



# PALAEONTOLOGICAL IMPACT ASSESSMENT

## PROPOSED MAYOGI PHOTOVOLTAIC ENERGY FACILITY NEAR KIRKWOOD IN THE EASTERN CAPE PROVINCE

2022

COMPILED for: CTS HERITAGE



## Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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



- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

**Disclosure of Vested Interest**

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

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This Palaeontological Impact Assessment (PIA) 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: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended)*

<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>The relevant section in the report</b>	<b>Comment where not applicable.</b>
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 <b>Appendix A</b>	-
(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;9 & 11	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised	Section 7 Approach and	-



process inclusive of equipment and modelling used	Methodology	
(f) details of an assessment of the specifically 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; & 11	
(g) An identification of any areas to be avoided, including buffers	Section 1 & 11	
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 11	
(k) Any mitigation measures for inclusion in the EMPr	Section 12	
(l) Any conditions for inclusion in the environmental authorisation	Section 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 & 11	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity,	Section 1 and 11	-



activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMP, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) process.
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to	Section 3 compliance with	



be applied to a specialist report, the requirements as indicated in such notice will apply.	SAHRA guidelines	
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## EXECUTIVE SUMMARY

Banzai Environmental was appointed by CTS Heritage to conduct the Palaeontological Impact Assessment (PIA) to assess the Mayogi Solar Photovoltaic (PV) Renewable Energy Facility near Kirkwood in the Sundays River Valley (Eastern Cape Province). 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 Mayogi Solar PV Facility is underlain by Kirkwood Formation (Uitenhage Group). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Kirkwood Formation (Uitenhage Group) is Very High (Almond and Pether, 2009; Almond *et al.*, 2013). Recent updated Geology (Council of Geosciences) corresponds with the geological map and indicates that the proposed development is underlain by the Kirkwood Formation.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on the weekend of 20 January 2023. No fossiliferous outcrop was detected in the proposed development area. A Medium Palaeontological Significance has been allocated to the Mayogi PV development. It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

### Recommendations:

- The ECO for this project must be informed that the Kirkwood Formation of the Uitenhage Group 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: Eastern Cape Provincial Heritage Resources Authority (ECPHRA), 16 Commissioner Street, East London, 5201, South Africa. Tel: 043 745 0888. Fax: 043 745 0889., email: [info@ecphra.org.za](mailto:info@ecphra.org.za); Web: <https://www.ecphra.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 Mayogi Solar PV Facility.

### Impact Summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Planning Phase Mayogi Solar PV Facility	No Impact	0	No Impact	0	No Impact
Construction Stage Mayogi Solar PV Facility Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	45	Negative Medium impact	30	Negative Medium impact
Operational Phase Mayogi Solar PV Facility	No Impact	0	No Impact	0	No Impact
Decommissioning Phase Mayogi Solar PV Facility	No Impact	0	No Impact	0	No Impact

It is therefore considered that the proposed Mayogi Solar PV Facility is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. From a Palaeontological point of view the construction of the Mayogi development may be authorised in its whole extent.



