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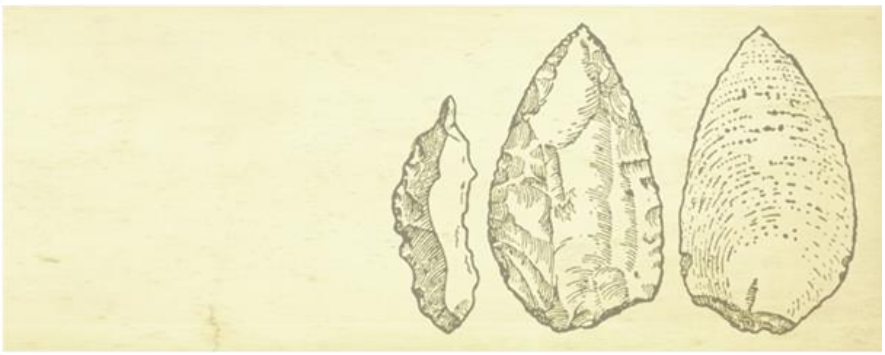

PHASE 1 HIA DOORNRIVIER SOLAR 2 VIRGINIA

PROPOSED DEVELOPMENT OF SOLAR PHOTOVOLTAIC (PV) FACILITY (DOORNRIVIER SOLAR 2) ON THE FARM, DOORNRIVIER 330 PORTION 5, VIRGINIA, MATJHABENG LOCAL MUNICIPALITY, LEJWELEPUTSWA DISTRICT MUNICIPALITY, FREE STATE PROVINCE

PREPARED FOR:

ENVIROAFRICA CC

PREPARED BY:

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31 AUGUST 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: 2022-08-31**

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

UBIQUE Heritage Consultants

SUMMARY OF SPECIALIST EXPERTISE

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 and has worked on numerous archaeological excavation and surveying projects over the past twelve years.

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 worked on various sites, including Historical, Iron Age, and Palaeontological sites.

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 of Richards Bay Minerals, research on the David Bruce heritage site at Ubombo in Kwa-Zulu Natal, and various archaeological excavations and historical, archaeological 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 facility (Doornrivier Solar 2), on the Farm Doornrivier 330 Portion 5, Virginia, Matjhabeng Local Municipality, Lejweleputswa District Municipality, Free State Province on any sites, features, or objects of cultural heritage significance.

Findings and Impact on Heritage Resources

A historically significant farmscape with the remains of an old farmhouse, stonewalled kraals, outbuildings, circular structures and numerous intact middens was recorded on the Farm Doornrivier 330 Portion 5. The cultural material visible on the surface dates from the late 19th to early 20th century. These include various European ceramic fragments (transferware, willowware, spongeware, and industrial ware), even some shaped and rounded into probable game pieces. In addition, late-19th century glass bottle pieces, metal fragments of food cans, building hardware, cast-iron pots, material from a harmonica, and bullets, are spread over the site surface. The intact nature of the site makes it an important site regarding local and regional history. Fortunately, the final project layout has excluded this area from the development footprint. Therefore no negative impact on these resources is anticipated. However, its importance should still be noted.

Numerous formal and informal graves are present on the Farm Doornrivier 330 Portion 5. The current project layout has considered these significant areas and avoids them. Therefore no negative impact is expected on these resources.

The proposed Doornrivier Solar 2 is underlain by Quaternary sediments in the middle of the study area, flanked by Permian-aged sandstone and shale of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS), the Palaeontological Sensitivity of Quaternary sediments in this area is Moderate, while that of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) is Vey High. In addition, numerous loose, fragmented, petrified wood fossils were detected in the Doringrivier floodplain. A buffer zone will be implemented along the Doringrivier, and thus the proposed PV development will not affect the area's fossils (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 historical farmscape (DRV02-001) is deemed to be of high significance. Therefore, we recommend that this area is conserved and considered a No-Go zone. The current project layout considers this sensitive area and will avoid these areas.

2. The identified graves on Doornrivier No 330 Portion 5 will be impacted negatively by the development. These would require costly mitigation before destruction. However, the current project layout considers this sensitive area and will avoid these areas. It is still recommended that buffer zones should be considered to avoid any accidental impact.

3. The ECO for this project must be informed that the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) has a Very High Palaeontological Sensitivity. If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance find Protocol attached should be implemented immediately (Appendix A Section 12). Fossil discoveries ought to be protected, and the ECO/site manager must report to South African Heritage Resources 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) so that mitigation (recording and collection) can be carried out. Before any fossil material can be collected from the development site, the specialist must 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 Doornrivier Solar 2 development.

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. Depending on the nature of the finds, a professional archaeologist or palaeontologist 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 due to 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 the proposed solar PV facility (Doornrivier Solar 2) on the Farm Doornrivier 330 Portion 5, Virginia, Matjhabeng Local Municipality, Lejweleputswa District 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.

The comprehensive field survey and intensive desktop study have taken all possible care 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 until 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 scoping and scanning historical texts/records, 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 is to extract data and information on the area in question, looking at archaeological sites, historical sites and graves.

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 was completed to locate, identify, record, photograph, and describe archaeological, historical or cultural interest sites.

UBIQUE Heritage Consultants inspected the proposed development and surrounding areas on the 15th, 16th, and 17th of November 2021 and completed a controlled-exclusive, pre-planned pedestrian and vehicular survey. We inspected 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. In addition, cut banks and other exposures were fortuitously observed without looking beneath the surface beyond inspecting rodent burrows.

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 to demonstrate 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).
	The site/resource should be mitigated before destruction (high/ medium significance).

FIELD RATINGS & GRADINGS	
General Protection Grade IVA	
General protection Grade IVB	The site/resource should be recorded before destruction (medium significance).
General protection Grade IVC	Phase 1 is considered a 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.

CRITERIA	RATING SCALES	NOTES
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.
	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.

CRITERIA	RATING SCALES	NOTES
	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. Alternatives are offered if any significant sites are impacted adversely by the proposed project. All efforts will be made to ensure that all studies, assessments, and results comply with the relevant legislation, 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 following 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 facility (Doornrivier Solar 2) on the Farm Doornrivier 330 Portion 5, Virginia, Matjhabeng Local Municipality, Lejweleputswa District Municipality, Free State Province.

The proposed project will consist of three Solar facilities: Doornrivier Solar 1, Doornrivier Solar 2, and Doornrivier Solar 3. The expected generating capacity of the Doornrivier areas) are as follows:

- Doornrivier Solar 1 219ha /2.5Ha/MW = 88 MW
- Doornrivier Solar 2 260ha /3Ha/MW = 87 MW
- Doornrivier Solar 3 208ha /2.5Ha/MW = 83 MW

Infrastructure will include Photovoltaic panels (on ground-mounted steel structures) with fixed axis and single-axis tracking (confirmed during detailed design), switching stations, access roads, offices, and water and sewage pipelines.

4.1 Technical information

PROJECT DESCRIPTION	
Project name	Phase 1 HIA Doornrivier Solar 2 Virginia
Description	Proposed Development of Solar Photovoltaic (Pv) Facility (Doornrivier Solar 2) on the Farm Doornrivier 330 Portion 21, Virginia, Matjhabeng Local Municipality, Lejweleputswa District Municipality, Free State Province
DEVELOPER	
Keren Energy Group Holdings	
Development type	Solar PV facilities and grid connection
LANDOWNER	
Private	
CONSULTANTS	
Environmental	EnviroAfrica CC
Heritage and archaeological	UBIQUE Heritage Consultants
Paleontological	Banzai Environmental
PROPERTY DETAILS	
Province	Free State
District municipality	Lejweleputswa
Local municipality	Matjhabeng
Topo-cadastral map	1: 50 000 2826BB

Farm name	Doornrivier 330 Portion 5
Closest town	Virginia
GPS Co-ordinates	28°10'26.00"S; 26°47'30.04"E
PROPERTY SIZE	568.6ha
DEVELOPMENT FOOTPRINT SIZE	260ha
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

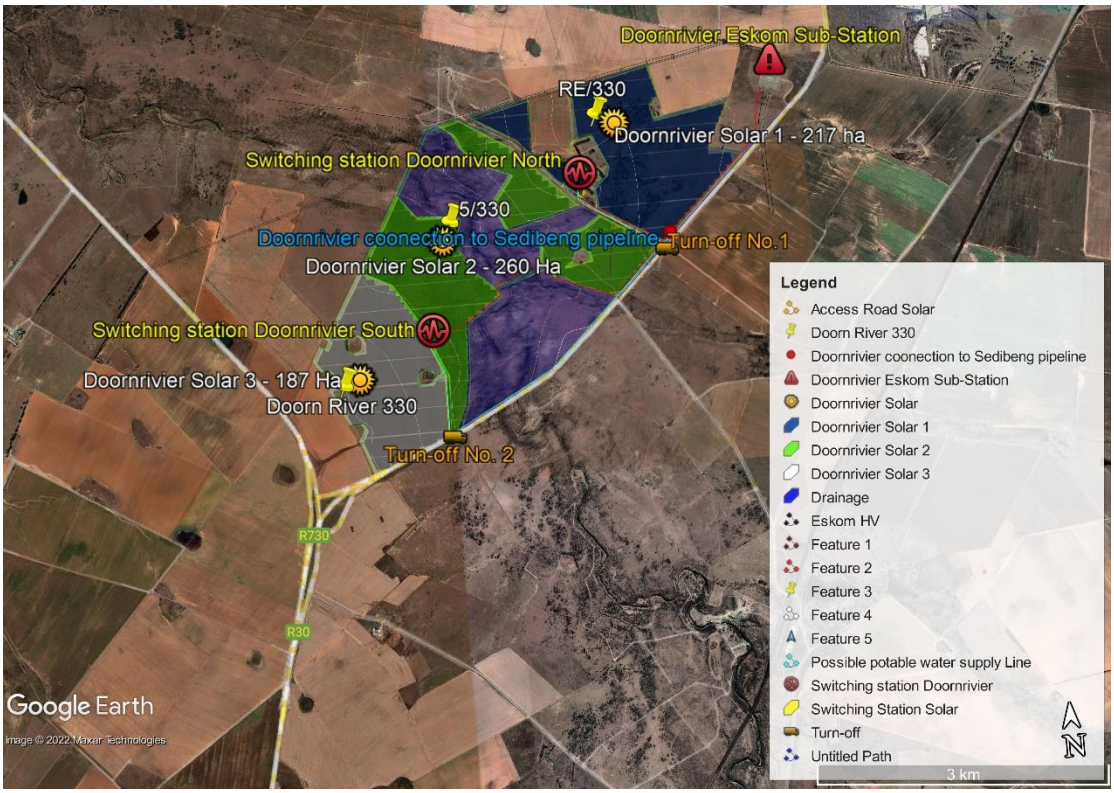

Figure 1 *Project layout provided by the client.*

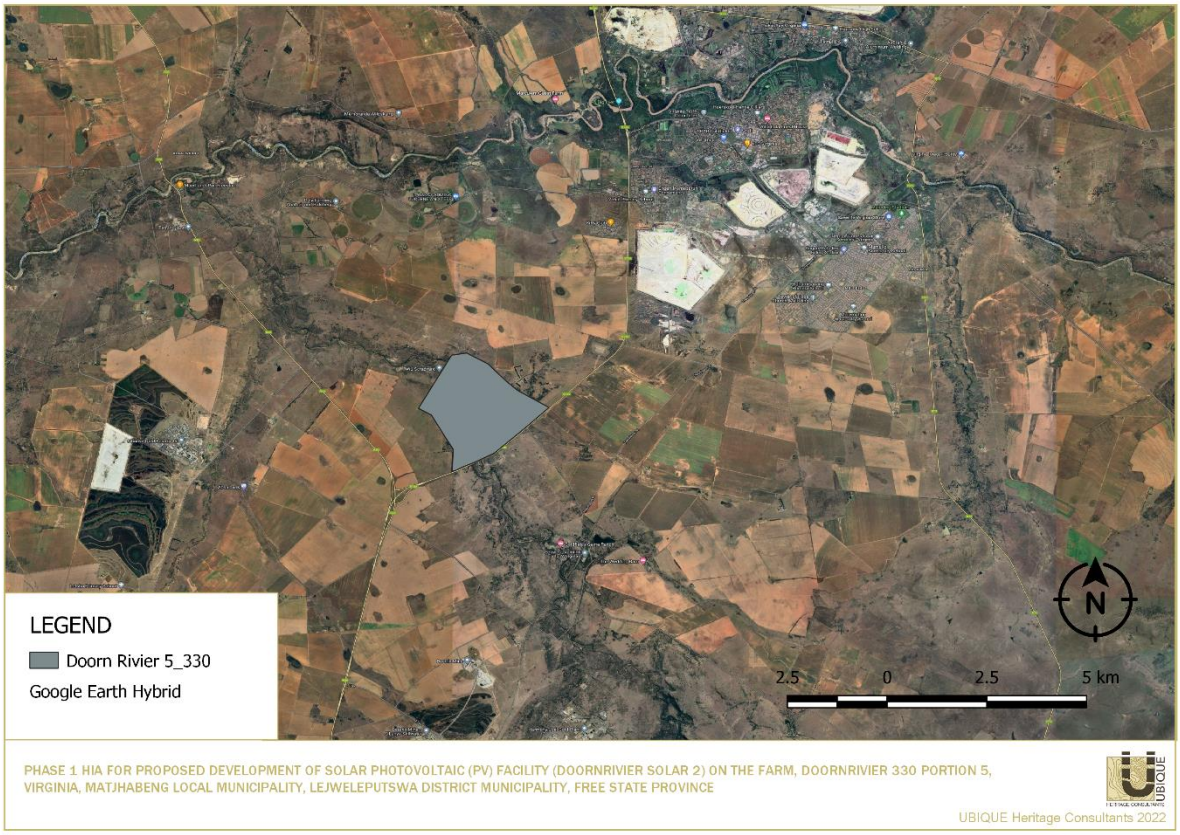

Figure 2 *Regional locality of the development footprint, indicated on Google Earth Satellite imagery.*

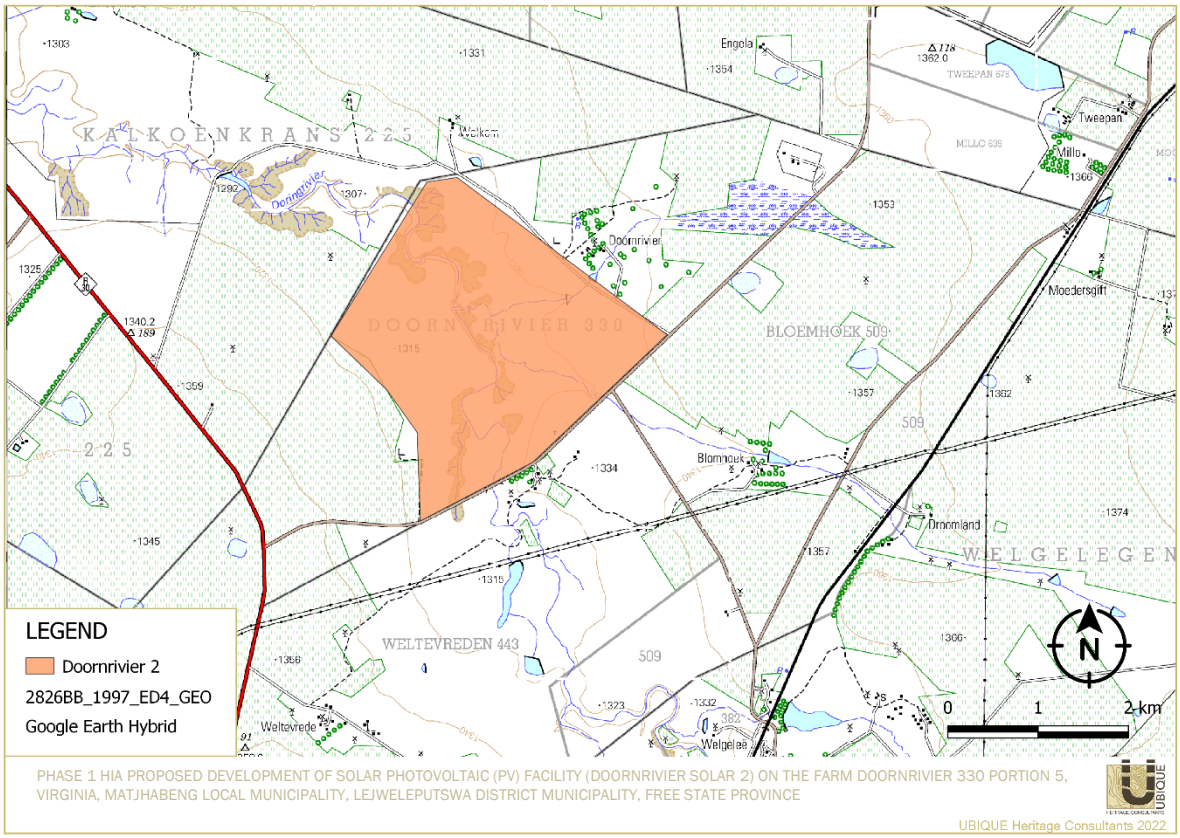

Figure 3 *Locality of the development footprint, indicated on 1: 50 000 2826BB map.*

5. HISTORICAL AND ARCHAEOLOGICAL BACKGROUND

5.1 Region: Free State

5.1.1 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

Early Stone Age assemblages include simple flakes from cobbles, core and pebble tools. Later stages include intentionally shaped hand axes and cleavers; final or transitional stages have smaller tools than the preceding stages and include large blades. The MSA is characterised by Levallois or prepared core techniques resulting in triangular flakes with convergent dorsal scars, with faceted striking platforms. Discoidal systems and intentional blade production also occur, and formal tools include unifacially and bifacially retouched points, backed artefacts, scrapers, and denticulates. Some evidence of hafted tools and deposits occasionally includes marine/ostrich eggshell shell beads, bone points, engraved ochre nodules and grindstones. The LSA varies with a wide range of micro- and macrolithic formal tools. Also occurring is hafted stone and bone tools; borers, bored stones, upper and lower grindstones, grooved stones; ostrich eggshell beads, ornaments, un/decorated flasks/flask fragments; fishing equipment; rock art, and ceramics in the late final phase (Lombard et al. 2012; Dusseldorp et al. 2013).

