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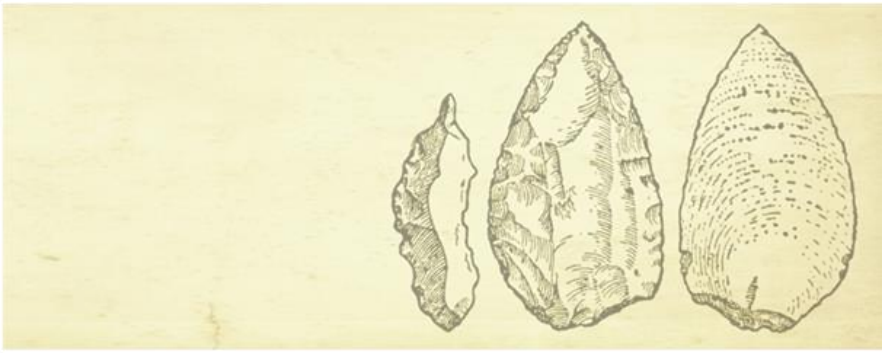

PHASE 1 HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF HARVARD SOLAR FARM, SPES BONA NO. 2355, PORTION 5.

PROPOSED DEVELOPMENT OF SOLAR PHOTOVOLTAIC (PV) FACILITY ON THE FARM SPES BONA NO. 2355, PORTION 5 (HARVARD 2), BLOEMFONTEIN, MANGAUNG METROPOLITAN MUNICIPALITY, FREE STATE PROVINCE

PREPARED FOR:
ENVIROAFRICA CC

PREPARED BY:
SKY-LEE FAIRHURST & HEIDI FIVAZ
ELIZE BUTLER & JAN ENGELBRECHT
UBIQUE HERITAGE CONSULTANTS

28 SEPTEMBER 2022

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Declaration of independence:

UBIQUE Heritage Consultants hereby confirm our independence as heritage specialists and declare that:

- we are suitably qualified and accredited to act as independent specialists in this application;
- we do not have any vested interests (either business, financial, personal or other) in the proposed development project other than remuneration for the heritage assessment and heritage management services performed;
- the work was conducted in an objective and ethical manner, in accordance with a professional code of conduct and within the framework of South African heritage legislation.

Signed: **Date: 2022-09-28**

J.A.C. Engelbrecht, H. Fivaz & S. Fairhurst

UBIQUE Heritage Consultants

SUMMARY OF SPECIALIST EXPERTISE

SKY-LEE FAIRHURST

ARCHAEOLOGIST

Sky-Lee Fairhurst has been informally part of UBIQUE Heritage Consultants since 2019. She is responsible for research, desktop studies, report compilation and surveys. Miss Fairhurst obtained her BA in Archaeology and Biblical archaeology in 2016 and her BA Hons in Archaeology (*cum laude*) at the University of South Africa (UNISA) in 2018, focussing on research themes such as gender, households and Late Iron Age settlements. She is currently pursuing her interest in southern African agropastoral societies as an MA Archaeology student at the University of South Africa (UNISA). She is skilled at artefacts and archaeological illustrations. Over the past nine years, she has obtained considerable excavation and survey experience and has worked on various sites, including Historical, Iron Age sites and Palaeontological.

HEIDI FIVAZ

CRM ARCHAEOLOGIST & OBJECT CONSERVATOR

Heidi Fivaz has been a part of UBIQUE Heritage Consultants since 2016 and took over ownership in 2018. She is responsible for project management, surveys, research and report compilation. She holds a B.Tech. Fine Arts degree (2000) from Tshwane University of Technology, a BA Culture and Arts Historical Studies degree (2012) from UNISA and received her BA (Hons) Archaeology in 2015 (UNISA). She has received extensive training in object conservation from the South African Institute of Object Conservation and specialises in glass and ceramics conservation. She is also a skilled artefact and archaeological illustrator. Ms Fivaz was awarded her MA in Archaeology (with distinction) in 2021 by the University of South Africa (UNISA), focusing on historical and industrial archaeology. She is a professional member of the Association of South African Archaeologists with CRM accreditation and has worked on numerous archaeological excavation and surveying projects over the past ten years.

JAN ENGELBRECHT

CRM ARCHAEOLOGIST

Jan Engelbrecht is accredited by the Cultural Resources Management section of the Association of Southern African Professional Archaeologists (ASAPA) to undertake Phase1 AIAs and HIAs in South Africa. He is also a member of the Association for Professional Archaeologists (ASAPA). Mr Engelbrecht holds an honours degree in archaeology (specialising in the history of early farmers in southern Africa (Iron Age) and Colonial period) from the University of South Africa. He has 12 years of experience in heritage management. He has worked on projects as diverse as the Zulti South HIA project of Richards Bay Minerals, research on the David Bruce heritage site at Ubombo in Kwa-Zulu Natal, and various archaeological excavations and historical projects. He has worked with many rural communities to establish integrated heritage and land use plans and speaks Zulu fluently. Mr Engelbrecht established Ubique Heritage Consultants in 2012. The company moved from KZN to the Northern Cape and is currently based at Askham in the Northern Cape within the Mier local municipality in the Kgalagadi region. He had a significant military career as an officer, whereafter he qualified as an Animal Health Technician at Technikon RSA and UNISA. He is currently studying for his MA Degree in Archaeology.

EXECUTIVE SUMMARY

Project description

UBIQUE Heritage Consultants were appointed by EnviroAfrica CC as independent heritage specialists in accordance with Section 38 of the NHRA and the National Environmental Management Act 107 of 1998 (NEMA) to conduct a cultural heritage assessment to determine the impact of the proposed solar PV facilities (Harvard Solar 2), on the Farm Spes Bona no. 2355, Portion 5, Bloemfontein, Mangaung Metropolitan Municipality, Free State Province on any sites, features, or objects of cultural heritage significance.

Findings and Impact on Heritage Resources

A total of five stone cairn graves were recorded at Portion 5 of Spes Bona 2355 (Harvard 2). Graves are considered to be of High Significance, these will be impacted negatively by the development.

One occurrence of an engraved stone was recorded. This engraved stone is believed to not be associated with the graves. The engraving is unclear, as it appears to have been scratched out. It is considered to be of low significance.

The proposed development area is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the north-west and south-east underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and Jurassic Karoo dolerite is Zero as it is igneous in origin. Therefore, a site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 5 January 2022. During the site visit, no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area (Butler 2022 Appendix A).

Recommendations

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

1. The engraved stone recorded to the southeast of the proposed development footprint is of low significance, and thus impact is negligible.

2. The five stone packed graves recorded during the investigation will be impacted negatively by development. These would require costly mitigation before destruction. It is, therefore, our recommendation that a buffer/safety zone should be implemented

3. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and Jurassic Karoo dolerite is Zero as it is igneous in origin. However, no fossiliferous outcrops were identified during the site visit. If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance Find Protocol (Appendix A/12) must be implemented by the Environmental Control Officer (ECO) in charge of these developments. Fossil discoveries ought to be protected, and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out (Butler 2022).

4. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) must be alerted as per section 35(3) of the NHRA. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Thingahangwi Tshivhase/Mimi Seetelo 012 320 8490), must be alerted immediately as per section 36(6) of the NHRA. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contacted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required subject to permits issued by SAHRA. UBIQUE Heritage Consultants and its personnel will not be held liable for such oversights or costs incurred as a result of such oversights.

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ABBREVIATIONS

AIA:	Archaeological Impact Assessment
ASAPA:	Association of South African Professional Archaeologists
CRM:	Cultural Resource Management
EIA:	Early Iron Age
EMP:	Environmental Management Plan
ESA:	Earlier Stone Age
GPS:	Global Positioning System
HIA:	Heritage Impact Assessment
HWC:	Heritage Western Cape
IA:	Iron Age
IMP:	Integrated Management Plan
LSA:	Later Stone Age
MIA:	Middle Iron Age
MSA:	Middle Stone Age
NBKB:	Ngwao-Boswa Jwa Kapa Bokone (Northern Cape PHRA)
NHRA:	National Heritage Resources Act
PHRA:	Provincial Heritage Resource Agency
SADC:	Southern African Development Community
SAHRA:	South African Heritage Resources Agency
SAHRIS:	South African Heritage Resources Information System

GLOSSARY

Archaeological:	Material remains resulting from human activity in a state of disuse, older than 100 years, including artefacts, human and hominid remains and artificial features and structures.
Historic building:	Structures 60 years and older.
Heritage:	That which is inherited and forms part of the National Estate (historic places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).
Heritage resources:	Valuable, finite, non-renewable and irreplaceable resources that provide evidence of the origins of South African society
Mitigation:	Anticipating and preventing adverse impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible.
'Public monuments:	All monuments and memorials, 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 – 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.
'Structures':	Any building, works, device or other facility made by people, and which are fixed to land, and include any fixtures, fittings and equipment associated therewith.

1. INTRODUCTION

1.1 Scope of study

The project involves the proposed development of two separate solar photovoltaic (PV) facilities, developed including associated infrastructure on Portion 5 of Farm 2355 (referred to as Harvard 2), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province. UBIQUE Heritage Consultants were appointed by EnviroAfrica CC. as independent heritage specialists in accordance with the National Environmental Management Act 107 of 1998 (NEMA), and in compliance with Section 38 of the National Heritage Resources Act 25 of 1999 (NHRA), to conduct a cultural heritage assessment (AIA/HIA) of the development area.

The assessment aims to identify and report any heritage resources that may fall within the development footprint; to determine the impact of the proposed development on any sites, features, or objects of cultural heritage significance; to assess the significance of any identified resources; and to assist the developer in managing the documented heritage resources in an accountable manner, within the framework provided by the National Heritage Resources Act (Act 25 of 1999) (NHRA).

South Africa's heritage resources are rich and widely diverse, encompassing sites from all periods of human history. Resources may be tangible, such as buildings and archaeological artefacts, or intangible, such as landscapes and living heritage. Their significance is based on their aesthetic, architectural, historical, scientific, social, spiritual, linguistic, economic or technological values; their representation of a time or group; their rarity; and sphere of influence.

Natural (e.g. erosion) and human (e.g. development) activities can jeopardise the integrity and significance of heritage resources. In the case of human activities, a range of legislation exists to ensure the timeous and accurate identification and effective management of heritage resources for present and future generations.

The result of this investigation is presented within this heritage impact assessment report. It comprises the recording of heritage resources present/ absent and offers recommendations for managing these resources within the context of the proposed development.

Depending on SAHRA's acceptance of this report, the developer will receive permission to proceed with the proposed development, considering any proposed mitigation measures.

1.2 Assumptions and limitations

It is assumed that the description of the proposed project, as provided by the client, is accurate. Furthermore, it is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is comprehensive and does not have to be repeated as part of the heritage impact assessment.

The significance of the sites, structures and artefacts is determined by means of their historical, social, aesthetic, technological and scientific value in relation to their uniqueness, condition of preservation and research potential. The various aspects are not mutually exclusive, and the evaluation of any site is done with reference to any number of these aspects. Cultural significance is site-specific and relates to the content and context of the site.

All possible care has been taken during the comprehensive field survey and intensive desktop study to identify sites of cultural importance within the development areas. However, it is essential to note that some heritage sites may have been missed due to their subterranean nature or dense vegetation cover. No subsurface investigation (i.e. excavations or sampling) was undertaken since a SAHRA permit is required for such activities. Therefore, should any heritage features and/or objects such as architectural features, stone tool scatters, artefacts, human remains, or fossils be uncovered or observed during construction, operations must be stopped, and a qualified archaeologist contacted for an assessment of the find. Observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to assess the significance of the site (or material) in question.

2. TERMS OF REFERENCE

2.1 Statutory Requirements

2.1.1 General

The principle is that the environment should be protected for present and future generations by preventing pollution, promoting conservation and practising ecologically sustainable development. With regard to spatial planning and related legislation at national and provincial levels, the following legislation may be relevant:

- Physical Planning Act 125 of 1991
- Municipal Structures Act 117 of 1998
- Municipal Systems Act 32 of 2000
- Development Facilitation Act 67 of 1995 (DFA)

The identification, evaluation and management of heritage resources in South Africa are required and governed by the following legislation:

- National Environmental Management Act 107 of 1998 (NEMA)
- KwaZulu-Natal Heritage Act 4 of 2008 (KZNHA)
- National Heritage Resources Act 25 of 1999 (NHRA)
- Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA)

2.1.2 National Heritage Resources Act 25 of 1999

The NHRA established the South African Heritage Resources Agency (SAHRA) together with its Council to fulfil the following functions:

- coordinate and promote the management of heritage resources at the national level;
- set norms and maintain essential national standards for the management of heritage resources in the Republic and to protect heritage resources of national significance;
- control the export of nationally significant heritage objects and the import into the Republic of cultural property illegally exported from foreign countries;
- enable the provinces to establish heritage authorities which must adopt powers to protect and manage certain categories of heritage resources; and
- provide for local authorities' protection and management of conservation-worthy places and areas.

2.1.3 Heritage Impact Assessments/Archaeological Impact Assessments

Section 38(1) of the NHRA of 1999 requires **the responsible heritage resources authority to notify the person who intends to undertake a development that fulfils the following criteria to submit an impact assessment report if there is reason to believe that heritage resources will be affected by such event**:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity that will change the character of a site—
    - exceeding 5000m² in extent; or
    - involving three or more existing erven or subdivisions thereof; or
    - involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    - the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
- the rezoning of a site exceeding 10 000m² in extent; or
- any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

2.1.5 Management of Graves and Burial Grounds

- **Graves younger than 60 years** are protected in terms of Section 2(1) of the Removal of Graves and Dead Bodies Ordinance 7 of 1925 as well as the Human Tissues Act 65 of 1983.

- **Graves older than 60 years, situated outside a formal cemetery administered by a local Authority are** protected in terms of Section 36 of the NHRA as well as the Human Tissues Act of 1983. Accordingly, such graves are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of NHRA) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above SAHRA authorisation.

The **protocol for the management of graves older than 60 years situated outside a formal cemetery administered by a local authority** is detailed in Section 36 of the NHRA:

> (3) *(a)* No person may, without a permit issued by SAHRA or a provincial heritage resources authority—
>
> *(a)* destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
>
> *(b)* destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
>
> *(c)* bring onto or use at a burial ground or grave referred to in paragraph *(a)* or *(b)* any excavation equipment, or any equipment which assists in the detection or recovery of metals.
>
> (4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)*(a)* unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation

and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

(5) SAHRA or a provincial heritage resources authority may not issue a permit for any activity under subsection (3)*(b)* unless it is satisfied that the applicant has, in accordance with regulations made by the responsible heritage resources authority—

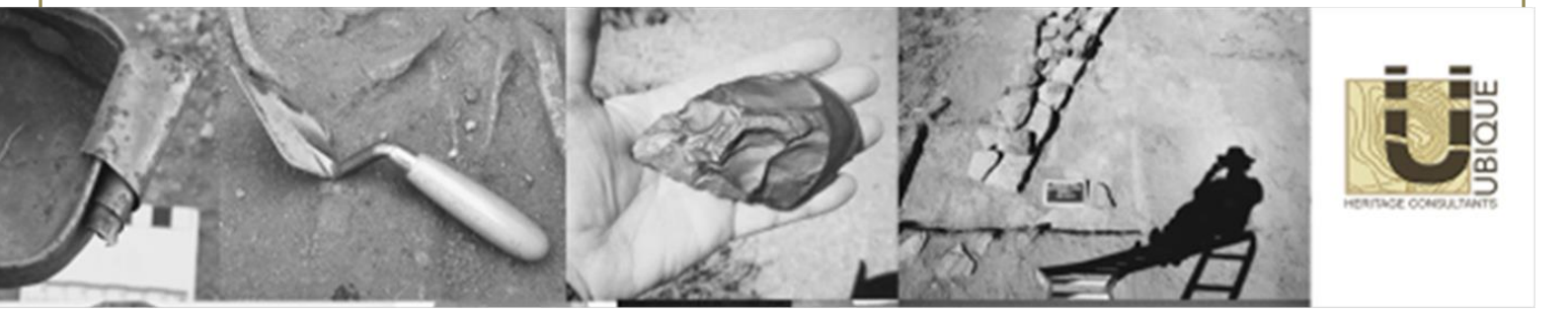
(a) made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and

(b) reached agreements with such communities and individuals regarding the future of such grave or burial ground.

(6) Subject to the provision of any other law, any person who in the course of development or any other activity discovers the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible heritage resources authority which must, in cooperation with the South African Police Service and in accordance with regulations of the responsible heritage resources authority—

(a) carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this Act or is of significance to any community; and

(b) if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangements as it deems fit.



3. STUDY APPROACH AND METHODOLOGY

3.1 Desktop study

The first step in the methodology was to conduct a desktop study of the heritage background of the area and the proposed development site. This entailed the scoping and scanning of historical texts/records as well as previous heritage studies and research around the study area.

The study area is contextualised by incorporating data from previous CRM reports in the area and an archival search. The objective of this is to extract data and information on the area in question, looking at archaeological sites, historical sites and graves in the area.

No archaeological site data was available for the project area. A concise account of the archaeology and history of the broader study area was compiled (sources listed in the bibliography).

3.1.1 Literature review

A literature survey was undertaken to obtain background information regarding the area. Through researching the SAHRA APM Report Mapping Project records and the SAHRIS online database (http://www.sahra.org.za/sahris), it was determined that several other archaeological or historical studies had been performed within the broader vicinity of the study area. Sources consulted in this regard are indicated in the bibliography.

3.2 Field study

Phase 1 (AIA/HIA) requires the completion of a field study to establish and ensure the following:

3.2.1 Systematic survey

A systematic survey of the proposed project area to locate, identify, record, photograph, and describe archaeological, historical or cultural interest sites were completed.

UBIQUE Heritage Consultants inspected the proposed development and surrounding areas on the 18th and 19th of November 2021 and completed a controlled-exclusive, pre-planned pedestrian and vehicular survey. We conducted an inspection of the ground's surface, wherever the surface was visible. This was done with no substantial attempt to clear brush, sand, deadfall, leaves or other material that may cover the surface and with no effort to look beneath the surface beyond the inspection of rodent burrows, cut banks and other exposures fortuitously observed.

The survey was tracked with a handheld Garmin global positioning unit (Garmin eTrex 10).

3.2.2 Recording significant areas

GPS points of identified significant areas were recorded with a handheld Garmin global positioning unit (Garmin eTrex 10). Photographs were taken with a Canon IXUS 185 20-megapixel camera. Detailed field notes were taken to describe observations. The layout of the area and plotted GPS points, tracks and coordinates, were transferred to Google Earth, and QGIS and maps were created.

3.2.3 Definitions of heritage resources

The NHRA defines a heritage resource as any place or object of cultural significance, i.e., aesthetic, architectural, historical, scientific, social, spiritual, linguistic, or technological value or significance. These include, but are not limited to, the following wide range of places and objects:

- living heritage as defined in the National Heritage Council Act No 11 of 1999 (cultural tradition; oral history; performance; ritual; popular memory; skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships);
- Ecofacts (non-artefactual organic or environmental remains that may reveal aspects of past human activity; definition used in KwaZulu-Natal Heritage Act 2008);
- places, buildings, structures and equipment;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds;
- public monuments and memorials;
- sites of significance relating to the history of slavery in South Africa;
- movable objects, but excluding any object made by a living person; and
- battlefields.

3.3 Determining significance

Heritage resources are considered of value if the following criteria apply:

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

Levels of significance of the various types of heritage resources observed and recorded are determined by the following criteria:

CULTURAL & HERITAGE SIGNIFICANCE	
LOW	A cultural object found out of context, not part of a site or without any related feature/structure in its surroundings.
MEDIUM	Any site, structure or feature is regarded as less important due to several factors, such as date, frequency and uniqueness. Likewise, any important object found out of context.
HIGH	Any site, structure or feature is regarded as important because of its age or uniqueness. Graves are always categorised as of a high importance. Likewise, any important object found within a specific context.

Field Ratings or Gradings are assigned to indicate the level of protection required and who is responsible for national, provincial, or local protection.

FIELD RATINGS & GRADINGS	
National Grade I	Heritage resources with exceptional qualities to the extent that they are of national significance and should therefore be managed as part of the national estate.
Provincial Grade II	Heritage resources with qualities provincial or regional importance, although it may form part of the national estate, it should be managed as part of the provincial estate.
Local Grade IIIA	Heritage resources are of local importance and worthy of conservation. Therefore, it should be included in the heritage register and not be mitigated (high significance).
Local Grade IIIB	Heritage resources are of local importance and worthy of conservation. Therefore, it should be included in the heritage register and mitigated (high/ medium significance).
General Protection Grade IVA	The site/resource should be mitigated before destruction (high/ medium significance).
General protection Grade IVB	The site/resource should be recorded before destruction (medium significance).
General protection Grade IVC	Phase 1 is considered as sufficient recording, and it may be demolished (low significance).

3.3.1 Assessment of development impacts

A heritage resource impact may be defined broadly as the net change, either beneficial or adverse, between the integrity of a heritage site with and without the proposed development. Beneficial impacts occur wherever a proposed development actively protects, preserves, or enhances a heritage resource by minimising natural site erosion or facilitating non-destructive public use. More commonly, development impacts are of an adverse nature and can include:

- destruction or alteration of all or part of a heritage site;
- isolation of a site from its natural setting; and / or
- introduction of physical, chemical or visual elements out of character with the heritage resource and its setting.

Beneficial and adverse impacts can be direct or indirect and cumulative, as implied by the examples. Although indirect impacts may be more difficult to foresee, assess and quantify, they must form part of the assessment process. Therefore, the following assessment criteria have been used to assess the impacts of the proposed development on possible identified heritage resources:

CRITERIA	RATING SCALES	NOTES
Nature	POSITIVE	An evaluation of the type of effect the construction, operation and management of the proposed development would have on the heritage resource.
	NEGATIVE	
	NEUTRAL	
Extent	LOW	Site-specific affects only the development footprint.
	MEDIUM	Local (limited to the site and its immediate surroundings, including the surrounding towns and settlements within a 10 km radius);
	HIGH	Regional (beyond a 10 km radius) to national.
Duration	LOW	0-4 years (i.e. duration of construction phase).
	MEDIUM	5-10 years.
	HIGH	More than 10 years to permanent.
Intensity	LOW	Where the impact affects the heritage resource in such a way that its significance and value are minimally affected.
	MEDIUM	Where the heritage resource is altered, and its significance and value are measurably reduced.
	HIGH	Where the heritage resource is altered or destroyed to the extent that its significance and value cease to exist.
Potential for impact on irreplaceable resources	LOW	No irreplaceable resources will be impacted.
	MEDIUM	Resources that will be impacted can be replaced, with effort.
	HIGH	There is no potential for replacing a particular vulnerable resource that will be impacted.
Consequence	LOW	A combination of any of the following: • Intensity, duration, extent and impact on irreplaceable resources are all rated low. • Intensity is low and up to two of the other criteria are rated medium. • - Intensity is medium, and all three other criteria are rated low.
	MEDIUM	Intensity is medium, and at least two of the other criteria are rated medium.
	HIGH	Intensity and impact on irreplaceable resources are rated high, with any combination of extent and duration. Intensity is rated high, with all the other criteria being rated medium or higher.
Probability (the likelihood of the impact occurring)	LOW	It is highly unlikely or less than 50 % likely that an impact will occur.
	MEDIUM	It is between 50 and 70 % certain that the impact will occur.

CRITERIA	RATING SCALES	NOTES
	HIGH	It is more than 75 % certain that the impact will occur, or it is definite that the impact will occur.
Significance (all impacts including potential cumulative impacts)	LOW	Low consequence and low probability. Low consequence and medium probability. Low consequence and high probability.
	MEDIUM	Medium consequence and low probability. Medium consequence and medium probability. Medium consequence and high probability. High consequence and low probability.
	HIGH	High consequence and medium probability. High consequence and high probability.

3.4 Report

The desktop research and field survey results are compiled in this report. The identified heritage resources and anticipated direct, indirect, and cumulative impacts of the proposed project's development on the identified heritage resources will be presented objectively. Should any significant sites be impacted adversely by the proposed project, alternatives are offered. All efforts will be made to ensure that all studies, assessments and results comply with the relevant legislation and the code of ethics and guidelines of the Association of South African Professional Archaeologists (ASAPA). The report aims to assist the developer in managing the documented heritage resources in a responsible manner and protecting, preserving, and developing them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999).

4. PROJECT OVERVIEW

UBIQUE Heritage Consultants were appointed by EnviroAfrica CC as independent heritage specialists in accordance with Section 38 of the NHRA and the National Environmental Management Act 107 of 1998 (NEMA) to conduct a cultural heritage assessment to determine the impact of the proposed development (including associated infrastructure) of solar photovoltaic (PV) facility on the farm Spes Bona No. 2355, Portion 8 (referred to as Harvard 1), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province.