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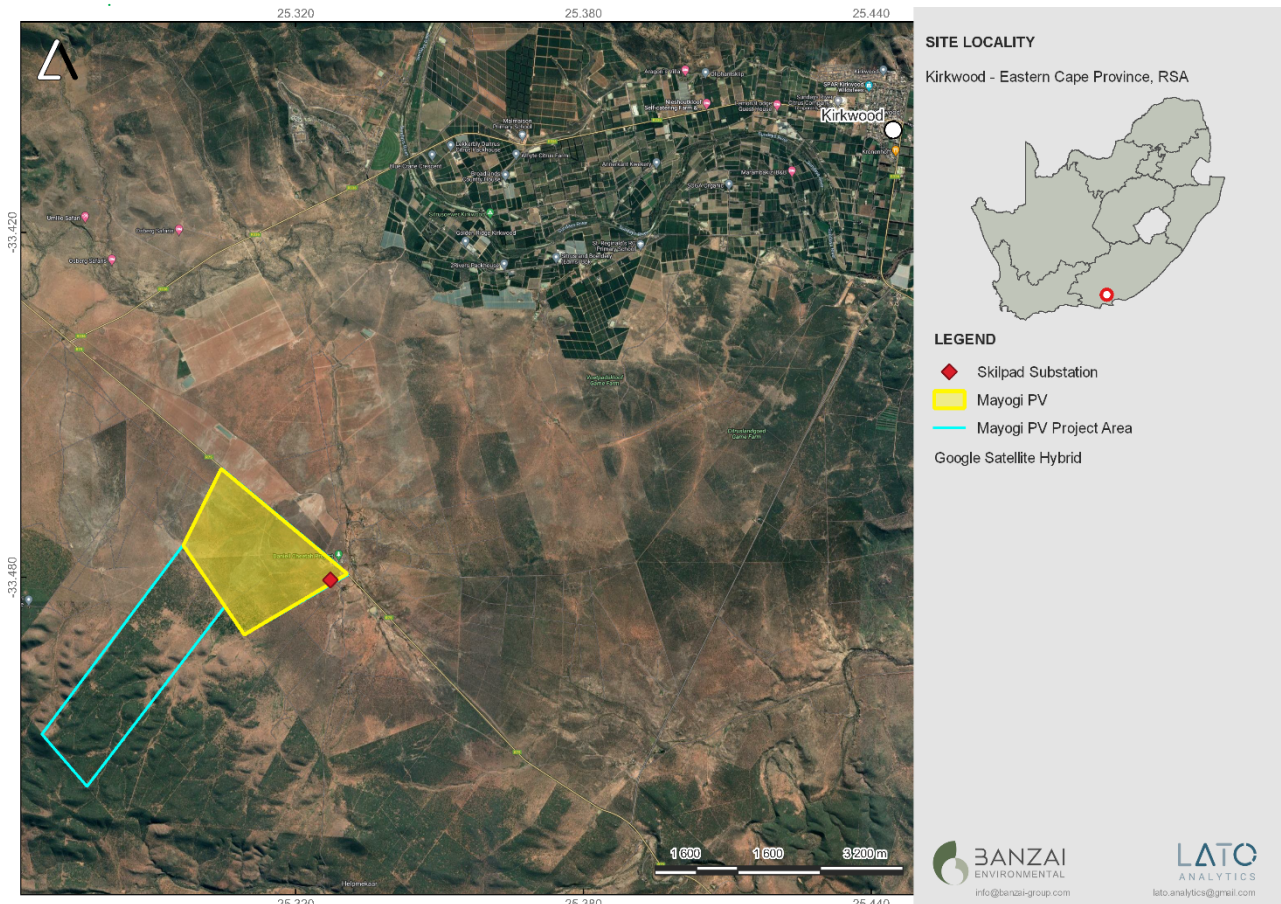
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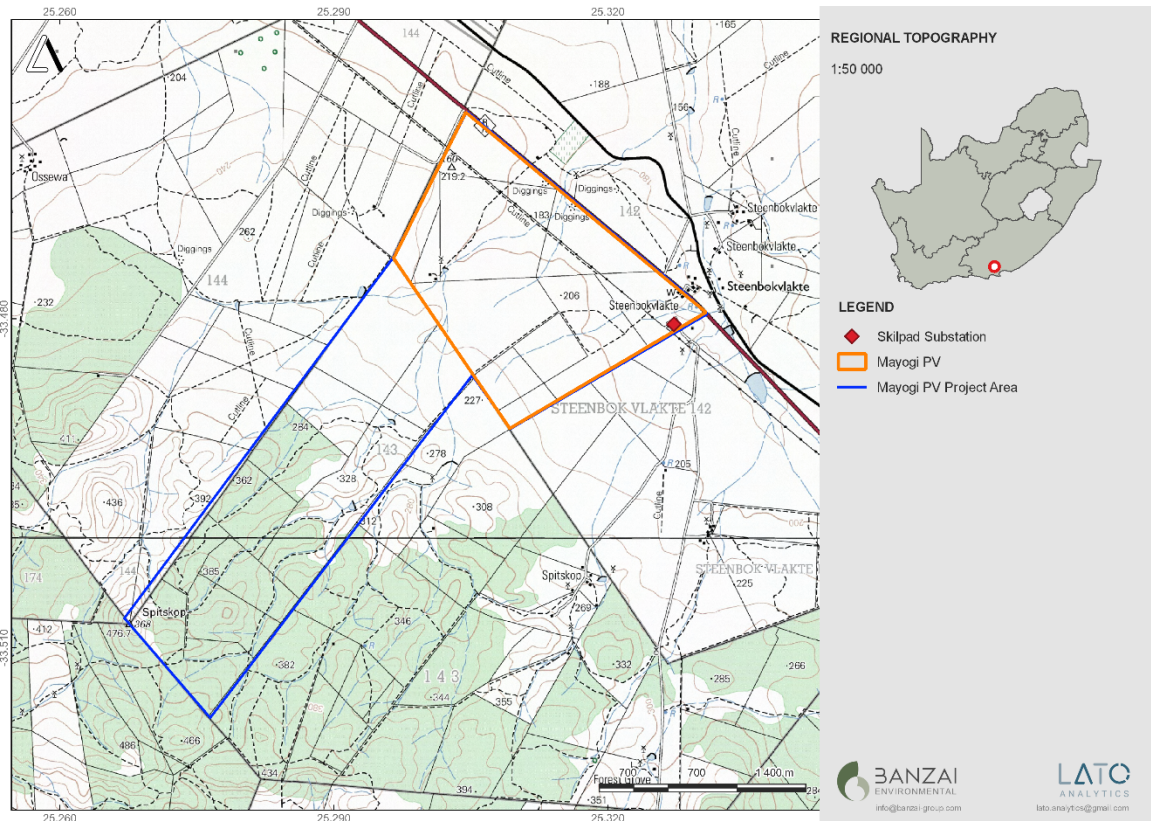