A rich archaeological landscape reflects the history of the Free State with a wealth of pre-colonial archaeological sites. Prominent sites such as Cornelia-Uitzoek, Florisbad, De Hoop, Roosfontein, Mauermanshoek, several open-air sites and Rose Cottage Cave have been identified and dates to the Early, Middle and Later Stone Ages (e.g., Wadley 1995; Kuman et al. 1999; Brink et al. 2012). Open-air occupation seems to have been preferred in the eastern Free State during the MSA, with lake shores such as Florsibad being used for hunting and butchering medium-sized bovids. Thus far, Rose Cottage is the only excavated cave containing MSA. In contrast, it seems that LSA people favoured camping in shelters due to LSA deposits occurring mainly in rock shelters, and few open-air sites have been recorded. However, by 1300 CE, pottery was present at Rose Cottage Cave. The presence of pottery suggests that local hunter-gatherers had contact with herder communities, who were already present in the neighbouring Seacow Valley (e.g., Wadley 1995; Sadr & Sampson 1999).

5.1.2 Iron Age

The South African Iron Age is generally characterised by farming communities that lived in sedentary settlements, kept livestock, cultivated plants, manufactured and made use of ceramics, and smelted iron for weapons and manufactured tools. These agropastoralists generally chose to live in areas with sufficient water for domestic use and arable soil that could be cultivated. The Iron Age as an archaeological period is subdivided as follows:

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

Late Iron Age settlements typically consist of stonewalling that demarcates primary cattle enclosures surrounded by huts, referred to as the Central Cattle Pattern (CCP). The main characteristics of the CCP are a settlement built encircling a cattle enclosure and living spaces arranged according to gender and social status. The centre of a village is a male domain and includes grain pits for storing grain and associated middens. The central area is also where men do crafts, like braying skins, carving objects from ivory or wood, and making metal objects. The outer residential area is the domain of women organised according to the seniority of a wife. This zone includes the households of individual wives with sleeping huts, kitchens, grain bins, storage pits, middens and graves (e.g., Huffman 2007).

Thus far, the earliest known Iron Age settlement in the Free State is OUI, dated to 505 ± 95 BP (GX-1014) (calibrated to CE 1330-1440) and the site OND2 dates to 215 ± 85 BP (GX-I463) (calibrated CE 1510-1800) (Maggs 1976). The Late Iron Age archaeology of the Free State is characterised by a wide distribution of stonewalled sites along the flat-topped ridges and hills. These settlements are associated with Basotho and Setswana speakers, who settled in the area during the last 500 years (Maggs 1976; Sadr 2019). However, during the 18th century, turmoil spread across the landscape, as evidenced at Makgwareng, which was occupied between 1720-1880 CE (Pta-133; Pta-1123). The distribution of some of the finds at Makgwareng suggests that the inhabitants left suddenly and maybe violently. Makgwareng may have been subject to attacks from Ndebele, Hlubi and Ngwane raiders that were active in the region during the Mfecane (Maggs 1976).

5.1.3 Historical period

The historical period within the region coincides with the incursion of white traders, hunters, explorers, and missionaries into the interior of South Africa. From the 1820s, *trekboers* and *Voortrekkers* were settling in the region, which the Basotho king Moshoeshoe controlled. Simultaneously in 1825, Dr John Philip of the London Missionary Society invited the Griqua leader, Adam Kok II, to settle with his people at Philippolis. During the 1820s, the Free State was under British sovereignty. Relations between the Griquas, Sotho's and Dutch immigrant farmers are characterised by interaction and interdependence as much as enmity and conflict. Concurrently these communities were also facing the socio-political effects of the Mfecane. In 1854, the British authorities withdrew their sovereignty and handed over power to the provisional government of the

newly created Orange Free State Republic with the signing of the Bloemfontein Convention (Moll 1977; Eldredge 1987; Keegan 1988; Giliomee & Mbenga 2007; Erasmus 2010).

Land speculation increased the pressure on land in the Orange Free State, providing further impetus to European competition for Basotho land. The commercialization and expansion of the rural settler economy required the continuous acquisition of more and more land. Border treaties between the Basotho and the British and settlers were negotiated and re-negotiated in the 1840s, 1850s, and 1860s. The discovery of mineral wealth, such as diamonds and gold during the 1860s and 1870s, also led to more migrants coming to the region as workers or speculators. Over time, as both Basotho and European societies experienced demographic and economic expansion, trade relations between the two groups gave way to more competitive political relations and an ongoing struggle for territorial control. The competition was exacerbated by droughts, famine and diseases in the Free State, ultimately leading to the violent conflict of the 1890s between the British, Basotho and farmers. Britain annexed the Zuid-Afrikaansche Republiek in 1877, resulting in the South African War (1899-1902). The province also housed the infamous concentration camps in Bloemfontein, Bethulie, Winburg and Kroonstad. After the South African War, the Union of South Africa was formed in 1910, and the former Orange Free State Province was established (Moll 1977; Eldredge 1987; Keegan 1988; Giliomee & Mbenga 2007; Erasmus 2010).

5.2 Local: Virginia

The town of Virginia is located in the Lejweleputswa (Sesotho word meaning "Grey rock" in English) District Municipality and the Matjhabeng (Sesotho word meaning "where nations meet") Local Municipality in the Free State. Matjhabeng refers to migrant labourers from countries like Lesotho and Mozambique who came to work in the Goldfields of the Free State. Laid out at the peak of the 1950s gold rush on the banks of the Sand River, Virginia is a gold mining town surrounded by some of the largest gold fields in the Free State. Commercial farms in the surrounding area grow maize (corn) and raise livestock. The town carries the name of the railway siding, named after the birthplace of two railway surveyors from the state of Virginia in the United States. They etched the name of their birthplace on a boulder near the farm Merriespruit in 1890 (Muller 1956; Wagener 1997).

6. HERITAGE SENSITIVITY

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

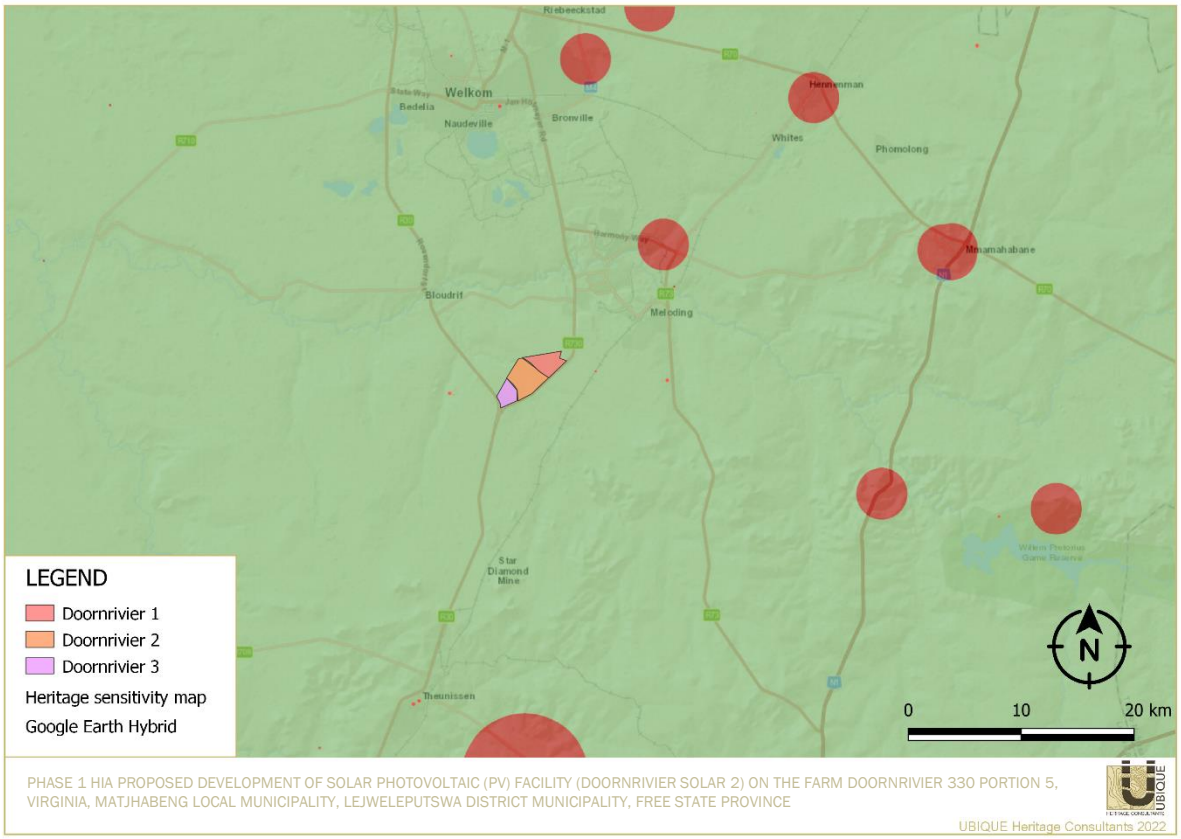

Figure 4 *The Project area indicated on the Heritage Screening tool (https://screening.environment.gov.za/)*

6.1 Summary of Local Heritage Resources

The desktop study revealed that little to no Heritage Assessments had been conducted on or directly adjacent to the proposed areas for development. However, numerous studies were completed in the broader landscape around Virginia. The assessments reported on cultural material and features relating to the Iron Age and Historical/Colonial era, which appear to be consistent with the history of the Free State. Studies encountered minimal or no archaeological materials/remains (e.g., Dreyer 2006; Van Schalkwyk 2010).

6.1.1 Stone Age

None of the HIA/AIA reports completed in the area recorded any stone tools, lithics or flakes.

6.1.2 Rock Art

Several rock art sites have been documented on the SAHRA Database in the Free State province.

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 X KM RADIUS			
HIA/AIA	SITES	COORDINATES PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
R & R CULTURAL RESOURCE CONSULTANTS 2007	ALDAM ESTATE, ALDAM	S28° 16' 17.3" E27° 10' 25.8" 40 km southeast	Late Iron Age Type V settlement

6.1.4 Historical/Colonial period

Very few impact assessments were reported on cultural material and sites associated with the Historical/Colonial Period. However, the wider vicinity is well known for Historical Period resources related to the ABO and colonial farming period.

HISTORICAL PERIOD RESOURCES RECORDED IN X KM RADIUS			
HIA/AIA	SITES	COORDINATES PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
EXIGO 2021	PORTIONS OF THE FARMS BLOEMHOEK 509, WELGELEGEN 382, MOOI UITZIG 352, FLORIDA 633, LE ROUX 717 AND DETENTE 744	S28.21863 E27.03644 16 km northwest	Historic era remains of a farm worker's compound (ca. 1940s)
R & R CULTURAL RESOURCE CONSULTANTS 2007	ALDAM ESTATE, ALDAM	S28° 16' 17.3" E27° 10' 25.8" 40 km southeast	Monuments commemorating Zandrivier Convention 1852 and 1914 - 1915 rebellion. Historic farmstead
COETZEE, F. 2008	PHAKISA HOUSING DEVELOPMENT, WELKOM	S27.94898 E26.73813 20 km north	Historic mine shaft post 1940s

6.1.5 Graves/Burials

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

GRAVES/BURIALS RECORDED IN X KM RADIUS			
HIA/AIA	SITES	COORDINATES PROXIMITY TO STUDY AREA	HERITAGE RESOURCES
DREYER, C. 2004	THABONG, WELKOM	S27°57'27. E026°50'42 25 km south	Graves of farm labourers
VAN SCHALKWYK, J.A. 2010	ROUTE 1, VENTERSBURG	S 28.08055 E 27.14759 35 km east	Formal town cemetery

6.1.6 Palaeontological Sensitivity

The Heritage Screening tool (https://screening.environment.gov.za/) palaeontological layer shows that the proposed project area has a high to very high palaeontological sensitivity.

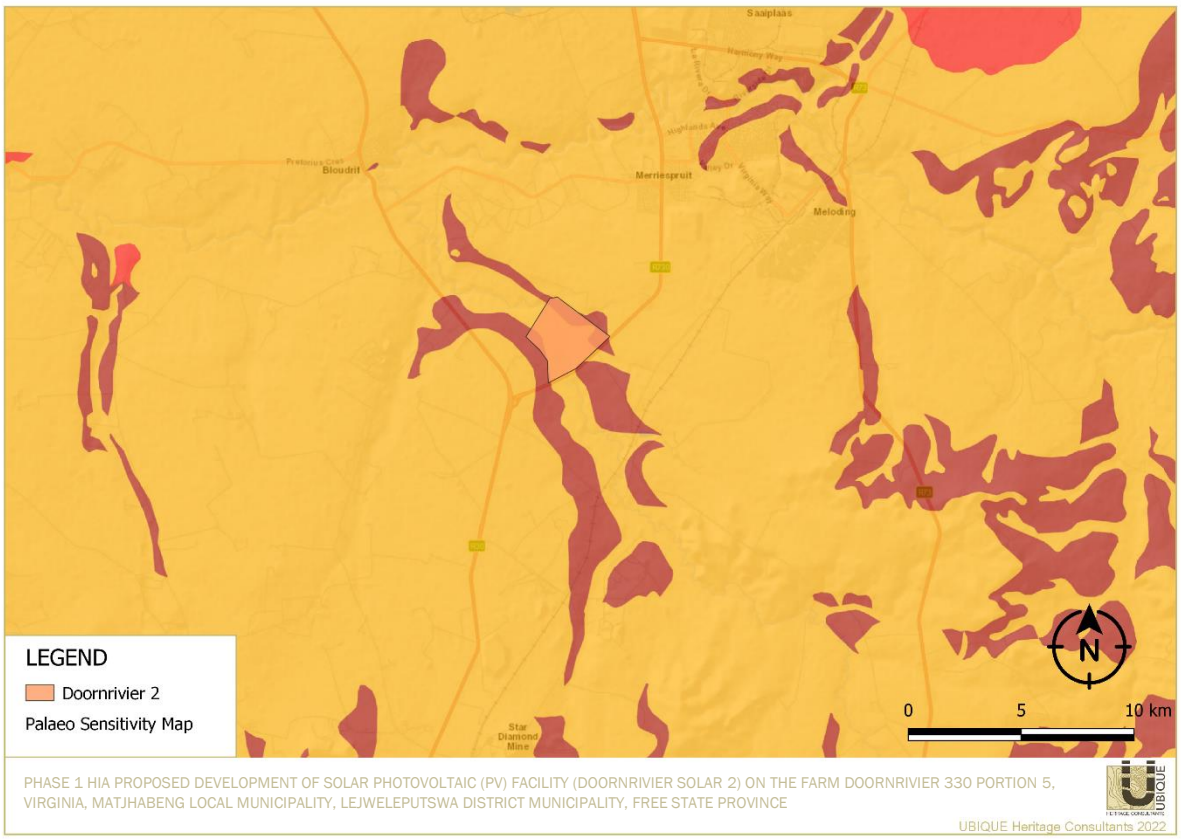

Figure 5 *The Project area indicated on the Palaeontological Heritage Screening tool (https://screening.environment.gov.za/)*

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. A two-person team surveyed the proposed Solar footprint areas by vehicle and foot. The pedestrian survey was conducted in predominantly 30-50 m transects.