The proposed project aims to develop two separate solar photovoltaic (PV) facilities, including associated infrastructure, one on Portion 8 of Farm 2355 (referred to as Harvard 1) and one on Portion 5 of Farm 2355 (referred to as Harvard 2). The envisaged Harvard Solar Farm is located approximately 11km West of Bloemfontein CBD. The combined size of the properties is 430 Ha. The Harvard Electrical Sub-Station is situated 2km to the north of the envisaged Harvard solar farm.

One of the following two photovoltaic solar panel technologies will be used:

- Single-axis tracking photovoltaic panels (on ground-mounted steel structures)
- Fixed axis photovoltaic panels (on ground-mounted steel structures)

The generating capacity of the two Harvard areas, are: Harvard 1 North 145 ha / 1.77 Ha/MW = 82 MW and Harvard 2 South 120 ha / 1.77 Ha/MW = 68 MW

The capacity of overhead power lines:

- Voltage: 132kV or higher
- Tower height: up to 25m typically
- Tower-type: Steel Monopole

The footprint of the switching station will be a 400m x 150m (typical) area in the middle of the Harvard Solar farm (Figure 3). The station will be constructed on an elevated flat area that protects the installation against stormwater damage. Stormwater channels can be seen around the elevated area. A perimeter fence protects the installation. The solar farm will also be fenced off.

Underground low voltage (0-1000V) electrical power lines (blue) transfer generates electricity from blocks of solar panels (approximately 8 ha) to inverter/transformer stations within the solar panel area. From these stations, the generated power of the solar block is conveyed through underground medium voltage (1000-33000V) electrical power cables (orange) to the grid connection station (Figure 5).

There is a possibility that a small battery storage facility with a capacity of 4 x 2.5MW – 10MW will be constructed.

Water requirements during the construction and the operational phase of the solar energy facility will differ. The following water source(s) can be utilized after official approval application processes have been followed and official permission has been granted: Bloemwater which supplies portable water to the small holdings areas to the south of the Harvard solar farm through a water reticulation network (Figure 9); and Boreholes in the Harvard area.

The Construction phase and the operational phase will be treated differently in terms of sewer treatment. Wastewater and sewer will be treated on-site close to the operational offices using a small bio-filter type package plant. The treated/recycled water will be used for irrigation and maintenance of roads This plant will be sized according to the calculated load. The operational offices will be located next to the switch station in the centre of the solar area. Two registered solid waste sites will be used during construction and operational phases.

4.1 Technical information

PROJECT DESCRIPTION	
Project name	Phase 1 Heritage Impact Assessment for the Proposed Development of Harvard Solar Farm, Spes Bona No. 2355, Portion 5.
Description	Proposed Development of Solar Photovoltaic (Pv) Facility on The Farm Spes Bona No. 2355, Portion 5 (Harvard 2), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province
DEVELOPER	
Keren Energy Group Holdings	
Development type	Development of Solar PV facilities and grid connection
LANDOWNER	
CONSULTANTS	
Environmental	EnviroAfrica
Heritage and archaeological	UBIQUE Heritage Consultants
Paleontological	Banzai Environmental
PROPERTY DETAILS	
Province	Free State
District municipality	Mangaung Metropolitan Municipality
Local municipality	Mangaung Metropolitan Municipality
Topo-cadastral map	1: 50 000 2926AA
Farm name	Portion 5 of Farm Spes Bona 2355
Closest town	Bloemfontein

GPS Co-ordinates	29° 07' 18.56" South, 26° 05' 51.69" East
PROPERTY SIZE	212.7842ha
DEVELOPMENT FOOTPRINT SIZE	215ha
LAND USE	
Previous	Agriculture/grazing
Current	Agriculture/grazing
Rezoning required	No
Sub-division of land	No

DEVELOPMENT CRITERIA IN TERMS OF SECTION 38(1) NHRA	YES/NO
Construction of a road, wall, power line, pipeline, canal or other linear forms of development or barrier exceeding 300m in length.	Yes
Construction of bridge or similar structure exceeding 50m in length.	No
Construction exceeding 5000m ^{2}.	Yes
Development involving three or more existing erven or subdivisions.	No
Development involving three or more erven or divisions that have been consolidated within the past five years.	No
Rezoning of site exceeding 10 000m ^{2}.	No
Any other development category, public open space, squares, parks, recreation grounds.	No

Figure 1 *Regional locality of the development footprint, indicated on Google Earth Satellite imagery.*

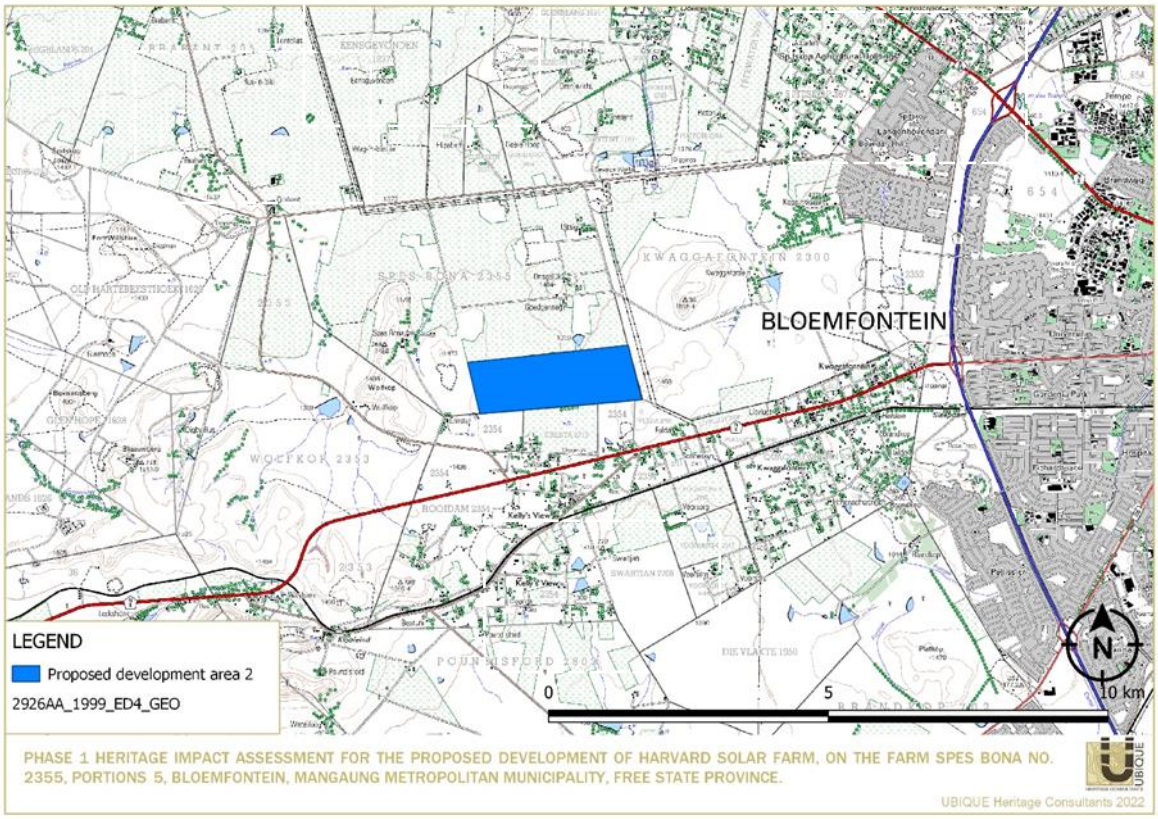


Figure 2 *Locality of the development footprint, indicated on 1: 50 000 2926AA map.*

Figure 3 Footprint of grid connection station, offices and laydown/storage area. Image provided by client.

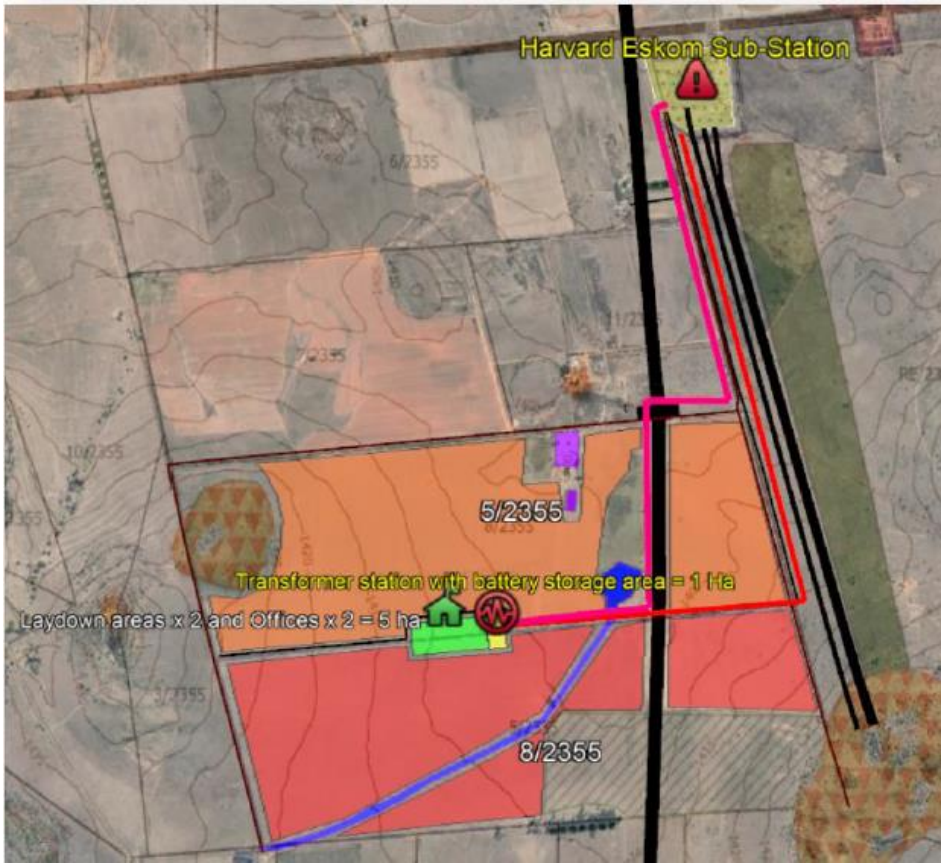


Figure 4 Existing power lines as well as the route of the proposed power line connection from the solar farm to the Harvard Eskom Sub-Station. MV transmission line 1 (Black line); MV transmission line 1 (Brown line); Existing HV transmission lines (Black bold line); Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station (Red line); Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station (If Eskom does not approve the application to grant permission for a line in the Eskom servitude) (Pink line) . Image provided by client

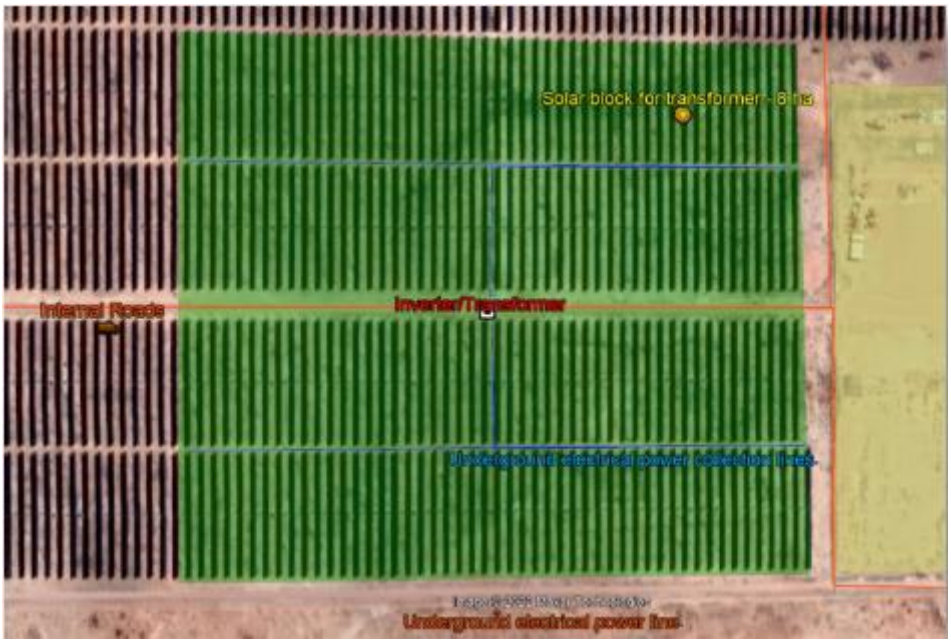


Figure 5 Electrical cables between solar panels and inverters/transformers. Image provided by client

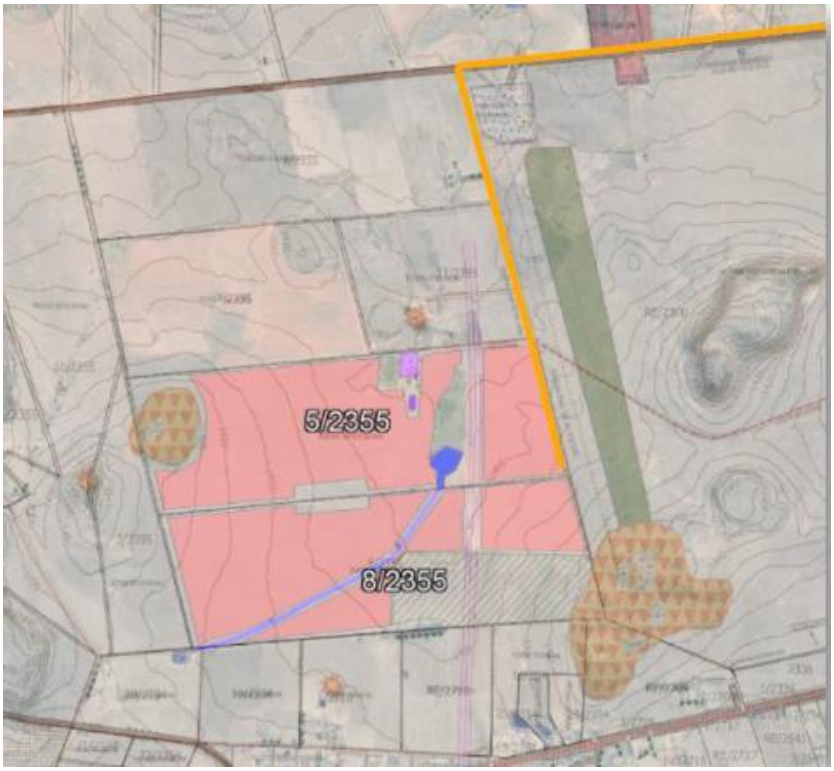


Figure 6 The current road from the North-East that gives access to the solar farm area is shown in gold on the Google image. Image provided by client

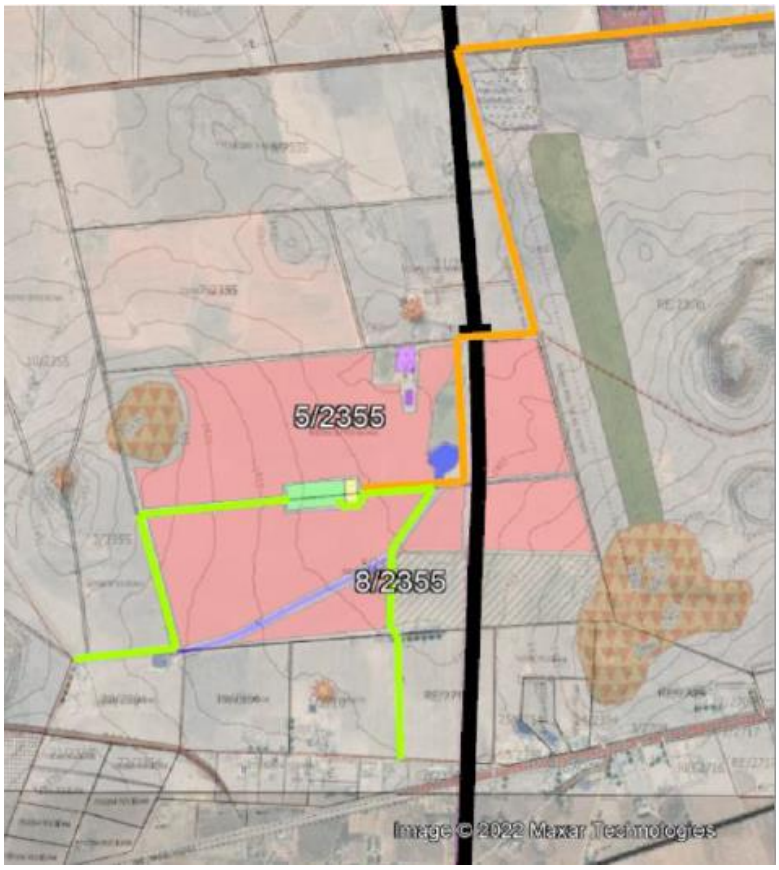


Figure 7 *Proposed access roads (with alternatives) to the Harvard solar farm. Image provided by client.*

Figure 8 *Internal roads. Image provided by client.*

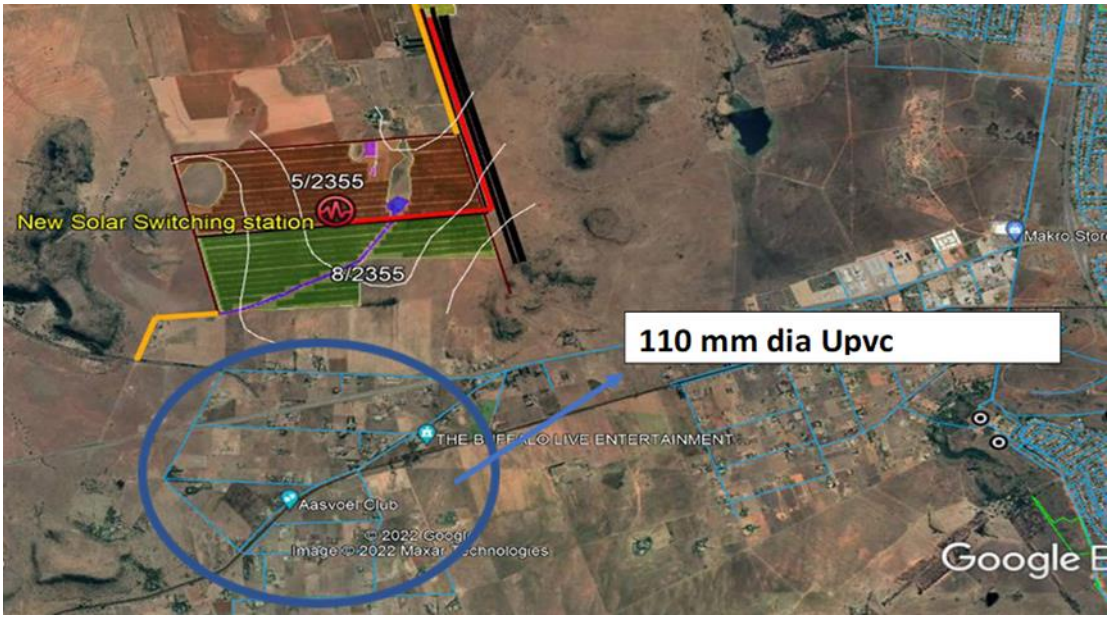


Figure 9 Possible water supply will be from the 110mm diameter Bloemwater reticulation network to the south of Harvard solar farm Image provided by client.

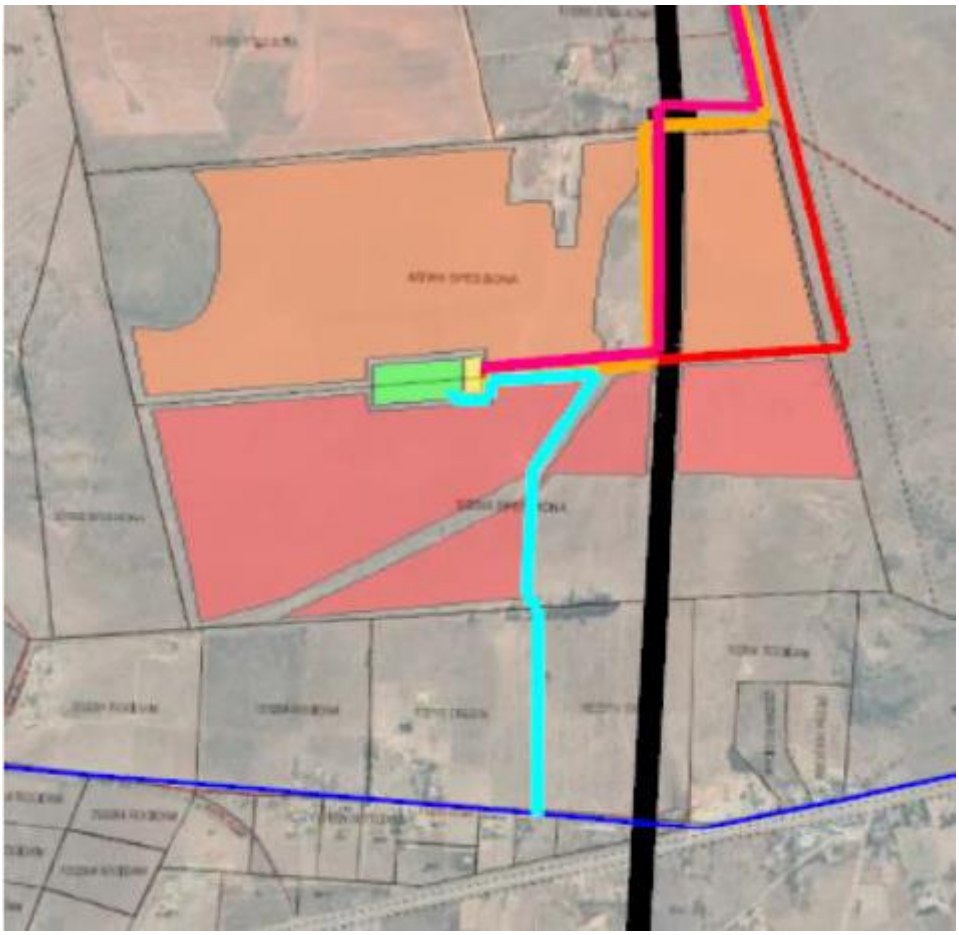


Figure 10 Planned connection from Bloemwater reticultation network to the operational centre of Harvard solar farm. Image provided by client.

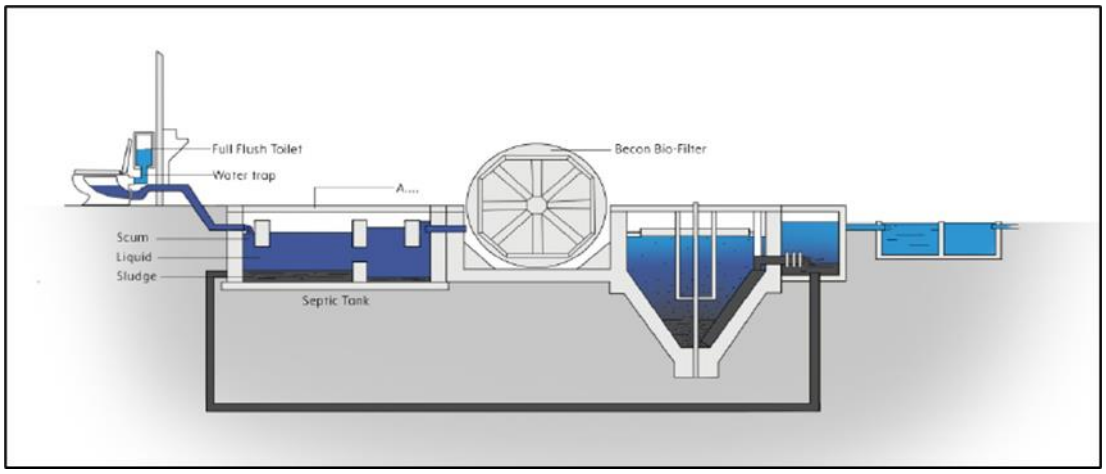


Figure 11 *Plan of bio-filter type package plant. Image provided by client.*

Figure 12 *The two solid waste sites that will be used. Image provided by client.*

Figure 13 *Stormwater catchment area. Image provided by client.*

Figure 14 *Contours and stormwater direction. Image provided by client.*

5. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

5.1 Region: Free State

South Africa has a very long and varied history of human occupation (Deacon & Deacon 1999). This occupation has been dated to approximately 2mya (million years ago) (Mitchell 2002). Briefly, the archaeology of South Africa can be divided into three "major" periods, namely: the Stone Age, the Iron Age and the Historical period. Various archaeological and historical sites have been identified and documented throughout South Africa, including the Free State Province. The Free State Province has a rich and diverse history. The area was sparsely populated until the arrival of the Boers (Voortrekkers) by the end of the 18th century.