## 1 INTRODUCTION

SIVEST Environmental has been appointed to commence with the required EIA / BA Processes for the construction of the Mayogi Solar PV Facility (Sarah Baartman Local Municipality, Dr Beyers Naude District Municipality) in the Sundays River Valley near Kirkwood in the Eastern Cape Province. CTS Heritage has been subcontracted to conduct the Archaeological Impact Assessment (AIA) and Banzai Environmental the Palaeontological Impact Assessment (PIA).



**Figure 1:** Regional locality of the proposed Mayogi Solar PV Renewable Energy Facility near Kirkwood in the Eastern Cape Province.



**Figure 2:** Locality map of the proposed Mayogi Solar PV Renewable Energy Facility near Kirkwood in the Eastern Cape Province.

## 2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 400 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-eight 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.

## 3. LEGISLATION

### National Heritage Resources Act (25 of 1999)

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



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

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

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

MPRDA Regulations of 2014

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

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

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

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

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

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

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.



- any development or other activity which will change the character of a site—
- (Exceeding 5 000 m<sup>2</sup> 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 m<sup>2</sup> in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

#### 4. OBJECTIVE

The objective of a Palaeontological Impact Assessment (PIA) is to determine the impact of the development on potential palaeontological material at the site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed as well as rock formations just below the surface in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a PIA are as follows:

##### General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study,
- Description and location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area.
- Identification 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** are impacting that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
  - Fair assessment of alternatives (infrastructure alternatives have been provided):
  - Recommend mitigation measures to minimise the impact of the proposed development; and
  - Implications of specialist findings for the proposed development (such as permits, licenses etc).

## 5. GEOLOGICAL AND PALAEOONTOLOGICAL HISTORY

The geology of the proposed Mayogi PV near Kirkwood in the Eastern Cape Province is depicted on the 1: 250 000 Port Elizabeth 3324 (1979) Geological Map (Council for Geosciences, Pretoria) (**Figure 3, Table 2**). The proposed Mayogi PV development is underlain by the Kirkwood Formation (J-Kk, orange) of the Uitenhage Group. The PalaeoMap (**Figure 4, Table 3**) of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Kirkwood Formation is Very High. (Almond and Pether, 2009; Almond *et al.*, 2013, Groenewald *et al* 2014. Recent updated Geology (Council of Geosciences Pretoria) (**Figure 5**) corresponds with the geological map and indicates that the proposed development is underlain by the Kirkwood Formation of the Uitenhage Group.

The Uitenhage Group consists of three formations namely the Enon (oldest), Kirkwood, and Sundays River Formation (youngest) (Torien and Hill, 1989). The Sundays River Formation is of Early Cretaceous age [approximately 136 Ma million years old (Ma)] (Valanginian-Hauterivian). This succession is up to 2km thick and consists of siltstones, thin-bedded grey sandstones, and finer-grained mudrocks that are often very fossiliferous (Shone 2006). Mc Millan (2003) described the depositional settings as estuarine through littoral (shoreline) to marine outer shelf. This formation can be distinguished from the underlying Kirkwood Formation by the

- the presence of prominent-weathering calcareous sandstones,
- absence of reddish-hued mudrocks, and
- the consistent occurrence of fossil marine shells.

The occurrence of fossilised marine shells is mostly associated with the calcareous, thin, sandstone beds, many of which are storm deposits (tempestites).