Figure 6 *Survey tracks across the development footprint.*

7.2 Description of the affected environment

The study area falls predominantly within the Vaal-Vet Sandy Grassland and Highveld Alluvial Vegetation types (SANBI 2022). A plains-dominated landscape characterises the Vaal-Vet Sandy Grassland vegetation type with scattered, slightly irregular undulating plains and hills and mainly low-tussock grasslands with an abundant karroid element. In addition, the Highveld Alluvial Vegetation type includes a flat topography supporting riparian thickets, dominated by *Acacia karroo*, accompanied by seasonally flooded grasslands and disturbed herb lands often dominated by alien plants. (Mucina & Rutherford 2006).

The Doring River flows through the centre of the study area, with the planned solar development laying on the western and eastern banks. The study area's landscape has been disturbed by agricultural activities but is currently very overgrown and densely vegetated. The vegetation density varies from very dense, with thorn bushes, shrubs and tall grass to open grass fields. The neighbouring farm fences bound the development footprint to the east, north and west, with the R730 bounds to the south. To the northeast are power lines and open fields. Various two-track roads give access to the different development areas.

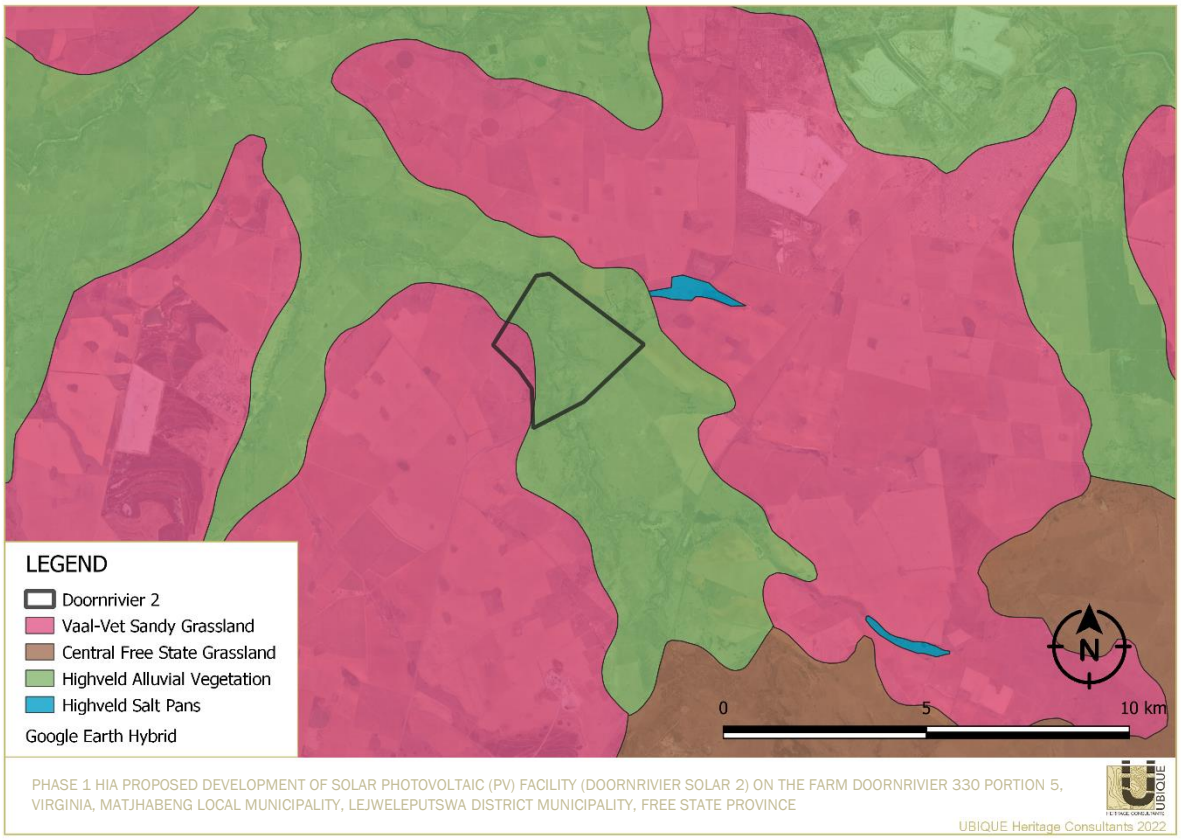

Figure 7 *Indication of the vegetation types in and around the study area*

Figure 8 Views of the affected development area.

7.3 Identified heritage resources

7.3.1. Historical/Recent resources Identified

HISTORICAL/RECENT RESOURCES IDENTIFIED					
SITE ID #	DESCRIPTION		PERIOD	LOCATION	FIELD RATING/ SIGNIFICANCE/ RECOMMENDED MITIGATION
DRV02-001	Type of site	Historical farmscape	Historical/ the 1880s	**28°11'3.99"S 26°48'8.06"E**	Field Rating Local Grade IIIA High significance No-Go Zone with Buffer
	Material	Various			
	N in m²	1 in 15.8 ha			
	Context	In-situ and undisturbed archaeological context			
	Additional	Outside of the final project layout, but highly significant. The site consists of multiple middens and structural ruins of the old farmhouse, multiple kraals, and outbuildings.			

7.3.2. Graves Identified

GRAVES/BURIALS IDENTIFIED					
SITE ID #	DESCRIPTION		PERIOD	LOCATION	FIELD RATING/ SIGNIFICANCE/ RECOMMENDED MITIGATION
DRV02-002 DRV02-003	Grave Markers	Cairn	Unknown	**28°10'44.85"S 26°48'37.69"E** **28°10'44.23"S 26°48'37.77"E**	Field Rating of Local Grade IIIB High/medium significance 30m buffer/safety zone recommended
	Inscription	None			
	Grave Orientation	East/West			
	Dimension/Extent	Average 1,8m x 1m			
	Additional	Two possible graves			
DRV02-004	Grave Markers	Formal marble stones	Buried 1920s-1930s	**28°11'2.70"S 26°48'17.18"E**	Field Rating of Local Grade IIIB High/medium significance 30m buffer/safety zone recommended
	Inscription	Human family			
	Grave Orientation	East/West			
	Dimension/Extent	2mx3m			
	Additional	Fenced graves, overgrown with vegetation, possibly three internments side by side			
DRV02-005 DRV02-006	Grave Markers	Cairns without headstone	Unknown	**28°11'2.56"S 26°48'8.67"E**	Field Rating of Local Grade IIIB High/medium significance 30m buffer/safety zone recommended
	Inscription	None			
	Grave Orientation	Undiagnostic			
	Dimension/Extent	1,9mx1,2m			
	Additional	Possible graves. It is not confirmed. Within the farmscape, No-Go zone.			

DRV02-007	Grave Markers	Four Cairns without headstones	Unknown	28°10'17.95"S 26°48'16.04"E	Field Rating of Local Grade IIIB High/medium significance 30m buffer/safety zone recommended
	Inscription	None			
	Grave Orientation	Undiagnostic			
	Dimension/Extent	1,9mx1,2m			
	Additional	Four graves. Outside footprint.			

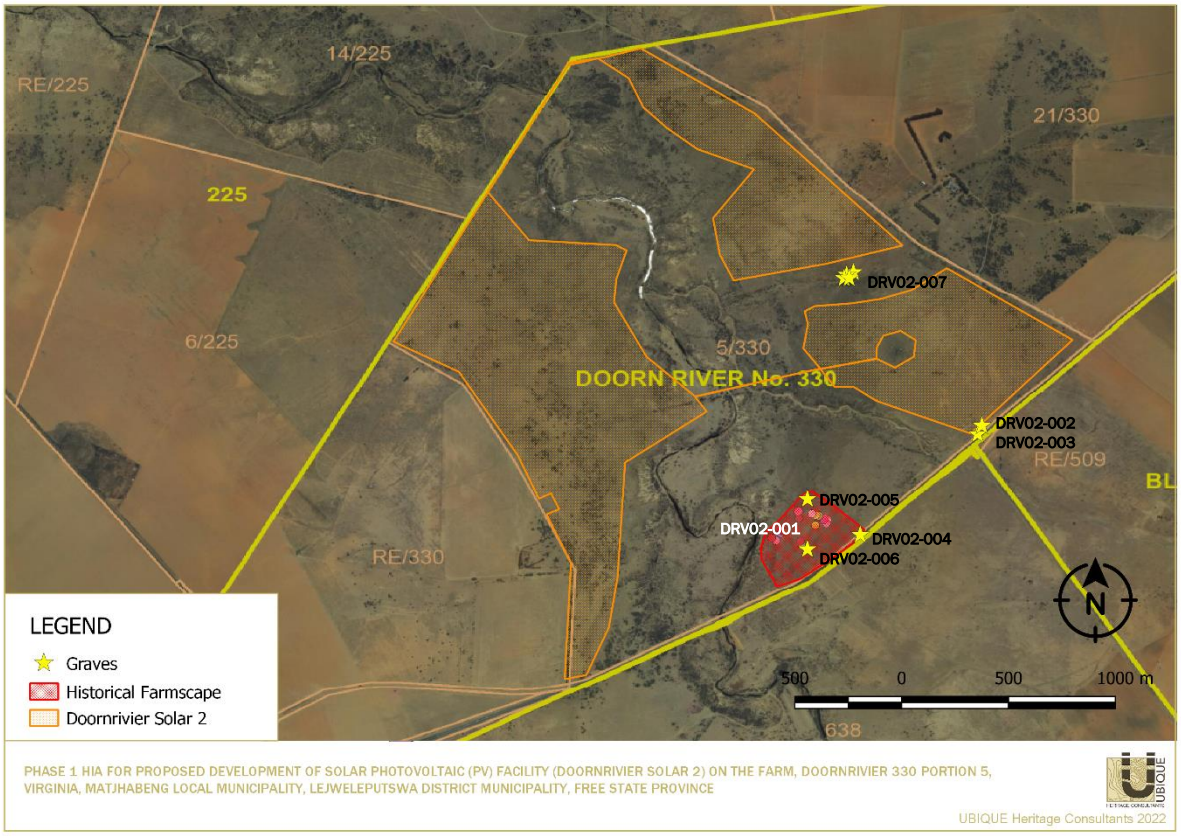

Figure 9 *Distribution of identified heritage resources.*

7.4 Discussion

7.4.1. Archaeological features

7.4.1.1. Historical/Recent

Site DRV02-001 is an undisturbed historical farmscape with the remains of an old farmhouse, stonewalled kraals, outbuilding, circular structures and numerous intact middens. The cultural material visible on the surface dates from the late 19th to early 20th century. These include various European ceramic fragments (transferware, willowware, spongeware, and industrial ware), even some shaped and rounded into probable game pieces. In addition, late-19th century glass bottle pieces, metal fragments of food cans, building hardware, cast-iron pots, material from a

harmonica, and bullets, are spread over the site surface. The intact nature of the site makes it an important site regarding local and regional history.

Fortunately, the final project layout has excluded this area from the development. However, its importance should still be noted.

The site has been rated with a field rating of 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).

Figure 10 *Historical features and structures found at Doornrivier Solar 2*

7.4.1.2. Graves

Numerous graves were recorded on the Farm Doornrivier 330 Portion 5 (DRV02-002, DRV02-003, DRV02-004, DRV02-005, DRV02-006, DRV02-007). Predominantly these graves are informal, consisting of field-stone cairns without headstones. However, the Human family graves (DRV02-004) have inscribed marble headstones and are fenced. Even though the recorded graves fall outside the finalised project layout, it is important to note that graves could be present anywhere in the landscape. Due to dense vegetation, it is possible that more graves could be present in the projected footprint that was missed during the survey.

These identified gravesites 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 11 *Graves recorded around the development footprint*

7.4.2. Palaeontological resources

Elize Butler from Banzai Environmental conducted a palaeontological field assessment for the development footprint (see Appendix A). She determined that the proposed Doornrivier Solar 2 is underlain by Quaternary sediments in the middle of the study area flanked by Permian-aged sandstone and shale of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS), the Palaeontological Sensitivity of Quaternary sediments in this area is Moderate, while that of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) is Vey High.

During the field survey, numerous loose, fragmented, petrified wood fossils were detected in the Doringrivier floodplain. The project layout includes a buffer zone along the Doringrivier; thus, the proposed PV development will not affect the area's fossils.

Therefore, an overall Medium palaeontological significance is allocated to the development footprint.