5.1.1 Stone Age

The history of the Free State is reflected in a rich archaeological landscape, with a wealth of pre-colonial archaeological sites. Numerous sites have been identified and documented across the region. These sites have been dated to the Earlier, Middle and Later Stone Age.
In southern Africa, the Stone Age can be divided into three periods. It is, however, critical to note that dates are relative and only provide a broad framework for interpretation. The division of the Stone Age, according to Lombard et al. (2012), is as follows:

- Earlier Stone Age (ESA): >2 000 000 - >200 000 years ago
- Middle Stone Age (MSA): <300 000 - >20 000 years ago
- Later Stone Age (LSA): <40 000 - until the historical period

In short, the Stone Age refers to humans that mainly utilised stone as their technological marker. Each sub-division is formed by industries where the assemblages share attributes or common traditions (Lombard et al. 2012). The ESA is characterised by flakes produced from pebbles, cobbles and percussive tools, as well as objects created later during this period, such as large hand axes, cleavers and other bifacial tools (Klein 2000). The MSA is associated with small flakes, blades and points. The aforementioned is generally suggested to have been made and utilised for hunting activities and had numerous functions (Wurz 2013). Fine-grain quartzite, quartz, silcrete, chalcedony, and hornfels are common materials used for MSA stone artefacts (Binneman et al. 2011; Tomose 2013). MSA stone artefacts, including ESA artefacts, occur in secondary contexts for various reasons, such as natural events (erosion) or animal and human disruptions (Tomose 2013). Furthermore, the LSA is characterised by microlithic stone tools, scrapers and flakes (Binneman 1995; Lombard et al. 2012). The LSA is also associated with rock art.

The wider geological region of the Free State has been inhabited since the ESA onward. This interpretation is supported by the discovery of stone tools and lithics dating from the Early, Middle, and Late Stone Ages in various locations. However, according to Kruger (2018), these are usually found near rivers, such as the Doring Spruit north of Kroonstad, the Vals River, and the Sand River

south of Ventersburg. In the Free State, the earliest known industry of the ESA is the Victoria West Industry, which also spreads into the Northern Cape. The Victoria West Stone Industry can be found in the Free State area along the Vaal River basin. However, it is believed that the prepared cores of the Victoria West industry indicate a transitional period in the Stone Age industry from the Acheulian into the MSA. The Victoria West industry is often seen as an evolutionary step toward the Levallois Prepared Core Technique. This likely signifies the outwards spread of the Stone Age technology (Tomose 2013).

ESA stone artefacts and lithics in the Free State are commonly found as open-air surface scatters, either as individual occurrences or in vast numbers. ESA artefacts/occurrences can also, very rarely, be found in association with other archaeological heritage, plant, and material remains (Binneman et al. 2011). According to Binneman et al. (2011), South African exceptions include Wonderwerk in the Northern Cape near Kimberly, the Montagu Cave in the Western Cape Province, and Amanzi Springs near Uitenhage bone and plant material were discovered in situ associated with the stone artefacts.

The MSA artefacts eventually replaced the dominant large hand axes and cleavers that characterised the ESA. This transition or distinction in the archaeological record has been dated to around 250 000 years ago. Smaller artefacts dominate the archaeological record during this time period, with the flake and blade industry being the most prominent. This industry innovation is thought to have peaked about 120 000 years ago. Throughout southern Africa, archaeologists can generally find surface scatters from the blade and flake industries (Tomose 2013). The early MSA stone industry known as the Mangosia had a wide distribution and stretched across the Limpopo, the Qriqualand in Northern Cape, Natal, the Cape Point and the Free State (Binneman et al. 2011; Tomose 2013). Artefacts associated with the Mangosia industry in the Free State are known to have been produced from the indurate shale raw material (Binneman et al. 2011). The MSA tools include flakes, blades and points and mainly occur as surface scatters. Other industries within the MSA include are the Howieson's Poort which is known to have a wide distribution throughout southern Africa, including the Free State province, the Orangia (128 000 to 75 000 years ago) and the Florisbad (dominant in the Free State province) and Zeekoegat industries (between 64 000 and 32 000 years ago) (Tomose 2013).

The LSA archaeological record is often associated with the San hunter-gatherers. However, the LSA also included Khoekhoe pastoralists from about 2 000 years ago. In the Karoo (Northern Cape regions), the Free State Province, and Lesotho, dark or black fine-grained chalcedony would have been the preferred material. Smithfield settlement sites are more commonly found among hills and ridges. The LSA archaeology is rich and varied. Archaeologists often find stone artefacts, beads (ostrich eggshell beads are dominant), pottery, and rock art relating to the LSA. Rock art can be either in the form of paintings or engravings (Tomose 2013).

Most of the studies and surveys that have been conducted throughout the Free State have recorded Stone Age sites, and surface scatters of Stone Age artefacts (ranging from the ESA, MSA and LSA) (e.g. Fourie 2020; Morris 2014a and b; Orton 2015; 2016a, b, c, d and e). Several examples of stone tool "factory" sites have been found at, but not limited to, Ventershoek near Wepener and Mooifontein near Zastron, at Spitzkop near Smithfield, and the Smithfield Townlands

(Fourie 2020). Materials associated with the MSA/LSA have also been reported around the Vredefort Dome. Some of these materials (such as scrapers, blades, cores, flakes, hammerstones, and small microlithic tools that occur as scattered finds) have been found in open-air areas, especially near the Vaal River as well as in caves. They are associated with transhumance (Mlilo 2017). Stone tool open-air sites were discovered near Rouxville at Goedemoed, Weenkop, and Wesselsdal and in the Aliwal North District at Middelplaats Melkspruit Grassridge Farm. Grinding hollows and grooves have been recorded as well as boulders with cupules ground into it (Orton2016 c and e).

5.1.2 Iron Age

The Iron Age (IA) is characterised by the use of metal (Coertze & Coertze 1996: 346). There is some controversy about the periods within the IA. Van der Ryst & Meyer (1999) have suggested that there are two phases within the IA, namely:

- Early Iron Age (EIA) 200 – 1000 A.D
- Late Iron Age (LIA) 1000 – 1850 A.D

However, Huffman (2007) suggests instead that there are three periods within the Iron Age, these periods are:

- Early Iron Age (EIA) 250 – 900 A.D
- Middle Iron Age (MIA) 900 – 1300 A.D
- Late Iron Age (LIA) 1300 – 1840 A.D

Thomas Huffman believes that the Middle Iron Age should be included within this period; his dates have been widely accepted in the IA field of archaeology.

The South African Iron Age is generally characterised by farming communities who had domesticated animals, cultivated plants, manufactured and made use of ceramics and beads, smelted iron for weapons and manufactured tools (Hall 1987). Iron Age people were often mixed farmers/agropastoralists. These agropastoralists generally chose to live in areas with sufficient water for domestic use along with arable soil that could be cultivated with an iron hoe. Most Iron Age (IA) settlements that were built by agropastoralists were permanent settlements (with a few exceptions, of course). They consisted of features such as houses, raised grain bins, storage pits and animal kraals/byres, which contrasts with the temporary camps of pastoralists and hunter-gatherers (Huffman 2007). It is evident in the archaeological record that IA groups had migrated with their material culture (Huffman 2002).

The EIA was a gradual spread or expansion of settlements of different indigenous people groups, which took place over a long period (Matenga 2019). Around 200 A.D., agriculturalist peoples arrived in southern Africa from West and East Africa, bringing with them settled agriculture, metalworking, animal husbandry, pottery production, and social stratification, all in contrast to the

Stone Age lifeways (Huffman 2007; Mlilo 2017). There are very few sites ascribed to the EIA in the country's central and western areas (Matenga 2019), which could be because IA communities appear to have favoured the country's eastern regions due to rainfall patterns. The summer rainfall climates were favourable for ploughing and growing crops like sorghum and millet. The first evidence of IA communities in the Free State has been recorded in the south-eastern region. The majority of current data regarding Iron Age cultures in the Free State dates from the 16th and 18th centuries when they passed over the Vaal River and came into contact with the San hunter-gatherers (Tomose 2013).

The material and features recorded at IA sites throughout the Free State and southern Africa include stonewalled settlements, pottery, iron and metal implements, beads, rainmaking sites and features, spear sharpening grooves on rock surfaces and grindstones, among many other types of materials (Tomose 2013). The Free State's IA archaeology is distinguished by the widespread distribution of stonewalled sites over flat-topped ridges and hills. Stonewalls and stonewalled settlements are some of the many prominent features of the Iron Age people. Stonewalled settlements dating to the IA have been widely documented in parts of the Free State (Morris 2016). The Caledon River Valley, known to have been inhabited by the Fokeng (Sotho speakers), is one of the well-known and well-documented areas in the Free State region with evidence of Iron Age farmers. The Fokeng moved to Metlaeeng after living in the foothills of Ntsuana-tsatsi between Frankfort and Vrede (Tomose 2013). The site of Doornpoort in the Free State has two recent occupations that yield evidence for various usages of faunal material. The site has been associated with Sotho-Tswana speakers. Cattle dominate the faunal assemblages for the occupation, which dates back to about 1700 A.D. However, according to Badenhorst (2010: 94), few cattle remains were recovered from the late 19th to early 20th centuries, with caprines dominating the faunal assemblage. The Rinderpest disease, which killed large numbers of cattle herds, is most likely to blame for the shift in livestock usage and consumption. Moreover, the Afrikaner colonialism's influence in the former Orange Free State (OFS) can also be seen as a potential explanation for this change (Badenhorst 2010: 94).

The spatial organisation plays an essential role among IA communities. In general, it is characterised by the central position of the stock/cattle byres and placing the main swelling area on the perimeter of a settlement. The LIA is known for its massive stonewalled sites and the importance of livestock, personal status, kinship, social organisation, and males' and females' roles within their settlement patterns. The pottery styles associated with this settlement type are generally characterised by shallow line incisions in bands and triangles below the rim and on the shoulder, combined with straight or curved lines and areas of red ochre burnish on the body of clay vessels. Batswana groups such as the Rolong and Thlaping have been associated with sites with bilobial dwellings. The Kubung people have also been linked to such sites. According to oral tradition and radiocarbon dating, several sites were inhabited from the 16th and 17th centuries to the early 19th century in Ventersburg and from the 18th century to the early 19th century in Bothaville (Kruger 2018). The Later Iron Age (LIA) is commonly associated with the Sotho and Tswana, divided into a variety of facies based on ceramic studies (Huffman 2007). In the Kroonstad area, extensive stonewalled settlements have been discovered and possibly date from the 16th century. Elaborate LIA stonewall sites on the farm Middenspruit 151 adjacent to Bospoort have been reported by Dreyer (2006). The walls are in differing preservation and deterioration states, with little evidence of wall-robbing, while some of the other structures are in good condition.

A single lower grinding stone was discovered next to one of the walls at one of the sites. On a southern portion of Middenspruit, he noted pottery, an upper grinding stone, and an unknown copper object (Kruger 2018). Interestingly, stonewalled sites in the Vrede Fort Dome have been associated with the Fokeng (Matenga 2019). The Askoppies site, located close to Vredefort Dome, is a large IA settlement with over 20 individual homesteads between 8 and 15 scalloped areas. Archaeological material recovered from the site includes seashells, pottery, ivory bangles, iron spears, a glass bead, hippo tusks, cuprous earrings, bone pendants, slag, smelting furnace remains, and tuyeres (Mlilo 2017). Researchers who have surveyed and studied the general area agree that the Vredefort Dome Conservancy area and its surroundings are rich in LIA dating from the 17th century to the early 19th century (Mlilo 2017). The Botanical Garden in the Free State is known to have been inhabited by IA Basotho dwellers. Pottery remains have been found here and are displayed in the Education Centre (SANBI 2021).

It is also believed that several IA communities north of the Vaal River (in the Limpopo Province) had practised the tradition of making rock art. Rock art is frequently connected to the later period in the IA when the farming communities had different encounters between other communities and the colonial settlers. The Makgabeng rock art is known for its depictions of conflict scenes associated with the Malebogo Wars (the war between Chief Malebogo of the Hananwa people and President Kruger of the Zuid Afrikaansche Republiek [ZAR]). In the Free State, rock art has also been linked to IA communities by association and is believed to have not been directly engraved or made by them. For instance, cattle paintings depict conflict scenes in the south-eastern Orange Free State (Tomose 2013). The figures include “hour-glass” Sotho shields, which has been argued to refer to the period of conflict and unrest known as the Difiqane/Mfecane (Binneman et al. 2011; Tomose 2013). Another known rock art site recorded in the Free State is on the Farm Kwartelfontein near Smithfield. Some rock art in the Free State depict cattle, sheep, and men walking with hunting dogs (Tomose 2013).

5.1.3 Historical period

The Historical/Colonial period generally refers to the last 500 years when European settlers and colonialism entered southern Africa (Binneman et al. 2011). It is believed that the historical period began with the arrival of Korana raiders in the area in the late 18th century. Soon after, in the 19th century, followed the arrival of traders, adventurers, and missionaries (Kruger 2018). The settlers were generally self-sufficient, surviving primarily on cattle/sheep farming and hunting (Van Schalkwyk 2014).

With the arrival of the Europeans, in the region north of the Orange River, by the end of the 18th century, the area was still sparsely populated. The bulk of the inhabitants seem to have been members of the Bechuana division of the Bantu speakers. Koranas were also in the Orange and Vaal valleys and Bushmen in the Drakensberg and western borders. The Griquas settled north of the Orange River in the early 19th century. Chief Mosilikatze (Mzilikazi) and his Matabele, between 1817 and 1831, ravaged the nation, and numerous large areas were depopulated. In 1824, Dutch farmers from the Cape Colony arrived in the country searching for pasture for their flocks. They

were followed by the first parties of the Great Trek in 1836. The Voortrekkers had left Cape Colony for various reasons, but essentially to escape British sovereignty (Hillier and Cana 1911: 154).

When the Voortrekkers started on the Great Trek out of the Cape Colony, some settled just north of the Orange River, which formed the boundary between the Cape Colony and the rest of South Africa (SAHO 2019). They established several towns and farms there. However, they soon clashed with some of the indigenous groups of the country, especially the Basotho (SAHO 2019). The emigrants soon ran into Mzilikazi, who led Zulus (Matabele) raiding parties against Boer hunters who had crossed the Vaal without first receiving permission from the chieftain. Retaliation ensued, and in November 1837, Mzilikazi was decisively defeated by the Boers and fled northward. Meanwhile, another group of emigrants had arrived at Thaba'nchu, where the Wesleyans had a mission station for the BaRolong. Chief Moroko treated the emigrants with great kindness, and the Boers maintained good ties with the BaRolong (Hillier and Cana 1911: 154). The constitution of the Orange Free State was sanctioned on the 7th of April 1854, three weeks after the renunciation of British sovereignty. In 1853, the Boers proclaimed the region the Orange Free State (OFS), a Boer republic. In 1854, the Bloemfontein Convention recognised the OFS as an independent territory (SAHO 2019).

The Basotho were founded by Moshoeshoe (also referred to as Moshesh) after the Mfecane. The Voortrekkers had fought against Mashoeshoe and his Basotho countless times. The battles were brought on by arguments about who had a claim over which land as well as where the border lies between the OFS and the Basotho kingdom (SAHO 2019). It is said that Moshoeshoe requested British protection to defend his Kingdom during the lengthy Second Basotho War, which lasted from 1864 to 1868 (SAHO 2019). In 1868, Moshoeshoe and his country were placed under British protection (Hillier and Cana 1911: 156). The Basotho kingdom was designated as a British protectorate, and the thirty years of strife between the Boers and the Basotho had ended (Hillier and Cana 1911 156; SAHO 2019). Trying to appease the Boers, the British had granted most of the Basotho's fertile land to the OFS. In turn, this created the current Lesotho borders along with the Free State (SAHO 2019).

The economy of South Africa, up until the 1860s, was primarily based on agriculture and trade. However, the discovery of diamonds led to the beginning of industrialisation in South Africa (SAHO 2019). Like their Transvaal neighbours, the Free State Boers had fallen into financial difficulties due to the conflicts with the Basothos. Paper money had been introduced, and the notes, known as "bluebacks", quickly fell to less than half their nominal value. Barter was the primary mode of exchange for goods and services, and many cases of bankruptcy occurred in the state. Nonetheless, just as British annexation rescued the Transvaal from ruin in 1877, so did the influx of British and other settlers to the diamond fields in the early 1870s returned public credit and individual wealth to the Free State's Boers. The diamond fields had a ready market for stock and agricultural products. Farmers started to make more money, and the public credit was restored. The government called in and redeemed the "bluebacks" after it regained par worth. The wealthiest diamond mine discovered in the Free State at the time was at Jagersfontein (Hillier and Cana 1911: 157). The Anglo-Boer War broke out in 1899. The OFS helped the ZAR to fight against the British. This was a significant turning point in the history of South Africa and was the last full-scale war fought on South African soil. In 1902 the Boers had lost the war. As a consequence, their republics

had become British colonies. The OFS was renamed the Orange River Colony. However, in 1910, it became one of the provinces of the new Union of South Africa and was renamed the OFS. Many years later, in 1995, after South Africa transitioned to democracy, the OFS was renamed the Free State (SAHO 2019; Britannica 2021). Interestingly, the Vaal River played an essential role during the Anglo-Boer War, forming a physical barrier that could only be crossed in a few areas. The ZAR forces burned the majority of the bridges in an attempt to hold the British at bay (Van Schalkwyk 2014). According to Van Schalkwyk (2014), the town of Vereeniging was where the peace negotiations had taken place between the Boer and British forces. However, the treaty was signed in Pretoria (Van Schalkwyk 2014).

In the Free State, there are various monuments, buildings (and their architectural styles) on farmsteads, statues and memorials associated with the various events that occurred during the Colonial/Historical period in the region (Tomose 2013). During the South African (Anglo-Boer) War (1899-1902), British forces were stationed near the Botanical Garden. The dam was constructed to keep water for their horses, and the stone wall can still be seen today. The Monk's Head beacon and an old stone wall commemorate a British patrol path used during the battle. Piles of horseshoes discovered near the nursery complex suggest that it was once home to a farrier's shop (SANBI 2021). Moreover, the south-eastern Free State is rich in historical encounters, tales, and material culture/remains from the Boer War. Binneman et al. (2011) remark that Bloemfontein's surroundings played an essential role in Boer War history. Colesburg is well-known for its historical events. In 1845, a skirmish between the Boers and the Griquas took place near Colesburg. Moreover, at Alleman's Drift near Colesburg, Adam Kok and many British individuals created a beacon proclaiming the whole nation from that point forward to be British territory, except areas in control by the Portuguese and native tribes (Binneman et al. 2011).

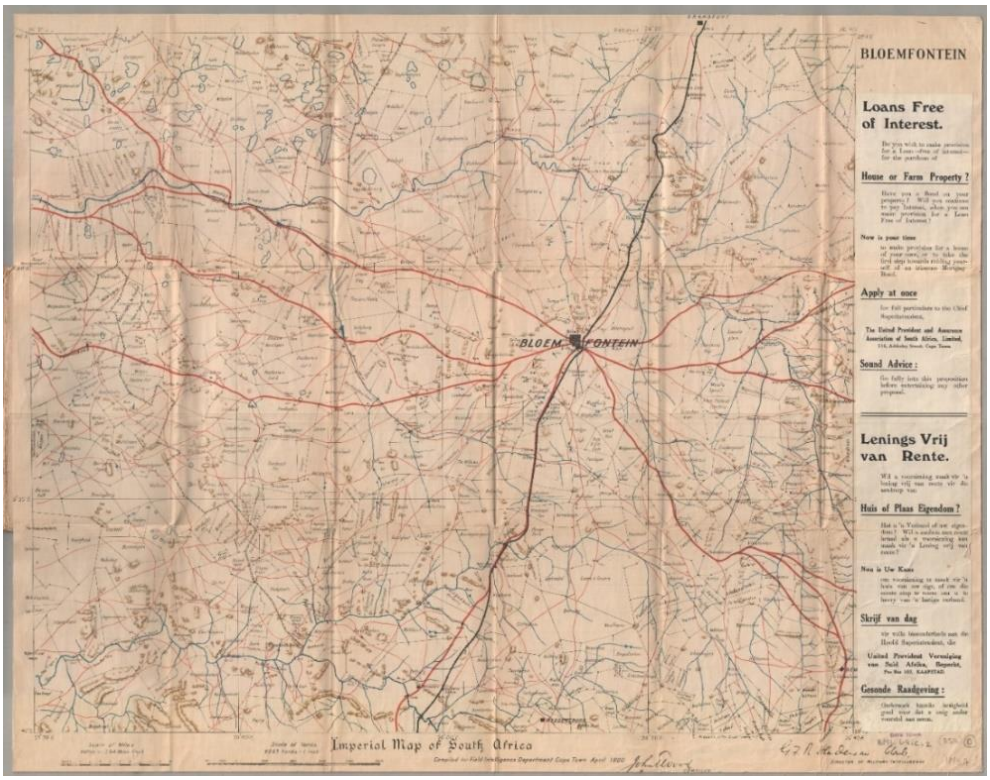


Figure 15 *Imperial Map of Bloemfontein and surrounds, with the wagon routes indicated. Image from UCT digital collections, https://digitalcollections.lib.uct.ac.za/*

5.2 Local: Spes Bona 2355 and surrounds

Unfortunately, not much is known about the early history of the farm Spes Bona 2355. The early 1900s map above indicates farm boundaries, fences, farm names, divisional boundaries, roads, rivers, telegraph lines and railways in the Bloemfontein area. The map also indicates hills, pans (often dry), homesteads, cultivated land and trees. Upon closer inspection of the map, it would appear that Spes Bona 2355 was initially part of Quaggafontein (Kwaggafontein). Therefore, the history of Kwaggafontein and Bloemfontein may provide some insight into the local history. The majority of the history related to Kwaggafontein surrounds Sir Cornelis Hermanus Wessels. Wessels was a stock farmer who later became the second Administrator of the Orange Free State Province. He had purchased the farm in 1892. Kwaggafontein is believed to have initially belonged to a businessperson from Bloemfontein, named K.A Chapman. The farm was put on sale after Chapman's death. Wessels and his family had settled on the farm. However, Wessels and his family eventually moved to Aliwal Street (Bloemfontein) in the early 1900s (Dreyer 2013; Wikipedia 2021).

Bloemfontein was initially a gathering point for hunters and was referred to as Mangaung (place of the cheetahs). The origin of the name Bloemfontein appears to be a source of contention. According to one explanation, which appears to be the most widely recognised, the fountain was surrounded by flowers (*Bloem* in Dutch), and therefore it was named Bloemfontein, which translates to "fountain of flowers." Another story is that the name was suggested by one of Brits' (a family who resided in Bloemfontein) neighbours, Mr Griesel, who was inspired by Mrs Brits' garden. It is also said to have been named after a person with the surname Bloem or an ox with the same name (Raper 1987; SAHO 2018).

Bloemfontein was founded in 1846 by Major H D Warden on the farm Bloemfontein, which, according to Raper (1987), was formerly owned by a Griqua named Mauritz Pretorius. However, it is also believed that Warden purchased the property in the 1840s from Johannes Nicolas Brits. Nevertheless, it was founded as a British military outpost of the South African frontier known as the Transoranje region (Fourie 2013a and b; Rossouw 2007). Bloemfontein served as the capital of the Orange River Sovereignty (1848-1854) and afterwards as the capital of the erstwhile Orange Free State Republic (1854-1902). In 1880, Bloemfontein was granted municipal status. Bloemfontein hosted the Bloemfontein Conference in 1899 to negotiate a peaceful settlement between President Kruger of the Transvaal Republic and British High Commissioner Alfred Milner on the status of British migrant mine workers. However, the conference failed, and the South African War broke out (Britannica 2019; Fourie 2013 a and b; Raper 1987). The initial railway line, which connected Bloemfontein to Cape Town, was erected in 1890. This line was crucial to the British occupation of the city later in 1900 during the Anglo-Boer War (Rossouw 2007).

The Bloemfontein area is rich in history from the Anglo-Boer war (1899-1902). The area was central and important during the ABO, specifically the region south of Bloemfontein. Briefly, the Boer forces anticipated a British onslaught on Bloemfontein from the west along the Riet River in March 1900. However, the Boer defence was out-manoeuvred by Lord Roberts when they approached from the

south (Dreyer 2006). On 13 March 1900, Bloemfontein was seized, allowing Lord Roberts to prepare for the attack on Pretoria. Between March 15 and March 28, 1900, about 40 000 British troops arrived around Bloemfontein, putting further strain on the town's already overburdened infrastructure. By the end of June 1900, when the march to Pretoria began, the defence of Bloemfontein was no longer a priority (Dreyer 2006; 2015).

