV overhead power line and associated EGI.*

Component	Description
Power line/pylon height	Up to 40 m
Power line length	Approx. 12 km
Power line capacity	Up to 132 kV
Minimum conductor ground clearance	Approx. 8.1 m
Distance between conductors	Between 2.4 m and 3.8 m
Pylon type	Monopole or steel lattice pylons, or combination of both where required.

Component	Description
Servitude width	Once built, the registered servitude will be up to 32 m wide in line with guidelines and requirements for 132 kV power lines stipulated in the 2011 Eskom Distribution Guide Part 19.
Associated Infrastructure	
Service roads	There are a number of existing gravel farm roads (some just jeep tracks) with widths ranging between 4 m and 5 m located around and within the proposed Vhuvhili power line corridor. A service road of approximately 5 m wide will be required below the power line.
Proximity to grid connection	The proposed 132 kV overhead power line will extend approximately 12 km from the proposed Vhuvhili SEF on-site substation to a switching station at the proposed Mukondeleli WEF site.

1.1.2. Identification of alternatives

Four alternative power line alignments have been provided by the Project Proponent for assessment. These alternatives relate to two different start (at the proposed Vhuvhili SEF on-site substation) and end points (at the proposed Mukondeleli WEF switching station) and are as shown in Figure 2.

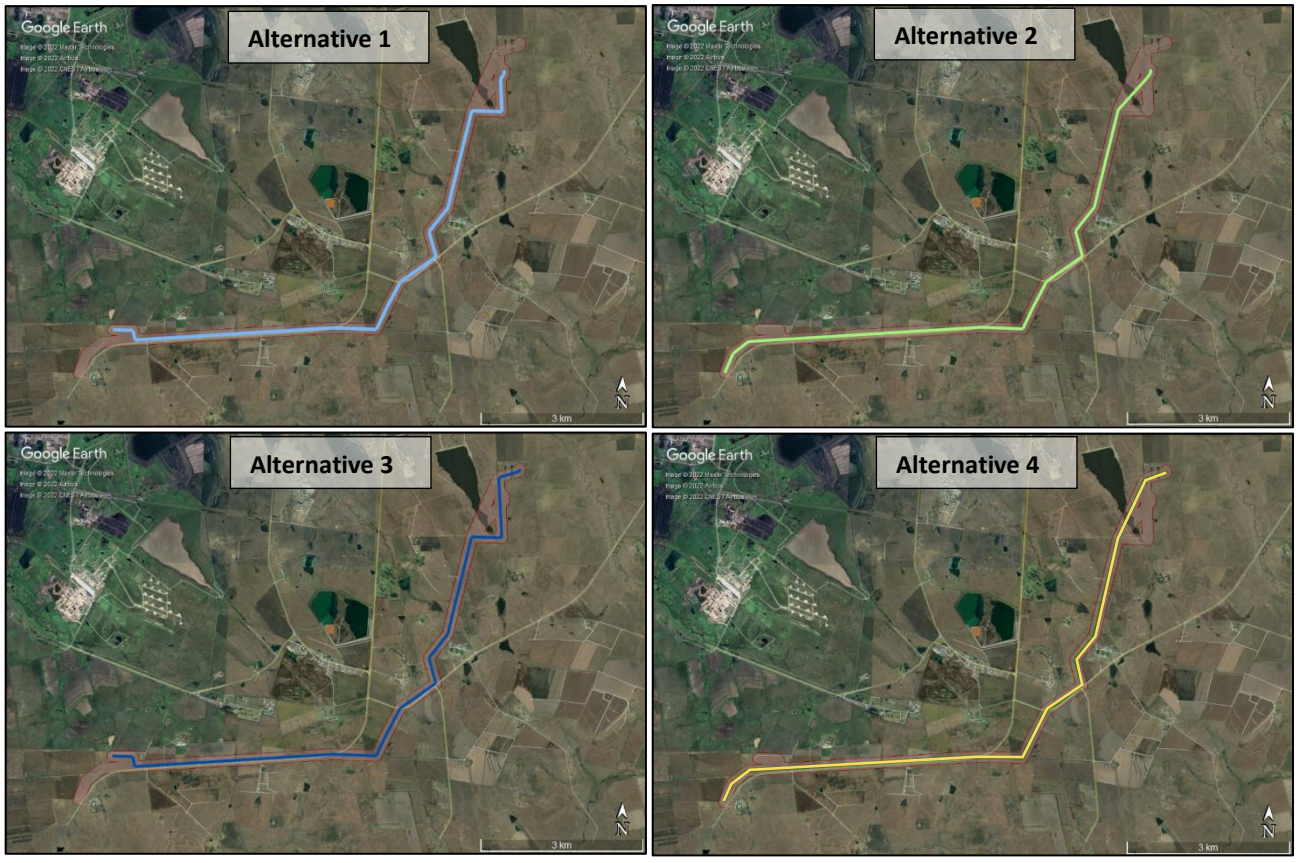


Figure 2: *Aerial view of the study area showing the four alternatives as labelled.*

1.1.3. Description of project aspects relevant to the heritage study

All aspects of the proposed development are relevant, since excavations for pylon 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 requested to compile a Heritage Impact Assessment (HIA) that met the requirements of the relevant heritage authorities as well as the following:

- Describe regional and local features of the receiving environment;
- Conduct a field survey to search for sensitive areas and sites of heritage significance;
- Map sensitive features;
- Assess (identify and rate) the potential impacts on the environment;
- Identify relevant legislation and legal requirements; and
- Provide recommendations on possible mitigation measures, rehabilitation procedures, and management guidelines.

1.3. Scope, purpose and objectives 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 by them for consideration by the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) who will review the Basic Assessment (BA) and grant or refuse Environmental Authorisation (EA). 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. Details of specialist

This specialist assessment has been undertaken by Dr Jayson Orton of ASHA Consulting (Pty) Ltd. He 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 South Africa (primarily in the Western Cape and Northern Cape provinces) 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; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) Cultural Resource Management (CRM) section (Member #233) as follows:

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

Jaco van der Walt has been practising as a CRM archaeologist for 20 years. He obtained an MA degree in Archaeology from the University of the Witwatersrand focussing on the Iron Age in 2012 and is a PhD candidate at the University of Johannesburg focusing on Stone Age Archaeology with specific interest in the Middle Stone Age (MSA) and Later Stone Age (LSA). Jaco is an accredited member of

ASAPA (#159) and APHP (#114) and has conducted more than 500 impact assessments in Limpopo, Mpumalanga, North West, Free State, Gauteng, KZN as well as the Northern and Eastern Cape Provinces in South Africa.

Jaco has worked on various international projects in Zimbabwe, Botswana, Mozambique, Lesotho, DRC, Zambia, Guinea, Tanzania as well as Afghanistan. Through this, he has a sound understanding of the IFC Performance Standard requirements, with specific reference to Performance Standard 8 – Cultural Heritage.

Signed specialist statements of independence are included at the front of this specialist assessment.

2. LEGISLATIVE CONTEXT

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

The NHRA protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old as well as military remains more than 75 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

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

- Structures: “any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith”;
- Palaeontological material: “any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace”;
- Archaeological material: a) “material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures”; b) “rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation”; c) “wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation”; and d) “features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found”;
- Grave: “means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place”; and

- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

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

a) its importance in the community, or pattern of South Africa's history;
b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
i) sites of significance relating to the history of slavery in South Africa.

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

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of S.38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the consenting authority prior to the issuing of a decision. Under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), as amended, the project is subject to a BA. The present report provides the heritage component. Mpumalanga Provincial Heritage Resource Authority (MPHRA; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA; for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the DARDLEA.

3. APPROACH AND METHODOLOGY

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. The information sources used in this report are presented in Table 2. Data were also collected via a field survey, while historical and modern aerial photography were used to search for potential sites along unsurveyed portions of the corridor.

Table 2: *Information sources used in this assessment.*

Data / Information	Source	Date	Type	Description
Maps	Chief Directorate: National Geo-Spatial Information	Various	Spatial	Historical and current 1:50 000 topographic maps of the study area and immediate surrounds
Aerial photographs	Chief Directorate: National Geo-Spatial Information	Various	Spatial	Historical aerial photography of the study area and immediate surrounds
Aerial photographs	Google Earth	Various	Spatial	Recent and historical aerial photography of the study area and immediate surrounds
Cadastral data	Chief Directorate: National Geo-Spatial Information	Various	Survey diagrams	Historical and current survey diagrams, property survey and registration dates
Background data	South African Heritage Resources Information System (SAHRIS)	Various	Reports	Previous impact assessments for any developments in the vicinity of the study area
Palaeontological sensitivity	South African Heritage Resources Information System (SAHRIS)	Current	Spatial	Map showing palaeontological sensitivity and required actions based on the sensitivity.
Background data	Books, journals, websites	Various	Books, journals, websites	Historical and current literature describing the study area and any relevant aspects of cultural heritage.

3.2. Field survey

The corridor itself has not been specifically studied in the field but the solar and wind farms on either end have been surveyed on 10, 11, 12 and 17 November 2021, and 24 and 25 March and 01 April 2022. These surveys were during early and late summer and, being a summer rainfall area, the grass was dense which negatively affected the ground visibility for the archaeological surveys. Other heritage resources are not affected by seasonality. During the survey the positions of finds and survey

tracks were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum (Figure 3). Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

It should be noted that the amount of time between the dates of the field inspection and the final report do not materially affect the outcome of the report.

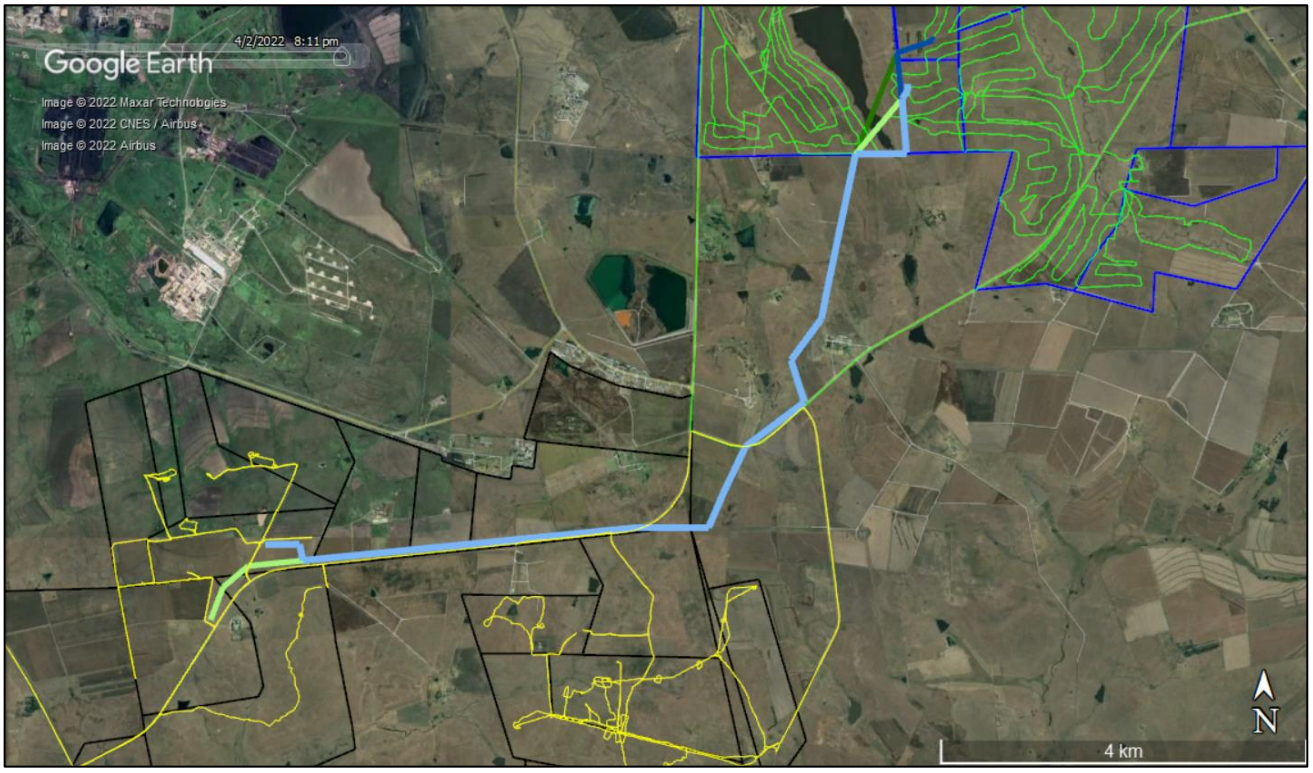


Figure 3: *Aerial view of the study area (all alternatives shown as per Figure 2) showing the survey tracks (green and yellow lines) as well as the farm portions accessible during the surveys for the adjoining solar and wind projects (blue and black polygons respectively).*

3.3. Specialist studies

A specialist palaeontological study was compiled by Prof. Marion Bamford and is submitted along with this HIA.

3.4. Impact assessment

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

3.5. 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 under S.7(2) 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. SAHRA (2007) has formulated its own system[4] 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 the 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' (GP) and rated as GP A (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GP C (low significance, requires no further action).

3.6. Assumptions, knowledge gaps and limitations

The study is carried out at the surface only and hence any completely buried archaeological sites will not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. The dense grass (and crops in some places) allowed very limited visibility of the ground surface.

Cumulative impacts are difficult to assess due to the variable site conditions that would have been experienced in different areas and in different seasons. Survey quality is thus likely to be variable. As such, some assumptions need to be made in terms of what and how much heritage might be impacted by other developments in the broader area.

3.7. Consultation processes undertaken

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of a BA which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP. Three farmers were consulted during the field survey to obtain information on potential heritage on their land.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The project area is situated between about 6 and 11 km southeast and south of Secunda, in an area characterised by grazing lands and ploughed fields. The various farms are subdivided into large grazing camps with multiple gravel roads running through the area. Existing infrastructure occurring across the project area includes farmsteads, power lines, pipelines, and farm dams. Slightly further afield are the SASOL facility to the northwest and various coal mines.

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

4.2. Site description

The site is mostly characterised by thick grass cover. There is a general lack of trees, but clusters do occur at farmhouses. Some fields were planted with crops at the time of the two inspections. Figures 4 to 13 show the nature of the study area and its vegetation covering.

Figure 4: *Grass cover and loose rocks in the north-eastern part of the broader study area (November 2021).*

Figure 5: *Grass cover in the north-eastern part of the broader study area (November 2021).*

Figure 6: *Grass cover and power lines in the north-eastern part of the broader study area (November 2021).*

Figure 7: *Arable land planted with crops in the north-eastern part of the broader study area (November 2021).*

Figure 8: *Looking north in the central section of the power line corridor (Google Earth Street View dated April 2022).*

Figure 9: *Looking south in the central section of the power line corridor (Google Earth Street View dated April 2022).*

Figure 10: *Looking west in the central part of the power line corridor (Google Earth Street View dated September 2010).*

Figure 11: *View of the landscape in the south-western part of the broader study area (March 2022).*

Figure 12: *Grass and power lines in the south-western part of the broader study area (March 2022).*

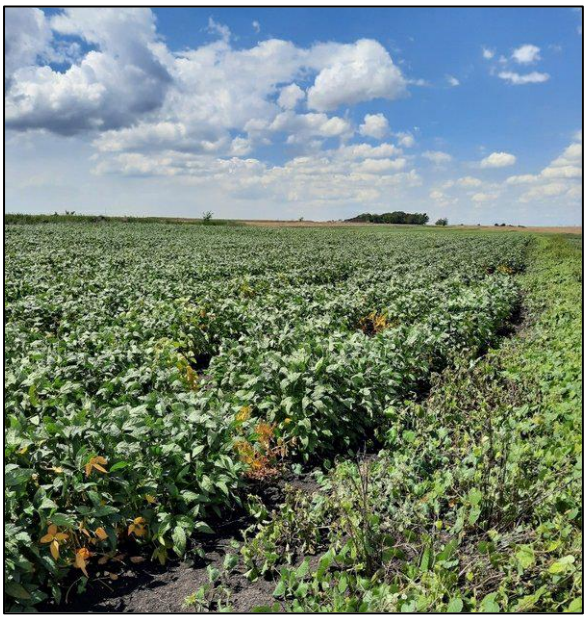


Figure 13: *Planted fields in the south-western part of the broader study area (March 2022).*

5. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the assessment. Their locations are listed in Table 3, mapped in Figure 14, and then described in full in Sections 5.2.2 and 5.3. Some were recorded in the Vhuvhili SEF study area and others in the Mukondeleli WEF study area (both projects are subject to separate S&EIA processes).