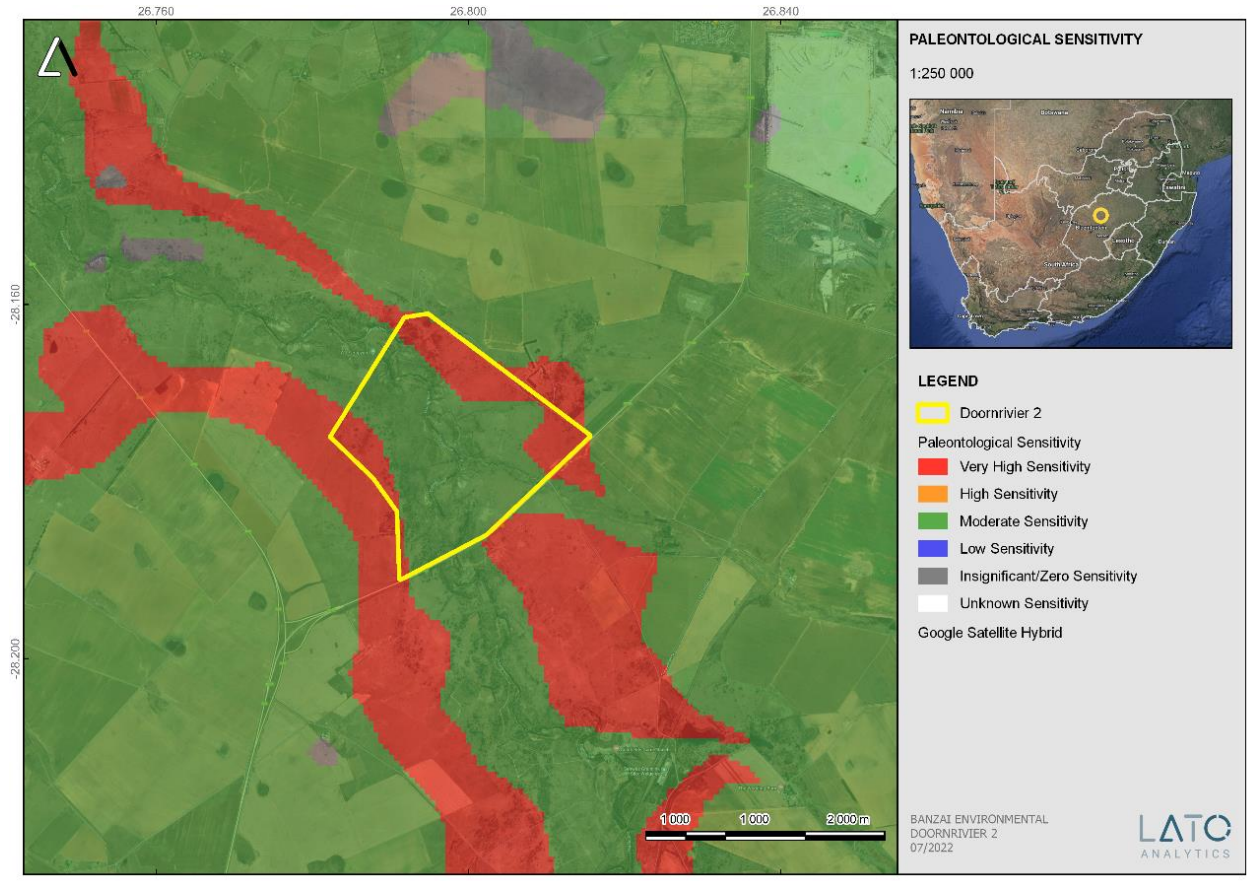

Figure 12 *Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in yellow. Image: Banzai Environmental*

8. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

Description	Development Impact		Mitigation	Field rating/ Significance
Archaeological				
1. Graves recorded (DRV02-002, DRV02-003, DRV02-004, DRV02-005, DRV02-006, DRV02-007)	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. The historical farmscape DRV02-001	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		
Paleontological				
3. The Palaeontological Sensitivity of Quaternary sediments in this area is Moderate, while that of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) is Vey High. Evidence of fossiliferous outcrops was found in the development footprint; thus, an overall MEDIUM palaeontological significance is allocated to the development footprint.	Nature	Negative	Chance Finds Protocol provided.	N/A
	Extent	High		
	Duration	Medium		
	Intensity	High		
	Potential of impact on irreplaceable resource	High		
	Consequence	High		
	Probability of impact	High		
	Significance	High		

The impact of the development holds a potential negative threat to heritage resources (archaeological and palaeontological) of high significance. However, the project layout has considered these heritage resources and mitigated the effects of the development by excluding these areas from the project layout plan. In addition, implementing buffer zones will help conserve heritage resources.

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:

5. The historical farmscape (DRV02-001) is deemed to be of high significance. Therefore, we recommend that this area is conserved and considered a No-Go zone. The current project layout considers this sensitive area and will avoid these areas.

6. The identified graves on Doornrivier No 330 Portion 5 will be impacted negatively by development. These would require costly mitigation before destruction. However, the current project layout considers this sensitive area and will avoid these areas.

7. The ECO for this project must be informed that the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) has a Very High Palaeontological Sensitivity. If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance find Protocol attached should be implemented immediately (Appendix A Section 12). Fossil discoveries ought to be protected, and the ECO/site manager must report to South African Heritage Resources 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) so that mitigation (recording and collection) can be carried out. Before any fossil material can be collected from the development site, the specialist must 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 Doornrivier Solar 2 development.

8. 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. Depending on the nature of the finds, a professional archaeologist or palaeontologist 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 due to such oversights.

10. CONCLUSION

This HIA has identified no significant heritage resources. Accordingly, the proposed development of solar photovoltaic (PV) facilities on Portion 5 of the farm Doornrivier 330 (Doornrivier SOlar 2), Virginia, Matjhabeng Local Municipality, Lejweleputswa District 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 DEVELOPMENT OF A SOLAR PHOTOVOLTAIC (PV) FACILITY (DOORNRIVIER SOLAR 2) ON THE FARM, DOORNRIVIER 330 PORTION 5, VIRGINIA, MATJHABENG LOCAL MUNICIPALITY, LEJWELEPUTSWA DISTRICT MUNICIPALITY, FREE STATE PROVINCE

BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL IMPACT ASSESSMENT

DOORNRIVIER SOLAR 2

NEAR VIRGINIA IN THE FREE STATE

July 2022

COMPILED FOR:

UBIQUE HERITAGE CONSULTANTS

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations, and all other applicable legislation.
- I will consider, 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 are facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application.
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct.
- I will perform all other obligations as expected as 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 offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

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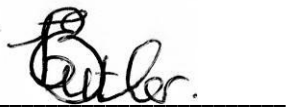
Email: elizebutler002@gmail.com

SIGNATURE: 

The heritage 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**
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 vita	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 12
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 12
(g) An identification of any areas to be avoided, including buffers	None Section 1 and 12
(h) A map superimposing the activity including the associated structures and infrastructure on the	Section 5 – Geological and Palaeontological history

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report
environmental sensitivities of the site including areas to be avoided, including buffers;	
(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 12
(k) Any mitigation measures for inclusion in the EMPr	Section 1 and 12
(l) Any conditions for inclusion in the environmental authorisation	Section 1 and 12
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 12
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 12
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and	
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 12
(o) A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(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.	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	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 **Doornrivier Solar 2**, southwest of Matjhabeng (formerly Virginia), 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 Doornrivier Solar 2 is underlain by Quaternary sediments in the middle of the study area, flanked by Permian-aged sandstone and shale of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS), the Palaeontological Sensitivity of Quaternary sediments in this area is Moderate, while that of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) is Vey High.

A 1-day site-specific field survey of the development footprint was conducted on foot and by a motor vehicle on 29 January 2022. Numerous loose, fragmented, petrified wood fossils were detected in the Doringrivier floodplain. A buffer zone will be implemented along the Doringrivier, and thus the proposed PV development will not have an effect on the fossils of the area. An overall Medium palaeontological significance is allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area, and construction of the development may be authorised to its whole extent.

Recommendations:

- The ECO for this project must be informed that the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) has 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 South African Heritage Resources 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) 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 Doornrivier Solar 2 development.

Impact Summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Construction Phase PV Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	30	Negative Medium impact	15	Negative Low impact
Operation Phase PV	No Impact		No Impact		No Impact
Decommissioning Phase PV	No Impact		No Impact		No Impact

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Appendix A: CV

» INTRODUCTION

Keren Renewable Energy (Pty) Ltd plans to develop the proposed Doornrivier Solar PV Facilities (Doornrivier Solar1, Doornrivier Solar 2, and Doornrivier Solar 3) about 4km south-west of Virginia in the Free State (Figure 1). EnviroAfrica cc has been appointed to conduct a separate NEMA application process for Environmental Authorisation for each of the proposed solar PV facilities. UBIQUE Heritage Consultants was 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 **Doornrivier Solar 2 PV facility** and associated infrastructure will be investigated.

The construction of a 100MW Doornrivier Solar 2 PV facility and associated infrastructure on a portion of Portion 21 of Farm 330 near Virginia in the Free State is proposed (**Figure 2-3**). This PV facility will be approximately 260 ha in extent.

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)[1].

[1]Information provided by EnviroAfrica cc, 2021

LEGAL MANDATE

The following listed activities with special reference to the proposed development are triggered

Government Notice R327 (Listing Notice 1): Activity No. 11, 12, 19, 27, 28
Government Notice R325 (Listing Notice 2): Activity No. 1, 9, 15
Government Notice R324 (Listing Notice 3): Activity No. 12, 14

The activities triggered under Listing Notice 1, 2 and 3 (Regulation 327, 325 & 324) for the project implies that the development is considered as potentially having an impact on the environment and therefore require the implementation of appropriate mitigation measures.

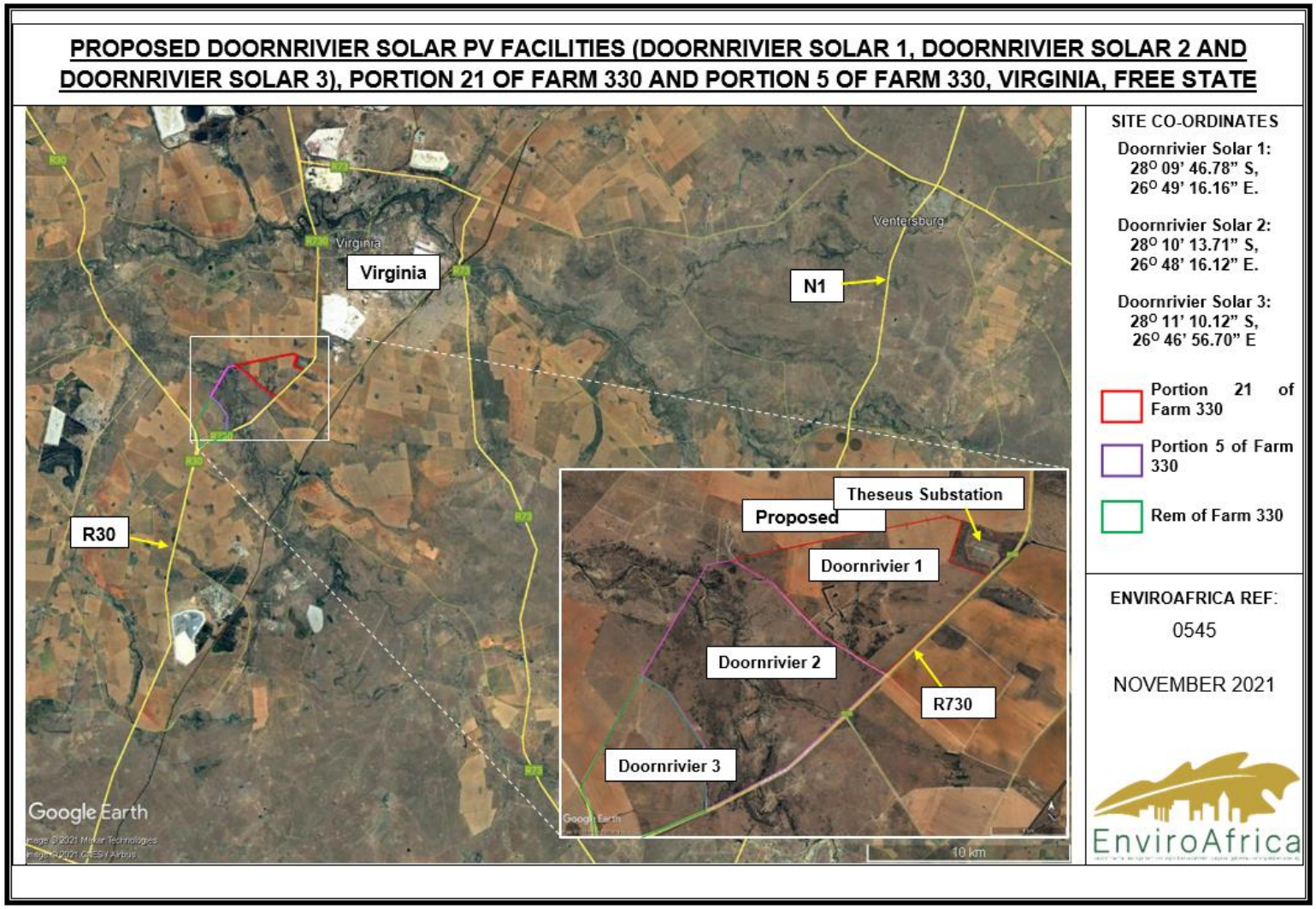

Figure 13:Proposed Doornrivier Solar PV Facilities near Virginia in the Free State

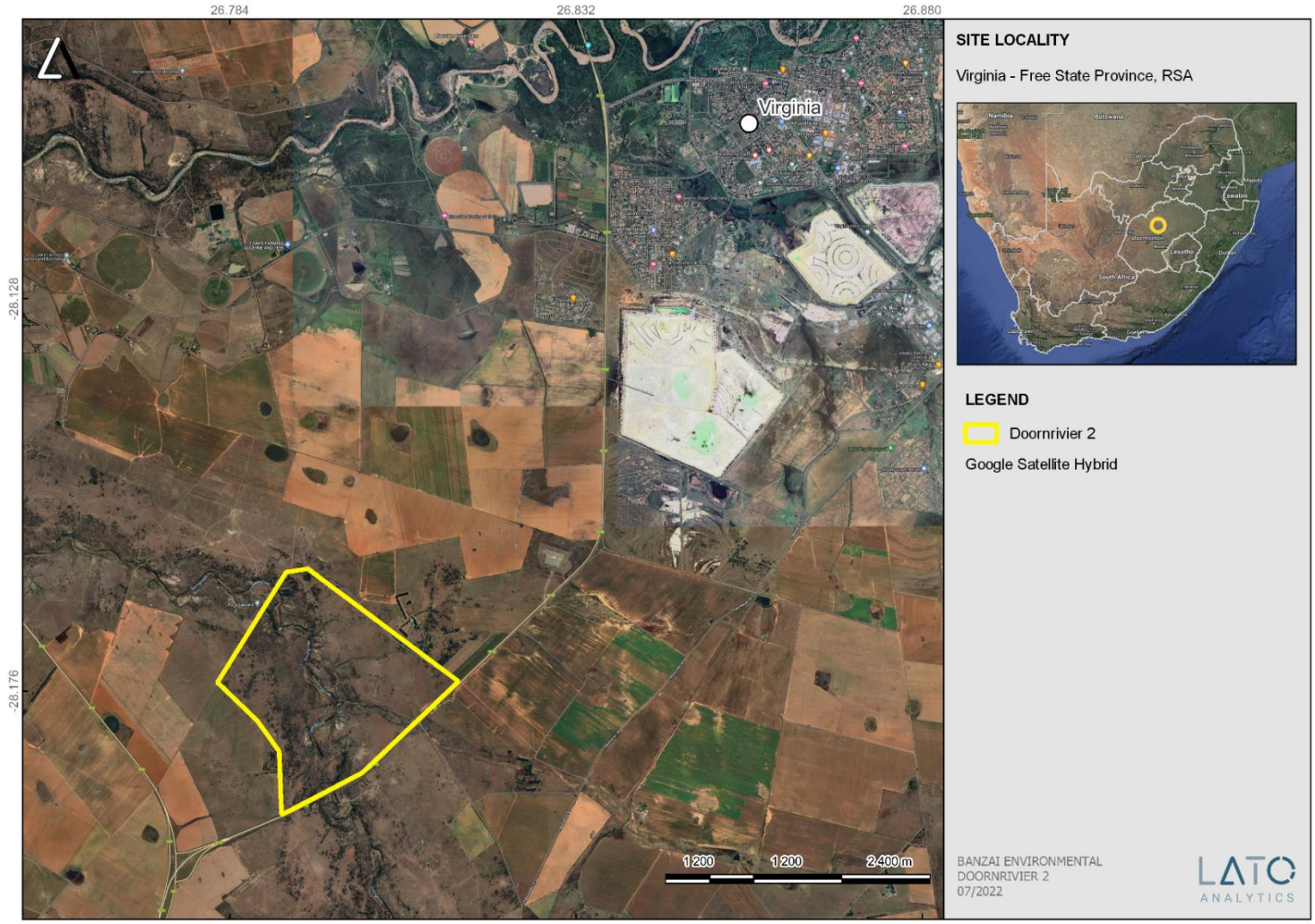

Figure 14: Location of the proposed Doornrivier Solar 2 PV Facility on a portion of Portion 21 of Farm 330, near Virginia in the Free State.