Bloemfontein was the capital of the Orange River Colony from 1902 to 1910, and it has since been the provincial capital of the erstwhile Orange Free State and contemporary Free State (Rossouw 2007).

6. HERITAGE SENSITIVITY

The Heritage Screening tool (https://screening.environment.gov.za/) shows low to medium significance with locations of high sensitivity towards the east, northeast and southeast of the proposed project area(s).

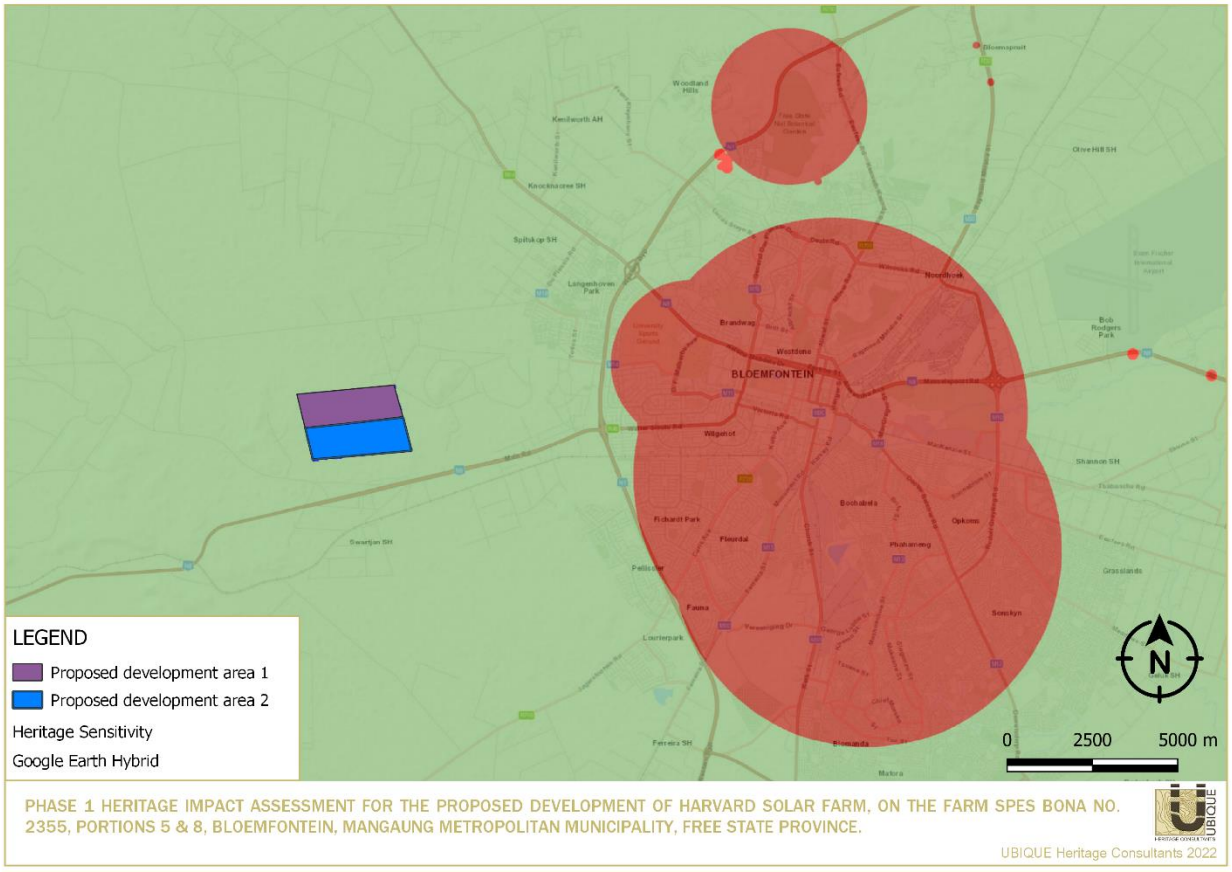


Figure 16 *The Project area indicated on the Heritage Screening tool (https://screening.environment.gov.za/)*

6.1 Summary of Local Heritage Resources: Spes Bona 2355 and surrounds

The desktop study revealed that several Impact Assessments had been done on several portions of Spes Bona 2355 and surrounding farms. Numerous reports have been done in and around Bloemfontein. However, due to the vast amount of impact assessments done in the wider region, the assessment zone focuses on farms directly surrounding Spes Bona 2355, such as WolfKop, Kwaggafontein, Picton, Eensgevonden, Brabant, Freewater, Rooidam, Cecilia, Donegal, and Glen Hope. The majority of the studies encountered minimal to no archaeological materials/remains (e.g. Dreyer 2007b, 2013; Rossouw 2014, 2015, 2016, 2018, Fourie 2013 a and b). Spes Bona 2355, and the wider region has mainly been disturbed by farming and industrial activities.

However, some of the assessments reported on cultural material and features relating to the Iron Age and the Historical/Colonial era (e.g. Dreyer 2005, 2006, 2007a, c and d,2015).

6.1.1 Stone Age

None of the reports done around Spes Bona 2355 recorded any stone tools, lithics or flakes. However, the Stone Age archaeological record around Bloemfontein dates between the early Middle Stone Age and Late Stone age periods (Rossouw 2018).

6.1.2 Rock Art

Several rock art sites have been documented on the SAHRA Database in the Free State province. The closest rock art sites are located (approximately 135km) to the east and southeast of the proposed development area.

HERITAGE SITES IN AND AROUND BLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:

Site/Object Name	Coordinates	Archive Status	Declaration Type	Site type	Site Reference	Site ID
Rose Cottage Cave, Ladybrand District	-29.216091; 27.469661		Provincial Heritage Site	Archaeological, Rock Art, Deposit	9/2/325/0006	32417
Rock Paintings, Modderpoortspruit, Ladybrand District	-29.112431; 27.443938	National monument	Provincial Heritage Site	Rock Art	9/2/325/0010	26445
Rock paintings, Ventershoek, Wepener District	-29.746241; 27.072694		Provincial Heritage Site	Rock Art	9/2/346/0003	26384

6.1.3 Iron Age

The Desktop study revealed that Iron Age sites are not uncommon in the area.

IRON AGE RESOURCES RECORDED IN A 10 KM RADIUS

HIA/AIA	SITE	COORDINATES / PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
Dreyer 2005	Stone-walled complex 1	29°08'08" S 26°03'01" E 3.5 km W	LIA stonewalled complex (1660-1810). Several ashy soil outcrops were visible near the stonewalls. No archaeological/cultural material was recorded on the surface.
Dreyer 2005		29°08'16" S	LIA stonewalled complex (1660-1810).

IRON AGE RESOURCES RECORDED IN A 10 KM RADIUS			
HIA/AIA	SITE	COORDINATES PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
	Stone-walled complex 2	26°02'59" E 3.5km W	
Dreyer 2005	Stone-walled complex 3	29°08'17" S 26°02'57" E 3.7km W	LIA stonewalled complex (1660-1810).
Dreyer 2007c	Kwaggafontein - kraal	None provided for kraal Approx 2.5 km E	Base stones of a Kraal was recorded. Unfortunately, the walls have been robbed for their stone.

6.1.4 Historical/Colonial period

Very few impact assessments reported on cultural material and sites associated with the Historical/Colonial Period. The wider vicinity is well known for Historical Period resources related to the ABO and colonial farming period, one example of ABO remains found in a 10km radius is included in the table below.

HISTORICAL PERIOD RESOURCES RECORDED IN X KM RADIUS			
HIA/AIA	SITE	COORDINATES PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
Dreyer 2007d	Kwaggafontein residential house	29°07'37" S 26°09'13" E 4.1 km E	Old residence at Plot 38 Kwaggafontein dating from about 1926.
Dreyer 2007a	Erf 24722	29°07'08" S 26°12'54" E Approx. 10km W	Historical and cultural remains occur in the form of old corrugated iron buildings, concrete foundations, cement irrigation furrows, stone terrace walls, steps and pathways and the indications of several possible ash heaps. The site appears to date as far back as 1939 or earlier.
Dreyer 2006	Hill B3	29°10'02"S 26°12'11"E	Anglo-Boer war remains and a rectangular stonewall foundation was noted.

HISTORICAL PERIOD RESOURCES RECORDED IN X KM RADIUS			
HIA/AIA	SITE	COORDINATES PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
		9.7 km SE	
Dreyer 2006	EHRLICH FOREST & HAMILTON FOREST	No coordinates provided SE of study area	Dreyer (2006) noted that the Ehrlich and Hamilton Forests were mentioned by respondents. These were founded during the British occupation after the ABO.
Dreyer 2015	Brandkop	29°11'13" S 26°09'27" E 7.5km SE	The farmyard contains several historical buildings, which date from about 1876, or even earlier. Other remains of previous farming activities occur in the form of corrugated iron buildings, concrete foundations, several water reservoir dams, irrigation furrows, stone steps and terrace walls. The farm used to be part of an important historical period in the history of Bloemfontein. The original house was erected in 1876 and was renovated and extended in 1919, with more alterations added through the years.

The Bloemfontein area has numerous National and provincial Monuments, ranging from places, buildings, battlefields, conservation areas and memorials , all of which are listed in this table below which can also be found on the SAHRA Database:

HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:						
Site/Object Name	Coordinates	Archive Status	Declaration Type	Site type	Site Reference	Site ID
Historic tree-garden, President Brand Street, Bloemfontein	-29.116673 26.216538	National monument	Provincial Heritage Site	Place	9/2/302/0001-001	26559
First University Building, University of the Orange Free State, Bloemfontein	-29.112058 26.186284	National monument	Provincial Heritage Site	Building	9/2/302/0001-005	26560
Sannaspos Battlefield, Ahmetnagher,	-29.155606 26.532725	National monument	Provincial Heritage Site	Battlefield	9/2/302/0002-001	26555

HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:

Site/Object Name	Coordinates	Archive Status	Declaration Type	Site type	Site Reference	Site ID
Bloemfontein District						
President Brand Street Conservation Area, Bloemfontein	-29.114710 26.217760	Conservation area	Provincial Heritage Site	Conservation area	9/2/302/0003	26556
The Original Archives Building, 37 Merriam Makeba Street, Bloemfontein	29.115826 26.214828	National monument	Provincial Heritage Site	Building	9/2/302/0005	26557
Old Prison, Bloemfontein	-29.116667 26.216667	Register	Heritage register	Building	9/2/302/0006	26558
Old Presidency, President Brand Street, Bloemfontein	-29.119636 26.215519	National monument	Provincial Heritage Site	Building	9/2/302/0007	26551
Two Tower Church, Charles Street, Bloemfontein	-29.115715 26.222264	National monument	Provincial Heritage Site	Building	9/2/302/0010	26552
Military Museum Fort Bloemfontein, Church Street, Bloemfontein	-29.124700 26.221567	National monument	Provincial Heritage Site	Building	9/2/302/0011	26553
Fichardt House, 40 Elizabeth Street, Bloemfontein	-29.115508 26.215538	National monument	Provincial Heritage Site	Building	9/2/302/0013	26554
Mapikela House, 1436 Maghoti Street, Batho, Bloemfontein	-29.137789 26.222761	Provisional monument	Provisional Protection	Building	9/2/302/0014	26549
The Railway Bureau Building, Maitland Street, Bloemfontein	-29.118670 26.225396	National monument	Provincial Heritage Site	Building	9/2/302/0016	26550
City Hall, President Brand Street, Bloemfontein	-29.114253 26.216682	National monument	Provincial Heritage Site	Building	9/2/302/0019	26546
Cathedral of St Andrew and St Michael, St George Street, Bloemfontein	-29.121105 26.219366	National monument	Provincial Heritage Site	Building	9/2/302/0022	26547
Main Building, Bloemfontein Technical College, Douglas Street, Bloemfontein	-29.120689 26.221632	National monument	Provincial Heritage Site	Building	9/2/302/0023	26548
Ramblers Club, Aliwal Street, Bloemfontein	-29.111766 26.219862	Register	Heritage register	Building	9/2/302/0024	26545
Freshford House Museum, 31 Kellner Street, Bloemfontein	-29.111306 26.216250	National monument	Provincial Heritage Site	Building	9/2/302/0026	26542
Vierde Raadsaal, President Brand Street, Bloemfontein	-29.115772 26.217724	National monument	Provincial Heritage Site	Building	9/2/302/0027	26543

HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:

Site/Object Name	Coordinates	Archive Status	Declaration Type	Site type	Site Reference	Site ID
Old Government Building, President Brand Street, Bloemfontein	-29.116533 26.215925	National monument	Provincial Heritage Site	Building	9/2/302/0028	26544
Anglo-Boer War Blockhouse, Riverford, Bloemfontein District	-29.400000 26.116667	Provincial Monument	Provincial protection	Building	9/2/302/0029	26539
Eerste Raadsaal, 95 St Georges Street, Bloemfontein	-29.120469 26.216674	National monument	Provincial Heritage Site	Building	9/2/302/0036	26540
Hertzog House Museum, 19 Goddard Street, Bloemfontein	-29.122791 26.218946	National monument	Provincial Heritage Site	Building	9/2/302/0037	26541
Orange Free State Botanical Gardens, Bloemfontein	-29.052775 26.212410	National monument	Provincial Heritage Site	Building	9/2/302/0039	26536
Conspiracy Tree, Onze Rust, Bloemfontein District	-29.276729 26.183050	National monument	Provincial Heritage Site	Natural, Place	9/2/302/0042	26537
Arthur Nathan Swimming Pool Complex, Fairview Street, Bloemfontein	-29.109039 26.222500	National monument	Provincial Heritage Site	Building	9/2/302/0043	26538
Women's Memorial, Monument Road, Bloemfontein	-29.141587 26.208364	National monument	Provincial Heritage Site	Monuments & memorials	9/2/302/0045	26534
Elizabeth le Roux Hostel, 99 Aliwal Street, Bloemfontein	-29.102484 26.220658	National monument	Provincial Heritage Site	Building	9/2/302/0049	26535
Hoffman Square, Bloemfontein	-29.118192 26.221833	Provincial Monument	Provincial protection	Place	9/2/302/0051	26532
Main Building and Hamilton Hall, Grey College, Bloemfontein	-29.112654 26.197019	National monument	Provincial Heritage Site	Building	9/2/302/0056	26533
Andrew Murray House, Grey College, Jock Meiring Street, Bloemfontein	-29.110684 26.193968	National monument	Provincial Heritage Site	Building	9/2/302/0057	26530
Brill House, Grey College, Jock Meiring Street, Bloemfontein	-29.111565 26.194668	National monument	Provincial Heritage Site	Building	9/2/302/0058	26531
Tuck shop, Grey College, Jock Meiring Street, Bloemfontein	-29.110816 26.195478	National monument	Provincial Heritage Site	Building	9/2/302/0059	26527
Corrugated-Iron Building, School of	-29.082889 26.184333	National monument	Provincial Heritage Site	Building	9/2/302/0061	139114

HERITAGE SITES IN AND AROUND NLOEMFONTEIN DOCUMENTED ON THE SAHRA DATABASE:

Site/Object Name	Coordinates	Archive Status	Declaration Type	Site type	Site Reference	Site ID
Armour, Tempe, Bloemfontein						
Somerlust, 32 Whites Road, Waverley, Bloemfontein	-29.090152 26.227723	Register	Heritage Register	Building	9/2/302/0063	26528
Main Building, University of the Orange Free State, Bloemfontein	-29.110660 26.186492	National monument	Provincial Heritage Site	Building	9/2/302/0064	26529
Station Building, Sannaspos Railway Station, Bloemfontein District	-29.160828 26.547184	National monument	Provincial Heritage Site	Building	9/2/302/0065	26526
Edwardian House, 72 president Reitz Avenue, Westdene, Bloemfontein	-29.108372 26.212602	National monument	Provincial Heritage Site	Building	9/2/302/0072	129906
Green Lodge, 81 St Georges Street, Bloemfontein	-29.120208 26.217162	National monument	Provincial Heritage Site	Building	9/2/302/0077	26523
White Horse Stone, Naval Hill, Bloemfontein	-29.100422 26.238832	National monument	Provincial Heritage Site	Place	9/2/302/0078	26524
Abraham Fischer House, University of the Orange Free State, Bloemfontein	-29.111767 26.185999	National monument	Provincial Heritage Site	Building	9/2/302/0079	26525
Grave of Martha Moipone Motlhakwana, Phahameng Cemetery, Bloemfontein	-29.154954 26.233313		Provincial Heritage Site	Burial Grounds & Graves	Grave of Martha Moipone Motlhakwana	105604
House of Martha Moipone Motlhakwana, 932 Gonyane Street, Bloemfontein	-29.138088 26.231460		Provincial Heritage Site	Building	House of Martha Moipone Motlhakwana	105606
Waaihoek Wesleyan Church, Bloemfontein	-29.123370 26.223759		National Heritage Site	Building	The Wesleyan Church	93129

6.1.5 Graves/Burials

Several graves were recorded in the area around the development footprint.

GRAVES/BURIALS RECORDED IN 10 KM RADIUS

HIA/AIA	SITE	COORDINATES PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
Dreyer 2007c	Kwaggafontein graves	29°06'47"S 26°08'09"E 2.6km E	Approximately 30 graves recorded.
Dreyer 2007c	Kwaggafontein cemetery	No coordinates provided for cemetery Approx. 2.5 km E	A cemetery near the farmhouse. It consists of graves belonging to the former owner, his first wife and relatives. The farm and cemetery farm belonged to Sir Cornelis Wessels, the second Administrator of the Free State.
Dreyer 2015	Brandkop	29°11'13"S 26°09'27"E 7.5km southeast	A graveyard near the farmhouse contains the burials of members of the Fichardt family, the first occupants, who were all prominent former citizens of Bloemfontein.

7. IDENTIFIED RESOURCES AND HERITAGE ASSESSMENT

7.1 Surveyed area

The area surveyed for the impact assessment was dictated by the Google Earth map of the development footprints provided by the client. The proposed agricultural areas were surveyed by vehicle and on foot by a two-person team. The pedestrian survey was conducted in predominantly 30-50 m transects.

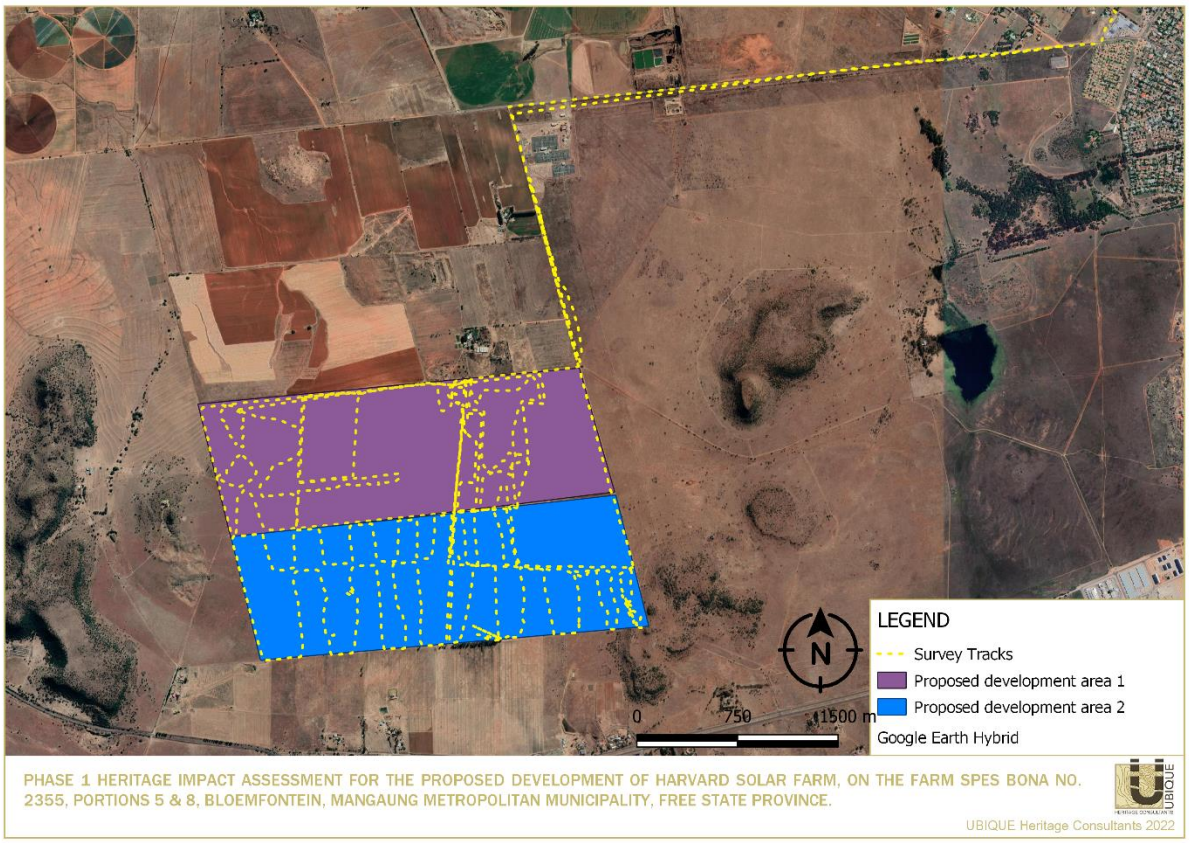


Figure 17 *Survey tracks across the development footprint.*

7.2 Description of the affected environment

The agricultural development area falls within the Winburg Grassy Shubland vegetation type, with the larger area being surrounded by Bloemfontein dry grassland and Bloemfontein aroid Grassland (SANBI 2022). Mesas distinguish the landscape with solitary hills, slopes, and escarpments form a variety of habitats ranging from open grassland to shrubland. Tall shrubs and, in some cases, small trees are protected from frost throughout the winter months and veld fires that occur regularly from late winter to early spring. *Olea europaea subsp. africana, Euclea crispa subsp.*

crispa, Gymnosporia buxifolia, Diospyros lycioides, Rhus burchellii, R. ciliata, R. erosa (mainly in the south), *Clutia pulchella and Grewia occidentalis* are present among the medium-height evergreen shrublands. Also common among this vegetation are trees such as *R. lancea, Celtis africana* and *Ziziphus mucronata* which are found in more deeply incised drainage lines (Mucina & Rutherford 2006).

According to Mucina and Rutherford (2006), the Winburg Grassy Shubland's geology and soils are made up of large dolerite sills that form ridges, plateaus, and slopes of oppies. There are also small escarpments that mark the erosion terraces. Furthermore, the dominant soil types are stony Mispah and gravel-rich Glenrosa derived from Jurassic dolerite (Mucina & Rutherford 2006).

The landscape has been severely disturbed by farming activities, specifically the northeastern most portion of the proposed development area. A hill is located in the southeasternmost portion of the study area, with several hills situated east outside of the development footprint. Neighbouring farm fences bound the development footprints to the east, south and west. Various two-track roads give access to the different development areas.