Table 3: *List of heritage finds recorded during the field surveys (waypoints as per Figures 14 and 15 but excludes the graves recorded by Hardwick* et al. *[2019]).*

Waypoint	Location	Nature	Grade
179	26° 34' 12.57" S 29° 15' 34.82" E	Graves	IIIA
182	26° 34' 30.94" S 29° 15' 22.54" E	Graves	IIIA
183	26° 34' 28.24" S 29° 15' 15.88" E	Archaeological – stone feature	GPB
Post-1968	26° 35' 06.55" S 29° 15' 11.80" E	Recent feature, looks like cement floors – not heritage	---
Ruins	26° 35' 32.72" S 29° 15' 10.19" E	Ruins visible on aerial photography, not visited	GPA
Post-1968	26° 36' 15.26"S 29° 14' 46.43"E	Recent feature, possibly foundations of farm workers' village – not heritage	---
MD006	26° 37' 31.22" S 29° 11' 38.34" E	Well-spaced stone piles along fence (likely cleared from fields) – not heritage	---
MD007	26° 36' 53.29" S 29° 10' 57.93" E	Ruins (farmstead)	GPA

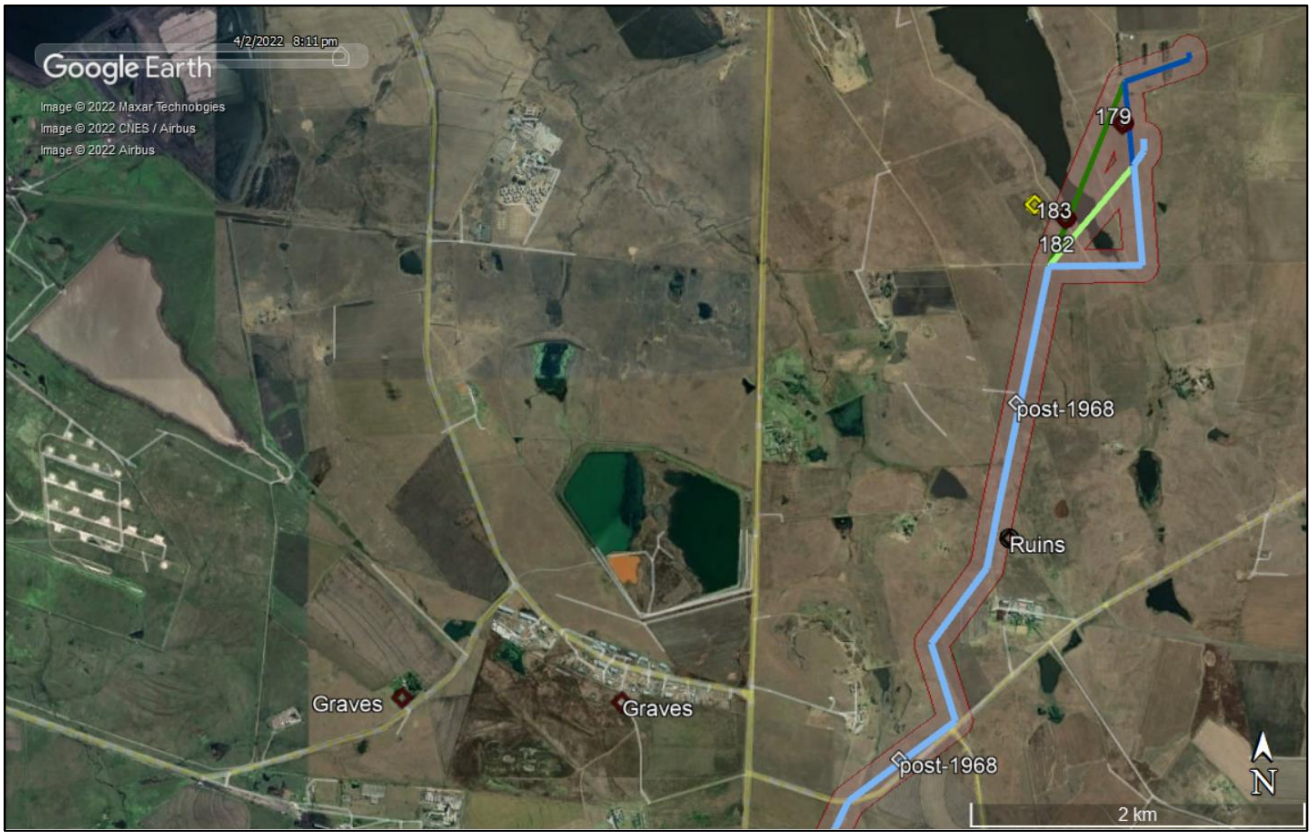


Figure 14: *Aerial view of the north-eastern part of the study area showing the locations of the recorded heritage resources. Here and on Figure 15 dark red symbols = Grade IIIA (includes two grave sites from Hardwick* et al. *2019[5]), red = Grade IIIB, yellow = GPB. Features identified from aerial photography as post-dating 1968 are marked by white symbols and are not heritage, while potential heritage resources also identified from aerial photography are ringed in black.*

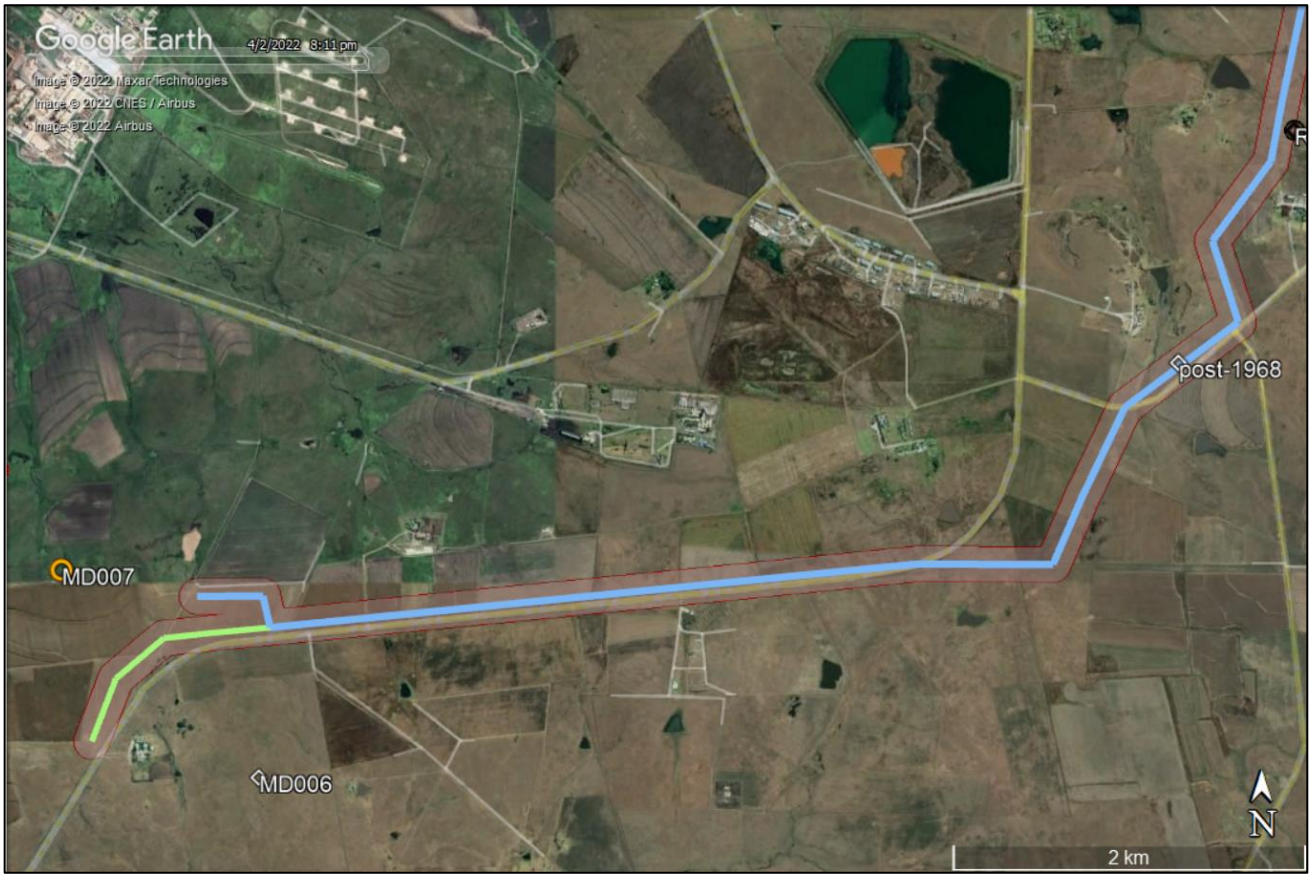


Figure 15: *Aerial view of the north-eastern part of the study area showing the locations of the recorded heritage resources.*

5.1. Palaeontology

The SAHRIS Palaeosensitivity Map shows the site to be of almost entirely zero sensitivity (dolerite geology) with just one small area in the northeast being of very high sensitivity (Figure 16). Because of the very highly sensitive area, a specialist palaeontological study was commissioned and is submitted separately with this HIA.

[5] Locations estimated as co-ordinates were not provided.

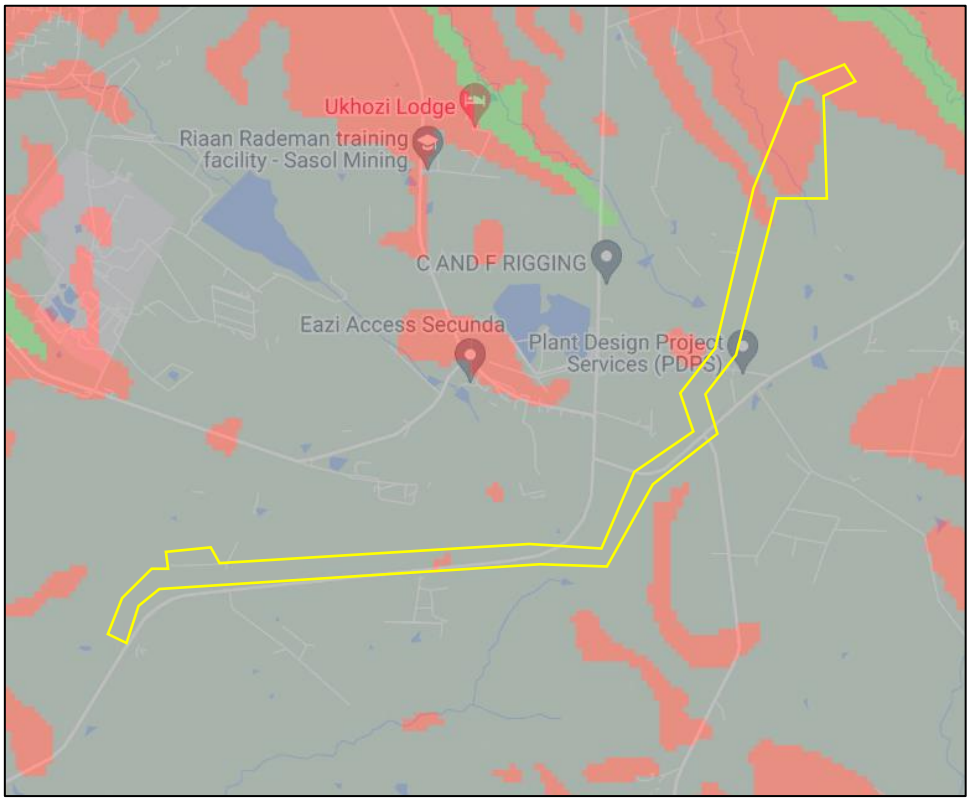


Figure 16: *Extract from the SAHRIS Palaeosensitivity Map showing the site to be of very high (red) and zero (grey) palaeontological sensitivity.*

5.2. Archaeology

5.2.1. Desktop study

Mpumalanga does not have an extensive Early Stone Age record (Esterhuysen & Smith 2007). Although the Middle and Late Stone Age periods have not yet been comprehensively studied, evidence for these periods has been excavated from Bushman Rock Shelter in the Ohrigstad District in the Limpopo province (Esterhuysen & Smith 2007) and it is known that San communities lived near Lake Chrissie, in Msukaligwa Local Municipality, Mpumalanga, as recently as the 1950s (e.g. Schlebusch et al. 2016).

The archaeological remains of Iron Age settlements are more frequently found in the province. The archaeology of farming communities of southern Africa encompasses three phases. The Early Iron Age (200-900 AD) represents the arrival of Bantu-speaking farmers in southern Africa. Living in sedentary settlements often located next to rivers, these farmers cultivated sorghum, beans, and cowpeas, and kept livestock. The Middle Iron Age (900-1300 AD) is mostly confined to the Limpopo Province with the most notable site in southern Africa located in the Limpopo Valley; Mapungubwe Hill probably represents the earliest 'state' in this region. The Late Iron Age (1300-1840s AD) marks the arrival and spread of ancestral Eastern Bantu-speaking Nguni and Sotho-Tswana communities into southern Africa. The location of Late Iron Age settlements is usually on or near hilltops for defensive purposes. The Late Iron Age as an archaeological period ended by 1840 AD, when the Mfecane caused major socio-political disruptions in southern Africa (Mitchell 2002; Huffman 2007).

Dates from Early Iron Age sites indicated that by the beginning of the 5th century AD Bantu-speaking farmers had settled in the Mpumalanga lowveld. Subsequently, farmers continued to move into and between the lowveld and highveld of Mpumalanga. By 1500 AD the escarpment was populated by chiefdoms, including Pedi and Bokoni communities. These chiefdoms would have had trade relations with Ndundza, Swazi and Zulu kingdoms, exchanging salt, cattle and metals as evidenced by the archaeological record (Esterhuysen & Smith 2007; Delius et al. 2012)

Other CRM surveys that have taken place in the vicinity of the present study area reveal the variety of heritage resources commonly encountered in the area. These are listed in Table 4.

Table 4: *CRM reports compiled for other projects close to the present study area.*

Author	Year	Project	Findings
Van Schalkwyk, J.A.	1998	A Survey of Cultural Resources for Secunda Collieries Block 5 And Syferfontein Mining Area Highveld Ridge District, Mpumalanga	Informal cemeteries; Farmstead ruins; Historical farmstead; Labourer homestead ruins; Middens (modern); Stone walling; Lower grinding stone; Circular stone structures; and Stone cairns (possibly graves).
Pistorius, C.C. J	2008	A Phase I Heritage Impact Assessment (HIA) study for Sasol's proposed new gas and liquid pipelines (along a corridor) from Sasol Synfuels in Secunda (Mpumalanga) to Sasol Infrachem and Natref in Sasolburg (Free State) on the Highveld in the Republic of South Africa. Unpublished report for Nature and Business Alliance Africa (Pty) Ltd	Historic farmstead complexes; Historic houses; Graveyards; and Individual graves.
Van Vollenhoven, A.C. & Pelser, A.J.	2010	A Report on a Heritage Impact Assessment the Proposed Secunda X 52 Industrial Township, Mpumalanga Province	Graveyard
Küsel, S.	2011	Cultural Heritage Resources Impact Assessment for proposed Sasol Electricity Generation from Raw Gas Cooling Erf 8488 Govan Mbeki Local Municipality Gert Sibande District Municipality Mpumalanga Province. Report prepared for SSI Engineers and Environmental Consultants	No finds
Beater, J.	2017	Mulalo Main Transmission Substation and Associated Power Lines Project, Secunda, Mpumalanga Province	Graveyard; Historic homestead ruins; and Labourer homestead ruins.

Hardwick, S., Bamford, M. & Du Piesanie, J.	2019	Environmental Regulatory Process to Decommission a Conveyer Belt Servitude, Road and Quarry at Twistdraai East Colliery, Secunda, Mpumalanga Province. N.I.D. Unpublished report Digby Wells Environmental.	Graveyards
Pistorius, C.C.J.	2020	A Phase I Heritage Impact Assessment Study for The Shondoni and Middelbult Mining Areas Near Secunda in the Mpumalanga Province	Historic farmstead complexes Graveyards Individual graves Commemorative beacons

5.2.2. Site visit

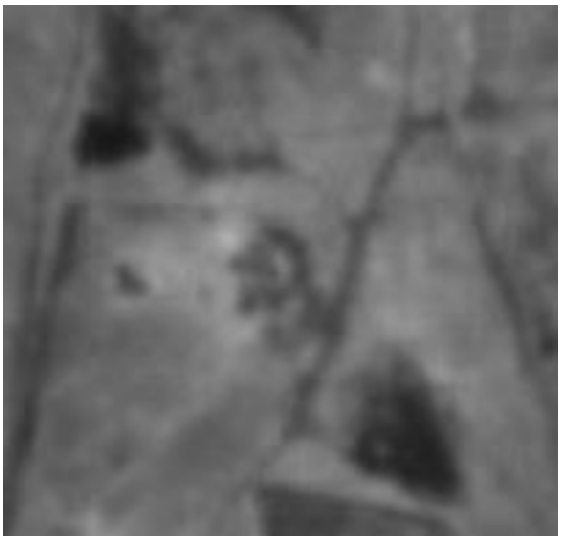
Despite the grass cover, the field surveys revealed a few archaeological remnants of old stone-built features. The age and functions of these features is not easily determined and, for precautionary reasons and in the absence of evidence to the contrary, they are generally treated as having been greater than 100 years of age and hence included within the legal definition of archaeological heritage. It seems likely that the above ground stones have largely been removed from these features for reuse elsewhere on the farms, leaving only the ground-level archaeological remnants. The various sites are discussed and illustrated in turn below.