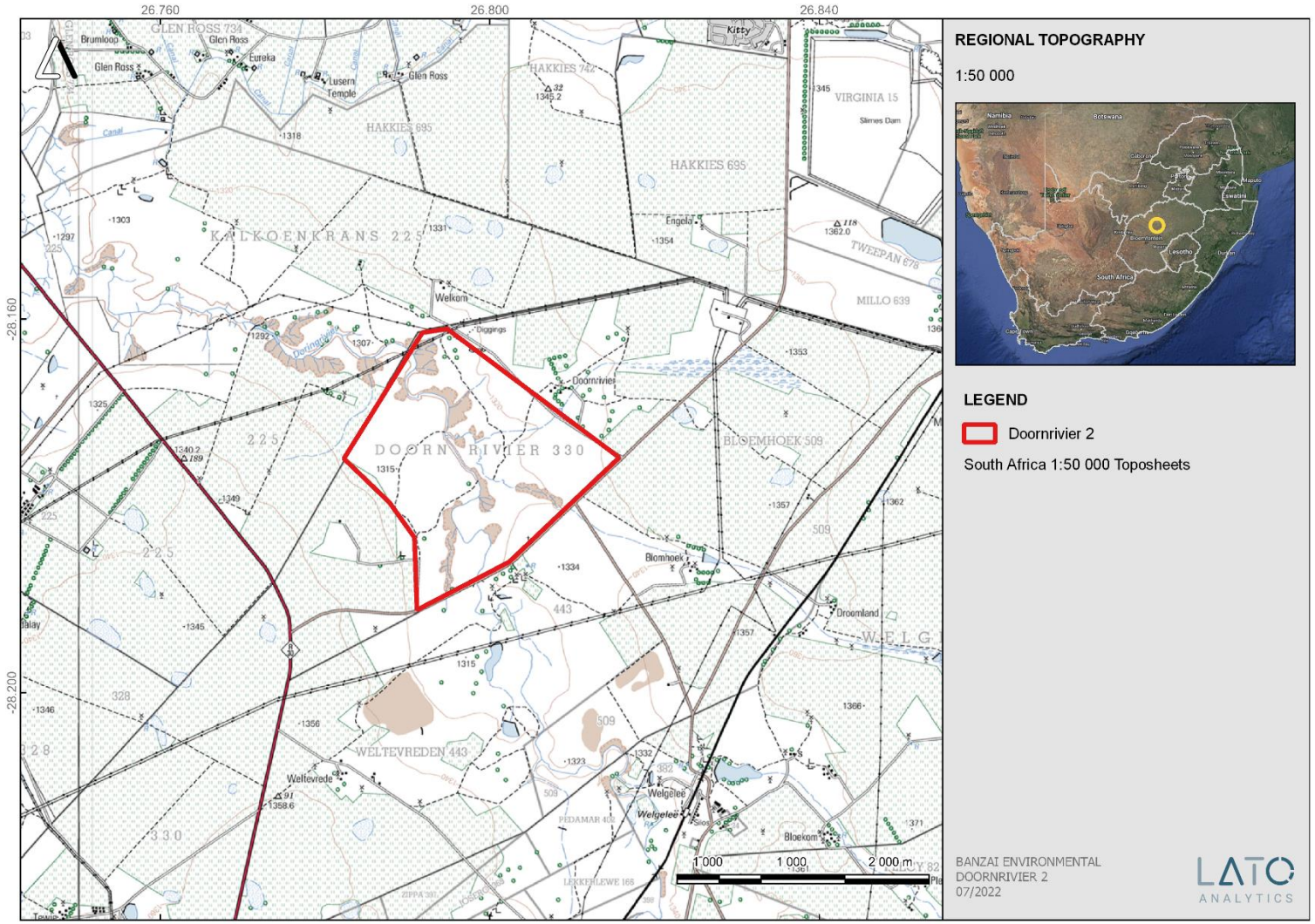

Figure 15: Locality Map of of the proposed Doornrivier Solar 2 PV Facility on a portion of Portion 21 of Farm 330, near Virginia in the Free State.

The following information was provided by EnviroAfrica cc

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 16:Installation type

ELECTRICITY

Generation capacity:

Doornrivier Solar 2 219 ha / 2.5 Ha/MW = 88 MW

Capacity of overhead power lines

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

- Existing MV transmission line
- **Existing HV transmission lines**
- **Proposed HV transmission line connection between Doornrivier Solar Farm and the Doornrivier Eskom Sub-Station**

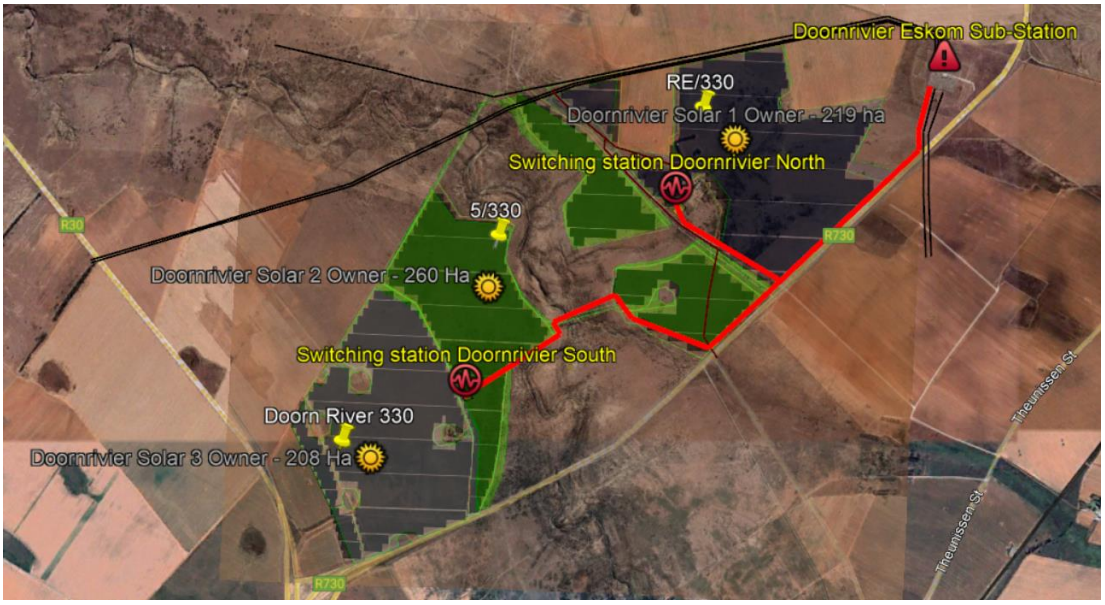

Figure 17: Footprint of switching stations with offices , existing power lines and route of the proposed power line connection from the solar farm to the Doornrivier Eskom Sub-Station.

The footprint of switching stations with offices:
100m x 150m (typical) areas.

WATER SUPPLY

There is a connection to Doornrivier on the Sedibeng pipeline running parallel with the R730 road. Water will be distributed to the two switching stations, as shown below.

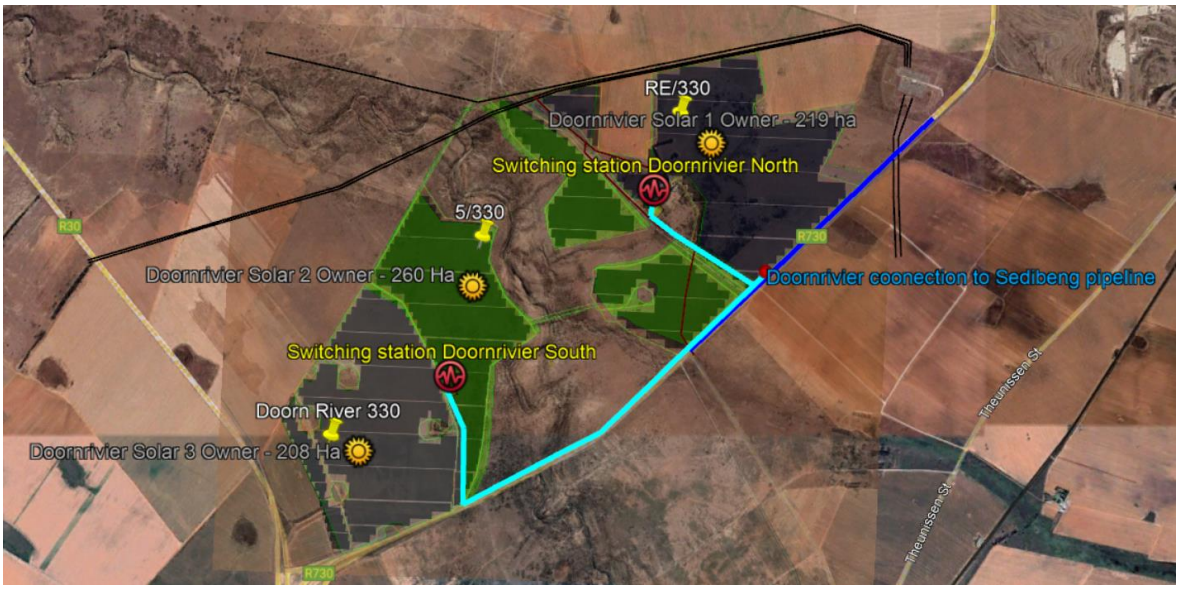

Figure 18:Water supply

Water will be applied for industrial purposes, and an application/letter must be submitted to Sedibeng Water for approval. Water will mostly be utilized for drinking purposes and the washing of solar panels every two or three months or less. The diameter of the pipelines will be 75mm or smaller.

SEWER

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.

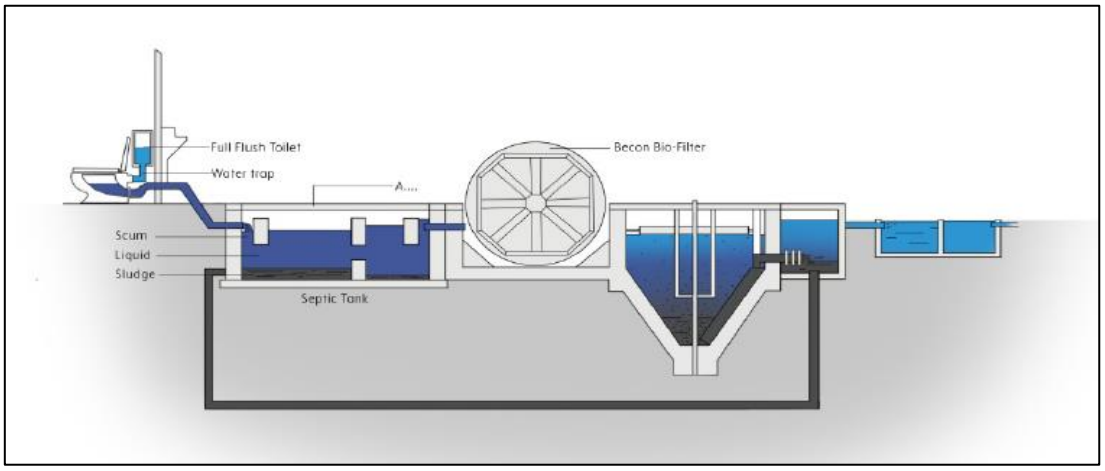

Figure 19:Wastewater and sewer

ROADS AND ACCESS

The R730 road runs along the southern boundary of the Doornrivier farm in a north-westerly direction. The two roads that give access to the two switching stations are shown in gold on the Google image below.

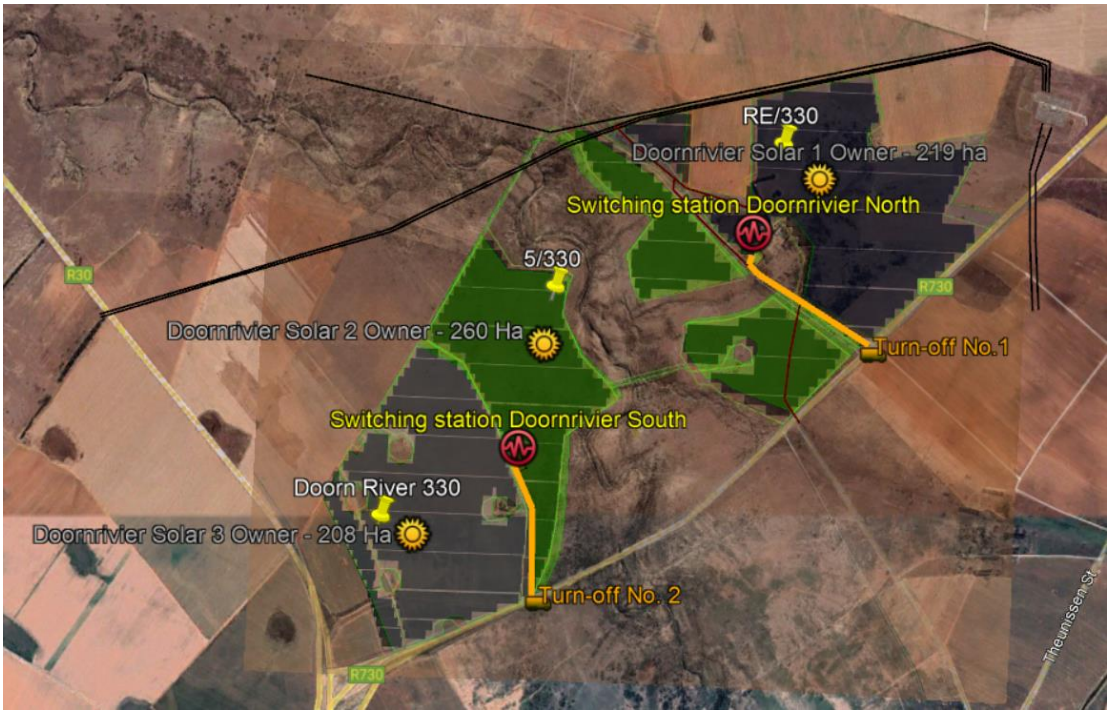

Figure 20: Access roads

STORM WATER

The Doorn River runs in a north-westerly direction through the middle of the solar farm area. The contours on the Google map below show that most of the drainage is overland, with slopes ranging from 1:35 to 1:500.

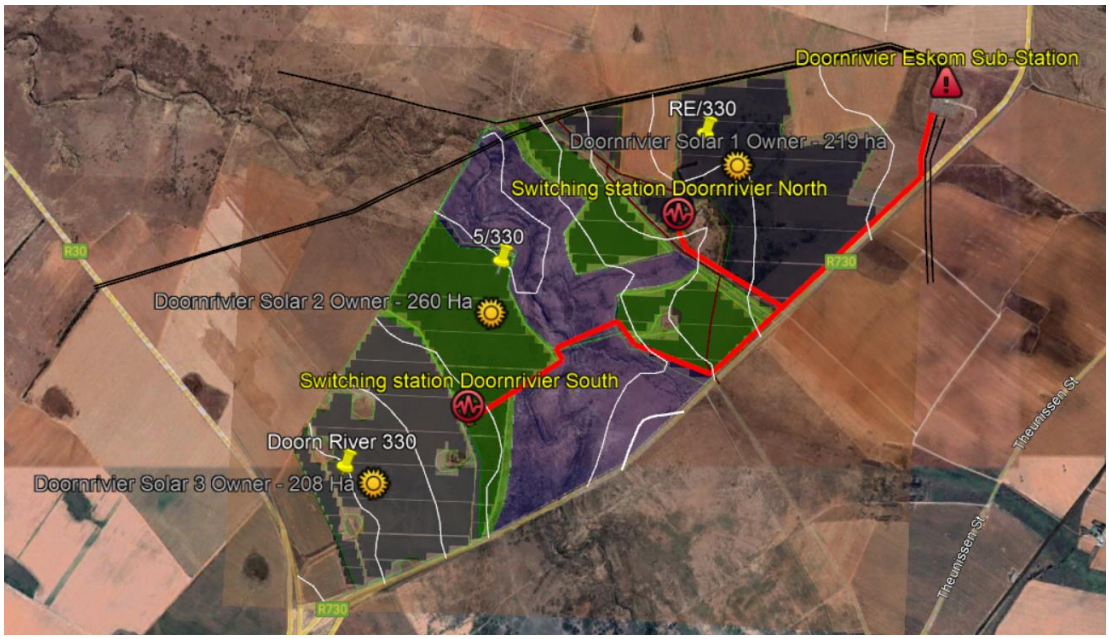

Figure 21: Storm water

OFFICES

The operational offices will be located next to the switching stations in the centre of the solar area.