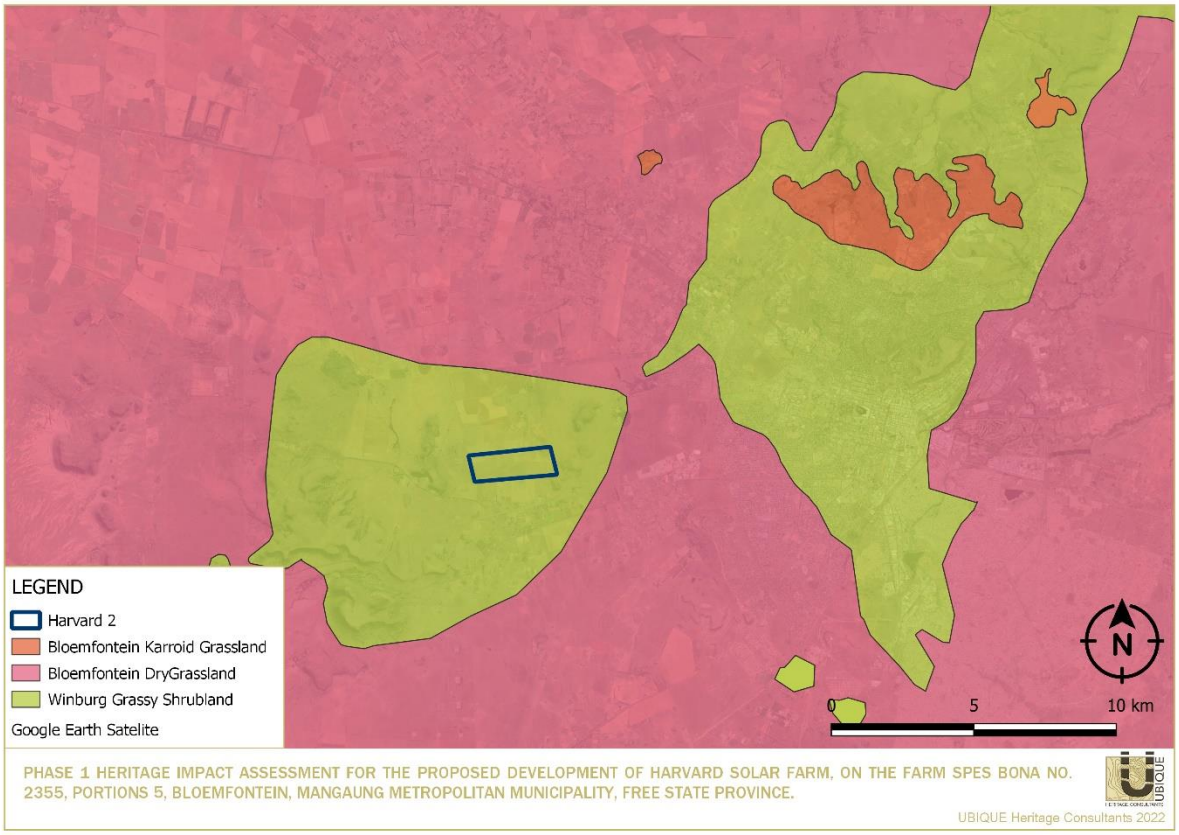


Figure 18 *Indication of the vegetation types in and around the study area (namely: Bloemfontein Karroid Grassland, Bloemfontein Dry Grassland, and Winburg Grassy Shrubland).*

Figure 19 *Views of the affected development area.*

7.3 Identified heritage resources

7.3.1. Rock Art Identified

ROCK ART IDENTIFIED					
SITE ID #	DESCRIPTION		PERIOD	LOCATION	FIELD RATING/ SIGNIFICANCE/ RECOMMENDED MITIGATION
SB2-002	Type of site	Open-air	Unknown – likely recent	**29° 7'48.72"S 26° 6'45.08"E**	Field Rating IV C Low significance No Mitigation Required
	Material	Rock Engraving			
	N in m²				
	Context	Situated near the eastern fence boundary			
	Additional	No other engravings or cultural material present			

7.3.2. Graves Identified

GRAVES/BURIALS IDENTIFIED					
SITE ID #	DESCRIPTION		PERIOD	LOCATION	FIELD RATING/ SIGNIFICANCE/ RECOMMENDED MITIGATION
SB2-001	Grave Markers	None	Unknown	**29° 7'43.52"S 26° 6'43.42"E**	Field Rating of Local Grade IIIB High/medium significance 30m buffer/safety zone recommended
	Inscription	None			
	Grave Orientation	East/West			
	Dimension/Extent	1,5m x 1m each packed with stones			
	Additional	Minimal stones remain in-situ			

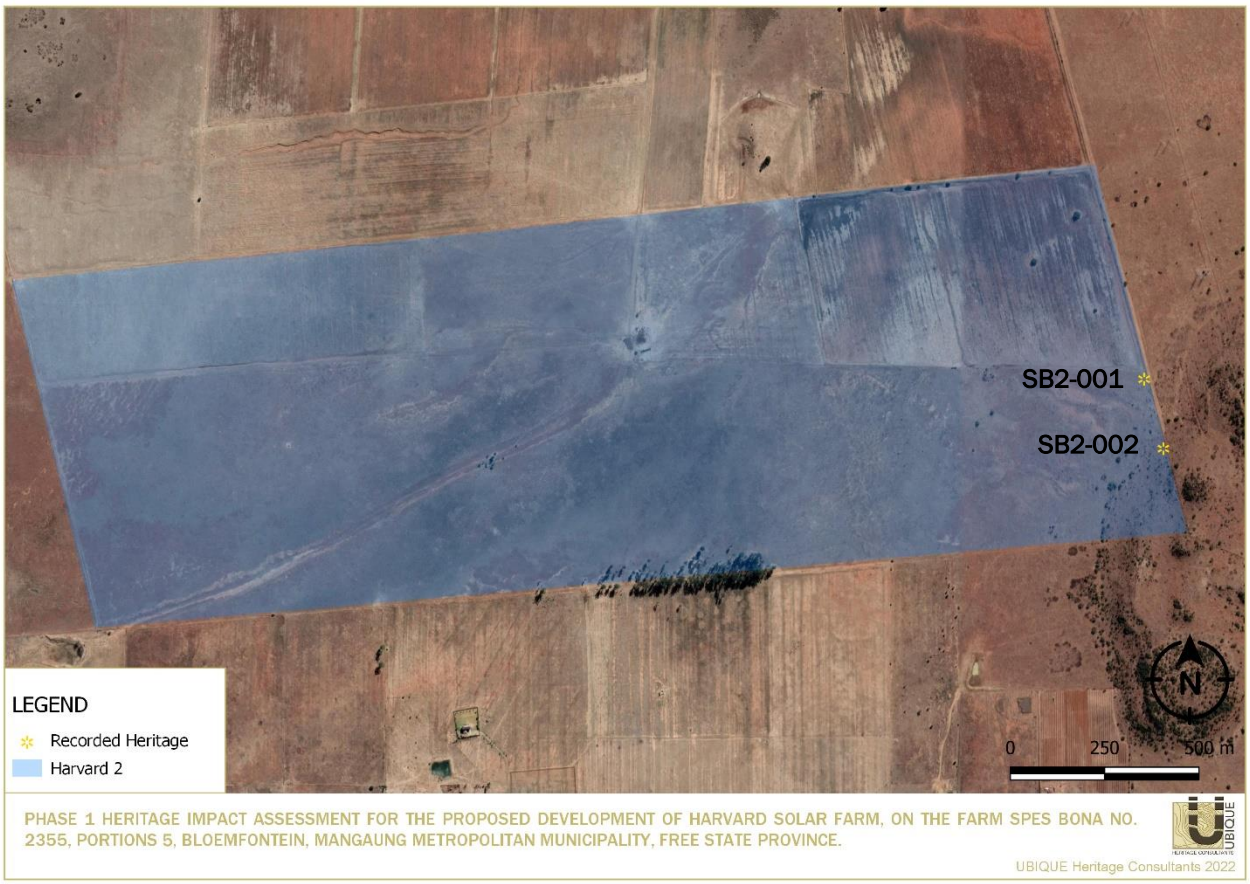


Figure 20 *Distribution of identified heritage resources, Spes Bona 2355 Portion 5.*

7.4 Discussion

6.3.1 Archaeological features

6.3.1.1 Rock Engraving

One rock was recorded with engravings on it (Site SB02-002). It was recorded near the eastern fence. It is unclear what is engraved on the rock, as it appears to have been scratched out. However, there are two letter Ns and an E, still somewhat visible. Unfortunately, a precise date cannot be provided as it could be related to the historical farmyard, but since the farm is still in use, it is more likely that it could be recent. There are also no other engravings, nor any cultural material/features situated near it.

This site is given the General protection C (Field Rating IV C). Phase 1 is considered as sufficient recording, and it may be demolished (low significance).

Figure 21 *Engraved stone*

6.2.1.2. Graves

Five stone packed graves were found on Portion 5 of Spes Bona (Harvard 2). The graves are located near the northeastern fence. The shapes of the graves are relatively visible, although there appears to be no stone cairns. The age of the graves are undetermined. The five graves are currently unfenced and unprotected.

These sites are given a 'Local Grade IIIB" rating. This means the graves should be included in the heritage register and may be mitigated (high/ medium significance).

Figure 22 *Five stone packed graves identified on Spes Bona 2355 Portion 5*

6.3.2 Palaeontological resources

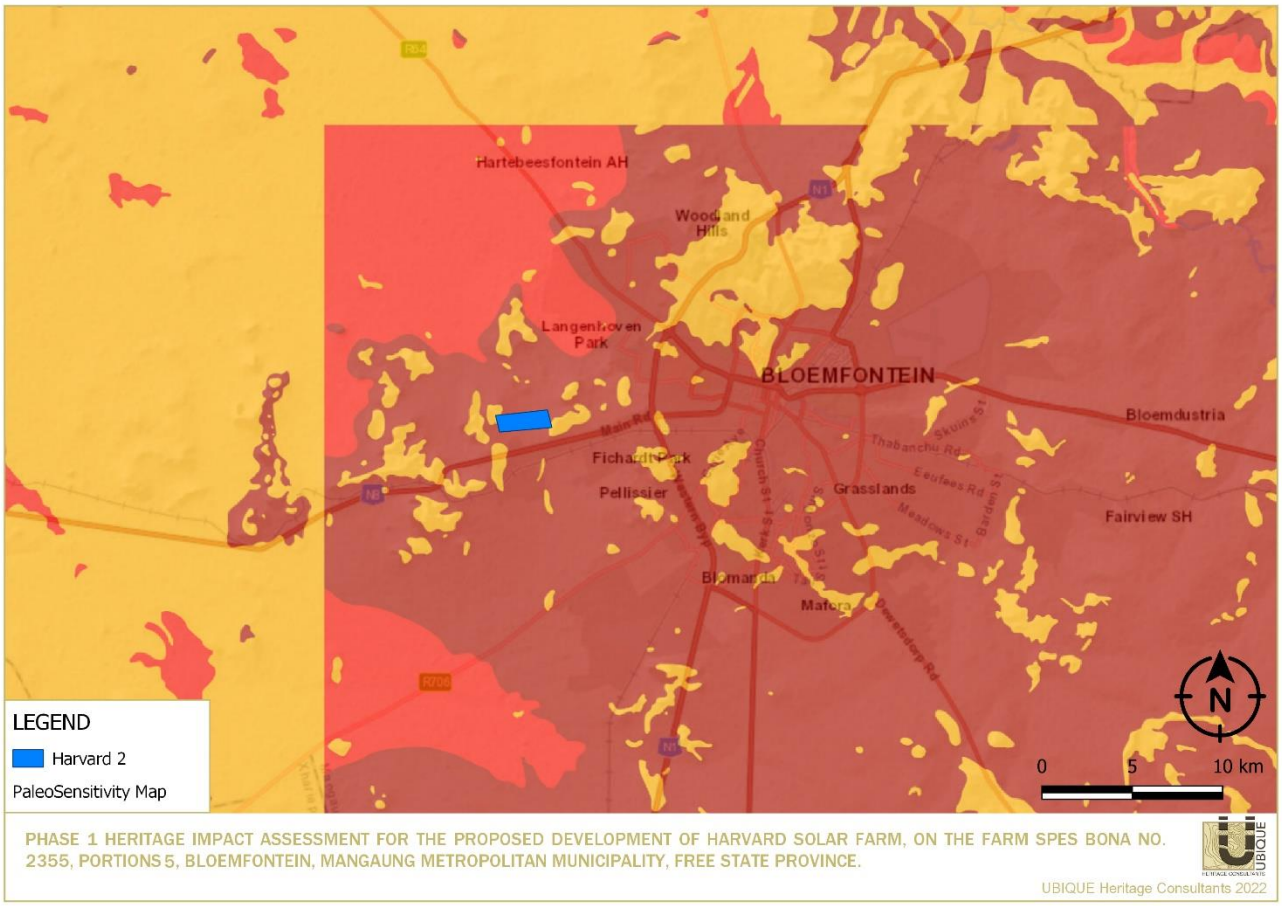


Figure 23 *The Heritage Paleo screening tool and SAHRIS PalaeoSensitivity Map, indicating Medium (yellow), High (Red), Very High (Dark red) palaeontological significance in the study area, (https://screening.environment.gov.za/ ; https://sahris.sahra.org.za/map/palaeo).*

The proposed Harvard 1 Solar PV near Bloemfontein in the Free State is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the south-west is underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and that Jurassic Karoo dolerite is Zero as it is igneous in origin (Almond and Pether 2008, SAHRIS website). During the site visit, no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. (Butler 2022 Appendix A).

Elize Butler from Banzai Environmental conducted a palaeontological field assessment for the development footprint (see Appendix A).

8. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

Description	Development Impact		Mitigation	Field rating/ Significance
Archaeological				
1. Five stone packed graves situated near the fence, within the proposed development area	Nature	Negative	Sites should be included in the heritage register and may be mitigated. Buffer zone recommended.	Field Rating of Local Grade IIIB High significance
	Extent	Medium		
	Duration	High		
	Intensity	Medium		
	Potential of impact on irreplaceable resource	High		
	Consequence	High		
	Probability of impact	High		
	Significance	High		
2. Single rock engraving	Nature	Neutral	No mitigation required	Field Rating of IV C Low significance
	Extent	Medium		
	Duration	Low		
	Intensity	Low		
	Potential of impact on irreplaceable resource	Low		
	Consequence	Low		
	Probability of impact	Low		
	Significance	Low		
Paleontological				
3. The Palaeontological Sensitivity of the Balfour Formation is Very High, and that Jurassic Karoo dolerite is Zero as it is igneous in origin. no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms.	Nature	Negative	Chance Finds Protocol provided.	N/A
	Extent	Low		
	Duration	Medium		
	Intensity	High		
	Potential of impact on irreplaceable resource	High		
	Consequence	High		
	Probability of impact	High		
	Significance	High		

The significance of the rock engraving recorded at site SB02-002 is not conservation worthy, and therefore, in the unlikely event that impact should occur, the negative impact is negligible.

The proposed agricultural development will impact negatively on the five graves recorded on Spes Bona Portion 5 (Harvard 2). A 30m safety/buffer zone is essential to negate the negative impact on the heritage resources.

With regards to the impact on palaeontological resources, the scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of low significance in palaeontological terms. Therefore, it is considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological reserves of the area (Butler 2022).

9. RECOMMENDATIONS

Based on the assessment of the potential impact of the development on the identified heritage, the following recommendations are made, taking into consideration any existing or potential sustainable social and economic benefits:

1. The engraved stone recorded to the southeast of the proposed development footprint is of low significance, and thus impact is negligible.

2. The five stone packed graves recorded during the investigation will be impacted negatively by development. These would require costly mitigation before destruction. It is, therefore, our recommendation that a buffer/safety zone should be implemented

3. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and Jurassic Karoo dolerite is Zero as it is igneous in origin. However, no fossiliferous outcrops were identified during the site visit. If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance Find Protocol (Appendix A/12) must be implemented by the Environmental Control Officer (ECO) in charge of these developments. Fossil discoveries ought to be protected, and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out (Butler 2022).

4. Although all possible care has been taken to identify sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the assessment. If during construction, any evidence of archaeological sites or remains (e.g. remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, charcoal and ash concentrations), fossils or other categories of heritage resources are found during the proposed development, SAHRA APM Unit (Natasha Higgitt/Phillip Hine 021 462 5402) must be alerted as per section 35(3) of the NHRA. If unmarked human burials are uncovered, the SAHRA Burial Grounds and Graves (BGG) Unit (Thingahangwi Tshivhase/Mimi Seetelo 012 320 8490), must be alerted immediately as per section

36(6) of the NHRA. A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contacted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance, a Phase 2 rescue operation may be required subject to permits issued by SAHRA. UBIQUE Heritage Consultants and its personnel will not be held liable for such oversights or costs incurred as a result of such oversights.

10. CONCLUSION

This HIA has identified significant heritage resources, five graves that may be impacted negatively by the proposed development. The proposed development of solar photovoltaic (PV) facilities on Portion 5 of farm Spes Bona 2355 (Harvard 2), Bloemfontein, Mangaung Metropolitan Municipality, Free State Province, may continue, provided the recommendations stipulated within this report, and the subsequent decision by SAHRA, are followed.

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APPENDIX A

PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF HARVARD 2 SOLAR PHOTOVOLTAIC (PV) FACILITY AND ASSOCIATED INFRASTRUCTURE, ON PORTION 5 OF FARM SPES BONA NO 2355 IN THE MANGAUNG METROPOLITAN MUNICIPALITY IN THE FREE STATE

PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED CONSTRUCTION OF HARVARD 2 SOLAR PHOTOVOLTAIC (PV) FACILITY AND ASSOCIATED INFRASTRUCTURE, ON PORTION 5 OF FARM SPES BONA NO 2355 IN THE MANGAUNG METROPOLITAN MUNICIPALITY IN THE FREE STATE

Compiled for:

UBIQUE Heritage Consultants

Web: www.ubiquecrm.com

Mail: info@ubiquecrm.com

Prepared by

Banzai Environmental

February 2022

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE: 

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 10	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1 and 11	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to	Section 1 and 11	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;		
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 11	
(k) Any mitigation measures for inclusion in the EMPr	Section 12	
(l) Any conditions for inclusion in the environmental authorisation	Section 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities, or portions thereof should be authorised, any avoidance,	Section 1 and 11	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by UBIQUE Heritage Consultants to conduct the Palaeontological Impact Assessment (PIA) to assess the proposed Harvard 2 Solar Photovoltaic (PV) facility on Portion 5 of Farm Spes Bona No 2355, Mangaung Metropolitan Municipality in the Free State. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to confirm if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The proposed Harvard 2 Solar PV near Bloemfontein in the Free State is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the north-west and south-east is underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and that of Jurassic dolerite is Zero as it is igneous in origin (Almond and Pether 2008, SAHRIS website). The Very High Palaeontological Sensitivity triggered a site visit.

A site-specific field survey of the development footprint was thus conducted on foot and by motor vehicle on 26 January 2022. During the site visit no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area.

Recommendations:

- The ECO for this project must be informed that sediments of the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a **Very High Palaeontological Sensitivity**.

- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out.

- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).

- These recommendations should be incorporated into the Environmental Management Plan for the Harvard 2 PV Facility.

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APPENDIX A: CV

1 INTRODUCTION

Keren Renewable Energy (Pty) Ltd plans to develop the Harvard Solar PV facilities, associated infrastructure, and grid connection west of Bloemfontein in the Mangaung Metropolitan Municipality, Free State Province. EnviroAfrica cc has been commissioned to commence with a separate NEMA application procedure for Environmental Authorisation for each of the planned solar PV facilities (Harvard Solar 1 and Harvard Solar 2) and the grid connection (**Figure 1-12**).

UBIQUE Heritage Consultants was in turn appointed to conduct the Archaeological Impact Assessment (AIA) while Banzai Environmental was employed to conduct the Palaeontological Impact Assessment (PIA) as part of the Heritage Impact Assessment (HIA).

In this report the Palaeontological Heritage of **Harvard Solar 2 PV facility** and associated infrastructure will be investigated.

The construction of Harvard Solar 2 PV facility and associated infrastructure on Portion 5 of Farm Spes Bona No 2355, Mangaung Metropolitan Municipality in the Free State is proposed (**Figure 1-12**). This PV facility will be approximately 215ha in extent.

The following Information was provided by EnviroAfrica CC
Due to proximity to the Eskom substation, consent use of land and other renewable energy developments/proposed developments, alternative sites do not exist. However, alternative options which include *inter alia* alternative PV technology, layout options and the option of not proceeding with the proposed development (the No-Go option) will be considered and assessed in the Environmental Impact Assessment Report (EIR). The EIR will include specialist reports and will undergo a further round of public participation.

1.1. TYPE OF SOLAR INSTALLATION

The solar installation type is as follows:

- Photovoltaic panels (on ground-mounted steel structures)
- Fixed axis and single-axis tracking (to be confirmed during detail design)

Figure 24: *Type of solar installation.*

1.2. ELECTRICITY

Generation capacity:

The generating capacity of the two Harvard areas, based on 2.5 Ha/MW are:

- Harvard North 150 ha / 2.5 Ha/MW = 60 MW
- Harvard South 130 ha / 2.5 Ha/MW = 52 MW

Capacity of overhead power lines

Voltage: 132kV or higher
Tower height: up to 25m typically
Tower type: Steel Monopole

The Google image below shows the existing power lines as well as the route of the proposed power line connection from the solar farm to the Harvard Eskom Sub-Station.

- Existing MV transmission line 1
- Existing MV transmission line 1
- **Existing HV transmission lines**

- **Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station**
- **Proposed HV transmission line connection between Harvard Solar Farm and the Harvard Eskom Sub-Station**

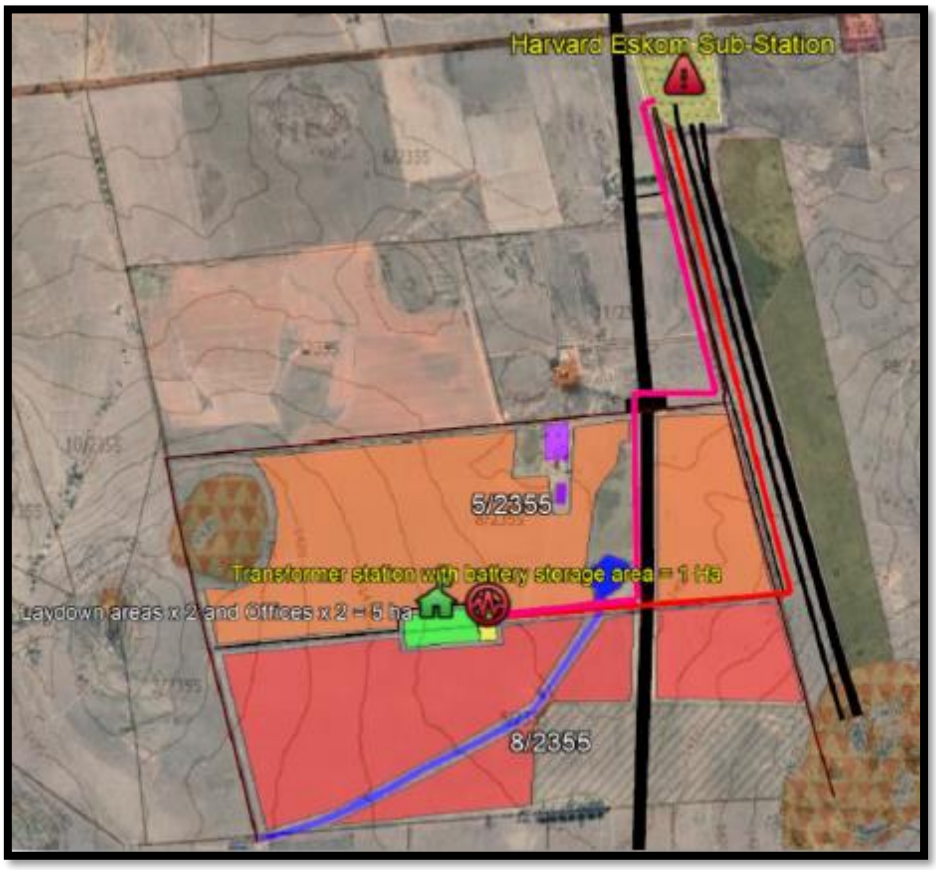

Figure 25: *Eskom power lines & proposed new power lines from the solar farm to Harvard Sub-Station*

A 6 Ha (400m x 150m) (typical) area in the middle of the Harvard Solar farm is needed for this purpose.

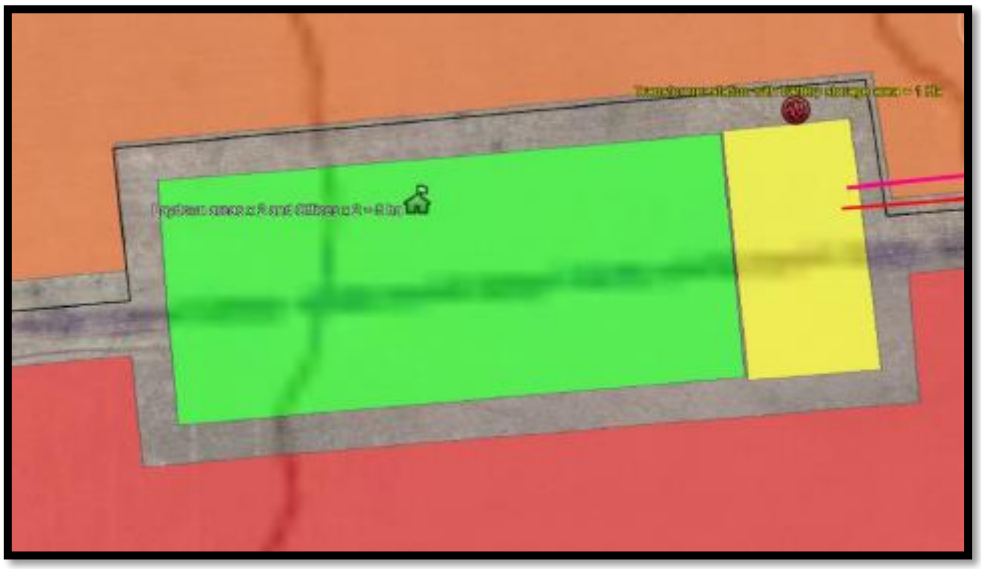

***Figure 26**: Footprint of grid connection station, offices, and laydown/storage area*

1.3. WATER SUPPLY

Water requirements during the construction and the operational phase of the solar energy facility will differ.