Site Number:	**Description:**	**Period**
183	A large square stone packed feature of some 30 m by 30 m and situated in an open field near a large farm dam. The feature is half buried under grass making it difficult to determine the layout. Remnants of intact wall foundations are still visible. The feature is possibly part of a demolished kraal.	Historic, recent.

Figures 17 & 18: *Large square packed stone feature.*
Significance and Grade: Low – GPB

Site Number:	Description:	Period
Ruins	A ruin covering an area of about 12 m by 13 m. The site was not visited but it was likely a house. From the 1953 aerial view below it seems it might already have been in ruin at that time. Based on the many other features on record from the area, the site is likely to be of no more than low-medium cultural significance.	Historic, recent.

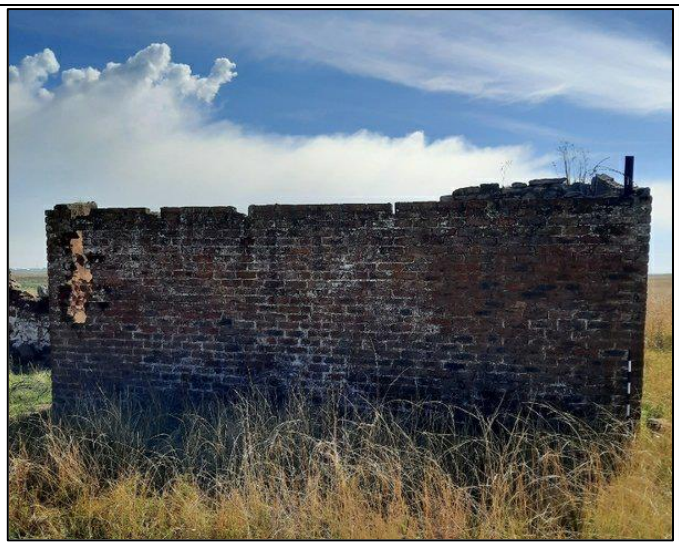
Figure 19: *Aerial view of the ruins (Google Earth; April 2021).*



Figures 20 & 21: *Comparative modern (left; Google Earth; April 2021) and 1953 (right; CDNGI Job 326, strip 003, photograph 3762) aerial views of the ruins.*

Significance and Grade: Low-medium – GPA

Site Number:	Description:	Period:
MD 007	Large degraded historical farmstead complex. The complex includes multiple degraded structures such as the farmhouse, a small rondavel, a small brick structure and a broken-down cattle handling area. The main farmhouse is built from mortar and stone and includes multiple rooms with an added brick garage that seems to be a recent addition to the structure. The rondavel is also built from red bricks as opposed to the sandstone. The footprint of the main house seems to be about 17 m by 13 m, while the whole complex occupies an area of some 100 m by 100 m.	Historic/recent




Figures 22 to 25: *Four views of the main house showing the stone construction of the house and red brick walling of the added room.*

Significance and Grade:
Low-Medium – GPA

No Stone Age or Iron Age archaeological materials such as stone artefacts or pottery were seen in the study areas for the Vhuvhili SEF and Mukondeleli WEF, perhaps largely due to the thick grass cover. The same situation is likely to pertain throughout the power line corridor. Furthermore, it is noted from an examination of historical and current aerial photography that a large proportion of the route has been cultivated in the past.

5.3. Graves

The only graves seen in close proximity to the corridor are two sets of graves that represent reburials. Both are noted on the grave markers to have been buried in 2020 but no dates of birth and death are known. The landowners noted that the graves were moved from the footprint of the enlarged farm dam, but historical aerial photography reveals that this dam was completed in 2017. This suggests that the remains were stored and only reburied later, perhaps after the full supply level of the dam had been reached.

Site Number:	Description:
179	A set of four graves placed in a single row with metal grave markers. The graves are indicated to have been moved from the enlarged farm dam and reburied in 2020. Although names are provided, dates of birth and death are indicated as unknown. Without knowing their temporal origins (which could very easily be older than 60 years), they are treated as heritage for precautionary reasons.


Figures 26 & 27: *Relocated graves situated in an open field. Scale bar = 1 m.*

Significance and Grade:
High - IIIA

Site Number:	**Description:**
182	A set of six graves placed in a single row with metal grave markers. The graves are indicated to have been moved from the enlarged farm dam footprint and reburied in 2020. Although names are provided, dates of birth and death are indicated as unknown. Without knowing their temporal origins (which could very easily be older than 60 years), they are treated as heritage for precautionary reasons.

Figures 28 & 29: *Series of relocated graves situated on the edge of a large farm dam. Scale bar = 1 m.*

Statement of Significance and Grade:
High - IIIA

5.4. Historical aspects and the Built environment

5.4.1. Desktop study

During the mid-17th century, the Dutch East India Company established a trading post at modern-day Cape Town. Simultaneously, the Portuguese colonised Lourenço Marques (Maputo), Mozambique. As such, the Mpumalanga landscape became a thoroughfare for local and foreign traders. However, the increasing intensity of interaction among indigenous peoples and European merchants led to intensified competition over control of trade routes and accumulating wealth. Consequently, political centralisation led to warfare and population displacement (Derricourt & Evers 1973; Esterhuysen & Smith 2007; Delius *et al.* 2012).

By the 1830s, Dutch-speaking farmers started to migrate from modern-day Cape Town towards the interior regions of South Africa. Dutch-speaking migrants entering the region were confronted with existing tension between local groups due to the ongoing Mfecane, trade conflicts, and pressure from foreign merchants. Motivated to improve their own economic position within the area, more conflict between the Dutch, Sotho-Tswana and Nguni speaking communities started to take place (Giliomee & Mbenga 2007). Ultimately, Dutch-speaking farmers did settle in Mpumalanga and neighbouring provinces.

During the 1850s coalfields were already being exploited. Coal served a variety of purposes, as it still does today. From powering steam trains, ships, furnaces for smelting metals, it was also utilised

within a domestic context, to heat up space and cook food. Since the discovery of diamonds and gold the industrial demand for coal increased significantly. Lucrative mining continued until the onset of the South African War of 1899 -1902 when the workforce joined the war effort, and, as usual during wartime, railways and infrastructure were destroyed. Following the end of the South African War, activities within the South African Union (formed in 1910) were aimed at stabilising the economy by focusing on agriculture and coal mining. However, post-war socio-economic and political crises, especially after World War I (1914-1918) had a profound economic and political impact on the South African coal industry and mine workers (Giliomee & Mbenga 2007). Due to the relative economic and political stability after World War II (1939-1945), mining towns were established and coal mining continued. Today coal is still an integral part of the South African economy, used for the generation of electricity, synthetic fuels, and petrochemical products (Mathu & Chinomona 2013).

The discovery of coal, gold and diamonds during the mid-19th century led to a variety of socio-economic changes within South Africa. Since the discovery of mineral wealth, the new wage-economy and migrant labour systems contributed to the demise of traditional homestead economies and social organisation. In addition, competition for resources led to conflict, political upheavals and ultimately warfare (e.g., Crush & Soutter 1999; Delius 2014).

The province of Mpumalanga has the most collieries and the largest coalfield. The study area is situated near the town of Secunda within the Govan Mbeki Local Municipality. The town was established in 1976 by Sasol Limited, on the farm Goede Hoop (Schirmer 2007; Mathu & Chinomona 2013). Hardwick *et al.* (2019) worked in the same study area as the present project and the only heritage resources they encountered were three graveyards with the oldest date among them being 1894. Location co-ordinates were unfortunately not provided but from their mapping it appears as though none are affected by the present project. No archaeology was reported by them. Küsel (2011) looked at a small area along the southern margin of the Sasol facility and found no heritage.

The site itself is an agricultural landscape and, as shown on the historical aerial photography in Figure 30, its overall character has not changed over the last 67 years. A few specific changes are noticeable, however:

- The cultivated lands have been reconfigured in places, sometimes in response to the construction of new roads;
- Several new farmsteads have been added in the surrounding areas (but none within the corridor);
- Coal mines and the Sasol facility have been developed in the broader study area; and
- A large farm dam has been recently constructed (2017) at the north-eastern end of the study area. This dam was on the site of a smaller dam, but there was no dam present at all there in 1955.

Figure 30: *Comparative aerial views from 1953/1955 (top) and 2021 (bottom) showing the overall nature of the landscape to be unchanged since 1953/1955.*

5.4.2. Site visit

Aside from the historical archaeological remains described above, it is clear from aerial photography that no historical sites (farmsteads, structures) are present anywhere within the corridor. A few

farmsteads occur within several hundred meters of the corridor but historical aerial photography indicates that the vast majority of structures and many entire farmsteads are modern. None of them occur within the corridor. The presence of the proposed power line in a landscape that already has an industrial layer (see Secton 5.5) is of no further concern.

5.5. Cultural landscapes and scenic routes

The landscape is an agricultural one characterised by grazing lands (grass) and arable lands (planted with crops). The landscape is extensive and is punctuated by towns and coal mines. It is not a particularly sensitive cultural landscape with the majority of its development having taken place during the 20th century. It is compromised by the very large Sasol facility located 6 km west of the study area, and several coal mines in the surrounding landscape. These add a modern industrial layer to the landscape.

There are no scenic routes in the area, although the N17 runs west to east about 8.5 km north of the north-eastern end of the proposed power line. Given the visual intrusions of the Sasol facility and coal mines of the area, this aspect is of no further concern.

5.6. 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 reasons that a place may have cultural significance are outlined in Section 3(3) of the NHRA (see Section 2 above).

The archaeological resources are deemed to have low-medium to low cultural significance at the local level for their scientific and possibly historical values. They are graded GPA or lower and will not make significant contributions to our understanding of the area’s heritage.

Graves are deemed to have high cultural significance at the local level for their social value. They are allocated a grade of IIIA.

The cultural landscape is largely an agricultural landscape with low aesthetic value due to the visual intrusions from the nearby Sasol facility and coal mines which add an industrial layer. It is rated as having low cultural significance at the local level.

6. IDENTIFICATION OF ENVIRONMENTAL SENSITIVITIES

6.1. Sensitivities identified by the National Web-Based Environmental Screening Tool

The screening tool identifies the entire study area as being of low sensitivity for archaeology and cultural heritage (Figure 31).

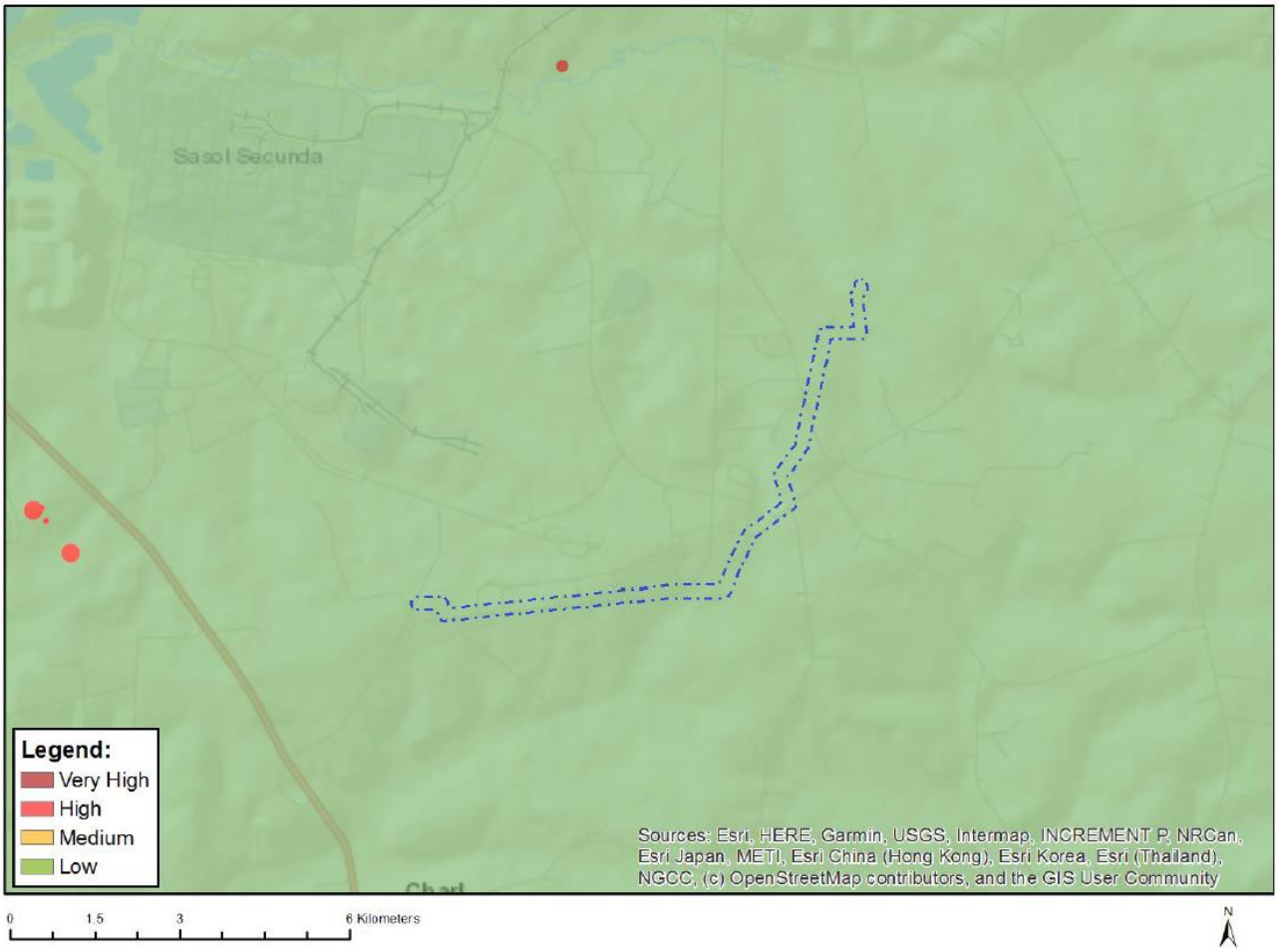


Figure 31: *Screening tool map showing the site to be of low archaeological and cultural heritage sensitivity (green shading). This shows the preferred alternative with the three other alternatives only having minor differences at the ends of the mapped corridor.*

6.2. Specialist Sensitivity Analysis and Verification

The fieldwork revealed that most of the site is indeed of very low sensitivity. The only areas considered to be of low sensitivity were some stone features, while a number of graves and some possible graves were allocated very high sensitivity. These areas are mapped in Figure 32.

Figure 32: *Sensitivity map showing the archaeological and cultural heritage sensitivity as determined by this assessment (dark red = very high, orange = medium-low, yellow = low). The finds are mapped with 50 m buffers.*

6.3. Sensitivity Analysis Summary Statement

The low sensitivity identified by the screening tool is largely confirmed, but a few areas where graves and other sites occur are deemed to be of very high and medium sensitivity respectively.

7. ISSUES, RISKS AND IMPACTS

7.1. Summary of issues identified

The only concerns identified on site are impacts to archaeology and impacts to graves. Both of these impacts would occur during the construction phase only. The broader cultural landscape would be affected during all phases of the development but, because of the low cultural significance of this resource, it is not deemed to be a key impact. It will still require assessment though.

No formal consultation was conducted, but landowners were asked about graves on their properties.

7.2. Identification of potential impacts/risks

Issues identified here all originated from the field survey.

The potential impacts identified are:

Construction Phase
- Potential impacts on archaeological remains
- Potential impacts on graves
- Potential impacts on the cultural landscape

Operational Phase
- Potential impacts on the cultural landscape

Decommissioning Phase
- Potential impacts on the cultural landscape

Cumulative impacts
- Potential impacts on archaeological remains
- Potential impacts on graves
- Potential impacts on the cultural landscape

8. IMPACT ASSESSMENT

Potential impacts are discussed here with all ratings shown in Table 5. Note that all alternatives are rated the same for all heritage resources with the exception of graves where Alternatives 3 and 4 would result in a higher impact significance. Separate ratings are provided for the various Alternatives under 8.1.2 and 8.1.3.