SOLID WASTE

The solid waste disposal site that will be used is shown in the Google image below:

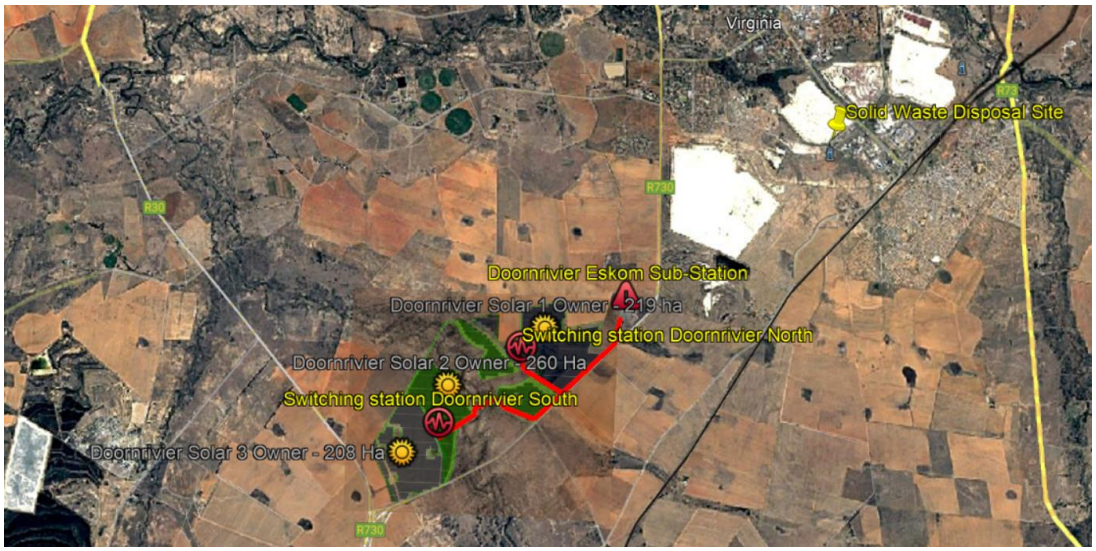

Figure 22:Solid waste

SERVITUDES

No information is available regarding existing road, Water and electrical servitudes at present.

» 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. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

» **LEGISLATION**

National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, including 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
- 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

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 reports have been compiled.

.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources 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 adheres to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts on 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.

» **OBJECTIVE**

The aim of a PIA is to decrease the effect of the development on potential fossils at the development site.

According to the "SAHRA Archaeology, Palaeontology and Meteorites (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 and 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 destroy or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precedes 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 is 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 and 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 of sensitive areas to be avoided (providing shapefiles/kmls) 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.).

» **GEOLOGICAL AND PALAEONTOLOGICAL HISTORY**

The proposed Doornrivier Solar 2 PV facility near Virginia in the Free State is depicted on the 1:250 000 Winburg 2826 Geological map (1998) Geological map (1989) (Council of Geoscience, Pretoria) (**Figure 11; Table 2-3**). The proposed Doornrivier Solar 2 PV facility development is underlain by Quaternary sediments (Qs, yellow) in the middle of the development and is flanked by Permian-aged sandstone and shale of the Adelaide Subgroup (Pa, green) (Beaufort Group, Karoo Supergroup). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS), the Palaeontological Sensitivity of Quaternary sediments is Moderate, while that of the Adelaide Subgroup (Beaufort Group) is Very High (Almond and Pether, 2009; Almond *et al*., 2013, Groenewald et al. 2014). The Shape files (Council of Geosciences, Pretoria; **Figure 12**) refine the geology of the 1998 Geological Map and indicates that the proposed development is mainly underlain by alluvium, colluvium, eluvium and gravel, while the Adelaide Subgroup is represented by the Balfour Formation.

The Virginia/Welkom District is known for the presence of fluvial deposits along the present river courses that are terrestrial sediments and includes diatomite (diatom deposits), calcareous tufa, pedocretes, peats, spring deposits, soils and gravel and other Tertiary calcrete deposits, that is very important for understanding the Early and Late Pliocene period in this region (De Ruiter et al., 2010). The late Cenozoic (Plio-Pleistocene) floodplain deposits (overbank sediments) found near the Sand-, Doring-, Vals- and Vet River systems, including pan sites, contain confined but abundant mammal vertebrate fossil sites. In 1955, Meiring described an *in situ* proboscidian fossil (mammoth), comprising a lower molar, a large part of a tusk, as well as a proximal portion of an ulna from the Sand River near Virginia. This specimen was found in pebbly channel-fill sediments about 40m above the current riverbed. This specimen was originally described as *Archidiskodon scotti* (Meiring 1955) but was later assigned to the Pliocene species *Mammuthus subplanifrons* (Coppens et al. 1978). Later investigations uncovered diverse fauna that includes amphibians, birds, fish, and reptiles, as well as several proboscideans, perissodactyls and artiodactyls from the same site (De Ruiter 2010).

Terrace gravels above the Vet River, southwest of Welkom, have uncovered Pliocene fossils, while surveys along the Doring, Vals, Sand and Vet Rivers produced moderately fossiliferous overbank sediments and erosional gullies that comprise a variety of Quaternary-aged mammals (Brink et al. 1999; De Ruiter et al. 2011) Ancient pan sites, for example near Whites, produced rich Quaternary-aged mammal fossil remains.

The proposed development is underlain by a series of Karoo sandstones, mudstones, and shales, deposited under fluvial environments of the Adelaide Subgroup that forms part of the Beaufort Group (**Figure 13**). The Beaufort Group is the third of the main subdivisions of the Karoo Supergroup. The Beaufort group overlays the Ecca Group and consists essentially of sandstones and shales deposited in the Karoo Basin from the Middle Permian to the early part of the Middle Triassic periods and was deposited on land through alluvial processes. The Beaufort Group covers a total land surface area of approximately 200 000 km^2 in South Africa and is the first fully continental sequence in the Karoo Supergroup and is divided into the Adelaide subgroup and the overlying Tarkastad subgroup. The Adelaide subgroup rocks are deposited under a humid climate that allowed for the establishment of wet floodplains with high water tables and are interpreted to be fluvio-lacustrine sediments. The Adelaide Subgroup is approximately 5 000m thick in the southeast, but this decreases to about 800m in the centre of the basin, which decreases to about 100 to 200m in the north.

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.

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 extensive beds, while ripple lamination is usually confined to thin sandstones towards the top of the thicker units.

The mudrocks of the Adelaide Subgroup usually have massive and blocky weathering. 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 world's most complete transition from early "reptiles" to mammals. The Beaufort Group is subdivided into a series of biostratigraphic units based on its faunal content (Kitching1977, 1978; Keyser *et al.* 1977, Rubidge 1995, Smith *et al.* 2020; Viglietti 2020). The south-western portion of the proposed development is underlain by the

Balfour Formation, which is divided into the *Daptocephalus* (DAZ), which in turn is divided into the upper (younger) *Lystrosaurus maccaigi - Moschorhinus* and lower (older) *Dicynodon-Theriognathus Subzones* (**Figure 13**; Viglietti, 2020).

The dicynodont, *Daptocephalus leoniceps,* is the main biozone defining fossil of the D*aptocephalus Assemblage Zone* **(Figure 14).** The Daptocephalus Assemblage Zone (DaAZ) is characterised by the co-occurrence of the dicynodontoid Daptocephalus leoniceps, the therocephalian Theriognathus microps, and the cynodont Procynosuchus delaharpeae. The DaAZ comprise two subzones representing the two distinct faunal assemblages in this assemblage zone. The Dicynodon -Theriognathus Subzone (in co-occurrence with Daptocephalus) is present in the lower Daptocephalus Assemblage Zone, while the Lystrosaurus maccaigi – Moschorhinus kitchingi Subzone (**Figure 16**) is present in the upper DaAZ. The defining taxa of the latter subzone are *L. maccaigi, Daptocephalus* and *Moschorhinus*. This Zone is characterized by the co-occurrence of the two therapsids, namely *Dicynodon* and *Theriognathus (**Figure 15**)*. 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 cynodonts 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 *Daptocephalus Assemblage Zone* (AZ) expands into the lower Palingkloof of the Upper Balfour Formation. 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. Fauna and flora from this assemblage zone are rare as few genera survived the Permo-Triassic Extinction Event. The *Lystrosaurus* declivis AZ is characterized by the dicynodont, *Lystrosaurus*, and captorhinid reptile, *Procolophon,* biarmosuchian and gorgonopsian Therapsida that do not survive in the *Lystrosaurus* Assemblage Zone, although the therocephalian and cynodont Therapsida are present in moderate quantities. Captorhinid Reptilia is reduced, but this interval is characterised by a unique diversity of oversize amphibians while fossil fish, millipedes and diverse trace fossils have also been recorded.

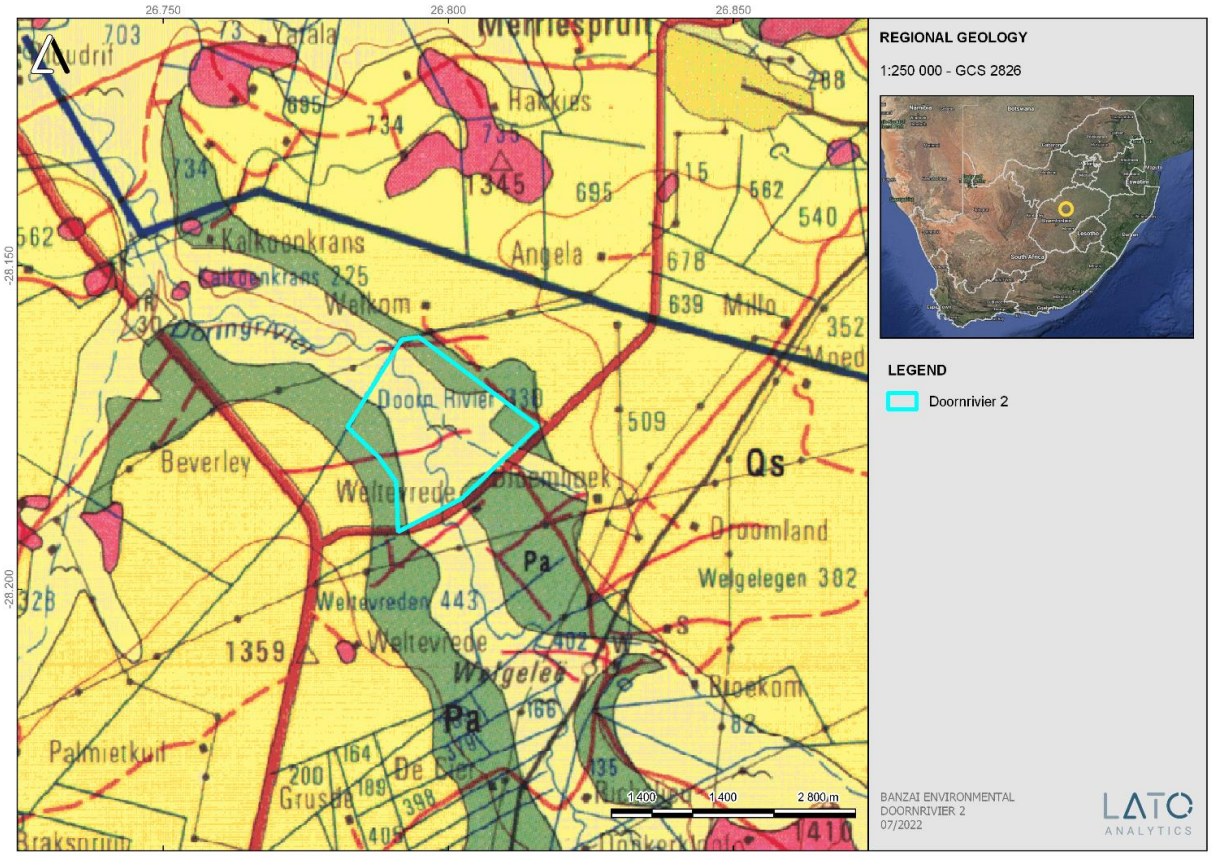

Figure 23: Extract of the 1:250 000 Winburg 2826 Geological map (1998) (Council of Geoscience, Pretoria) indicating the surface geology of the proposed development, underlain by Quaternary sediments (Qs, yellow) in the middle of the development flanked by the Adelaide Subgroup (Pa, green) of the Beaufort Group (Karoo Supergroup).

Table 2:Legend of the 1:250 000 Winburg 2826 (1998) Geological map (Council of Geoscience, Pretoria)

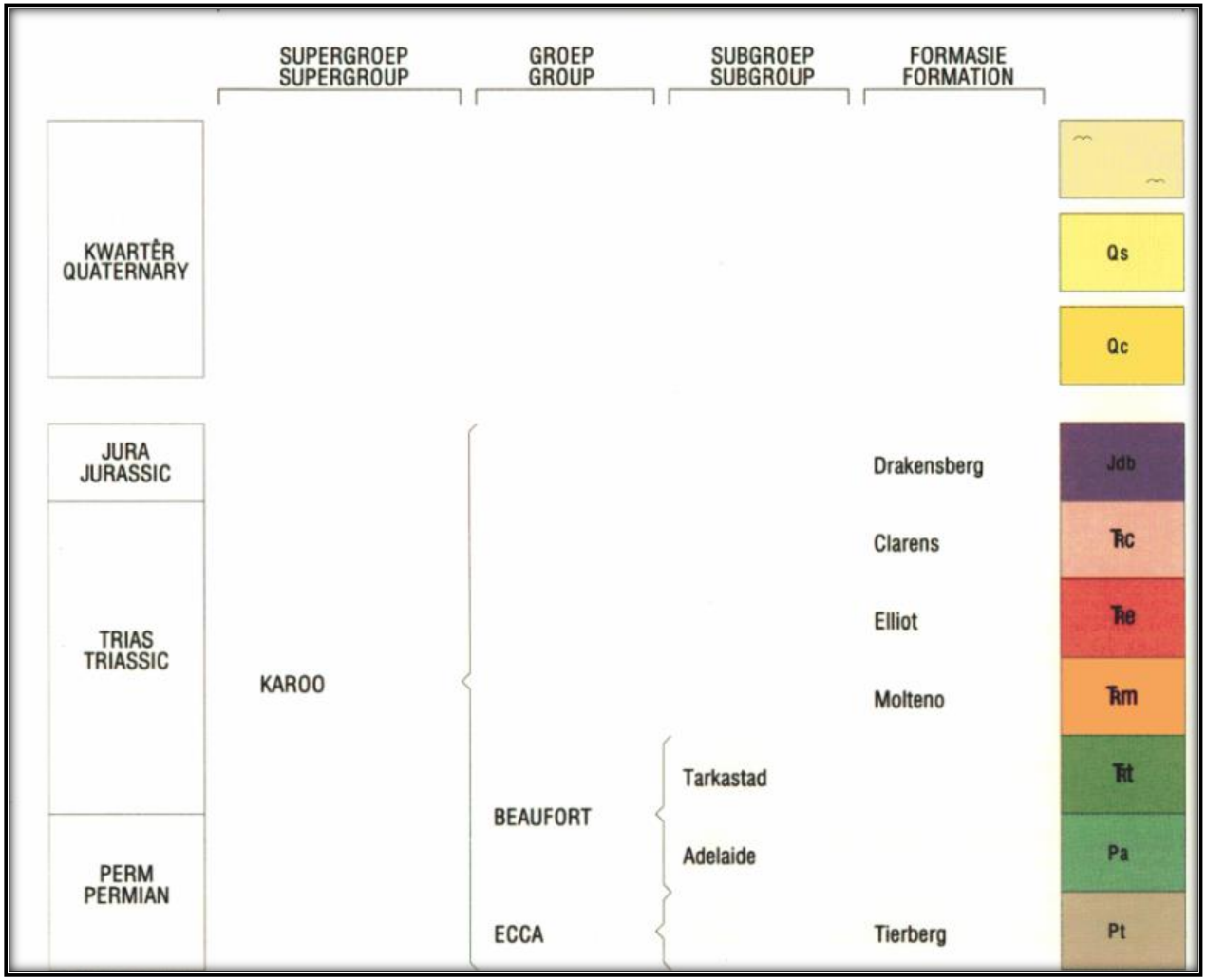

Figure 24: Surface Geology of the proposed mainly underlain by alluvium, colluvium, eluvium and gravel, while the Adelaide Subgroup is represented by the Balfour Formation, Beaufort Group, and Karoo Supergroup).