Possible water supply will be from the 110mm diameter Bloemwater reticulation network to the south of Harvard solar farm shown on the Google image below:

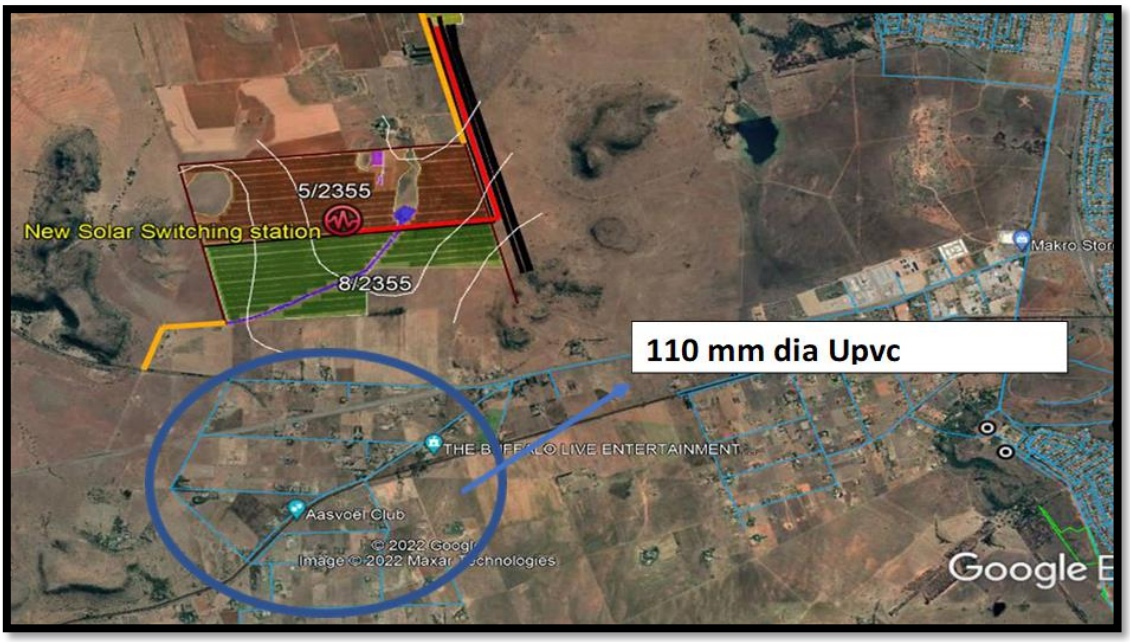

***Figure 27**: Water supply*

An official application must be submitted to Bloemwater. Water will mostly be utilized for drinking purposes and washing of solar panels every two or three months, or less. The diameter of the pipeline will be 75mm or smaller.

The proposed Harvard Solar Project will be located 11 km West of Bloemfontein's CBD in the Northern Cape Province. The area may have a groundwater occurrence of between 5 and 20 Litres/second.

The Developer will solicit the services of a consultant to undertake an assessment of groundwater resources that will include hydro-census and yield test studies.

The google image shows a possible connection from the water reticulation network to the Switching station.

***Figure 28**: Planned connection from Bloemwater reticulation network to the operational centre of Harvard solar farm.*

1.4. SEWER

The Construction phase and the operational phase will be treated differently in terms of sewer treatment.

Wastewater and sewer will be treated on-site close to the offices by using a small bio-filter type package plant sized according to the calculated load.

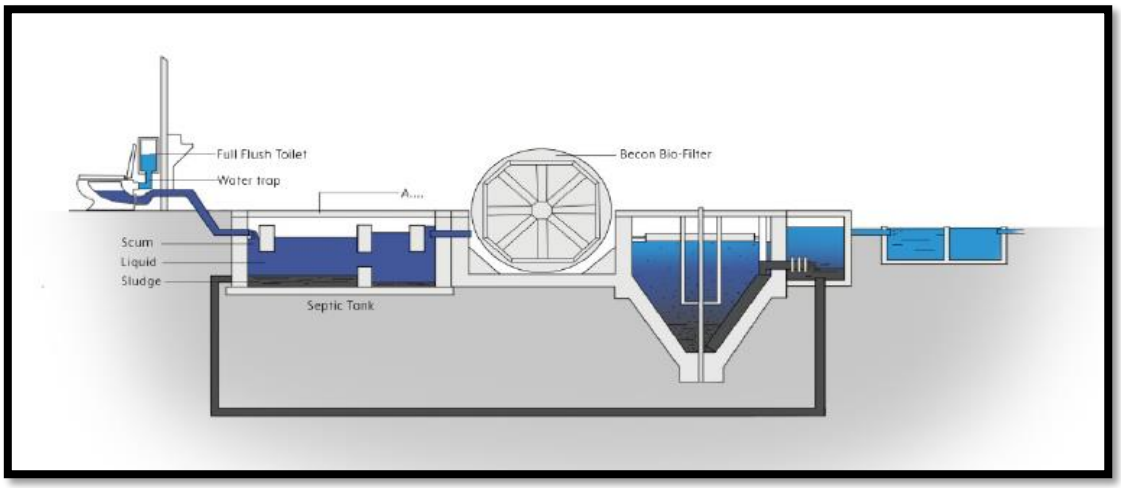

***Figure 29**: Sewer treatment*

1.5. ROADS AND ACCESS

The current road from the north-east that gives access to the solar farm area are shown in gold on the Google image below.

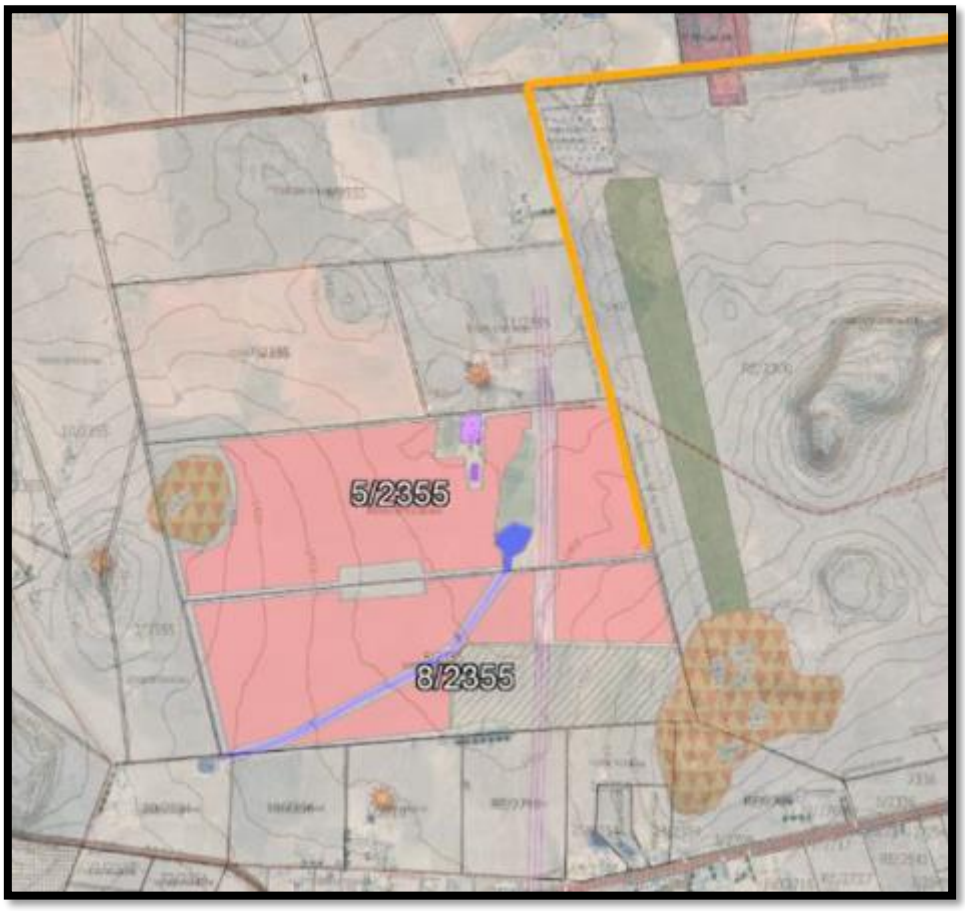

***Figure 30**: Access roads*

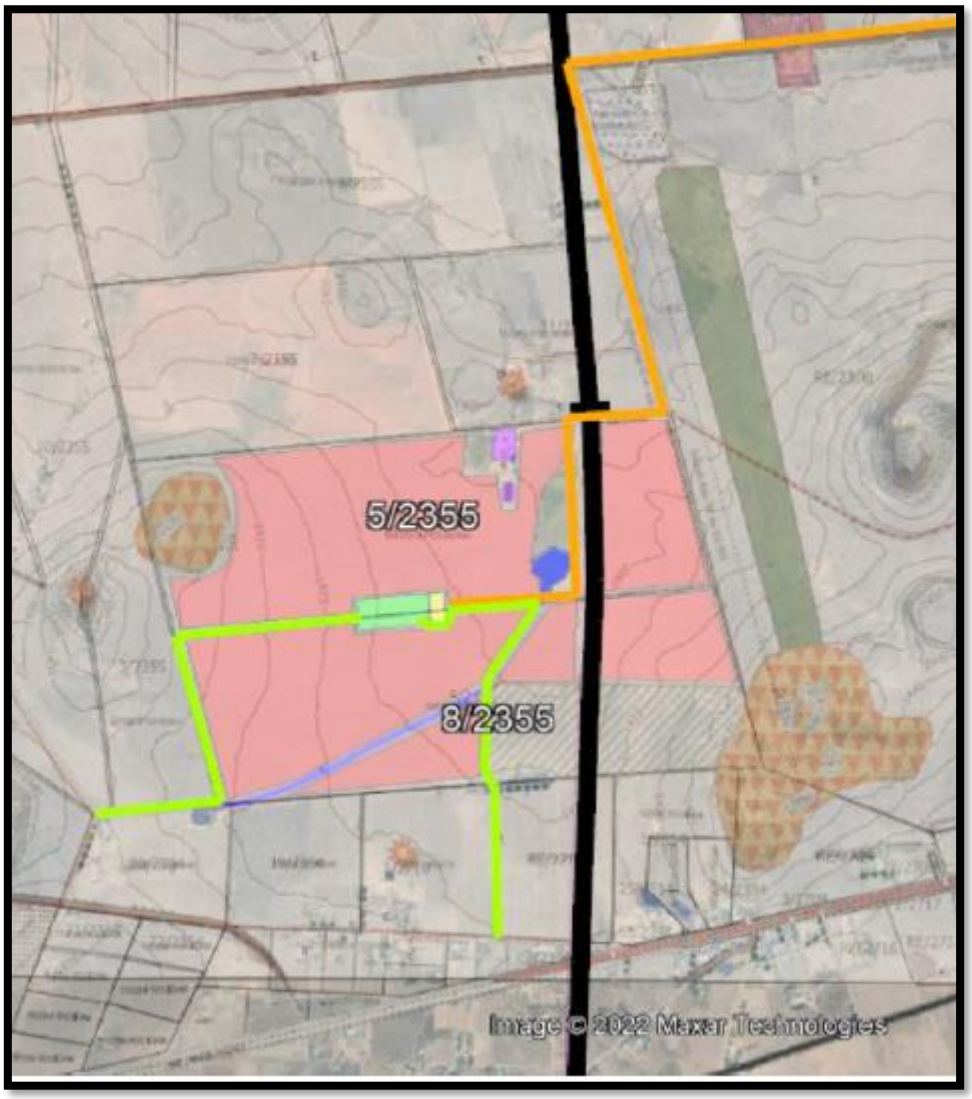

Figure 31: *Proposed access roads (with alternatives) to the Harvard solar farm)*

***Figure 32**: Internal roads*

The possibility to construct an access road from the south as shown in green on the Google image must be investigated. This rout is more assessable and closer to the main road infrastructure.

1.6. STORM WATER

The contours on the Google map below shows that most of the drainage is overland with slopes that vary from 1:40 t0 1:80.

***Figure 33**: Storm water contours*

***Figure 34**: Stormwater catchment area*

1.7. OFFICES

The operational offices will be located next to the switch station in the centre of the solar area.

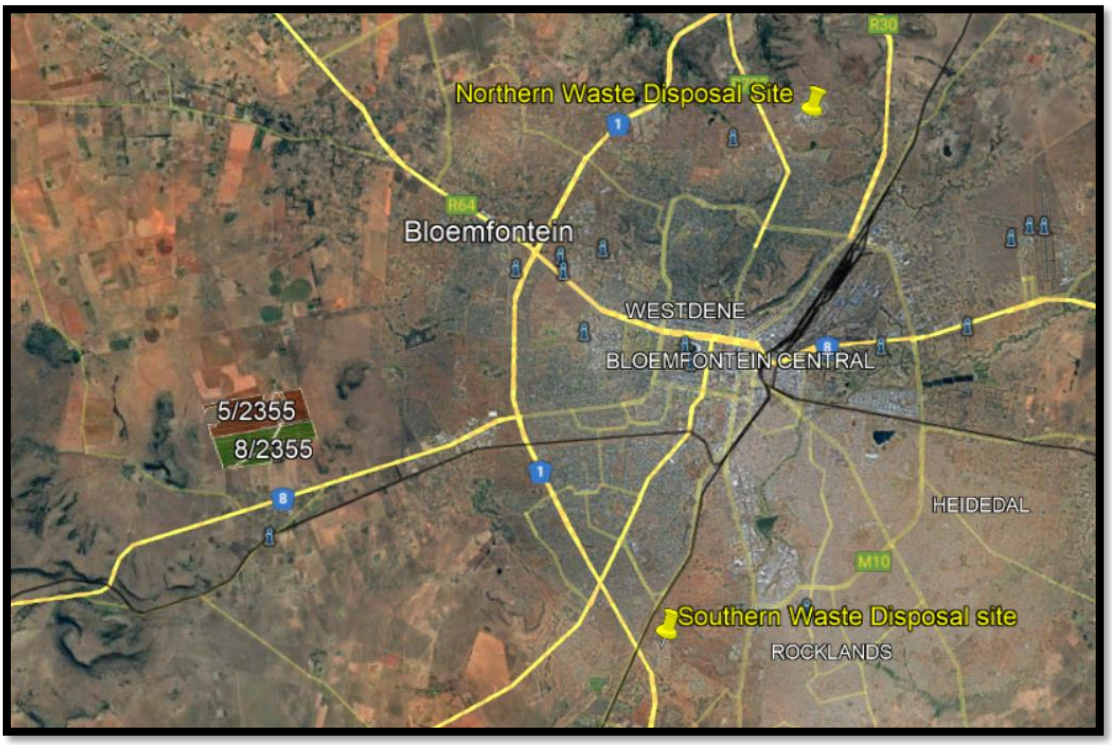

***Figure 35**:Locality map*

2. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

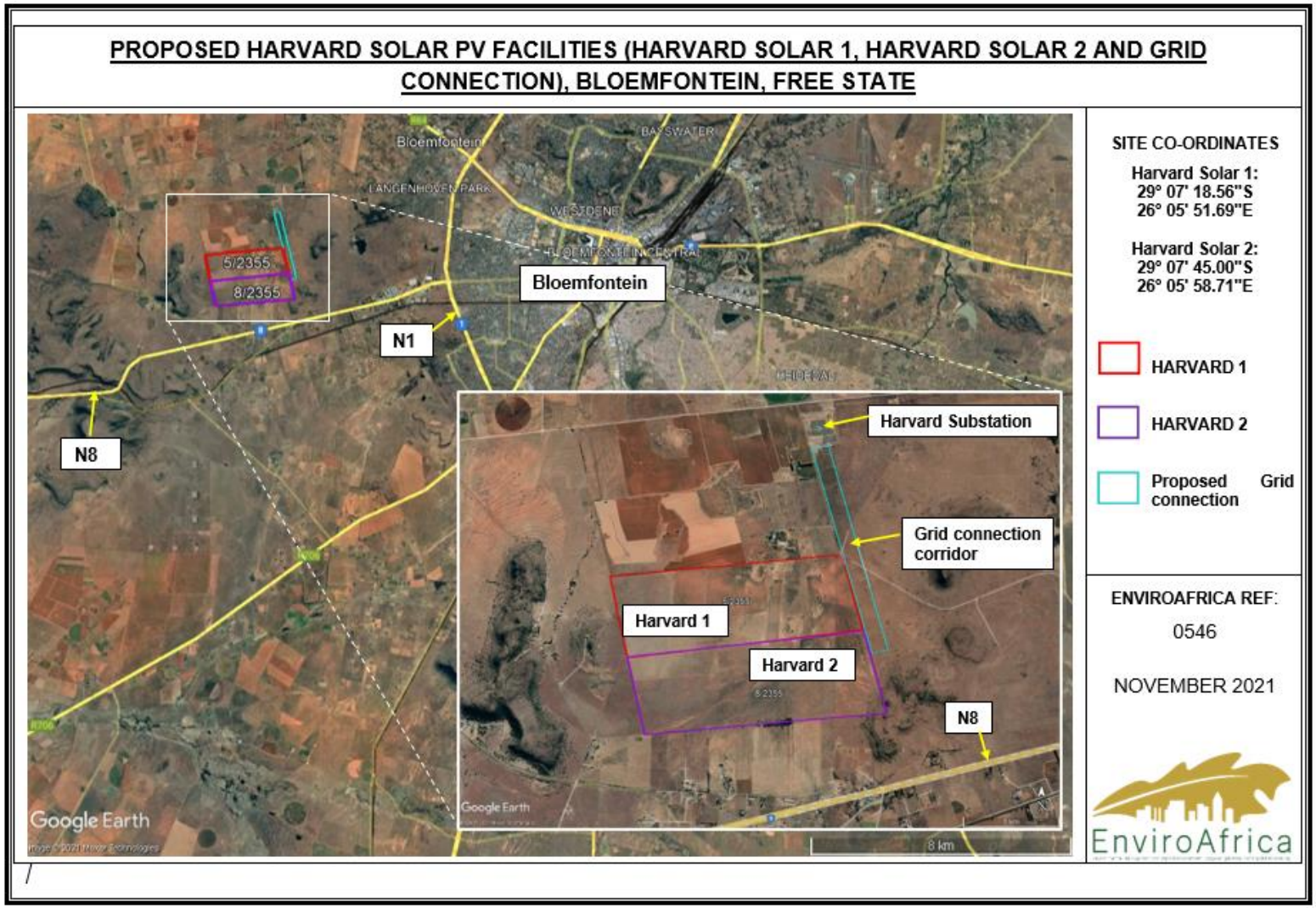

Figure 36:*Proposed Harvard Solar PV facilities near Bloemfontein in the Free State Province.*

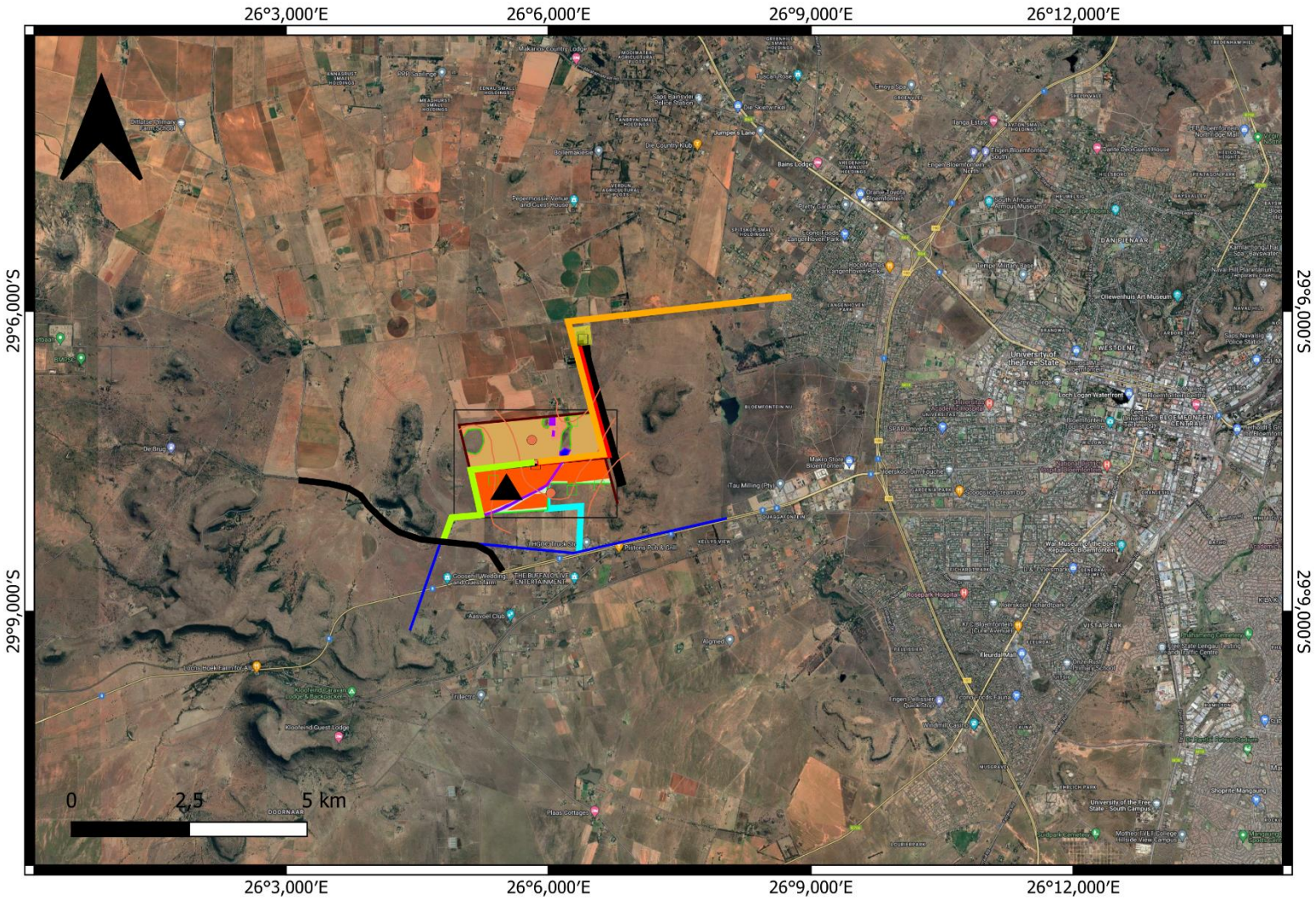

***Figure 37**: Google Earth (2022) Image of the proposed Harvard Solar 2 PV facility and associated infrastructure (area indicated in orange and black triangle) on Portion 5 of Farm Spes Bona No 2355, Mangaung Metropolitan Municipality in the Free State.*

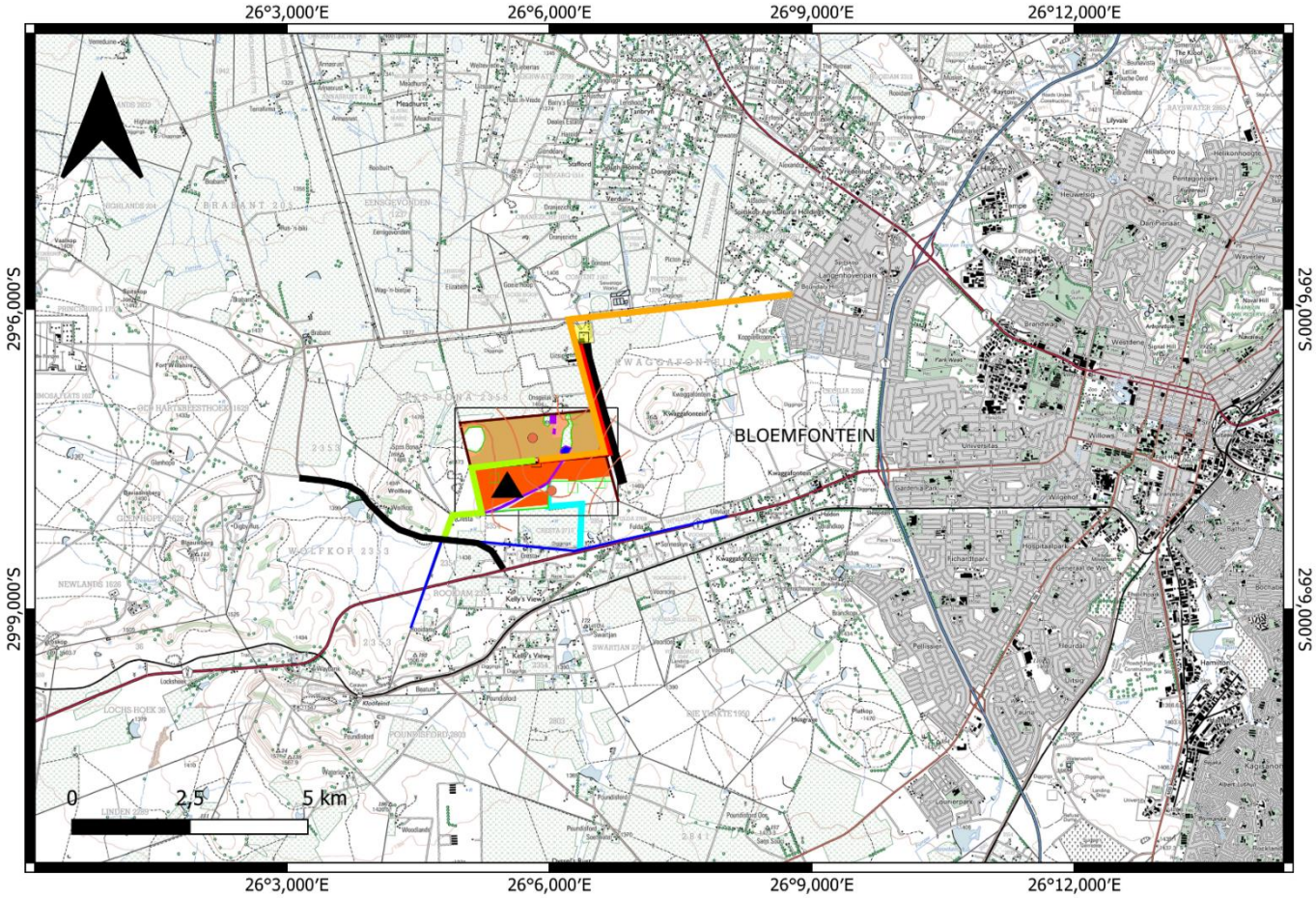

***Figure 38**: Extract of the 1:50 000 topographical maps [2926AA] indicating the location (area indicated in orange and black triangle) of Harvard 2 Solar Photovoltaic (PV) facility on Portion 5 of Farm Spes Bona No 2355, Mangaung Metropolitan Municipality in the Free State*

3. LEGISLATION

3.1. National Heritage Resources Act (25 of 1999)

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

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

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) "*…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*".