8.1. Construction Phase

8.1.1. Impacts to archaeological resources

Impacts to archaeological resources would only occur during the construction phase when earthworks occur for the access track and pylon construction. Due to the low to very low cultural significance of the sites recorded in the surroundings, the consequence is rated as moderate and the impact significance as **low negative**. Mitigation would entail commissioning a pre-construction survey of the final chosen alignment, followed by micro-siting of infrastructure to avoid impacts to

known sites and reporting any further sites discovered during earthworks. With mitigation, the significance reduces to **very low negative**.

There are no fatal flaws for any of the four alternative power line routings in terms of construction phase impacts to archaeology.

8.1.2. Impacts to graves (Alternatives 1 & 2)

Although graves have been recorded in the surrounding area, none are known within the Alternative 1 and 2 corridors. Because of the very high cultural significance of graves the consequence of impacts to graves is rated as extreme, but, despite no full survey of the corridor, the probability of impacts is extremely unlikely. The resulting significance is **very low negative**. Mitigation will entail commissioning a pre-construction survey of the final chosen alignment, followed by micro-siting of infrastructure to avoid any graves and potential graves. Any chance finds of unmarked graves during construction should be reported. With mitigation the significance would remain **very low negative**.

There are no fatal flaws in terms of construction phase impacts to graves for Alternatives 1 and 2.

8.1.3. Impacts to graves (Alternatives 3 & 4)

One small graveyard occurs within the north-easternmost part of each of the Alternative 3 and 4 corridors. In both instances the 50 m buffers around the graves fall wholly within the assessed 200 m wide corridors, although off-centre. Because of the very high cultural significance of graves the consequence of impacts to graves is rated as extreme and, with a high probability of impacts, the significance is **high negative**. Mitigation will entail commissioning a pre-construction survey of the final chosen alignment, avoiding all graves and potential graves and reporting any chance finds of unmarked graves during construction. With mitigation the significance would reduce to **low negative**.

The probability of impacts is by no means definite because there is more than enough space in the assessed corridors to avoid the graves. This means that there are no fatal flaws in terms of construction phase impacts to graves for Alternatives 3 and 4, although these alternatives are not preferred.

8.1.4. Impacts to the cultural landscape

The local landscape is already heavily compromised by the nearby Sasol facility and coal mines. As such, the intrusion into this landscape of the construction equipment and power lines is considered to be of only moderate consequence. The significance would likely be **low negative**. Minimising the construction duration, reusing existing farm tracks and roads as far as possible and ensuring rehabilitation of areas not needed during operation will result in the significance with mitigation being reduced to **very low negative**.

There are no fatal flaws for any of the four alternative power line routings in terms of construction phase impacts to the cultural landscape.

8.2. Operation Phase

8.2.1. Impacts to the cultural landscape

As before, the local landscape is already heavily compromised by the nearby Sasol facility and coal mines. As such, the intrusion into this landscape of the solar panels and related infrastructure is considered to be of only moderate consequence. The significance would likely be **very low negative**. There are no specific mitigation measures that can be applied during operation other than the best practice measure of ensuring that all maintenance work occurs within designated areas. Post-mitigation significance would remain at the **very low negative** level.

There are no fatal flaws for any of the four alternative power line routings in terms of operation phase impacts to the cultural landscape.

8.3. Decommissioning Phase

8.3.1. Impacts to the cultural landscape

Once again, because the local landscape is compromised by the Sasol facility and coal mines, the intrusion into this landscape of the equipment needed for decommissioning is considered to be of only moderate consequence. The significance would likely be **low negative**. Minimising the decommissioning duration and ensuring full rehabilitation post-closure will result in the significance with mitigation being reduced to **very low negative**.

There are no fatal flaws for any of the four alternative power line routings in terms of decommissioning phase impacts to the cultural landscape.

8.4. Cumulative Impacts

Cumulative impacts relate to the impacts on heritage from all proximate developments. For the most part, impacts to archaeology, graves and buildings are avoided but, inevitably, some of the former two heritage types may be damaged when they were not visible during surveys (e.g. due to crops or dense grass). Without a doubt, surveys help to minimise impacts and, with the power line having a relatively small overall footprint, it is likely that the potential cumulative impact significance to archaeology, graves and buildings would be **low negative**. Mitigation measures would be as detailed for the individual resource types above and with mitigation the significance reduces to **very low negative** because there are always likely to be some impacts that will go unnoticed. These are construction phase impacts.

Impacts to the landscape are ones related to visual intrusion and the degree to which the prevailing landscape is altered and would occur during all phases of the proposed project. The main impacts in this region are associated with the Sasol facility and coal mines. The power lines would be fairly inconsequential when viewed in the context of these larger industrial facilities and will thus make a very small contribution to cumulative impacts. As such, the potential cumulative cultural landscape impacts related to this project are rated as **very low negative**. Mitigation will do little to alter the significance which remains **very low negative**.

Table 5: *Assessment of impacts.*

Impact		Impact Criteria		Significance and Ranking (Pre-Mitigation)	Potential mitigation measures	Significance and Ranking (Post-Mitigation)	Confidence Level
Construction Phase							
Damage or destruction of archaeological materials		Status	Negative	Low (4)	- Preconstruction survey of final alignment. - Micro-siting of infrastructure where possible to minimise impacts. - Report any chance finds to determine the best way forward.	Very low (5)	High
		Spatial extent	Site-specific				
		Duration	Permanent				
		Consequence	Moderate				
		Probability	Very unlikely				
		Reversibility	Non-reversible				
		Irreplaceability	High				
ALT. 1 & 2	**Damage or destruction of graves**	Status	Negative	Very Low (5)	- Preconstruction survey of final alignment. - Micro-siting of infrastructure to avoid impacts to known graves and potential graves. - Report any chance finds, protect *in situ*, and appoint archaeologist to exhume.	Very low (5)	High
		Spatial extent	Site specific				
		Duration	Permanent				
		Consequence	Extreme				
		Probability	Extremely unlikely				
		Reversibility	Non-reversible				
		Irreplaceability	High				
ALT. 3 & 4	**Damage or destruction of graves**	Status	Negative	High (2)	- Preconstruction survey of final alignment. - Micro-siting of infrastructure to avoid impacts to known graves and potential graves. - Graveyard must be fenced with a farm-style wire fence with a pedestrian gate to facilitate public access. - Report any chance finds, protect *in situ*, and appoint archaeologist to exhume.	Low (4)	High
		Spatial extent	Site specific				
		Duration	Permanent				
		Consequence	Extreme				
		Probability	Likely				
		Reversibility	Non-reversible				
		Irreplaceability	High				
Intrusion of facility and equipment into the landscape		Status	Negative	Low (4)	- Minimise duration of construction period. - Make use of existing tracks where possible for final alignment. - Ensure effective rehabilitation of areas not needed during operation.	Very Low (5)	High
		Spatial extent	Local				
		Duration	Short term				
		Consequence	Moderate				
		Probability	Very likely				
		Reversibility	High				
		Irreplaceability	Low				
Operational Phase							
Intrusion of facility into the landscape		Status	Negative	Very low (5)	- Ensure that all maintenance vehicles and activities stay within designated areas.	Very low (5)	High
		Spatial extent	Local				

	Duration	Long term				
	Consequence	Slight				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Low				
Decommissioning Phase						
Intrusion of facility and equipment into the landscape	Status	Negative	Low (4)	- Minimise duration of decommissioning period. - Ensure effective rehabilitation of all areas after completion.	Very low (5)	High
	Spatial extent	Local				
	Duration	Short term				
	Consequence	Moderate				
	Probability	Very likely				
	Reversibility	High				
	Irreplaceability	Low				
Cumulative impacts						
Impacts to archaeology, graves	Status	Negative	Low (4)	- Micro-siting of infrastructure where possible to minimise impacts, but this is not mandatory due to the low cultural significance. - Report any chance finds to determine the best way forward.	Very low (5)	High
	Spatial extent	Regional				
	Duration	Permanent				
	Consequence	Moderate				
	Probability	Unlikely				
	Reversibility	Non-reversible				
	Irreplaceability	High				
Intrusion of facility and equipment into the landscape	Status	Negative	Very low (5)	- Minimise duration of construction period. - Minimise cut-and-fill and landscape scarring in general. - Ensure effective rehabilitation of areas not needed during operation.	Very low (5)	High
	Spatial extent	Regional				
	Duration	Long term				
	Consequence	Slight				
	Probability	Very likely				
	Reversibility	High				

8.5. Evaluation of impacts relative to sustainable social and economic benefits

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

The proposed power line is intended to support a renewable energy facility, i.e. the proposed Vhuvhili SEF, that will be providing electricity to South Africa which will result in obvious benefits to society at many levels. There will be local job creation during construction and operation but, more widely, an improvement in electricity supply in South Africa will stimulate the economy and result in new job opportunities opening up and quality of life improving. These are clear economic and social benefits and, if mitigation is applied as suggested above, then the socio-economic benefits outweigh the residual impacts.

8.6. Existing impacts to heritage resources

There are currently no obvious threats to heritage resources along the power line route aside from the natural degradation, weathering and erosion that will affect archaeological materials. Trampling from grazing animals and/or farm/other vehicles could also occur. These impacts would be of **negligible negative** significance. The local landscape, which is generally agricultural in nature, is, as noted above, already impacted by the Sasol facility and coal mines. Although the significance of this impact could be considered as **moderate to high negative**, such facilities are an expected part of the Highveld landscape and have been for many years.

8.7. The No-Go alternative

If the project was not implemented, then the site would stay as it currently is (impact significance of **neutral**). Although the heritage impacts with implementation would be greater than the existing impacts, the loss of socio-economic benefits is more significant and suggests that the No-Go option is less desirable.

8.8. Levels of acceptable change

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time as the resource has been inspected and studied further if necessary. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many vantage points is undesirable. Because of the height of the majority of the proposed development, the relative flatness of the terrain, and the low likelihood of the project being visible from main roads, such an impact to the landscape is not envisaged.

9. IMPACT ASSESSMENT SUMMARY

The overall impact significance essentially follows the most significant impact in each phase following the implementation of the proposed mitigation measures. These are shown in Table 6.

Table 6: *Overall Impact Significance (Post Mitigation)*

Phase	**Overall Impact Significance**
Construction	Low
Operational	Very low
Decommissioning	Very low
Nature of Impact	**Overall Impact Significance**
Cumulative - Construction	Very low
Cumulative - Operational	Very low
Cumulative - Decommissioning	Very low

10. LEGISLATIVE AND PERMIT REQUIREMENTS

This report and the proposed recommendations will need to be approved by SAHRA and MPHRA. There are no further legislative requirements for the approval process under the NHRA but if archaeological (or palaeontological) mitigation is needed then the appointed archaeologist (or palaeontologist) will need to apply for and be granted a permit from SAHRA to do the work. This must be carried out well in advance of construction to ensure that there is enough time for SAHRA to approve the mitigation work before construction commences.

11. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

The actions recorded in Table 7 should be included in the Environmental Management Programme(EMPr) for the project.

Table 7: *Heritage considerations for inclusion in the EMPr.*

Impact	**Mitigation / management objectives & outcomes**	**Mitigation / management actions**	**Monitoring**		
			Methodology	**Frequency**	**Responsibility**
Impacts to archaeology and graves					
Damage or destruction of archaeological sites or graves	Rescue information, artefacts or burials before extensive damage occurs	Pre-construction survey of any as yet unsurveyed areas	Appoint archaeologist to conduct survey	Once-off	Project developer
		Reporting chance finds as early as possible, protect *in situ* and stop work in immediate area	Inform staff and carry out inspections of excavations	Ongoing basis	Construction Manager or Contractor
				Whenever on site (at least weekly)	ECO
Impacts to the cultural landscape					
Visible landscape scarring	Minimise landscape scarring	Ensure disturbance is kept to a minimum and does not exceed project requirements.	Monitoring of surface clearance relative to approved layout	Ongoing basis	Construction Manager or Contractor
				As required	ECO

		Rehabilitate areas not needed during operation.			

12. CONCLUSIONS

The primary concern for this project is the presence of graves in the Alternative 3 and 4 power line corridors. Although archaeological materials are known from the area, these are of medium-low significance and of little further concern (all currently known sites lie outside of the proposed corridors). One graveyard is located within each of the Alternative 3 and 4 corridors and the final layout will need to take account of these sites and their 50 m buffers if either of these alternatives are to be used. Destruction of known graves can be considered a fatal flaw but it is highly likely that the graveyards can be avoided by the final alignment within the assessed 200 m wide power line corridor. There are currently no concerns for Alternatives 1 and 2. From a heritage perspective, the preference is as follows:

1. Alternative 1 (most preferred);
2. Alternative 2;
3. Alternative 3; and
4. Alternative 4 (least preferred);

Figure 32 shows the known and potential graves (with 50 m buffers) that should be avoided by the proposed development.

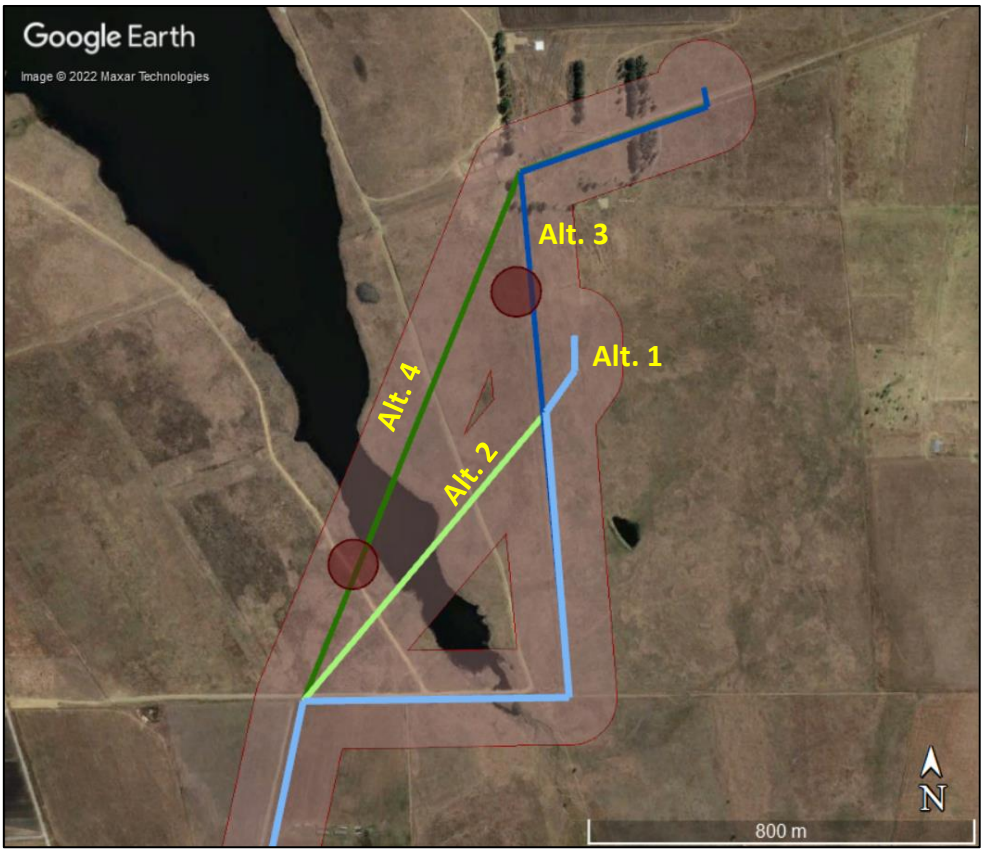


Figure 32: *Aerial view of part of the study area showing the two known graveyard locations that should be avoided*

12.1. Statement and reasoned opinion of the specialist

The vast majority of the proposed corridors is likely to be of low sensitivity but two areas within the Alternatives 3 and 4 corridors are of high sensitivity because of known graves. Despite their 50 m buffers being wholly within the corridors, these areas should still be readily avoided and, if they are, there is no reason why the development should not be allowed to proceed with Alternatives 3 or 4. However, Alternatives 1 and 2 have no significant concerns. It is thus the opinion of the heritage specialist that the proposed power line should be authorised in its entirety with any alternative, but it is noted that Alternatives 1 and 2 are strongly preferred.

13. RECOMMENDATIONS

It is recommended that the proposed power line should be authorised, but subject to the following conditions which should be incorporated into the Environmental Authorisation:

- The graves in the Alternative 3 (waypoint 179) and Alternative 4 (waypoint 182) corridors must be avoided and protected if either of these corridors are used. The power line and associated service track must be located at least 50 m from the graves.
- If Alternatives 3 or 4 are used then, before construction starts, the relevant graveyard must be fenced with a farm-style wire fence with a pedestrian gate to facilitate public access. The fence must be placed a minimum of 5 m away from all graves.
- A pre-construction survey of the final alignment must be carried out once the design is completed so as to determine whether there are any further areas requiring intervention.
- If any archaeological 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. Such heritage is the property of the state and may require excavation and curation in an approved institution.