Table 3: Legend of the 1:250 000 Winburg 2826 (1998) (Council of Geoscience, Pretoria)

Symbol	Age	Group/Formation		Lithology	Palaeontological Sensitivity
Qs	Quaternary	Quaternary		Alluvium, colluvium, eluvium, gravel, scree, sand, soil and debris	Moderate
Qc	Tertiary			Calcrete	High
Jd	Jurassic			Dolerite	Zero
Pa	Permian	Adelaide Subgroup	Beaufort Group Karoo Supergroup	Grey and brownish-red mudstone, subordinate sandstone	Very High
T_{RT}	Triassic	Tarkastad Subgroup		Brownish-red and grey mudstone, sandstone	Very High

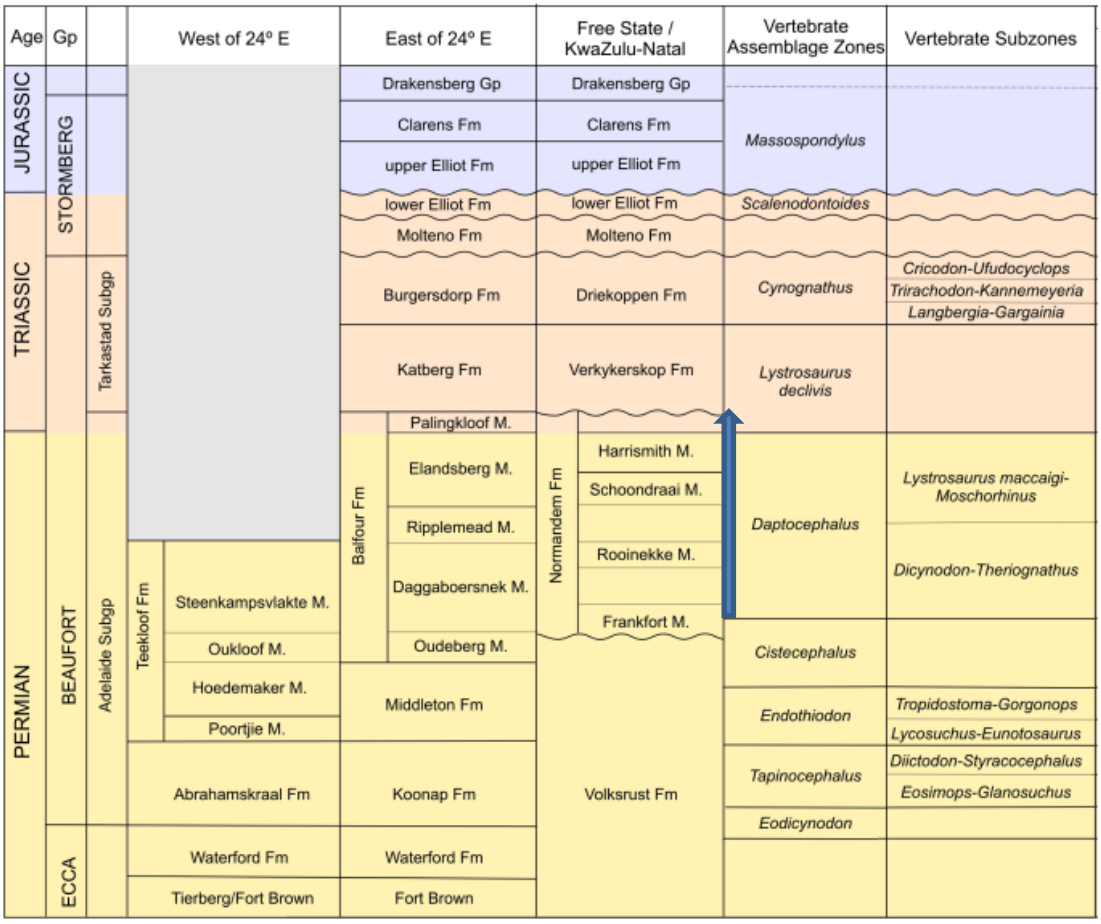

Figure 25: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa. Solid lines indicate known ranges; dotted lines indicate suspected but not confirmed ranges; a single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed.

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

The proposed cemetery development is an indication by the blue arrow

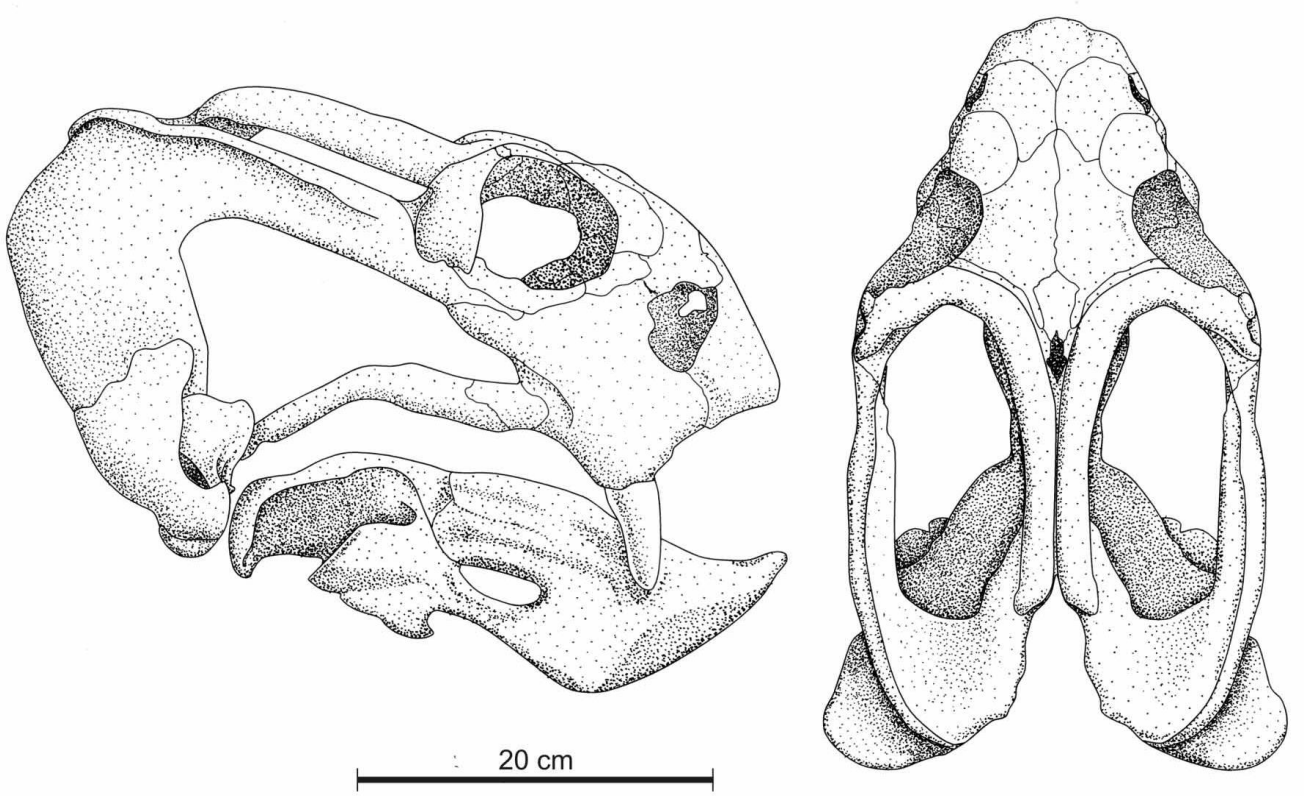

Figure 26: Lateral and dorsal views of the skull of the dicynodont Daptocephalus leoniceps, the *main biozone defining fossil (Image taken from Viglietti, 2020) and dorsal views (Image taken from Viglietti, 2020).*

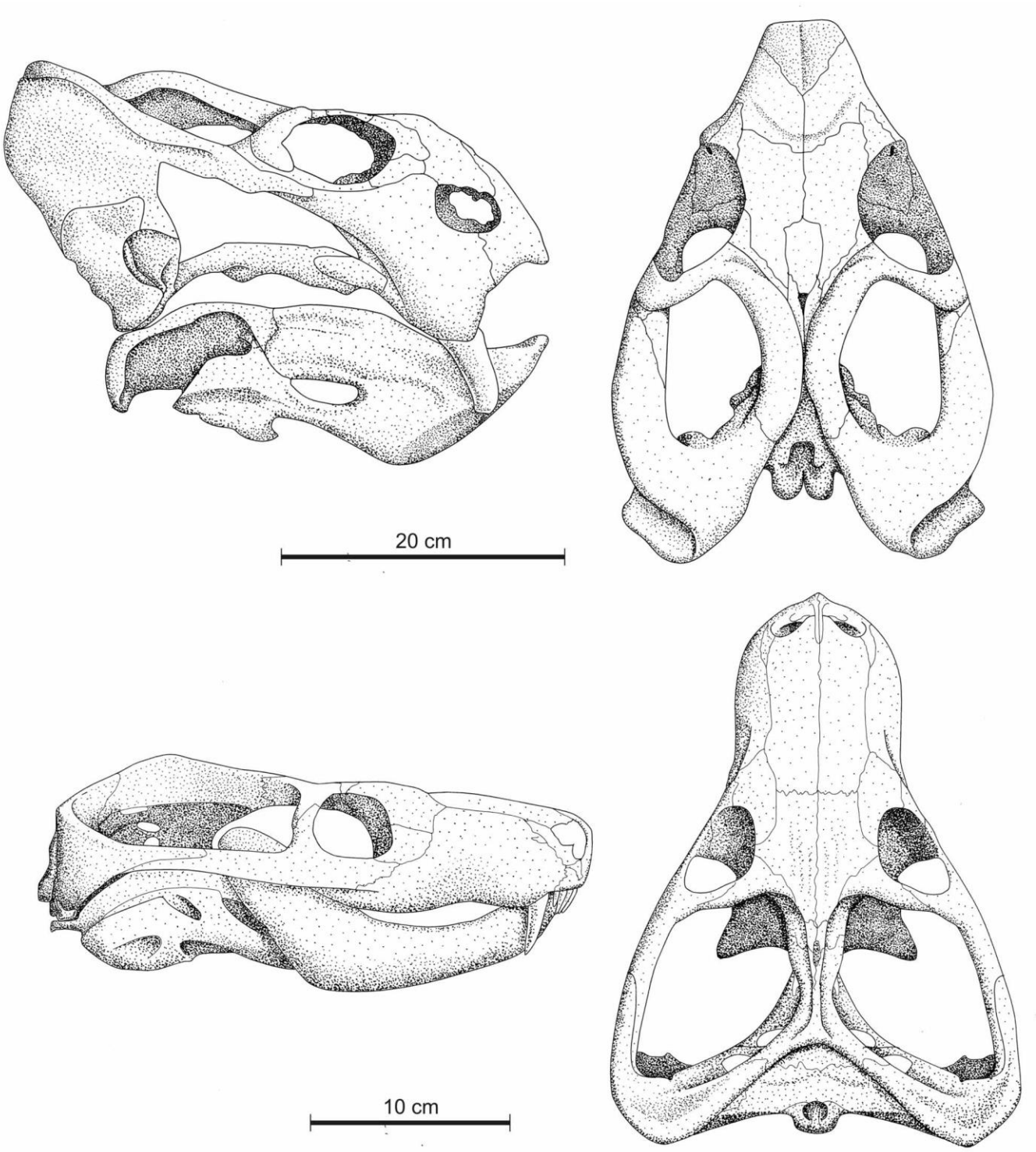

Figure 27: Skulls of the biozone-defining fossils of the Dicynodon-Theriognathus Subzone in lateral and dorsal views. Dicynodon lacerticeps (top), Theriognathus microps (bottom) (Image taken from Viglietti, 2020).

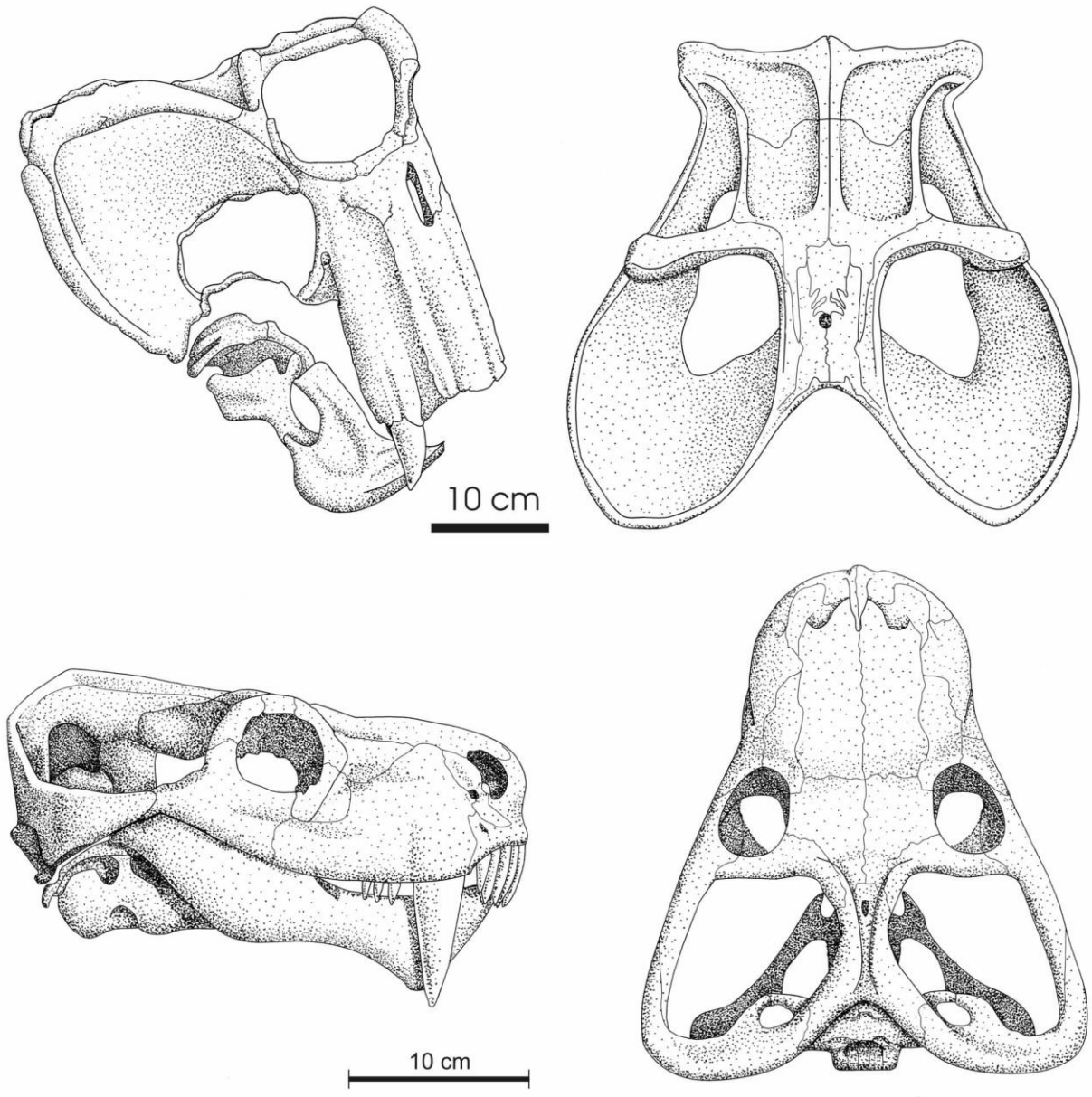

Figure 28: Biozone defining fossils of the Lystrosaurus maccaigi- Moschorhinus Subzone. The skulls of the Lystrosaurus maccaigi (top) and Moschorhinus kitchingi (bottom) in lateral