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

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

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

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
- Exceeding 5 000 m^2 in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4. OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to decrease the effect of the development on potential fossils at the development site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to clarify the **impact** on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.

- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:
    a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
    c. Cumulative impacts result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5. GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the proposed Harvard 2 PV Facility is indicated on the 1:250 000 Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria) (**Figure 16, Table 2**). This map indicates that the proposed development is underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) with a small portion in the north-west and south-east underlain by Jurassic Karoo dolerite. The Shape files (obtained from the Council of Geosciences, Pretoria) indicates that the proposed development is primarily underlain by the Balfour Formation (**Figure 17**). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High while that of the Karoo Dolerite is Zero as it is igneous in nature (Almond and Pether 2008, SAHRIS website).

The **Jurassic dolerite** present in the development form part of the Karoo Igneous Province that is one of the worlds classic continental flood basalts (CFB) provinces. This Suite was formed approximately 183 million years ago and consists of intrusive and extrusive rocks that occur over a large area (Duncan et al, 2006). Generally, the flood basalts do not contribute to prominent volcanic structures, but instead are formed by successive eruptions from a set of fissures that form sub-horizontal lava flows (sills and dikes) varying in thickness. This lava caps the landscape on which they erupted. As the Karoo is an old flood basalt province it is today preserved as erosional fragments of a more extensive lava cap that covered much of southern Africa in the geological past. It is estimated that the Karoo lava outcrop currently covered at least 140 000 km^2 while it was larger in the past [~2 000 000 km^2 (Cox 1970, 1972)]. The Karoo Igneous Province can be divided into the Lebombo and the Drakensberg Groups. This Igneous Province contains a large volume of flood basalts as well as silicic volcanic rocks. These units consist of hyodacite and rhyolitic magma and crops out along the Lebombo monocline. Individual units span up to 60 km and sometimes show massive pyroclastic structures and are thus classified as rheoignimbrites. The basal lavas lie conformable on the Clarens Formation but in specific localities sandstone erosion occurred before the volcanic eruptions took place. Lock *et al* (1974) found evidence in the Eastern Cape that in the early stages of volcanism magma interacted with ground water to produce volcaniclastic deposits as well as phreatic and phreatomagmatic diatremes. Eales *et al* (1984) also found evidence of aqueous environments during early volcanism by the existence of pillow lavas and associated hyaloclastite breccias and thin lenses of fluviatile sandstones interbedded with the lowermost magmas.

The planned development is underlain by mudstones, sandstones, and shales, which were deposited under fluvial environments of the **Adelaide Subgroup**. The Adelaide Subgroup forms part of the Beaufort Group. The Beaufort Group is the third of the main subdivisions of the Karoo Supergroup. This group overlays the Ecca and consists essentially of sandstones and shales, deposited in the Karoo Basin from the Middle Permian to the early part of the Middle Triassic periods. The Beaufort Group was deposited on land through alluvial processes. This Group covers a total land surface area of approximately 200 000 km^2 in South Africa and is the first fully continental sequence in the Karoo Supergroup. The Beaufort Group is divided into the Adelaide and the overlying Tarkastad Subgroup. The Adelaide subgroup rocks are deposited under a humid climate that allowed for the establishment of wet floodplains with high water tables and are interpreted to be fluvio-lacustrine sediments (Johnson *et al* 2006).

In the south eastern portion of the Karoo Basin the Adelaide Subgroup consists of the Koonap, Middleton and Balfour Formations. West of 24° the Adelaide Subgroup is represented by the Abrahamskraal and Teekloof Formations and in the north the Group is represented by the

Normandien Formation. The Adelaide Subgroup is approximately 5 000 m thick in the southeast, but this decreases to about 800m in the centre of the basin which thinness out to about 100 to 200m in the north. The Balfour Formation is approximately 200 m thick, while the Abrahamskraal Formation is about 2 500 m thick and the Teekloof Formation 1 000 m. The Normandien Formation is only about 320 m thick.

The Adelaide Subgroup contains alternating greyish-red, bluish-grey, or greenish grey mudrocks in the southern and central parts of the Karoo Basin with very fine to medium grained, grey lithofeldspathic sandstones. The **Balfour formation** in the development footprint comprise of greenish- to bluish-grey and greyish-red mudstone, siltstone, subordinate sandstone. In the northern Normandien formation the basin consists of course to very coarse sandstones and granulostones. Coarsening–upward cycles are present in the lower part of the Normandien Formation while the mudrocks and sandstone units usually form fining-upward cycles. These cycles are positioned on erosion surfaces which is overlain by thin intraformational mud-pellet conglomerate and vary in thickness from a few meters to tens of meters. Singular sandstone units could vary from 6 meters to 60 meters in the south thinning northwards, but thick sandstone units are also present in the northern Normandien Formation (Groenewald1989, 1990).

The thicker sandstones of the Adelaide are usually multi-storey and usually have cut-and fill features. The sandstones are characterized internally by horizontal lamination together with parting lineation and less frequent trough crossbedding as well as current ripple lamination. The bases of the sandstone units are massive beds, while ripple lamination is usually confined to thin sandstones towards the top of the thicker units. The mudrocks of the Adelaide Subgroup usually has massive and blocky weathering apart from in the Normandien and Daggaboersnek Member (Groenewald1989, 1990). Sometimes desiccation cracks and impressions of raindrops are present. In the mudstones of the Beaufort Group calcareous nodules and concretions occur throughout.

The flood plains of the Beaufort Group (Karoo Supergroup) are **internationally renowned** for the **early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals**. The Beaufort Group is subdivided into a series of biostratigraphic units based on its faunal content (**Figure 18**) (Kitching1977, 1978; Keyser *et al*, 1977, Rubidge 1995, Smith *et al,* 2020; Viglietti 2020). The proposed development is underlain by the Balfour Formation which is divided in the *Daptocephalus* (DAZ) which in turn is divided in the upper (younger)

Lystrosaurus maccaigi - Moschorhinus and lower (older) *Dicynodon-Theriognathus Subzones* (**Figure 18**) (Viglietti, 2020).

The *Daptocephalus* Assemblage Zone (AZ) expands into the lower Palingkloof of the Upper Balfour Formation. This Zone is characterized by the occurrence of the two therapsids namely *Dicynodon* and *Theriognathus (***Figure 19-20***)*. The *Daptocephalus* Assemblage Zone of the Beaufort Group shows the greatest vertebrate diversity and includes numerous well-preserved genera and species of dicynodonts, biarmosuchians, gorgonopsian, therocephalian and cynodont therapsid Synapsida. Captorhinid Reptilia are also present while eosuchian Reptilia, Amphibia and Pisces are rarer in occurrence. Trace fossils of vertebrates and invertebrates as well as *Glossopteris* flora plants have also been described.

The lower Palingkloof Member is of special importance as it precedes the Permo-Triassic Extinction Event which destroyed the vertebrate fauna and extinguished the diverse glossopterid plants. The lower *Lystrosaurus* declivis AZ forms part of the Katberg Formation (**Figure 18**). Vertebrate fossils are mostly found in the mudrock units between channel sandstones in the *Lystrosaurus declivis Assemblage Zone* (**Figure 21-22**). Specimens are well preserved and articulated skull and skeleton specimens have been abundantly found. Several bonebeds have been recorded. A common fossil taxon to the floodplain bonebeds is juvenile *Lystrosaurus declivis* that most probably died due to severe drought conditions (Smith and Botha, 2005, Viglietti et al., 2013, Smith and Botha-Brink, 2014). Numerous positively identified skeletons have been identified in burrows in this Assemblage Zone (Bordy et al., 2011; Botha-Brink, 2017, Damiani et al., 2003, Kitching, 1977; Modesto and Botha-Brink, 2010; Smith and Botha-Brink, 2014). Synchrotron scanning made it possible for Fernandez, et al., 2013 to describe a burrow cast from the Early Triassic of the Karoo (**Figure 23**). This scan depicts a unique mixed-species association of an injured temnospondyl amphibian (*Broomistega*) sheltering in a burrow inhabited by an aestivating *Thrinaxodon*.

West of the proposed development is an area underlain by the Tierberg Formation, of the Ecca Group (Karoo Supergroup) while Quaternary superficial deposits are present north of the proposed development (**Figure 15**). The Quaternary deposits consists of alluvium, colluvium, eluvium, gravel, scree, sand, soil and debris.

The Quaternary deposits reveal palaeoclimatic changes in the different geological formations (Hunter et al., 2006). The climatic fluctuations in the Cenozoic Era were responsible for the

formation of most geomorphologic features in southern Africa (Maud, 2012). Various warming and cooling events occurred in the Cenozoic but climatic changes during the Quaternary, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past Barnosky (2005). Climate in the Quaternary Period were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004). The fossil assemblages of this Group are generally very low in diversity but locally High and occur over a wide range. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile remains have been uncovered where the depositional settings in the past were wetter.

The majority of the Tierberg Formation comprises of well-laminated, dark grey to black shale (Johnson et al 2006). Some yellowish tuffaceous beds up to 10cm thick occur in the lower part of the succession along the western and northern margins of the Basin. Calcareous concretions are common towards the top of the formation. Clastic rhythmites occur at various levels in the sequence (Cole, 2005). This formation is considered to be a deep-water deposit associated with event beds. The Tierberg formation is known for its rare trace fossils assemblages. Vascular plants (including petrified wood) and palynomorphs of Glossopteris flora have been found while crustaceans, shelly marine invertebrates, insects, and fish fossils as well as microfossils have been identified.

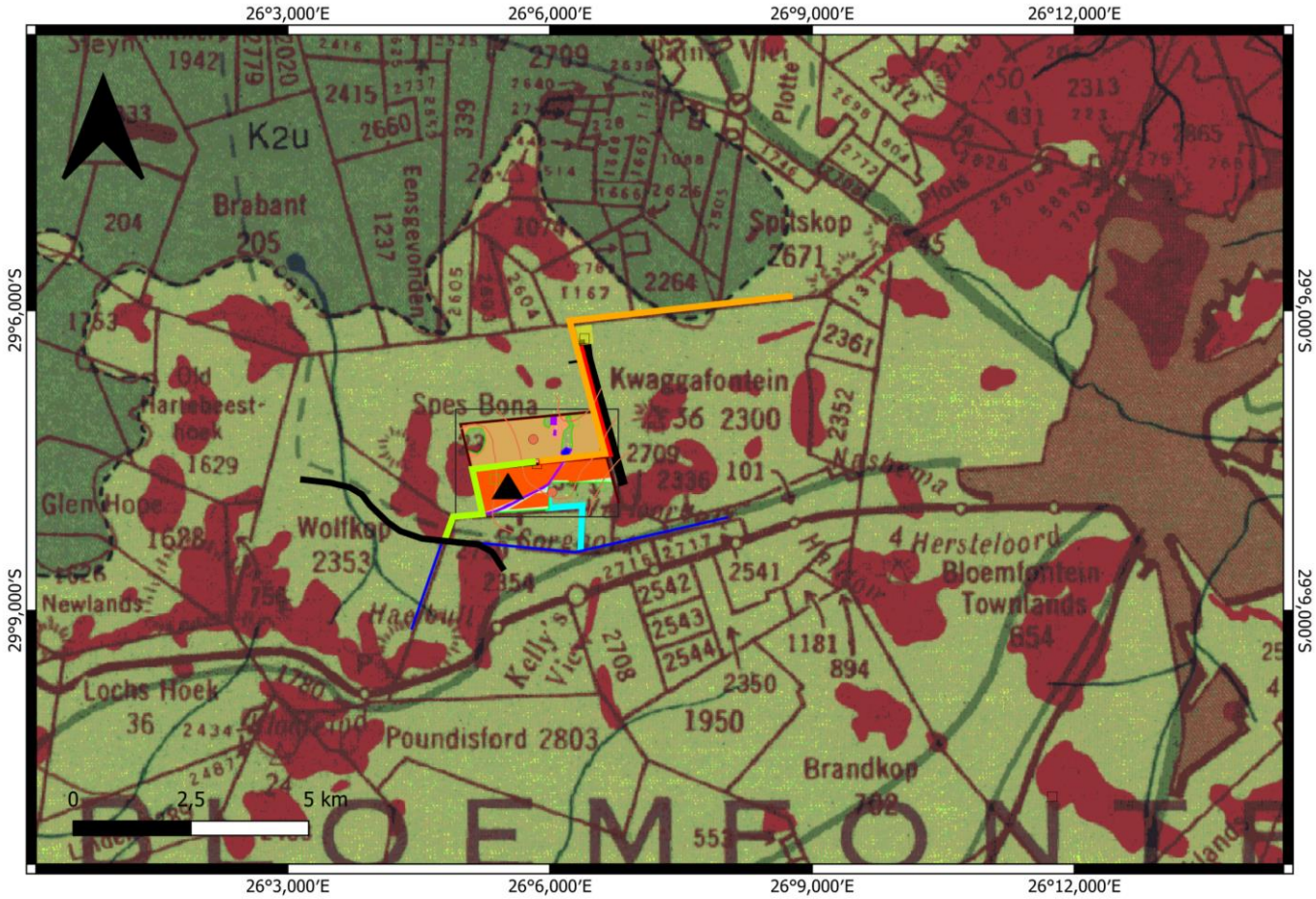

***Figure 39**: Extract of the 1:250 000* Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria) *indicating the surface geology of the proposed development (area indicated in orange and black triangle). The development is underlain by the Balfour Formation of the* Adelaide Subgroup of the *Karoo Supergroup and Jurassic dolerite in the east and west of the footprint.*

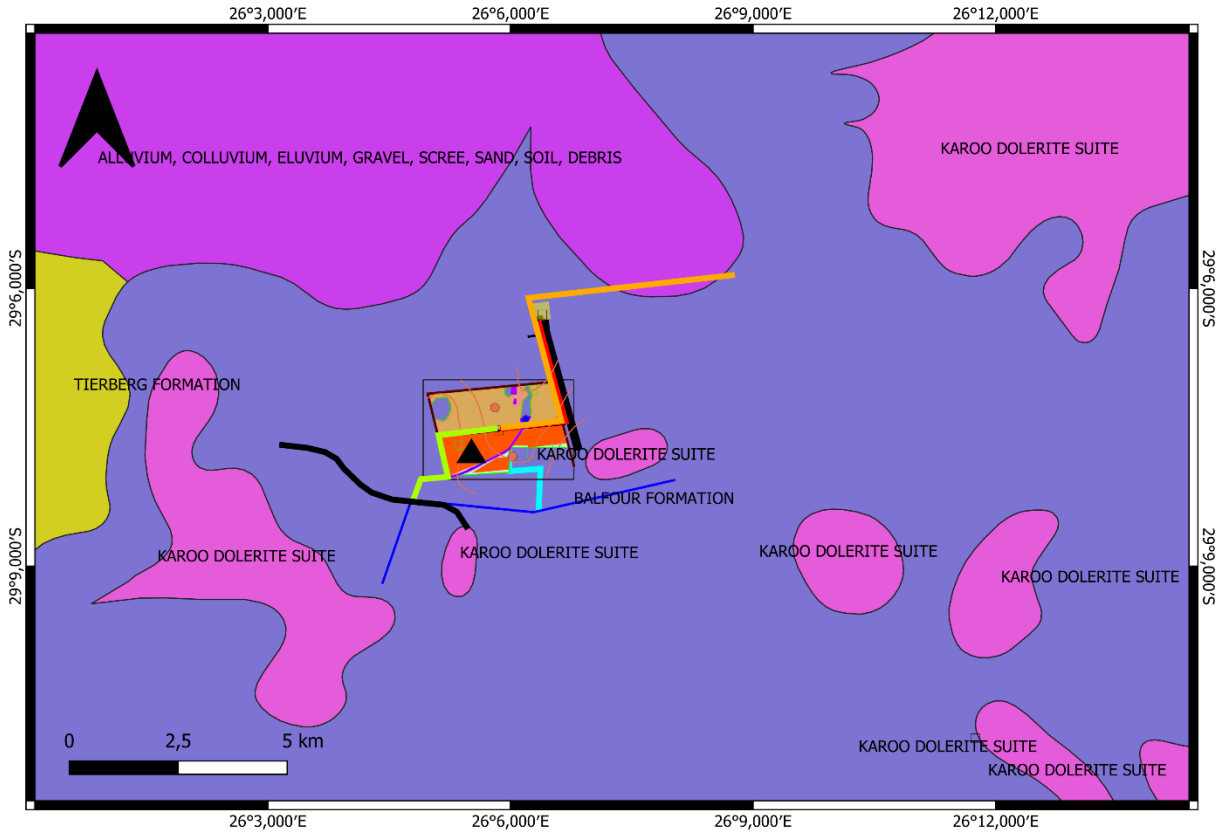

***Figure 40**: Surface Geology of the proposed development (Shape files obtained from the* Council of Geoscience, Pretoria) indicates that site is underlain by the Balfour Formation of the Adelaide Group (Beaufort Group, Karoo Supergroup)

Table 2:Legend of the Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria)

	Age	**Group/Formation**		**Lithology**	**Palaeontological Sensitivity**
Q	Quaternary			Alluvium, Colluvium, Eluvium, gravel, scree, sand, soil and debris	High
Jd	Jurassic			Dolerite	Zero
Pa	Permian	Adelaide Subgroup		Grey and brownish-red mudstone,	Very High

			Beaufort Group	subordinate sandstone	
T_{RT}	Triassic	Tarkastad Subgroup	Karoo Supergroup	Brownish-red and grey mudstone, sandstone	Very High
K2U		Tierberg Formation	Ecca Group (Karoo Supergroup)	Mudstone , Shale	High

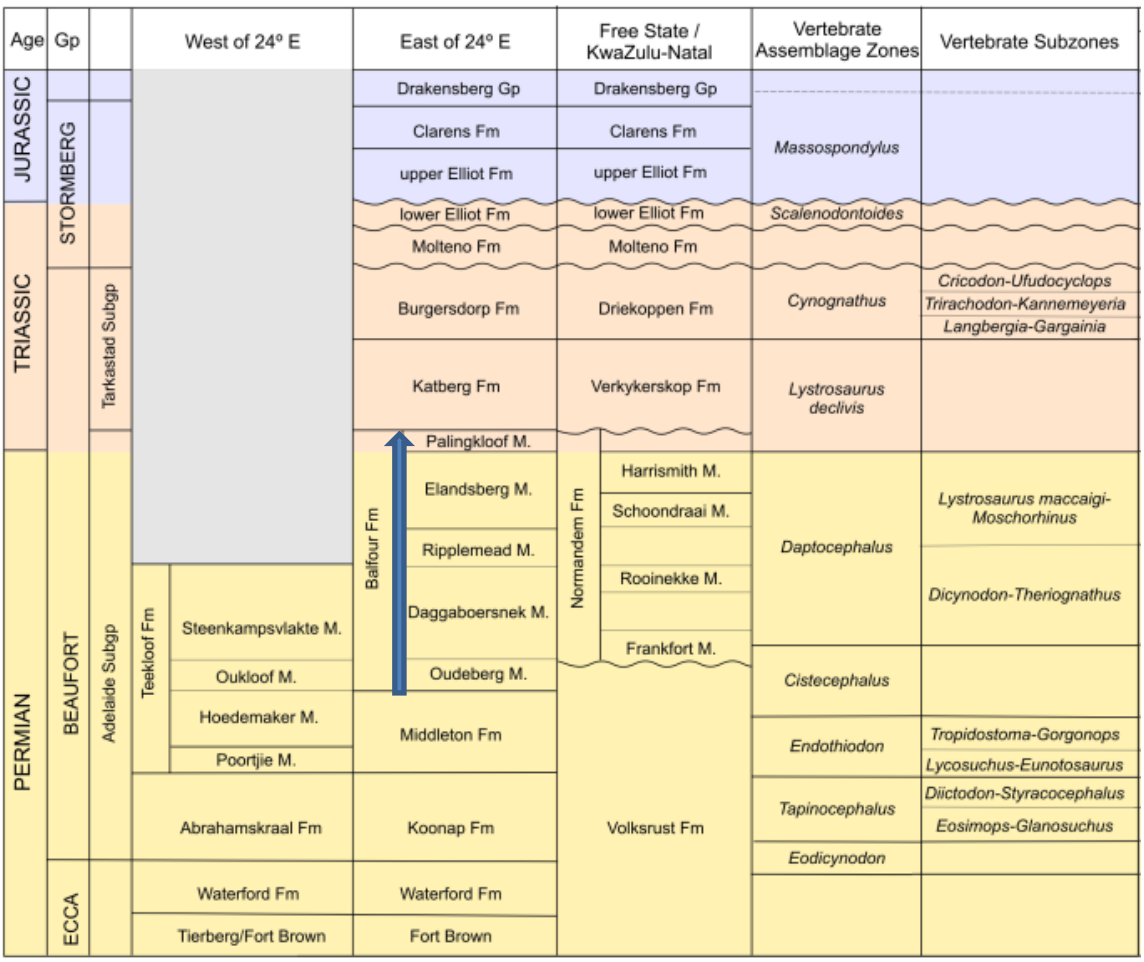

***Figure 41**: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa.*

Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed.

Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES+Mammaliaformes. Gp=group, Subgp-Supbroup, Fm=Formation, M=Member

The proposed cemetery development is indication by the blue arrow

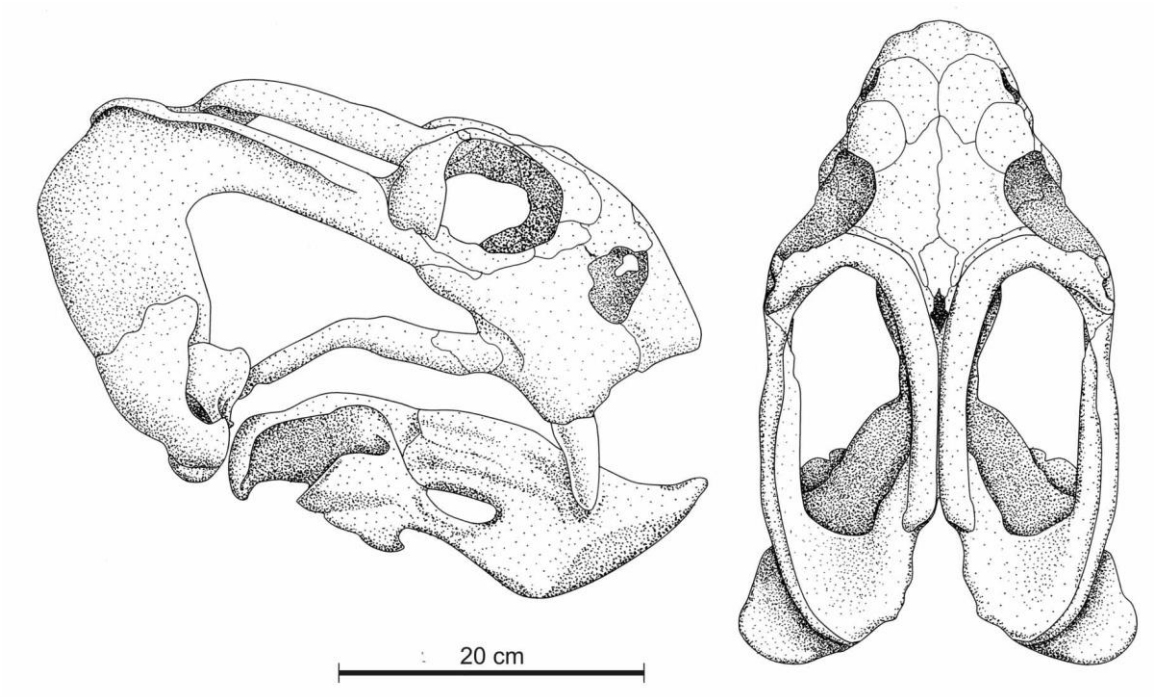

***Figure 42**: Lateral and dorsal views of skull of the dicynodont Daptocephalus leoniceps, the main Daptocephalus AZ defining fossil (Image taken from Viglietti, 2020).*

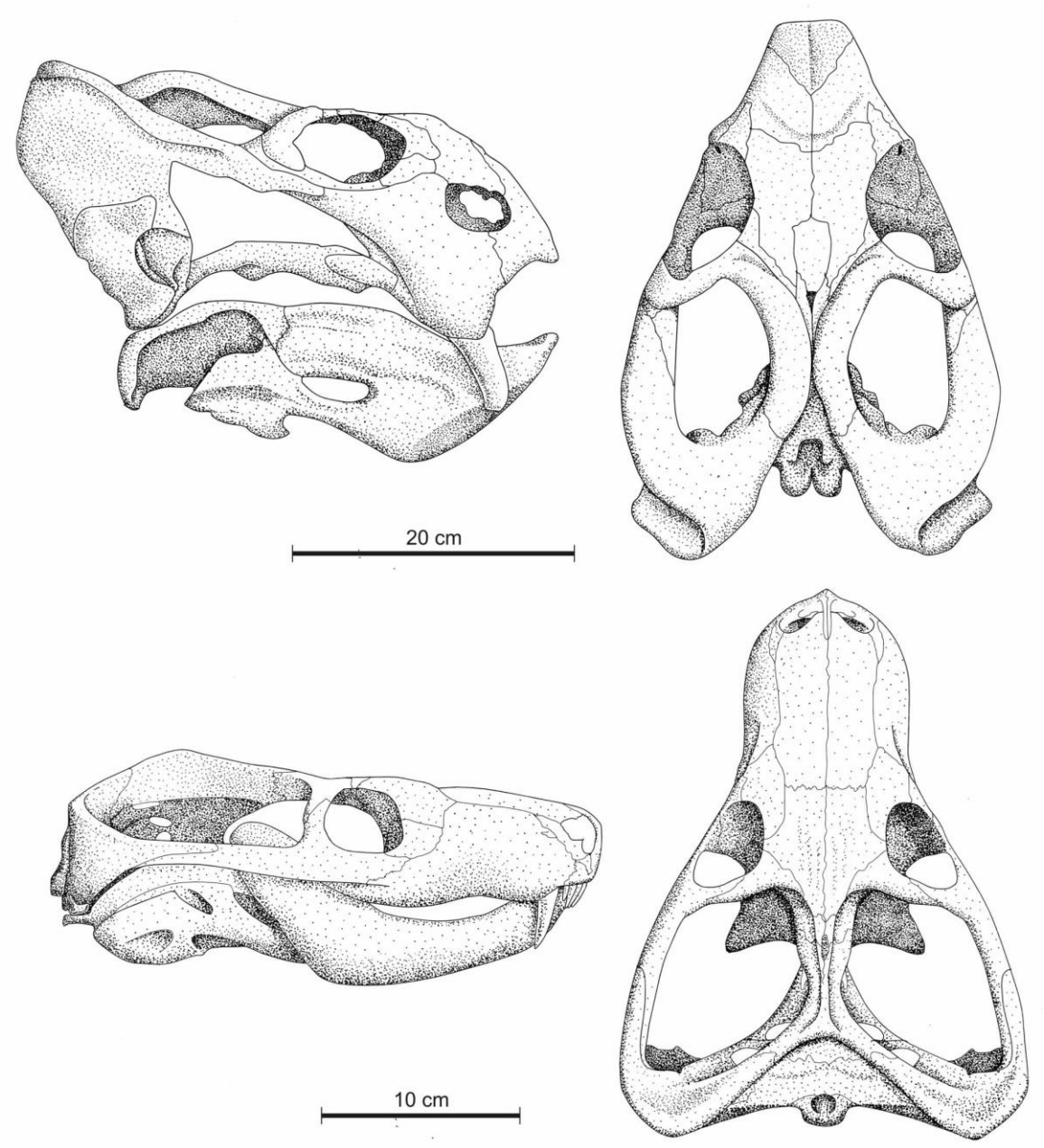

Figure 43: *Skulls of the biozone defining fossils of the Dicynodon-Theriognathus Subzone in lateral and dorsal views. Dicynodon lacerticeps (top), Theriognathus microps (bottom) (Image taken from Viglietti, 2020).*

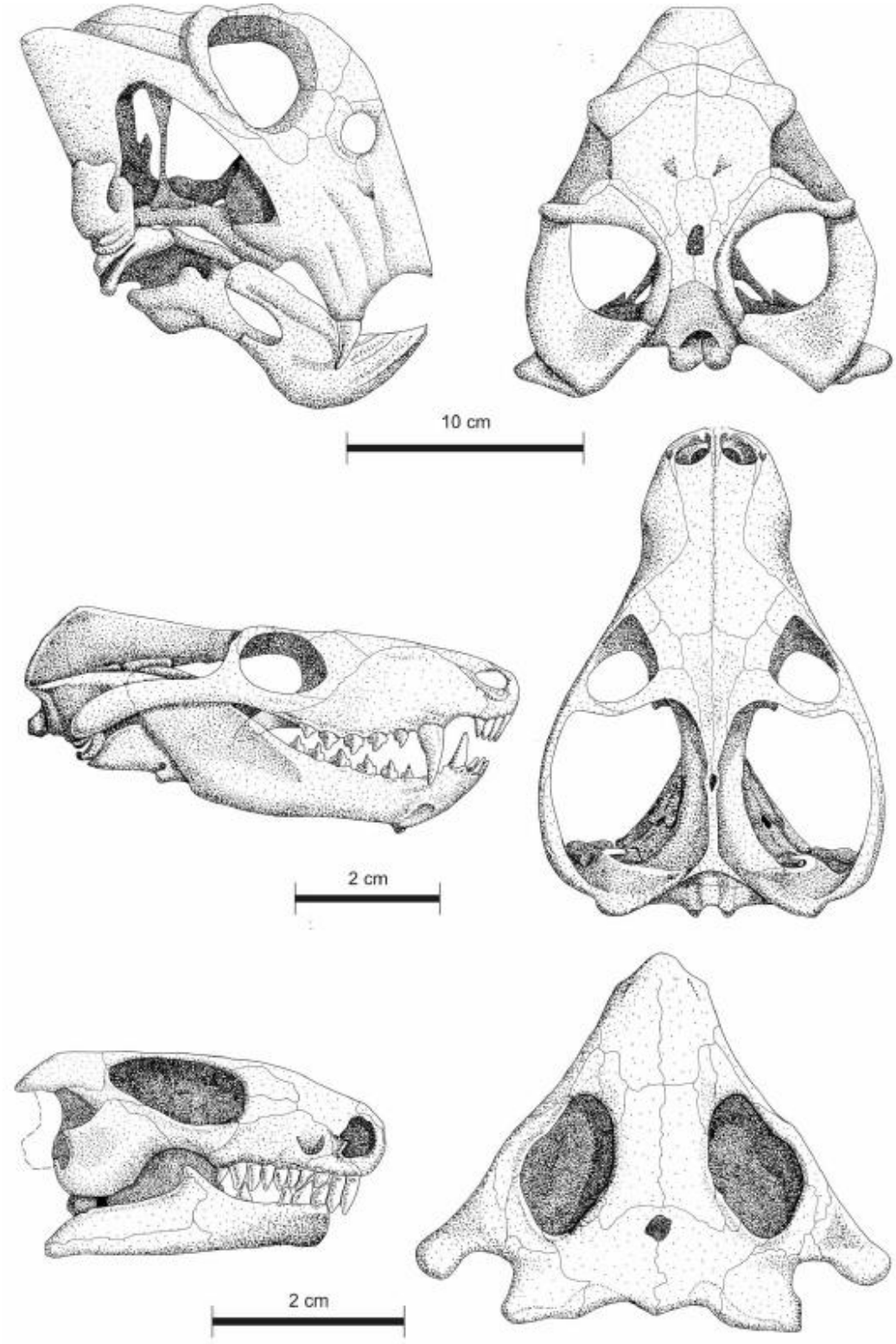

Figure 44: *Lateral and dorsal views of the index taxa defining the Lystrosaurus declivis Assemblage Zone. (top) Lystrosaurus declivis, (centre) Thrinaxodon liorhinus, (bottom) Procolophon trigoniceps (Image taken from Botha et al, 2022).*

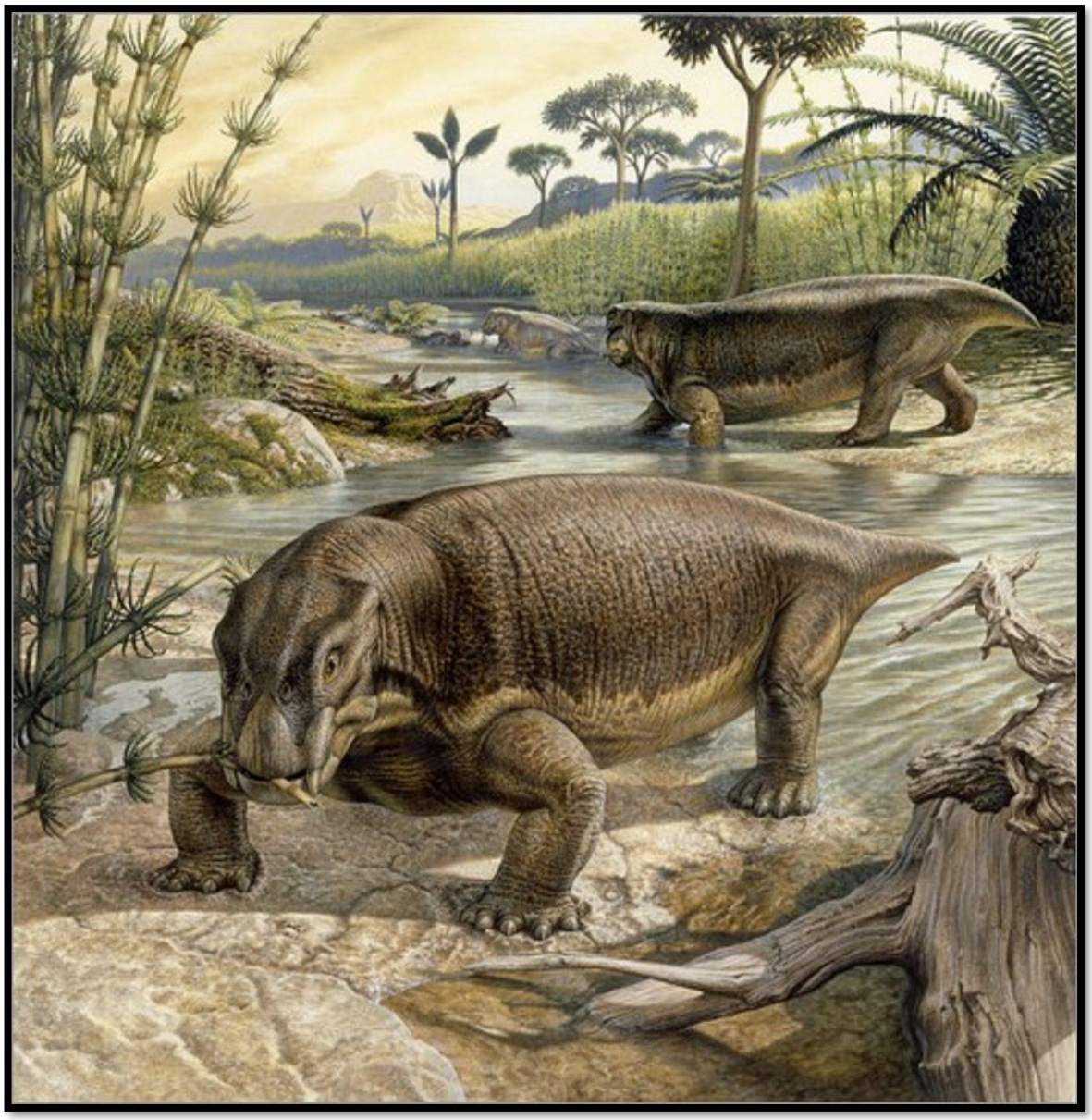

Figure 45: *Reconstruction of Lystrosaurus*

https://i.pinimg.com/564x/ac/7b/13/ac7b132d1d9882e6d9f9af804820a21e.jpg

Lystrosaurus sp

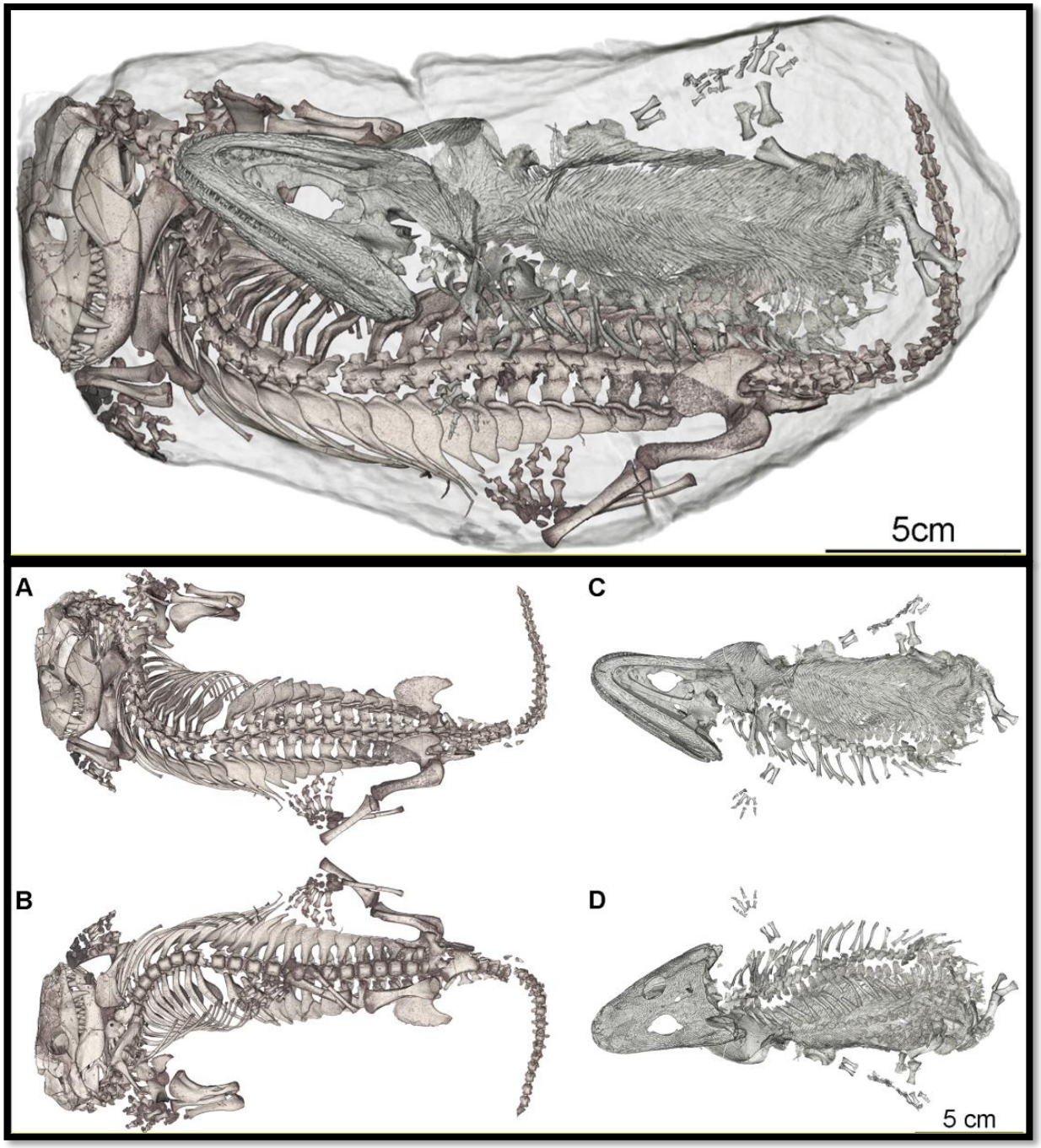

***Figure 46**: Synchrotron scan of a burrow cast from the Early Triassic indicates an injured temnospondyl amphibian (*Broomistega*) that sheltered in a burrow occupied by an aestivating therapsid (*Thrinaxodon*) Image taken from Fernandez, et al., 2013.*

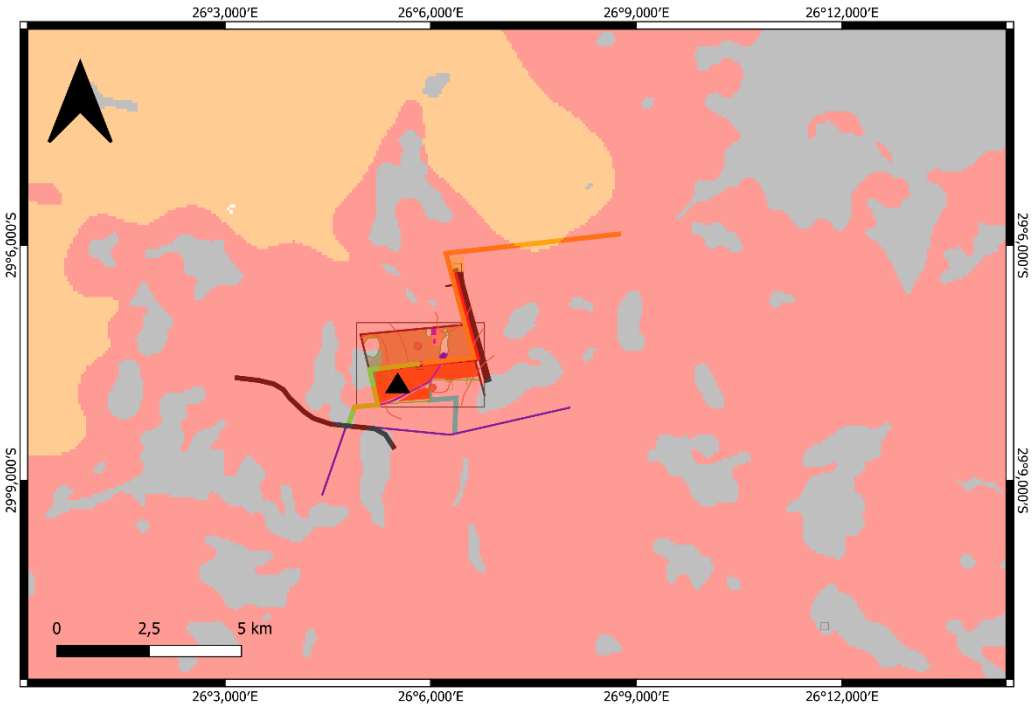

***Figure 47**: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in orange with a black triangle.*

According to the SAHRIS Palaeosensitivity map (**Figure 24)** the proposed development is underlain by sediments with a Very High (red), and Zero (grey) Palaeontological Sensitivity.

Table 3:Palaeontological Sensitivity on SAHRIS

COLOUR	SENSITIVITY	REQUIRED ACTION
RED	**VERY HIGH**	**field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	**INSIGNIFICANT/ZERO**	**no palaeontological studies are required**
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The colours on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

6. GEOGRAPHICAL LOCATION OF THE SITE

The proposed Harvard 2 Solar PV facility on Portion 5 of Farm Spes Bona No 2355 in the Mangaung Metropolitan Municipality is about 5km west of Bloemfontein (Figure1-3). This Power Facility will connect to the present Harvard substation north of the Harvard 1 Solar PV facility via an approximately 2,3km long 275kV overhead grid connection line situated on the western edge of Remainder of Farm 2300 (separate application). The Harvard 2 Solar PV facility will be approximately 215ha in extent.

Table 4: Location of the proposed Harvard 2 Solar PV facility and associated infrastructure.

Study Area **GPS Coordinates -**	**Northern western border**: -29.126747° 26.085058°	**North-eastern border:** -29.124312° 26.110816°
	South -western border: -29.134077° 26.087118°	**South -eastern border:** -29.132095° 26.113113°

7. METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological impact assessment reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps.

7.1. Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8. ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1:250 000 Bloemfontein 2926 Geological Map (1966) (Council of Geoscience, Pretoria)
- A Google Earth map with polygons of the proposed development was obtained from EnviroAfrica.

9. SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 26 January 2022. A dolerite koppie is present in the south-eastern portion of the proposed development but no visible dolerite outcrops were detected in the western end of the development.. **Although no surface outcrops were identified in the development footprint, fossil heritage could be**

embedded within rocks beneath the surface. It is thus possible that fossil heritage could be present in the development footprint and thus a Chance Find Protocol is included in this report. The following photographs were taken during the site visit to the proposed development.

***Figure 48**: View from the northern border overlooking Harvard Solar 2 development. Area is utilized for agriculture.*

GPS coordinates -29.124722, 26.105556

***Figure 49**: View from the southern border overlooking the proposed Harvard Solar 2 development.*

The area has a very flat topography

GPS coordinates -29.128333. 26.104444

Figure 50: *Dolerite rocks scattered at the base of the Dolerite Koppie*

GPS coordinates: -29.138333 26.117778

10. IMPACT ASSESSMENT METHODOLOGY

Impact assessment must take account of the nature, scale, and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

- Construction.
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 5: The rating system

NATURE		
The Nature of the Impact is the possible destruction of fossil heritage		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).

2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still

		continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component, and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	**Very high**	**Impact affects the continued viability of the system/component, and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.**

REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.

4	Complete loss of resources	The impact is result in a complete loss of all resources.

CUMULATIVE EFFECT

This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.

1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects

SIGNIFICANCE

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula:

[(Extent + probability + reversibility + irreplaceability + duration + cumulative effect] x magnitude/intensity.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.

51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

10.1. Summary of Impact Tables

Table 6: Impact Summary

	Extent	Probability	Duration	Magnitude	Reversibility	Irreplaceable	Cumulative	Significance	**Impact**
Pre-mitigatio	1	4	4	3	4	4	2	57	**High**
Post Mitigatio	1	4	4	1	4	4	2	19	**Low**

Loss of fossil heritage will be a negative impact. Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures, the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur. A negative High Significance has been allocated to the proposed development pre-mitigation while a LOW significance has been allocated post mitigation.

11. FINDINGS AND RECOMMENDATIONS

The proposed Harvard 2 Solar PV near Bloemfontein in the Free State is largely underlain by the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) and only a small portion in the north-west and south-east underlain by Jurassic Karoo dolerite. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Balfour Formation is Very High, and that Jurassic Karoo dolerite is Zero as it is igneous in origin (Almond and Pether 2008, SAHRIS website).

A site-specific field survey of the development footprint was thus conducted on foot and by motor vehicle on 5 January 2022. During the site visit no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area.

Recommendations:

- The ECO for this project must be informed that sediments of the Balfour Formation of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) have a **Very High Palaeontological Sensitivity**.

- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that mitigation (recording and collection) can be carried out.

- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).

- These recommendations should be incorporated into the Environmental Management Plan for the Harvard 1 PV Facility.

12. CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

12.1. Legislation

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

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

12.2. Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

12.3. Introduction

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

12.4. Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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APPENDIX A – ELIZE BUTLER CV

ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	26 years in Palaeontology
EDUCATION:	B.Sc Botany and Zoology, 1988 University of the Orange Free State
	B.Sc (Hons) Zoology, 1991 University of the Orange Free State
	Management Course, 1991 University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009 University of the Free State

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology

	University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

TECHNICAL REPORTS

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