14. REFERENCES

Beater, J. 2017. Mulalo Main Transmission Substation and Associated Power Lines Project, Secunda, Mpumalanga Province. Report prepared for Senkosi Environmental. JLB Consulting.

Crush. J. & Soutter, C. 1999. Natural Family Conditions: Narratives of stabilization and the South African Coal Mines, 1910–1970. *South African Geographical Journal* 81: 5-14.

Delius, P. 2014. The Making and Changing of Migrant Workers' Worlds (1800–2014). *African Studies* 73: 313-322.

Delius, P., Maggs, T. & Schoeman, M. 2012. Bokoni: Old structures, new paradigms? Rethinking pre-colonial society from the perspective of the stone-walled sites in Mpumalanga. *Journal of Southern African Studies* 38:399-414.

Derricourt, R.M. & Evers, T.M.1973. Robertsdrift, an Iron Age site and settlement on the banks of the Vaal and Klip rivers near Standerton, South-Eastern Transvaal. *African Studies* 32:183-193.

Esterhuysen, A. & Smith, J. 2007. The Archaeology of Mpumalanga. In: Delius, P. (ed.) *Mpumalanga History and Heritage: Recapturing the Past, Defining the Future* pp: 7-18. KwaZulu-Natal: University of KwaZulu-Natal Press.

Giliomee, H. Mbenga, B. 2007. New history of South Africa. Cape Town: Tafelberg Publishers.

Hardwick, S., Bamford, M. & Du Piesani, J. 2019. Environmental Regulatory Process to Decommssion a Conveyer Belt Servitude, Road and Quarry at Twistdraai East Colliery, Secunda, Mpumalanga Province. N.I.D. Unpublished report, Digby Wells Environmental.

Huffman, T.N. 2007. *Handbook to the Iron Age: The archaeology of pre-colonial farming societies in southern Africa*. Pietermaritzburg: University of KwaZulu-Natal Press.

Küsel, S. 2011. Cultural Heritage Resources Impact Assessment for proposed Sasol Electricity Generation from Raw Gas Cooling Erf 8488 Govan Mbeki Local Municipality Gert Sibande District Municipality Mpumalanga Province. Report prepared for SSI Engineers and Environmental Consultants. Magalieskruin: African Heritage Consultants cc.

Lombard, M., Wadley, L., Deacon, J., Wurz, S. Parsons, I., Moleboheng, M., Swart, J. & Mitchell, P.J. 2012. South African and Lesotho Stone Age sequence updated. *South African Archaeological Bulletin* 67: 120-144.

Mathu, K. & Chinomona, R. 2013. South African coal mining industry: Socio-economic attributes. *Mediterranean Journal of Social Sciences* 4: 337-357.

Mitchell, P.J. 2002. *The Archaeology of southern Africa*. Cape Town: Cambridge University Press.

Pistorius, C.C.J. 2008. A Phase I Heritage Impact Assessment (HIA) study for Sasol's proposed new gas and liquid pipelines (along a corridor) from Sasol Synfuels in Secunda (Mpumalanga) to Sasol Infrachem and Natref in Sasolburg (Free State) on the Highveld in the Republic of South Africa. Report prepared for Nature and Business Alliance Africa (Pty) Ltd.

Pistorius, C.C.J. 2020. A Phase I Heritage Impact Assessment Study for The Shondoni and Middelbult Mining Areas Near Secunda in the Mpumalanga Province. Report prepared for JMA Consulting (Pty) Ltd. Rustenburg: Dr Julius CC Pistorius.

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

Schirmer, S. 2007. Enterprise and exploitation in the 20th century. In: P. Delius, ed. *Mpumalanga History and Heritage: Recapturing the Past, Defining the Future*. Scottsville: University of KwaZulu-Natal Press, pp. 291-350.

Schlebusch, C.M. Prins, F. Lombard, M. Jakobsson, M. & Soodyall, H. 2016. The disappearing San of south-eastern Africa and their genetic affinities. *Human Genetics* 135: 1365-1373.

Van Schalkwyk, J.A. 1998. A Survey of Cultural Resources for Secunda Collieries Block 5 And Syferfontein Mining Area Highveld Ridge District, Mpumalanga. Report prepared for Walmsley Environmental Consultants. Sunnyside: National Cultural History Museum.

Van Vollenhoven, A.C. & Pelser, A.J. 2010. A Report on a Heritage Impact Assessment the Proposed Secunda X 52 Industrial Township, Mpumalanga Province. Report prepared for The African Planning Partnership. Groenkloof: Archaetnos Culture & Cultural Resource Consultants.

APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 23 Dover Road, Muizenberg, 7945
Telephone: (021) 788 1025
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 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- 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)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

➢ ***Memberships and affiliations:***

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 – 2017
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience 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:

Feasibility studies:
- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:
- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - 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 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:
- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- 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

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

APPENDIX 2 – Site Sensitivity Verification

As required in Part A of the Government Gazette 43110, GN 320, a site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area. The details of the site sensitivity verification are noted below:

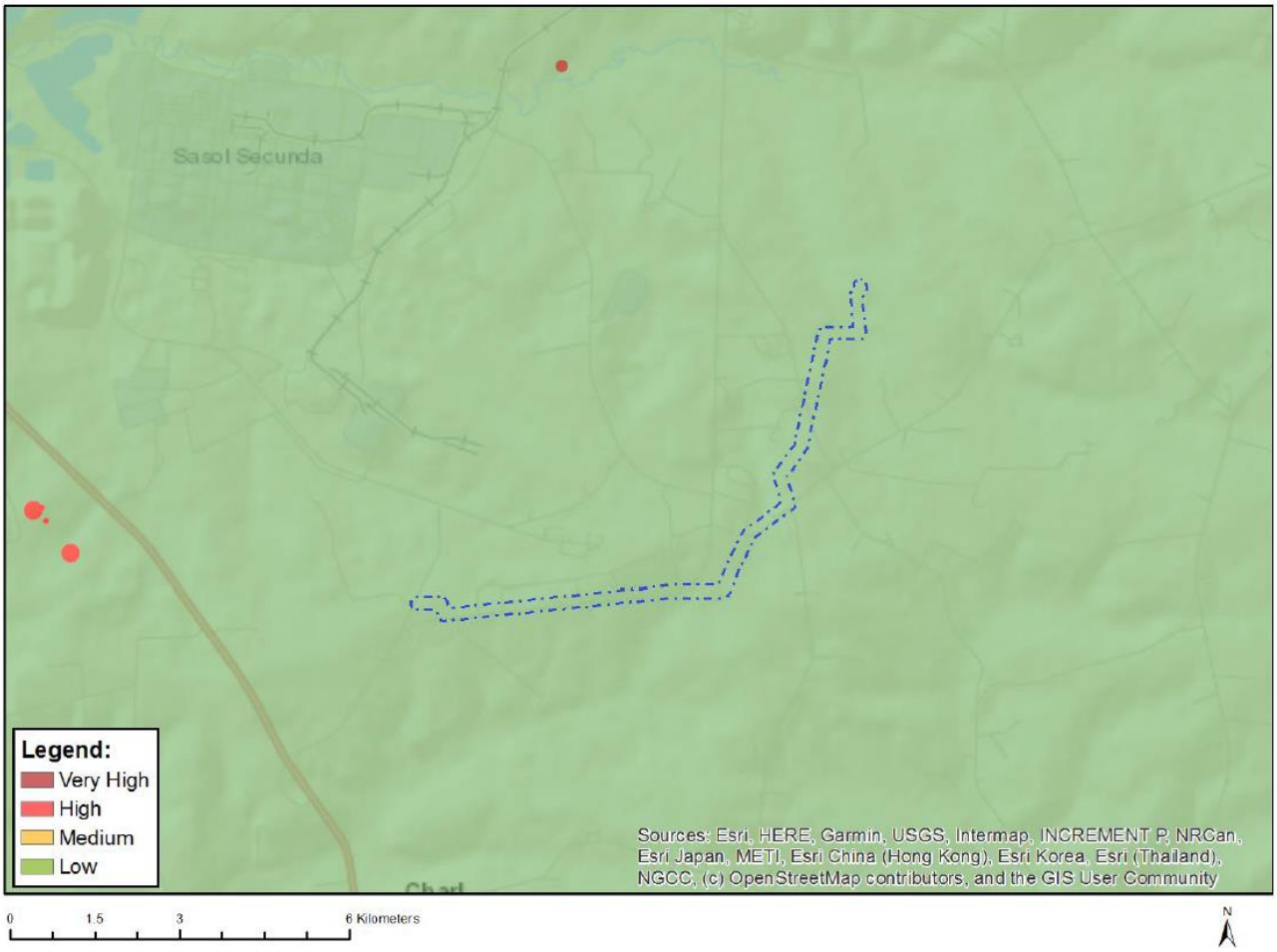
Date of Site Visit	10, 11, 12 and 17 November 2021, and 24 and 25 March 2022 and 01 April 2022
Specialist Name	Jaco van der Walt
Professional Registration Number	Association of Southern African Professional Archaeologists (ASAPA): 159 Association of Professional Heritage Practitioners (APHP): 114
Specialist Affiliation / Company	Beyond Heritage

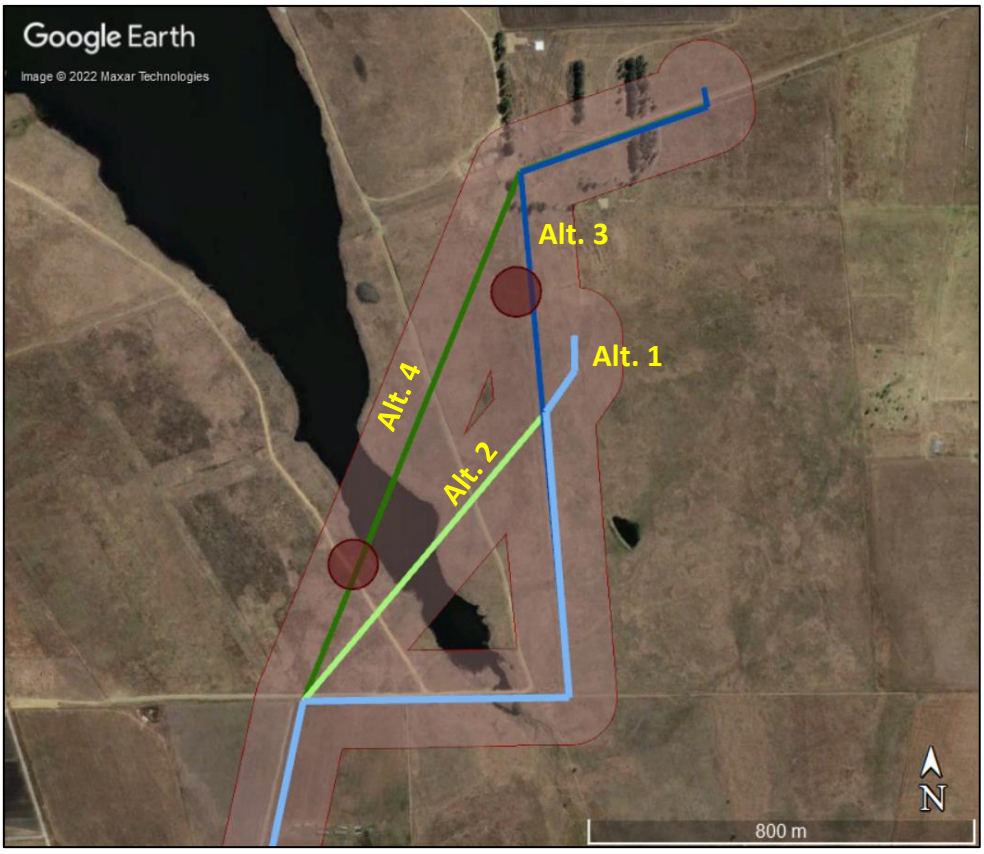
Method of the Site Sensitivity Verification

Initial work was carried out using satellite aerial photography in combination with the authors' accumulated knowledge of the local landscape. This was used to identify potentially sensitive areas. Although fieldwork was not done specifically for this project, the work in the adjacent Renewable Energy Facilities (REFs) assisted with identifying landscape features likely to be sensitive. Desktop research was also used to inform on the heritage context of the area. This information is presented in the report (Sections 5.2.1 and 5.4.1).

Outcome

The map below is extracted from the screening tool report and shows the archaeological and heritage sensitivity to be low throughout the wider study area. The site visits to the adjacent REFs showed that while most of the power line corridor is of low sensitivity, small pockets (where confirmed graves and possible graves occur) are of very high sensitivity. The Screening Tool map is thus largely correct but specific points of very high sensitivity do occur. The second map below shows the areas considered to be very highly sensitive in the north-eastern part of the corridor. The remainder of the corridor is deemed to be of low sensitivity. A photographic record and description of the relevant heritage resource is contained within the impact assessment report.


Sasol Secunda
Legend:
Very High
High
Medium
Low
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
0
1.5
3
6 Kilometers
N


Google Earth
Image © 2022 Maxar Technologies
Alt. 3
Alt. 1
Alt. 4
Alt. 2
N
800 m

Palaeontological Impact Assessment – Ver2

Proposed Development of a 132 kV Overhead Power Line and Associated Electrical Grid Infrastructure to support the Proposed Vhuvhili Solar Photovoltaic Energy Facility, near Secunda, Mpumalanga Province

Prepared by: Marion Bamford – revised 09 October 2022

Executive Summary

Vhuvhili Solar RF (Pty) Ltd proposes the construction of a 132 kV overhead transmission power line and associated EGI to feed the electricity generated by the proposed Vhuvhili SEF to the switching station at the proposed Mukondeleli WEF. The electricity will be transferred from the proposed on-site substation at the proposed Vhuvhili SEF via a 132 kV power line that extends approximately 12 km in length to the proposed switching station at the proposed Mukondeleli WEF. The project is south of Secunda, Mpumalanga Province.

This report is for the palaeontological impact. Both the Mukondeleli on-site switching station connections (including both alternatives) and the proposed 132 kV power line (including all four alternatives) connecting the Vhuvhili SEF to the Mukondeleli WEF are on non-fossiliferous dolerite of the Jurassic so there is no impact on the palaeontology.

The Mukondeleli WEF switching station and the grid connection route to the Vhuvhili SEF complex will have no impact on the palaeontology. The proposed Vhuvhili on-site substations and hub connections (four alternatives) are on potentially very highly sensitive rocks of the Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve fossil plants of the *Glossopteris* flora. No fossils are likely to occur in the overlying soils but might occur below ground in undisturbed shales but would only be discovered once excavations commence. Mitigation would be the removal of any fossils found once excavations commence. The impact would only be during the construction phase. The impact before mitigation is low, and the impact post-mitigation is very low.

There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed power line project (all four alternative routings) on condition that (i) the recommended mitigation measures and (ii) the Fossil Chance Finds Protocol are implemented in full during the Construction Phase.

Table of Contents

List of Figures

List of Synonyms

EGI – Electrical Grid Infrastructure
PIA – Palaeontological Impact Assessment
SEF – Solar Energy Facility
WEF – Wind Energy Facility

1. Background and Project Description

Vhuvhili Solar RF (Pty) Ltd, the Applicant, is proposing the construction of a 132 kV overhead transmission power line and associated EGI to feed the electricity generated by the proposed Vhuvhili SEF to the switching station at the proposed Mukondeleli WEF. The electricity will be transferred from the proposed on-site substation at the proposed Vhuvhili SEF via a 132 kV power line that extends approximately 12 km in length to the proposed switching station at the proposed Mukondeleli WEF.

.

- It is important to note that this Basic Assessment (BA) process only includes the assessment of the proposed 132 kV power line to transfer the electricity from the proposed Vhuvhili SEF to the proposed Mukondeleli WEF switching station. The proposed Vhuvhili SEF, including the on-site substation and Battery Energy Storage System (BESS), is subject to a separate Scoping and Environmental Impact Assessment (S&EIA) process which is currently underway (DARDLEA NEAS Reference Number: MPP/EIA/0001063/2022). The proposed Mukondeleli WEF, including the on-site switching station to which the proposed 132 kV power line will connect, is also subject to a separate S&EIA process (NEAS: MPP/EIA/0001099/2022), as summarised below.