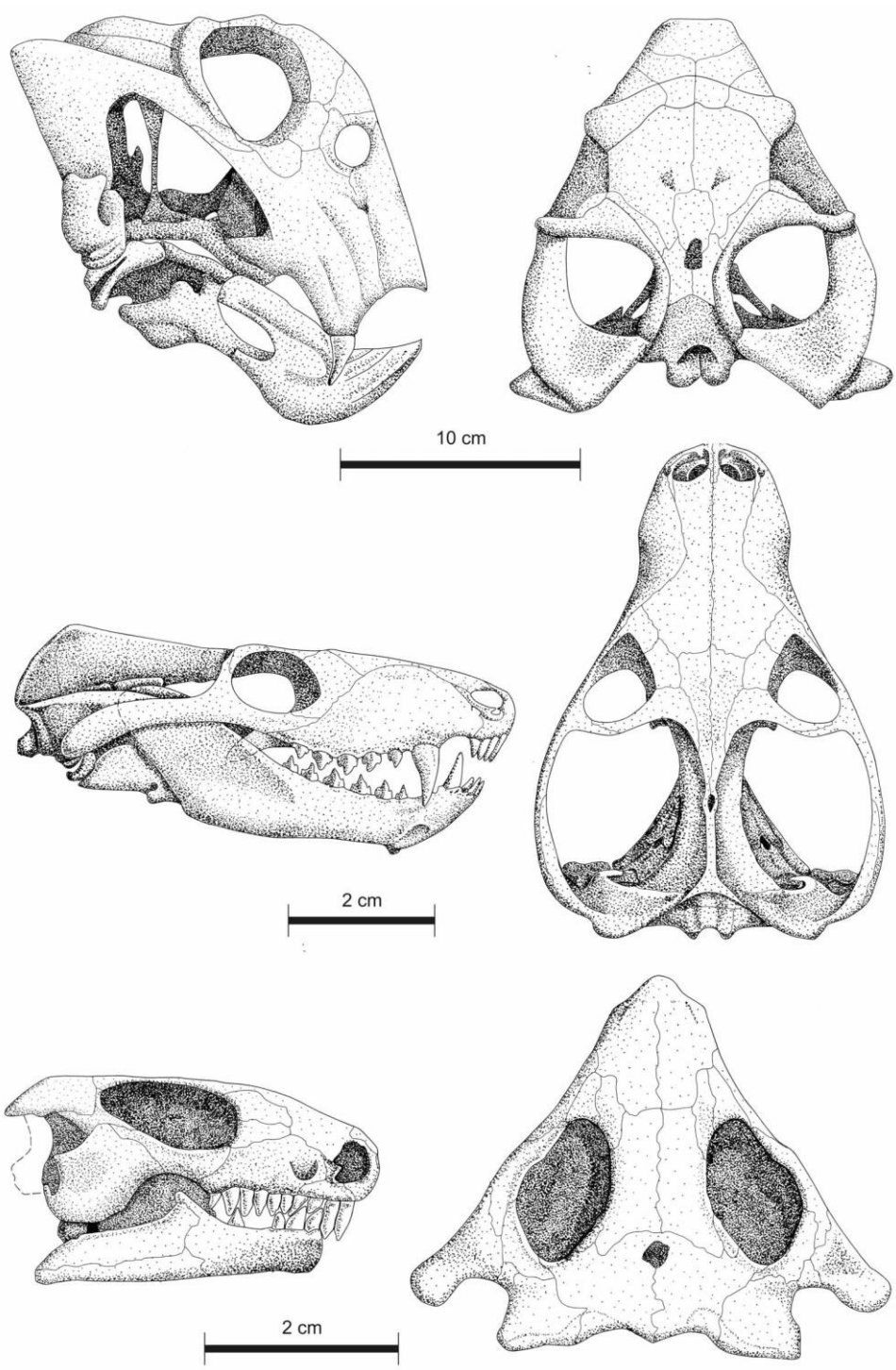

Figure 29: Lateral and dorsal views of the index taxa defining the Lystrosaurus declivis Assemblage Zone. (top) Lystrosaurus declivis, (centre) Thrinaxodon liorhinus, (bottom) Procolophon trigoniceps (Image taken from Botha and Smith, 2020).

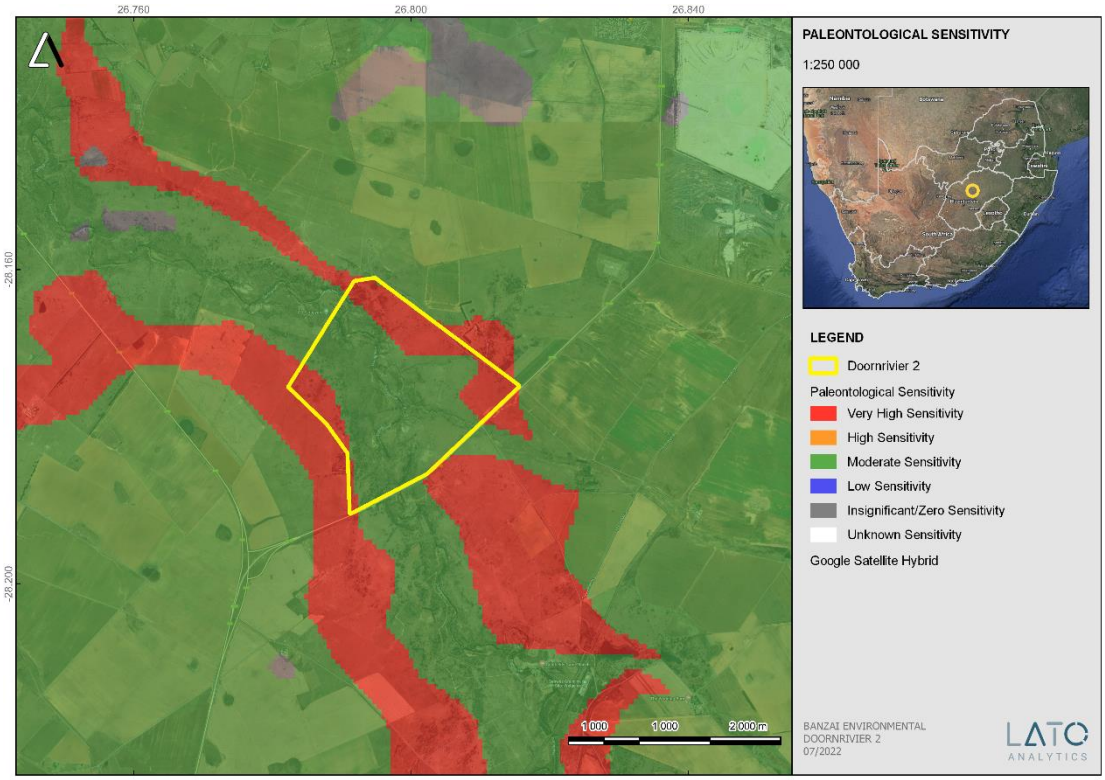

Figure 30: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in yellow.

According to the SAHRIS Palaeosensitivity map (**Figure 18),** the proposed development is underlain by sediments with a Very High (red) and Moderate (green) Palaeontological Sensitivity.

Table 4:Palaeontological Sensitivity on SAHRIS

» Colour	» Sensitivity	» Required Action
RED	**VERY HIGH**	**field assessment and protocol for finds are required**
ORANGE/YELLOW	HIGH	the desktop study is required, and based on the outcome of the desktop study; a field assessment is likely
GREEN	**MODERATE**	**the 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.

» **GEOGRAPHICAL LOCATION OF THE SITE**

It is proposed that three separate solar photovoltaic (PV) facilities be developed, including associated infrastructure, each with a maximum output of 100MW, on the portion of Portion 21 of Farm 330 and Portion 5 of Farm 330 and Remainder of Farm 330. These will be connected to the existing Theseus substation located northeast, directly adjacent to the proposed developments.

» **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 PIA reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps.

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 university databases have not been kept up to date, and data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas are 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 are used, it is generally **assumed** that exposed fossil heritage is present within the footprint.

» **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 Winburg 2826 Geological map (1998) (Council of Geoscience, Pretoria)

A Google Earth map with polygons of the proposed development was obtained from EnviroAfrica cc.

» **SITE VISIT**

A 1-day site-specific field survey of the development footprint was conducted on foot and by a motor vehicle on 29 January 2022. The central parts of the country experienced an exceptional wet season, and the whole development is covered by lush vegetation. Numerous loose, fragmented petrified wood fossils were detected in the Doringrivier floodplain.

Figure 31:View of the existing Theseus substation northeast of the Doornrivier PV 1 Facility.

Figure 32:Doringrivier meandering through the proposed PV development. Floodplains are extensively covered by lush vegetation, while the river banks consist of unconsolidated Quaternary deposits.

Figure 33: View of the proposed study area indicates a lush vegetation, low topography and no outcrops

Figure 34:Fragments of petrified wood

GPS coordinates: -28.172004, 26.803867

» IMPACT ASSESSMENT METHODOLOGY

Impact Rating System

Impact assessment must take into account 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 project phases:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance 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 are used:

Table 5:The rating system

NATURE		
Include a brief description of the impact of the environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted by a particular action or activity.		
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 effects.

The impact of the development will be regional. The proposed development will have a negative impact on Fossil Heritage. The expected duration of the impact is assessed as potentially permanent to long-term. The impact could occur. The significance of the impact occurring will be Very High. As fossil heritage is destroyed, the impact is irreversible. The impact on fossil heritage will be Very High pre-mitigation and Moderate post-mitigation.

» **FINDINGS AND RECOMMENDATIONS**

The proposed Doornrivier Solar 2 is underlain by Quaternary sediments in the middle of the study area, flanked by Permian-aged sandstone and shale of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS), the Palaeontological Sensitivity of Quaternary sediments in this area is Moderate, while that of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) is Vey High.

A 1-day site-specific field survey of the development footprint was conducted on foot and by a motor vehicle on 29 January 2022. Numerous loose, fragmented, petrified wood fossils were detected in the Doringrivier floodplain. A buffer zone will be implemented along the Doringrivier, and thus the proposed PV development will not affect the fossils of the area. An overall Medium palaeontological significance is allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area, and construction of the development may be authorised to its whole extent.

Recommendations:

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

- However, if Palaeontological Heritage is uncovered during surface clearing and excavations, the **Chance finds Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected, and the ECO/site manager must report to

South African Heritage Resources 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) 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 Doornrivier Solar 2 development.

» **CHANCE FINDS PROTOCOL**

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

Legislation

Cultural Heritage in South Africa (including 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.

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.

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 uncover 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 so as not to compromise the conservation of fossil material.

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 coordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) the 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, and 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 sandbags. 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). Fossil 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 in 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

TECHNICAL REPORTS

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Butler, E. 2016. Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's River valley Local Municipality, Eastern Cape Province. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.

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Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of a railway siding on a Portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

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Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed of the Lephalale Coal and Power Project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the H_2 Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.

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Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Rustplaas near Piet Retief, Mpumalanga. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment of the authorisation and amendment processes for Manangu mine near Delmas, Victor Khanye local municipality, Mpumalanga. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.

Butler, E. 2018. Palaeontological Phase 1 Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.

Butler, E. 2018. Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.

Butler, E. 2018. Palaeontological Field Assessment for the proposed re-alignment and de-commissioning of the Firham-Platrand 88kv Powerline, near Standerton, Lekwa Local Municipality, Mpumalanga province. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.

Butler, E. 2018. Palaeontological field Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.

Butler, E. 2018. Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.

Butler, E. 2018. Palaeontological desktop assessment of the proposed housing development on portion 237 of farm Hartebeestpoort 328. Bloemfontein.

Butler, E. 2018. Palaeontological desktop assessment of the proposed New Age Chicken layer facility located on holding 75 Endicott near Springs in Gauteng. Bloemfontein.

Butler, E. 2018 Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.

Butler, E. 2018. Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.

Butler, E. 2018. Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein

Butler, E. 2018. Palaeontological Impact Assessment of the proposed diamonds Alluvial & Diamonds General Prospecting Right Application near Christiana on the Remaining Extent of Portion 1 of the Farm Kaffraria 314, Registration Division HO, North West Province. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delportshoop in the Northern Cape. Bloemfontein.

Butler, E. 2018. Palaeontological Field Assessment of the proposed construction of a new 22 kV single wood pole structure power line to the proposed MTN tower, near Britstown, Northern Cape Province. Bloemfontein.

Butler, E. 2018. Palaeontological Exemption Letter for the proposed reclamation and reprocessing of the City Deep Dumps in Johannesburg, Gauteng Province. Bloemfontein.

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Butler, E. 2018. Proposed Kalabasfontein Mine Extension project, near Bethal, Govan Mbeki District Municipality, Mpumalanga. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment of the proposed Mookodi – Mahikeng 400kV Line, North West Province. Bloemfontein.

Butler, E. 2018. Environmental Impact Assessment (EIA) for the Proposed 325mw Rondekop Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape Province.

Butler, E. 2018. Palaeontological Impact Assessment of the proposed construction of the Tooverberg Wind Energy Facility, and associated grid connection near Touws River in the Western Cape Province. Bloemfontein.

Butler, E. 2018. Palaeontological impact assessment of the proposed Kalabasfontein Mining Right Application, near Bethal, Mpumalanga.

Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Westrand Strengthening Project Phase II.

Butler, E., 2019. Palaeontological Field Assessment for the proposed Sirius 3 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province

Butler, E., 2019. Palaeontological Field Assessment for the proposed Sirius 4 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province

Butler, E., 2019. Palaeontological Field Assessment for Heuningspruit PV 1 Solar Energy Facility near Koppies, Ngwathe Local Municipality, Free State Province.

Butler, E., 2019. Palaeontological Field Assessment for the Moeding Solar Grid Connection, North West Province.

Butler, E., 2019. Recommended Exemption from further Palaeontological studies for the Proposed Agricultural Development on Farms 1763, 2372 And 2363, Kakamas South Settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.

Butler, E., 2019. Recommended Exemption from further Palaeontological studies: of Proposed Agricultural Development, Plot 1178, Kakamas South Settlement, Kai! Garib Municipality

Butler, E., 2019. Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:

Butler, E., 2019. Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province

Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo

Butler, E., **2019.** Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape

Butler, E., 2019. Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province

Butler, E., 2019. Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.

Butler, E., 2019. Palaeontological Desktop Assessment for the proposed construction of an iron/steel smelter at the Botshabelo Industrial area within the Mangaung Metropolitan Municipality, Free State Province.

Butler, E., 2019. Recommended Exemption from further Palaeontological studies for the proposed agricultural development on farms 1763, 2372 and 2363, Kakamas South settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.

Butler, E., 2019. Recommended Exemption from further Palaeontological Studies for Proposed formalisation of Gamakor and Noodkamp low-cost Housing Development, Keimoes, Gordonia Rd, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

Butler, E., 2019. Recommended Exemption from further Palaeontological Studies for proposed formalisation of Blaauwskop Low-Cost Housing Development, Kenhardt Road, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

Butler, E., 2019. Palaeontological Desktop Assessment of the proposed mining permit application for the removal of diamonds alluvial and diamonds kimberlite near Windsorton on a certain portion of Farm Zoelen's Laagte 158, Registration Division: Barkly Wes, Northern Cape Province.

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Butler, E., 2019. Palaeontological Desktop Assessment for The Proposed 920 KWP Groenheuwel Solar Plant Near Augrabies, Northern Cape Province

Butler, E., 2019. Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province

Butler, E., 2019. Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province

Butler, E., 2019. Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London

Butler, E., 2019. Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km of the Merensky-Kameni 132KV Powerline

Butler, E., 2019. Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape

Butler, E., 2019. Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.

Butler, E., 2019. Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaining Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng

Butler, E., 2019. Palaeontological Desktop Assessment of The Proposed Upgrade of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction

Butler, E., 2019. Palaeontological Desktop Assessment of The Expansion of The Jan Kempdorp Cemetery on Portion 43 Of Farm Guldenskat 36-Hn, Northern Cape Province

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