Table 1: Details of this BA process and related S&EIA processes underway

Project	**Process**	**Authority Reference Number**	**EAP**	**Status**	**Subject of this application and BA process**
Proposed Vhuvhili-to-Mukondeleli 132 kV power line and associated EGI	BA	To be assigned	Paul Lochner (CSIR) (EAP 2019/745)	Application submitted	Yes
Proposed Vhuvhili SEF Proposed on-site substation and BESS complex at the proposed Vhuvhili SEF site	S&EIA	NEAS: MPP/EIA/0001063/2022	Paul Lochner (CSIR) (EAP 2019/745)	Application and Final Scoping Report submitted	No
Proposed Mukondeleli WEF Proposed switching station at the proposed Mukondeleli WEF site	S&EIA	NEAS: MPP/EIA/0001099/2022	WSP	WEF Draft Scoping Report out for public comment	No

- The Project Applicant is currently investigating four power line routing alternatives for the transfer of the electricity generated by the proposed Vhuvhili SEF to the switching station at the proposed Mukondeleli WEF. Please refer to Figure 1 for the power line routing alternatives that are assessed as part of this BA process. The Figure also includes the preferred and alternative substation and BESS complexes at the proposed Vhuvhili SEF site and the two switching station alternatives at the proposed Mukondeleli WEF site.

- This study will assess A: the four short grid connections associated with the Vhuvhili on-site substation alternatives, C: the long route between Vhuvhili and Mukondeleli, and B: the two short routes for the grid connection to the alternatives for the Mukondeleli switching stations.

A.1 - Proposed alternatives should the Vhuvhili on-site substation hub A-B (Preferred) be built:

- *Alternative 1 (Preferred) (A to E as marked in Figure 1)*

  - This is the Preferred power line routing should the proposed Preferred on-site substation hub A-B at the Vhuvhili SEF site be built. The proposed 132 kV power line will extend from the Preferred on-site substation hub at the proposed Vhuvhili SEF site to switching station E at the proposed Mukondeleli WEF site.

- *Alternative 2 (A to F as marked in Figure 1)*

  - Alternative proposed 132 kV power line that will extend from the Preferred on-site substation hub A-B at the proposed Vhuvhili SEF site to switching station F at the proposed Mukondeleli WEF site.

A.2 - Proposed alternatives should the Vhuvhili on-site substation hub C-D (Alternative 2) be built:

- *Alternative 3 (Preferred) (C to E as marked in Figure 1)*

  - This is the Preferred power line routing should the proposed Alternative 2 on-site substation hub C-D at the Vhuvhili SEF site be built. The proposed 132 kV power line will extend from the Alternative 2 on-site substation hub at the proposed Vhuvhili SEF site to switching station E at the proposed Mukondeleli WEF site.

- *Alternative 4 (C to F as marked in Figure 1)*

  - Alternative proposed 132 kV power line that will extend from the Alternative 2 on-site substation hub C-D at the proposed Vhuvhili SEF site to switching station F at the proposed Mukondeleli WEF site.

B – Proposed 132 kV overhead power line, approximately 12 km in length, from the Vhuvhili SEF onsite substation to the Mukondeleli WEF switching station.

- As explained above, a 132 kV power line of approximately 12 km is proposed to feed electricity from the on-site substation hub at the proposed Vhuvhili SEF to the switching station at the proposed Mukondeleli WEF. The Applicant provided four power line routing alternatives that are linked to the locality of the Vhuvhili on-site substation infrastructure as the starting point of the proposed power line, and the Mukondeleli switching station infrastructure as the end point of the proposed power line. The proposed power line will be supported by monopole or steel lattice pylons, or a combination of both where required. The choice of pylon type will depend on whether the pylons will be placed within a straight section within the power line corridor or at bends, as well as how sharp the bend is.

- The type of pylon to be used depends on the topography and the alignment of the power line corridor. In general, monopole-type pylons are used for transmission lines with shorter spans, whereas steel lattice-type pylons are only used where long spans (>500m) across valleys and rivers are required.

- Insulators will be used to connect the conductors to the towers. The span lengths are estimated to range between 200 m and 300 m. The exact specifications of the proposed pylon component will be determined during the detailed engineering phase and that the information provided below is seen as the worst-case scenario.

- As noted above, the power line will be constructed within the assessed 200 m wide EGI corridor.

- Underground power lines are not feasible because of technical losses involved with large lengths of underground cables and high costs. Maintenance is also easier on suspended power lines in comparison to underground cables, the latter of which would also result in more terrestrial disturbance.

C – Proposed alternatives for the routes to the Mukondeleli switching station

Alternative 1 (E on Figure 1)

Alternative 2 (F on Figure 1)

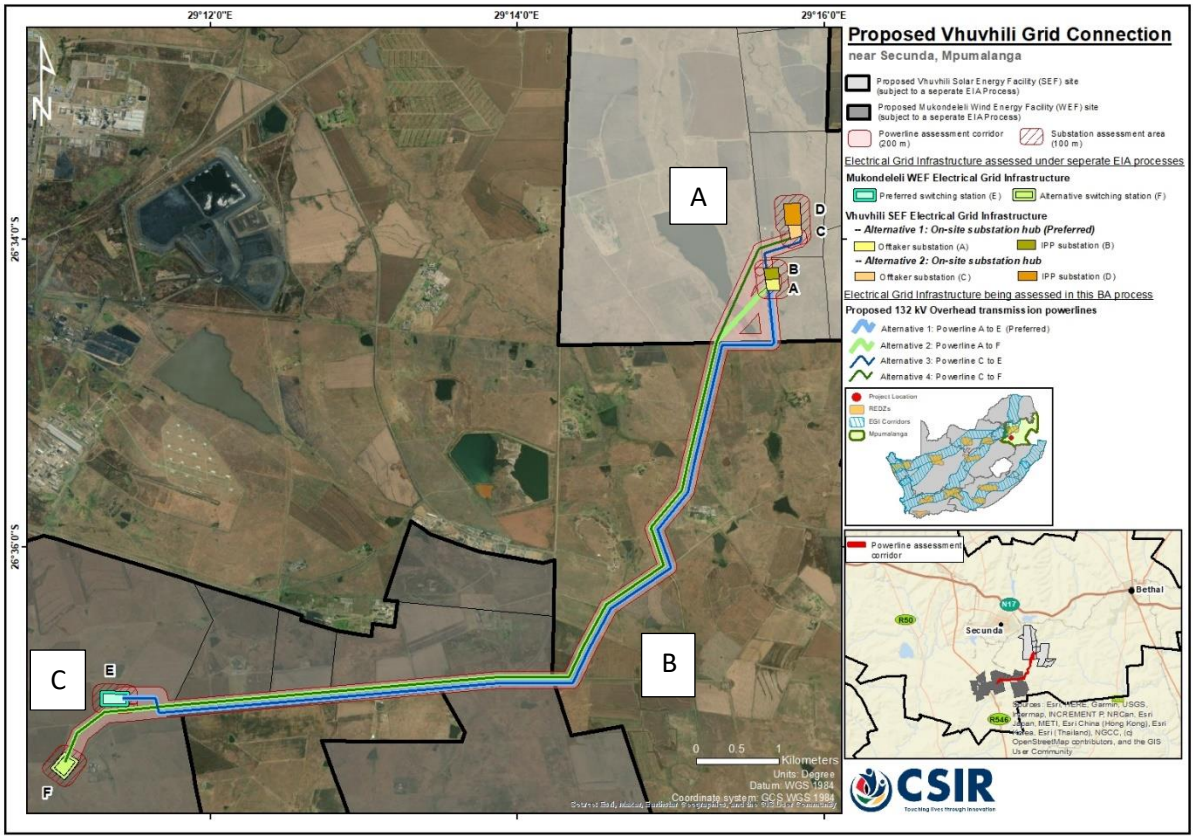


Figure 1: Locality map showing the proposed 132 kV overhead power line routing alternatives that extend from the proposed Vhuvhili SEF (subject of a separate S&EIA process) to the proposed Mukondeleli WEF (subject of a separate S&EIA process). A-B-C refer to the sections as divided for the palaeontology.

A description of the key components of the proposed power line and EGI project is provided in Table 2 below. It is important to note at the outset that the exact specifications of the proposed project components will be determined during the detailed engineering phase (subsequent to the issuing of EA, should such authorisation be granted for the proposed power line and EGI project) but that the information provided below is seen as the worst-case scenario for the proposed power line project.

Table 2: Description of the project components for the proposed 132 kV overhead power line and associated EGI

Component	Description
Power line/pylon height	Up to 40 m
Power line length	Approx. 12 km
Power line capacity	Up to 132 kV
Minimum conductor ground clearance	Approx. 8.1 m
Distance between conductors	Between 2.4 m and 3.8 m
Pylon type	Monopole or steel lattice pylons, or combination of both where required.
Servitude width	Once built, the registered servitude will be up to 32 m wide in line with guideline and requirements for 132 kV power lines stipulated in the 2011 Eskom Distribution Guide Part 19. Note that the entire servitude will not be cleared of vegetation. Vegetation clearance within the servitude will be undertaken in compliance with relevant standards and specifications. Specialists were required to assess an approximately 200 m wide power line corridor (100 m on either side of the centre line).
Associated Infrastructure	
Service roads	There are a number of existing gravel farm roads (some just jeep tracks) with widths ranging between 4 m and 5 m located around and within the proposed Vhuvhili power line corridor. A service road of approximately 5 m wide will be required below the power line.
Proximity to grid connection	The proposed 132 kV overhead power line will extend approximately 12 km from proposed Vhuvhili SEF to a switching station at the proposed Mukondeleli WEF site.

Overview of the Project Development Cycle

The proposed project can be divided into the following three main phases:

- Construction Phase; - relevant to the palaeontology
- Operational Phase; (not relevant) and
- Decommissioning Phase (not relevant).

Only the Construction Phase is relevant to the palaeontological impact because this is when the ground will be broken and if fossils are present they could be destroyed – or removed (mitigation). Thereafter, there would be no further impact on the palaeontology.

- **Construction Phase**

The construction phase will take place subsequent to the issuing of an EA from the Competent Authority (i.e., the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs [DARDLEA]) and once the commercial agreements have been concluded with a suitable off-taker, which could either be private off-takers (such as Sasol) or via a public procurement programme (such as the Renewable Energy Independent Power Producer Programme [REIPPPP]). The construction phase for the proposed 132 kV overhead power line and associated EGI project is expected to be up to 24 months.

The main activities that are proposed to take place during the construction phase will entail:

- Site preparations, construction of servitude access and detailed geotechnical investigations of the power line servitude and grid corridor footprint;
- Preparation of a detailed layout of the grid connection infrastructure;
- Removal of vegetation within the power line servitude and substation site for the placement of pylons and EGI, where necessary;
- Stockpiling of topsoil and vegetation will be retained for replanting, where necessary;
- Establishment of a temporary laydown area for storage of construction equipment and machinery;
- Excavations of pylon infrastructure and associated anchorage, as well as busbar foundations;
- Onsite assembly and erection of pylon tower sections and stringing of the power line cables; and
- Rehabilitation of disturbed areas and removal of equipment and machinery following completion of power line construction.

The construction phase will also involve the transportation of personnel, construction materials and equipment to and from the site. All efforts will be made to ensure that all construction work will be undertaken in compliance with local, provincial and national legislation, local and international best practice, as well as the approved EMPr that has been compiled and appended to the BA Report. An independent Environmental Control Officer (ECO) will be appointed during the construction phase and will monitor compliance with the recommendations and conditions of the EMPr and EA, respectively.

- **Electricity Requirements**

In terms of electricity supply during the construction phase, the Project Developer will make use of generators on site.

The proposed EGI will consist of the components listed below. It is important to note at the outset that the exact specifications of the proposed project components will only be determined during the detailed engineering phase prior to construction (subsequent to the issuing of an EA), should such an authorisation be granted for the proposed project, but that the information provided below is seen as the worst-case scenario for the project. It is however important to note that these

specifications are subject to change as the BA process progresses. Any changes will be communicated to the specialists to update their specialist assessments and reports accordingly.

Table 2: Electricity requirements for the Construction Phase

Power line capacity:	132kV power line (single circuit or double circuit)
Power line corridor length	Approx. 12km
Power line corridors width	200m (100m on either side of centre line)
Power line servitude (once built)	32m
Power line pylons	Monopole or Lattice pylons, or a combination of both where required
Power line pylon height	Maximum 40m
Minimum conductor ground clearance	Approx. 8.1m
Distance between conductors	Between 2.4m and 3.8m
Battery and substation complex	A 100m buffer must be assessed around the approximately 2 hectare battery and substation complex which comprises the BESS, the 33/132 kV step-down SS and a collector SS.

Legislation for Palaeontology

A Palaeontological Impact Assessment was requested for the Vhuvhili EGI project. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 3: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report,	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page **Error! Bookmark not defined.**
c	An indication of the scope of, and the purpose for which, the report was prepared	Section **Error! Reference source not found.**

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Page 1
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 0
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section **Error! Reference source not found.**
k	Any mitigation measures for inclusion in the EMPr	Section 5, Appendix A
l	Any conditions for inclusion in the environmental authorisation	Section 5
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 6, 7
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
r	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

3i. Project location and geological context

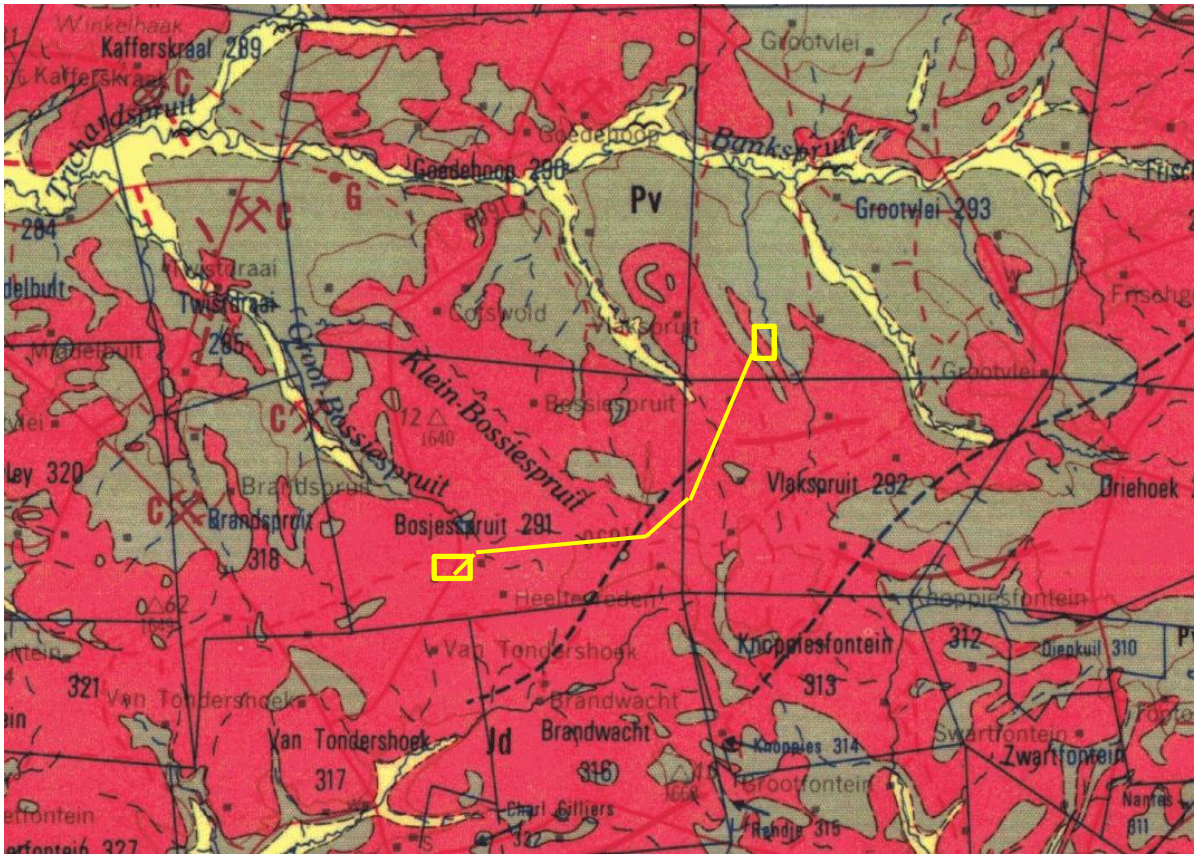


Figure 2: Geological map of the area around Secunda and the Vhuvhili EGI. The location of the proposed project is indicated within the yellow rectangles. Abbreviations of the rock types are explained in Table 4. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

Table 4: Explanation of symbols for the geological map and approximate ages (2006. Johnson et al., 2006; Partridge et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Quaternary ca 1.0 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 183 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shale, siltstone, sandstone, coal seams	Early Permian Ca 280-270 Ma

The project lies in the central part of the Karoo Basin where the older rocks of the Ecca Group are exposed. They are intruded by the non-fossiliferous igneous rocks, the dolerite dykes of Jurassic age. Along the rivers and streams, much younger transported alluvium and sands overlie the older rocks.

During the Late Carboniferous and Early Permian times (ca 300-250 million years ago) Africa was part of the continental landmass known as Gondwanaland. Southern Africa was positioned over the South Pole and was covered by a number of ice-sheets. These melted as the landmass moved slowly northwards and the sediments deposited from the ice sheets formed the Dwyka Group, the basal group of the Karoo Supergroup. Over time the large inland Karoo Sea filled with sediments and shrank. Overlying the Dwyka Group tillites and diamictites are the Ecca Group shales and sandstones that include coal seams formed by the buried peats that were the result of a very lush flora that had become established on the deltas and flood plains around the Karoo Sea. The next layers of infilling shales and sandstones are called the Beaufort Group, followed by the Stormberg Group as the sea shrank while the basin filled. Finally, all these sediments were capped by the massive basaltic outpourings of the Drakensberg Group. Associated with these eruptions are numerous dykes and sills that have intruded through the Karoo Group sediments. This signalled the end of the Karoo Supergroup. Since the underlying rocks, mostly the Transvaal Supergroup in the north and the Namaqua-Natal Group in the south, formed an undulating topography, as well as the flexure of this forearc basin, the Karoo sediments are not continuous across the basin. In particular, the coal seams are discontinuous because of the above, but also because the local setting and varied plant distributions affect the type and thickness of coal seams (Plumstead, 1969; McRae, 1999; McCarthy and Rubidge, 2005; Johnson et al., 2006).

Coal seams are layers of peat that have been buried and altered by temperature from geothermal energy, and pressure from the increasing overburden. The original plant matter that formed the peats is no longer distinguishable but impressions and compressions of plants can be preserved in the carbonaceous shales and siltstones between, above and below the coal seams. These Permian plants belong to the *Glossopteris* flora that includes *Glossopteris* leaves, seeds, reproductive structures, wood and roots, as well other plants such as lycopods, sphenophytes, ferns, cordaitales and early gymnosperms (Plumstead, 1969, Anderson et al., 1999).

Plants were diverse and abundant but during the early Permian there were very few vertebrates present as they evolved in the later Permian. In addition, for the preservation of fossil plants to occur requires reducing and anoxic environments, while bones can tolerate more oxidising environment. Therefore, one seldom finds fossil plants and animals in the same site (Cowan, 1995).

3ii. Palaeontology of the project footprint

The rocks present are those of the Jurassic dolerite dykes that do not preserve any fossils because they are of volcanic origin, and the Vryheid Formation shales that might preserve fossils of the *Glossopteris* flora associated with the coal seams. All these rocks are covered by modern soils; in some cases, they are quite deep and cultivated. Soils do not preserve fossils because they are formed by weathered sediments and organic matter.

In this area, known as the Highveld Coalfield, the uppermost seam, No 5, is more than 30 m below the surface (Kriel, Fig 16 in Snyman, 1998) and is covered by soil, interbedded shale and sandstone. No fossils are likely to occur in the sandstone as it is too coarse-grained but plant impressions might occur in the shales.

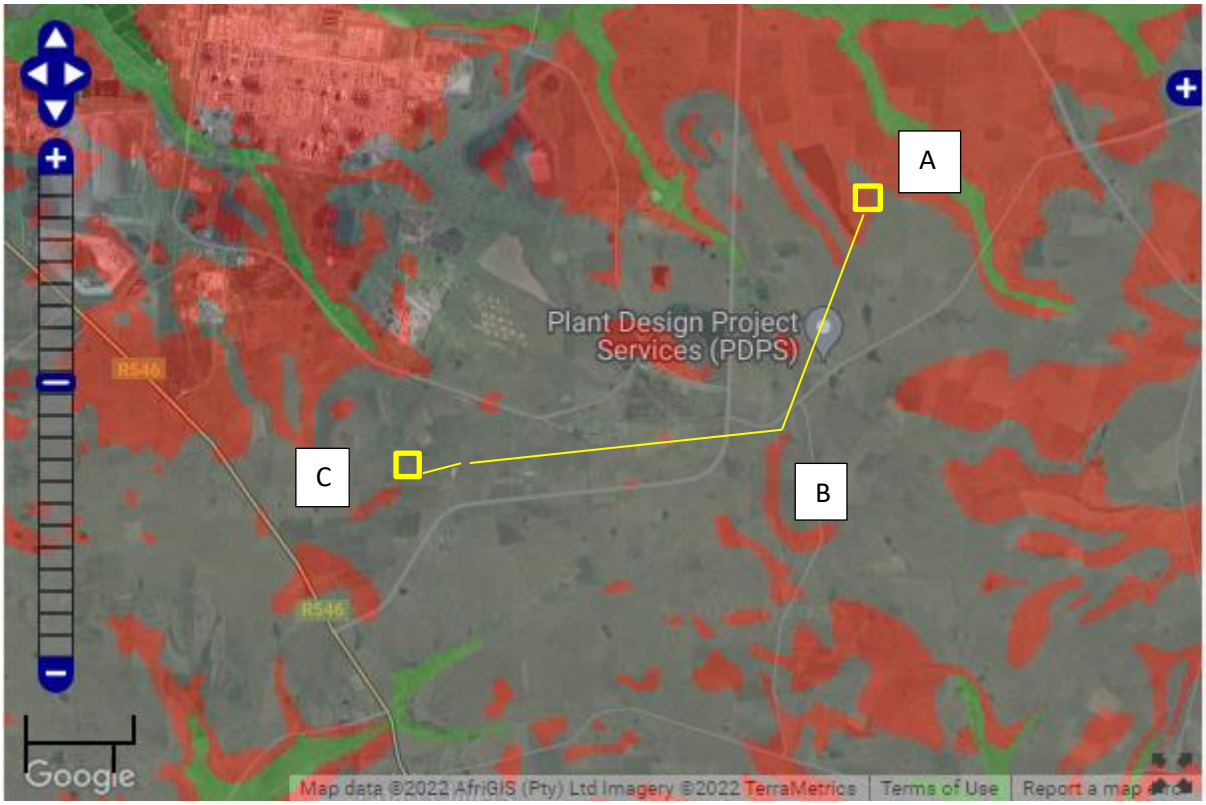


Figure 3: SAHRIS palaeosensitivity map for the proposed Vhuvhili EGI and overhead power line (OHPL) to Mukondeleli WEF shown by the yellow outlines. A = grid connections from Vhuvhili on-site Substation to the main OHLP; B = main OHPL route; C = grid connections to the Mukondeleli switching station. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

It should be noted that the proposed Mukondeleli WEF in the southwest have zero palaeosensitivity (Figures 3-5) while the proposed Vhuvhili SEF and EGI are partly on very highly sensitive rocks.

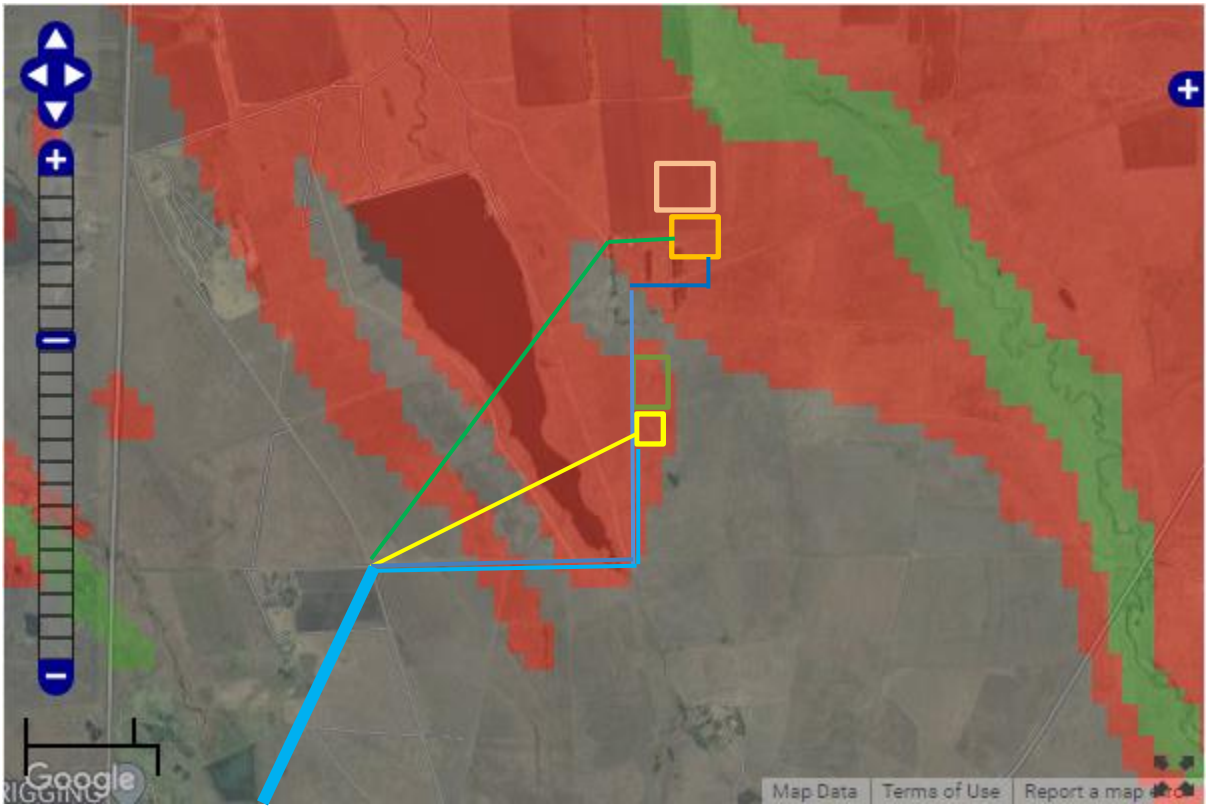


Figure 4: SAHRIS palaeosensitivity map for the proposed Vhuvhili EGI routes for the Vhuvhili on-site substation alternates A-D (cluster A). Line colours as in Figure 1. Background colours as in Figure 3.

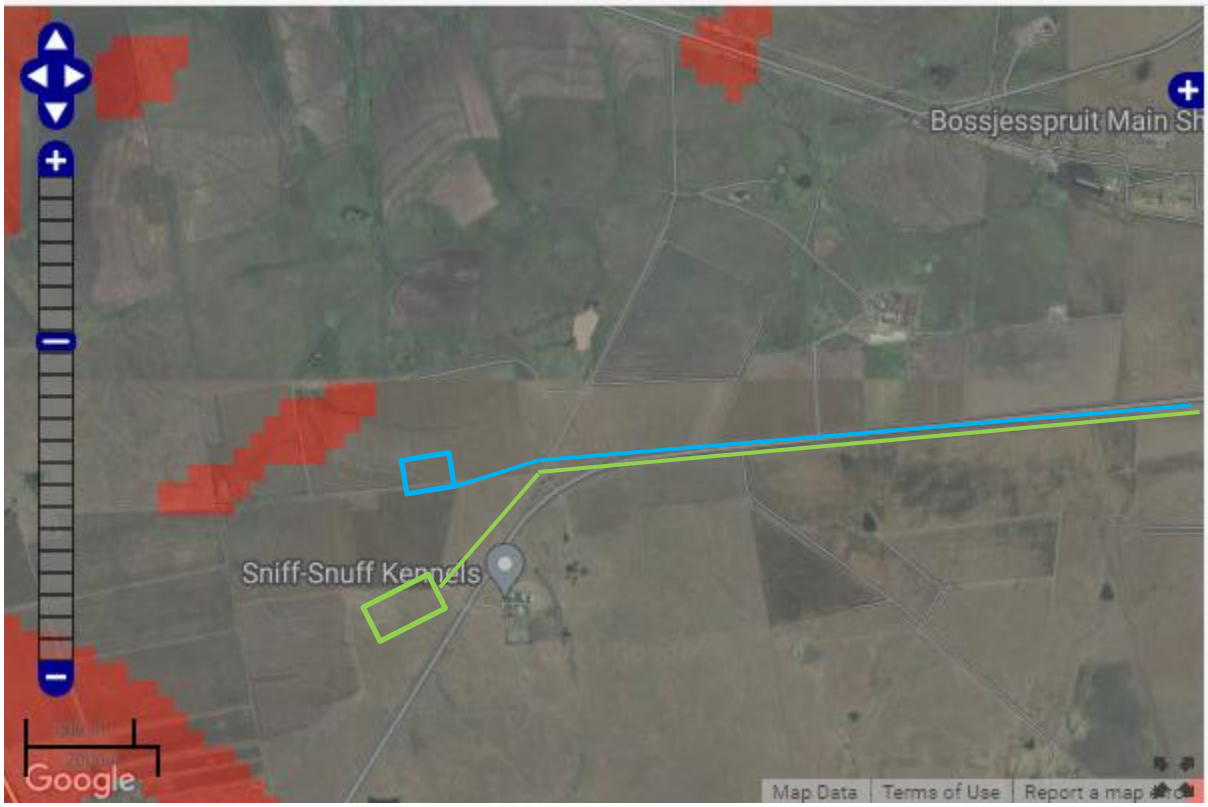


Figure 5: SAHRIS palaeosensitivity map for the proposed Vhuvhili EGI routes for the Mukondeleli switching station alternates E-F (cluster C). Line colours as in Figure 1. Background colours as in Figure 3. Note all zero sensitivity (grey)

4 – Impact Assessment

Specialist Impact Assessment Criteria

The identification of potential impacts includes impacts that may occur during the construction, operational and decommissioning phases of the proposed development. The assessment of impacts includes direct, indirect as well as cumulative impacts.

In order to identify potential impacts (both positive and negative) it is important that the nature of the proposed activity is well understood so that the impacts associated with the activity can be understood. The process of identification and assessment of impacts will include:

- Determine the current environmental conditions in sufficient detail so that there is a baseline against which impacts can be identified and measured;
- Determine future changes to the environment that will occur if the activity does not proceed;
- An understanding of the activity in sufficient detail to understand its consequences; and
- The identification of significant impacts which are likely to occur if the activity is undertaken.

The impact assessment methodology has been aligned with the requirements for BA Reports as stipulated in Appendix 1 (3) (j) of the 2014 EIA Regulations, which states the following:

“A BA Report must contain the information that is necessary for the Competent Authority to consider and come to a decision on the application, and must include an assessment of each identified potentially significant impact and risk, including –

- (i) cumulative impacts;
- (ii) the nature, significance and consequences of the impact and risk;
- (iii) the extent and duration of the impact and risk;
- (iv) the probability of the impact and risk occurring;
- (v) the degree to which the impact and risk can be reversed;
- (vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and
- (vii) the degree to which the impact and risk can be mitigated”.

As per DEA *Guideline 5: Assessment of Alternatives and Impacts* the following methodology is to be applied to the prediction and assessment of impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:

- **Direct impacts** on our fossil heritage will occur only during the construction phase but only if there are fossils present in the site of each foundation or excavation, i.e. not between the substations or between the power line poles.
- **Cumulative impacts** are not relevant because each site is unique and may or may not have any fossils below ground. Once fossils have been destroyed or removed there can be no additional impact as it is finite. **Note from the CSIR: A separate list and map will be provided**

to the specialist in order to provide a list of other projects that need to be considered as part of the assessment.

- **Nature of impact** – the damage or destruction of fossils could happen if any fossils occur in the rocks that will be excavated for foundations, piping, and amenities. Fossils are part of our National Heritage and provide evidence of past life and environments so they are of scientific interest with respect to evolutionary processes, past ecosystems and biodiversity. By understanding the interaction between plants, animals and climate, we can better understand and plan for future climate change.

- **Spatial extent** – The size of the area that will be affected by the risk/impact:
  - Site specific; only the area that will be excavated is relevant for palaeontology because fossils can be in isolated areas, or lots of fossils (usually plants) can occur in layers over wide areas, such as in the shales associated with coal seams. In the latter setting, the fossils are likely to be all from the same flora.

- **Duration** – The timeframe during which the risk/impact will be experienced:
  - Very short term (instantaneous); fossils are not living so if damaged or destroyed this is a finite event.

- **Reversibility of impacts** - the extent to which the impacts/risks are reversible assuming that the project has reached the end of its life cycle (decommissioning phase) will be:
  - The reversibility is moderate with mitigation because fossils can be removed when they are found, donated to a research centre of museum and protected for future generations or for research;
  - Low reversibility of impacts; or

- **Irreplaceability of resource loss caused by impacts** – the degree to which the impact causes irreplaceable loss of resources assuming that the project has reached the end of its life cycle (decommissioning phase) will be:
  - Moderate irreplaceability of resources; although the individual fossil is not replaceable, in this formation the fossil plants, when present, are numerous. Mitigation and collection of fossils will have a positive impact on the science.

Using the criteria above, the impacts will further be assessed in terms of the following:

- **Consequence** – The anticipated severity of the impact:
  - Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected). Fossils do not affect the modern environment.

- **Probability** – The probability of the impact occurring:
  - Very unlikely (<30% chance of occurring); it is very unlikely that fossils occur in the covering soils and sandstones that will be excavated, but there is small chance that fossils may occur below the ground surface in the shales (probably several metres below the surface).

- **Significance** – Pre-mitigation the consequence is moderate and the probability is very unlikely which gives a significance of moderate (4). Post-mitigation where any fossils occurring are

removed and rescued, the significance is reduced to a very low risk/impact (5). The significance is rated qualitatively as follows against a predefined set of criteria (i.e. probability and consequence) as indicated in Figure 6:

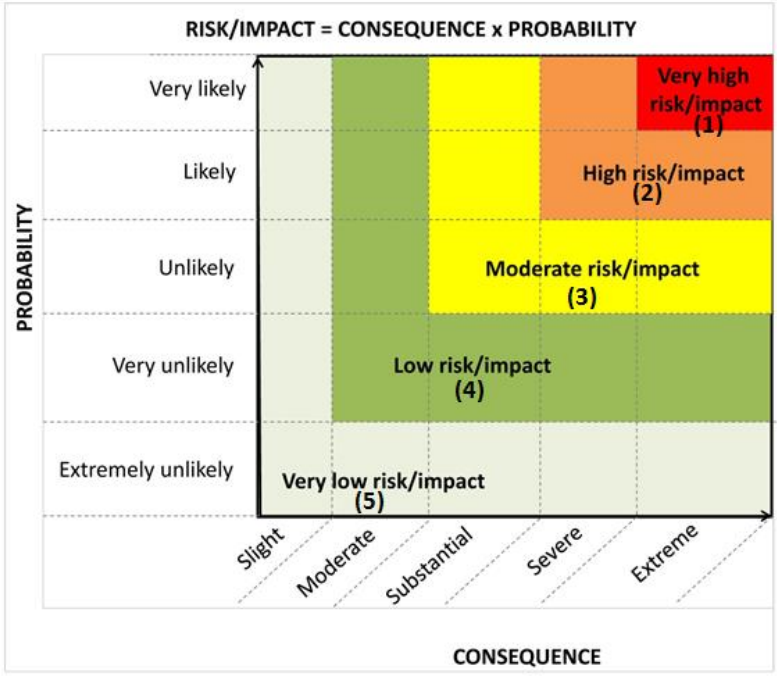


Figure 6: Guide to assessing risk/impact significance as a result of consequence and probability.

- **Significance** – Will the impact cause a notable alteration of the environment?
  - Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making);
  - Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated);
  - High (the risk/impacts will result in a major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making); or
  - Very high (the risk/impacts will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).

With the implementation of mitigation measures, the residual impacts/risks must be ranked as follows in terms of significance:

  - Very low = 5;
  - Low = 4;
  - Moderate = 3;

- High = 2; and
- Very high = 1.

- **Status** - Whether the impact on the overall environment (social, biophysical and economic) will be:
  - Neutral - environment overall will not be affected. Loss of fossils will not affect the environment but would only be a loss to science and heritage so have a minor social impact.

- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge:
  - High because the geology is well mapped and from the literature and experience we know that fossils do not occur in overlying soils, and are only sporadically distributed in the shales. Mitigation (collection of fossils) would have a positive scientific and social impact.

Impacts will then be collated into an EMPr and these will include the following:

Collation of impacts for the EMPr.

Any impact on the palaeontology will occur only during the construction phase. No fossils will occur in the overlying soils but they might be present below ground but this is unknown until the rocks are broken open during the excavations for foundations for poles, substations and infrastructure. Monitoring of the rocks excavated by the responsible person, then mitigation in the form of rescuing and collection of fossils means they will not all be destroyed but will be preserved for future generations and scientific research (See Fossil Chance Find Protocol in Section 5)

Once the fossils, if present, have been removed then there would be no impact during operation or decommissioning phase.

.

Table 6 Table for rating of impacts – Palaeontology of the three components A-B-C

Vhuvhili on-site substation connections – Alternatives 1 and 2; 3 and 4						
Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
Construction Phase						
Damage or destruction of palaeontological materials in excavations	Status	Neutral	Low	Removal of all fossils on discovery	Very low	High
	Spatial extent	Site only				
	Duration	Very short				
	Consequence	Moderate				
	Probability	Very unlikely				
	Reversibility	Reversible				
	Irreplaceability	Moderate				
Operational Phase						
Damage or destruction of palaeontological materials	Status		None	None	None	
	Spatial extent					
	Duration					
	Consequence					

	Probability					
	Reversibility					
	Irreplaceability					
Decommissioning Phase						
Damage or destruction of palaeontological materials	Status		None	None	None	
	Spatial extent					
	Duration					
	Consequence					
	Probability					
	Reversibility					
	Irreplaceability					

EGI power line route between Vhuvhili and Mukondeleli						
Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
Construction Phase						
Damage or destruction of palaeontological materials in excavations	Status	Neutral	None	Removal of all fossils on discovery	None	High
	Spatial extent	Site only				
	Duration	Very short				
	Consequence	Moderate				
	Probability	Very unlikely				
	Reversibility	Reversible				
	Irreplaceability	Moderate				
Operational Phase						
Damage or destruction of palaeontological materials	Status		None	None	None	
	Spatial extent					
	Duration					
	Consequence					
	Probability					
	Reversibility					
	Irreplaceability					
Decommissioning Phase						
Damage or destruction of palaeontological materials	Status		None	None	None	
	Spatial extent					
	Duration					
	Consequence					
	Probability					
	Reversibility					
	Irreplaceability					

Mukondeleli switching station connections – Alternatives 1 and 2						
Impact	***Impact Criteria***		***Significance and Ranking (Pre-Mitigation)***	***Potential mitigation measures***	***Significance and Ranking (Post-Mitigation)***	***Confidence Level***
Construction Phase						
Damage or destruction of palaeontological	Status	Neutral	None	Removal of all fossils on discovery	None	High
	Spatial extent	Site only				
	Duration	Very short				

materials in excavations	Consequence	Moderate				
	Probability	Very unlikely				
	Reversibility	Yes				
	Irreplaceability	Not				
Operational Phase						
Damage or destruction of palaeontological materials	Status		None	None	None	
	Spatial extent					
	Duration					
	Consequence					
	Probability					
	Reversibility					
	Irreplaceability					
Decommissioning Phase						
Damage or destruction of palaeontological materials	Status		None	None	None	
	Spatial extent					
	Duration					
	Consequence					
	Probability					
	Reversibility					
	Irreplaceability					

Table 7 Table for rating of impacts – Vhuvhili on-site Substation grid (both alternatives).

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													
Palaeontology	**Destruction of fossil materials**	L Neutral;	Site	Short term	Moderate	Very unlikely	Not reversible	Not	Removal of any fossils found on surface or below ground once excavations commence (EMPr)	Low	Very low	4	High

5. Monitoring Programme and Fossil Chance Find Protocol – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.

2. When excavations begin the rocks and discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone or trace fossils) should be put aside in a suitably protected place. This way the project activities will not be interrupted.

3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Appendix A). This information will be built into the EMPr's training and awareness plan and procedures.

4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.

5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.

6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.

7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.

8. If no fossils are found and the excavations have finished then no further monitoring is required.

6. Assumptions and limitations

It is well known that fossils do not occur in Jurassic dolerite because it is of volcanic origin. Fossils are preserved in sedimentary rocks. Fossils of the *Glossopteris* flora have been recorded from the carbonaceous shales and mudstones from some sites in the Vryheid Formation but they are by no means ubiquitous. Much of the area has been cultivated for agriculture for decades which means the rocks are covered by much younger soils. Since soils are the product of weathering and breakdown of rocks, plus humus, they do not preserve fossils either. Therefore, there is only a chance of finding fossils in the underlying rocks of the Vryheid formation and in surface outcrops. Further complicating the palaeontology, wetlands generally do not preserve fossils because the

moisture and drying out destroys the delicate impressions of plants in the shales. In summary, fossils are very unlikely to occur on the ground surface in the northwestern part of the project footprint (Vhuvhili on-site substation hub). Fossils might occur below ground in the mostly dry and un-weathered shales of the Vryheid Formation, but this will not be determined until excavations for foundations commence.

7. Recommendation

A. Both alternatives for the Vhuvhili on-site substation and the four alternatives for grid connection routes are on potentially fossiliferous rocks BUT no fossils would occur on the ground surface (cultivation and wetland) but might occur below ground. Therefore, the fossil chance find protocol should be followed (Section 5).
B. The overhead power line route between the proposed Vhuvhili on-site substations hubs and the Mukondeleli switching stations is on dolerite so there is no impact on the fossils.
C. The Mukondeleli switching station grid connection (both alternatives) are on non-fossiliferous dolerite so there is no impact on the fossils.
D. There are no identified fatal flaws and no objections on palaeontological heritage grounds to authorisation of the proposed power line project (all four alternative routings) on condition that (i) the recommended mitigation measures and (ii) the Fossil Chance Finds Protocol as discussed above, are implemented in full during the Construction Phase."

When the final grid connection route has been determined based on other specialist inputs, and excavations for pole foundations have commenced, and only if fossils are found, then the Vhuvhili substation site grid route should be visited by a palaeontologist and any fossils found should be removed (see Fossil Chance Find Protocol; Section 5).

8. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Bamford, M.K. 2004. Diversity of woody vegetation of Gondwanan southern Africa. Gondwana Research 7, 153-164.

Barbolini, N., Rubidge, B.S., Bamford, M.K. 2018. A new approach to biostratigraphy in the Karoo retroarc foreland system: utilising restricted-range palynomorphs and their first appearance datums for correlation. Journal of African Earth Sciences 140, 114-133.

Cadle, A.B., Cairncross, B., Christie, A.D.M., Roberts, D.L., 1993. The Karoo basin of South Africa: the type basin for the coal bearing deposits of southern Africa. International Journal of Coal Geology 23, 117-157.

Cairncross, B. 1990. Tectono-sedimentary settings and controls of the Karoo Basin Permian coals, South Africa. International Journal of Coal Geology 16: 175-178.

Cairncross, B. 2001. An overview of the Permian (Karoo) coal deposits of southern Africa. African Earth Sciences 33: 529–562.

Isbell, J.L., Henry, L.C., Gulbranson, E.L., Limarino, C.O., Fraiser, F.L., Koch, Z.J., Ciccioli, P.l., Dineen, A.A., 2012. Glacial paradoxes during the late Paleozoic ice age: Evaluating the equilibrium line altitude as a control on glaciation. Gondwana Research 22, 1-19.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Taverner-Smith, R., Mason, T.R., Christie, A.D.M., Smith, A.M., van der Spuy, M., 1988. Sedimentary models for coal formation in the Vryheid Formation, northern Natal. Bulletin of the Geological Survey of South Africa, 94. 46pp.

Visser, J.N.J., 1986. Lateral lithofacies relationships in the glacigene Dwyka Formation in the western and central parts of the Karoo Basin. Transactions of the Geological Society of South Africa 89, 373-383.

Visser, J.N.J., 1989. The Permo-Carboniferous Dwyka Formation of southern Africa: deposition by a predominantly subpolar marine icesheet. Palaeogeography, Palaeoclimatology, Palaeoecology 70, 377-391.

9. Appendix A – examples of fossils that could occur in the Vryheid Formation

Figure 7: Photographs of a variety of plants that occur as impressions in rocks of the Vryheid Formation - glossopterids, ferns and sphenophytes. Bottom right shows bones in the rock.

10. Appendix B – Short CV of Specialist

Curriculum vitae (short) - Marion Bamford PhD
July 2022

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016

SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	11	0
Masters	13	3
PhD	11	7
Postdoctoral fellows	14	2

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12 - 20 students per year.

ix) Editing and reviewing
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

25 years' experience in PIA site and desktop projects

Selected from recent projects only – list not complete:

- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala

- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2022 for AHSA
- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage

Xi) Research Output

Publications by M K Bamford up to July 2022 peer-reviewed journals or scholarly books: over 165 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 30; Google Scholar h-index = 36; -i10-index = 95
Conferences: numerous presentations at local and international conferences.

11. Appendix C – Site Sensitivity Verification

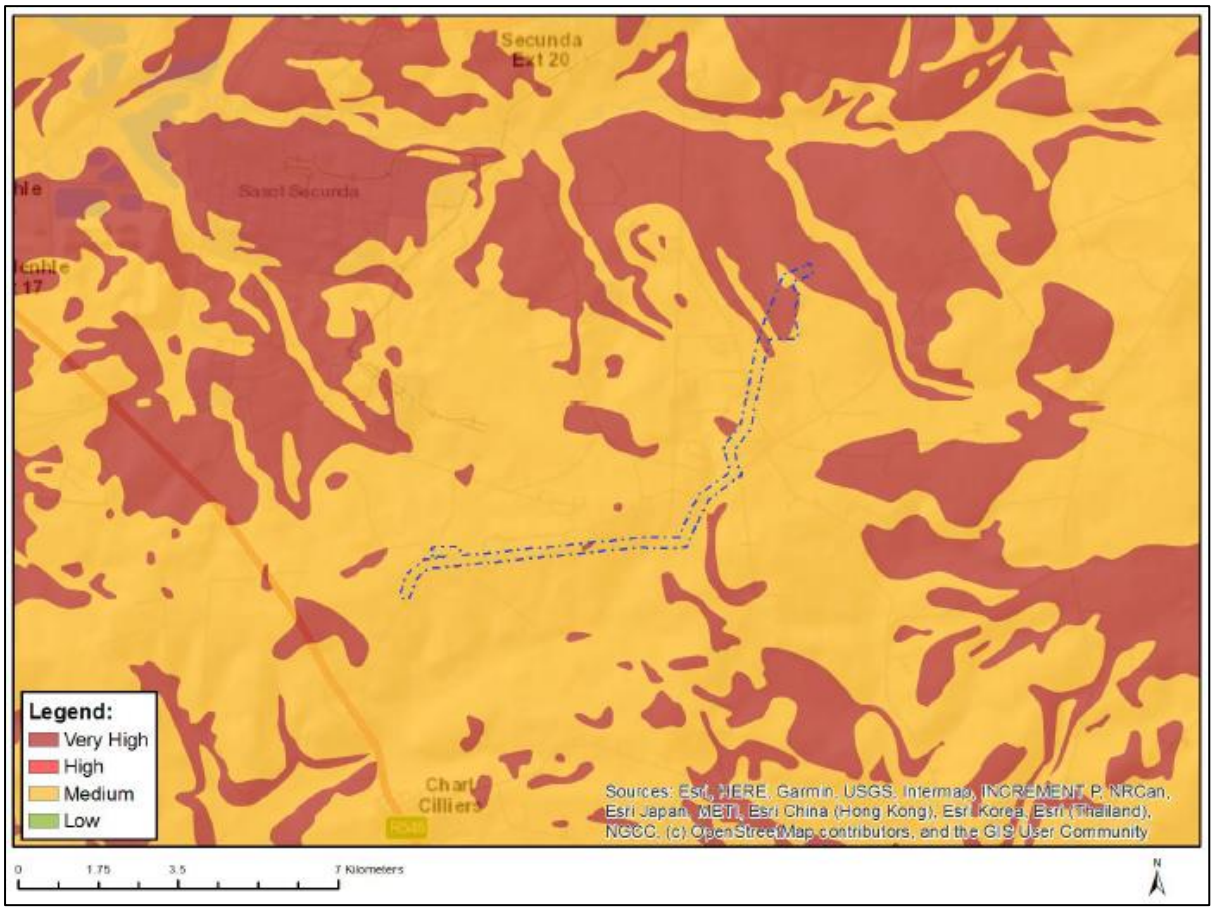


Figure 7: Palaeosensitivity map as required in Part A of the Government Gazette 43110, GN 320,

Note, the map (Figure 7) is not as detailed as the one provided on the SAHRIS website for which SAHRA bases their impact assessment requirements. The SAHRIS map is presented in Figures 3-5 and they consider that most of the route (orange in Figure 7 but grey in Figures 3-5) is on dolerite that has no fossils. This is correct because dolerite is a volcanic rock and does not preserve fossils. The northwestern portion corresponds on both maps (dark red in Figure 7 and red in Figures 3-5) because the site is on the Vryheid Formation that could have fossils so is very highly sensitive.