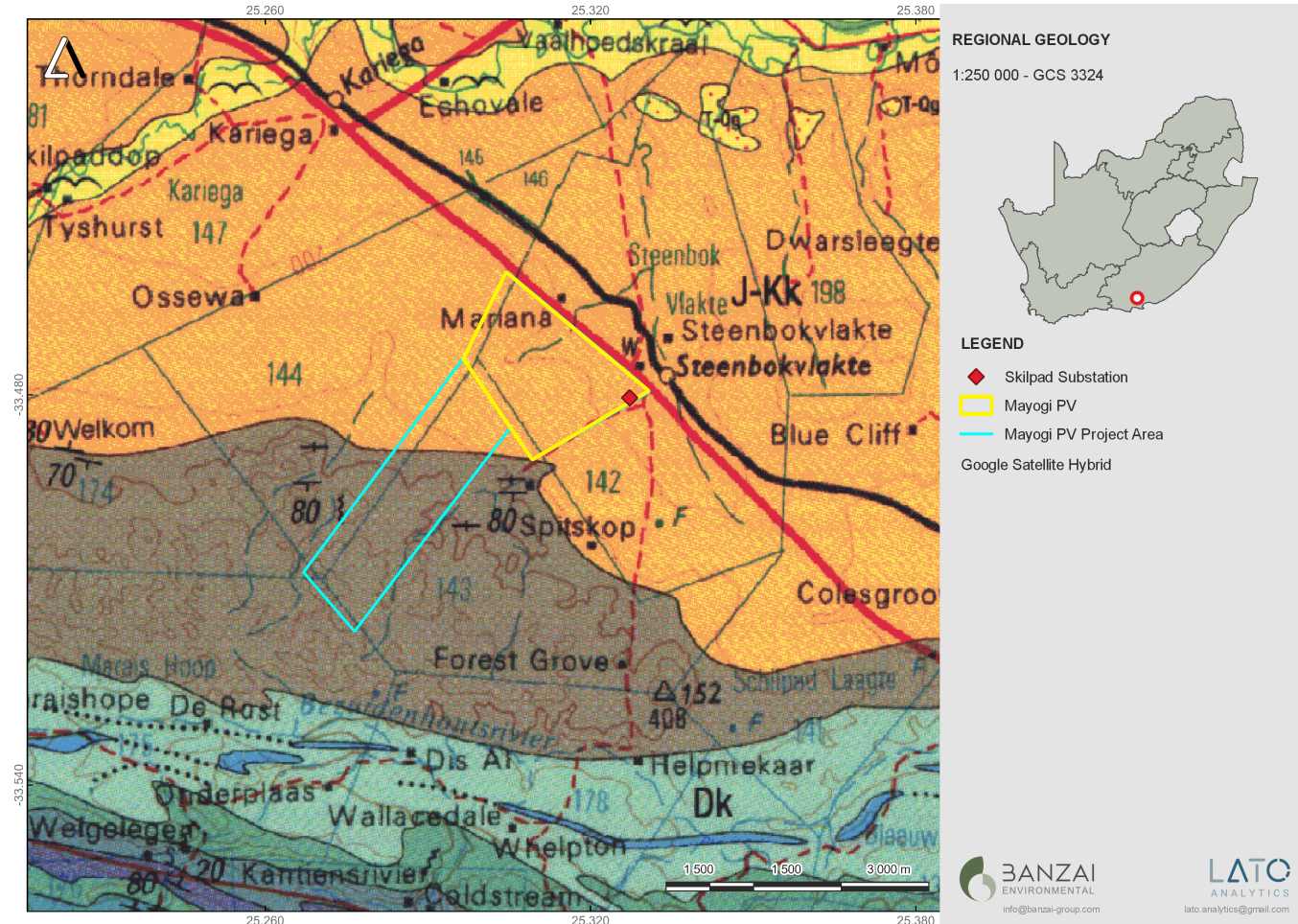
It appears that the Formations of the **Uitenhage Group** represent diverse depositional environments within a generally contemporaneous fluvial system, but the boundaries of the formations are not always clear. The oldest Enon Formation occasionally consist of remarkable boulder conglomerates that is characteristic of a high energy depositional environment (in both alluvial fans and braided rivers). The **Kirkwood Formation** (J-Kk) overlies the Enon formation, but the





contact is not always clear. The Kirkwood formation characterises the palaeosols and flood-plain deposits generally correlated with meandering river systems, as well as lacustrine, and probably coastal, settings. This formation is easily weathered and generally consists of sandstone and silty mudstones. Multi-coloured reddish brown, pinkish or greenish grey palaeosols are typical of this formation. The sandstones may be pale grey, yellowish or whitish in colour. The Kirkwood grades into the Sundays River Formation (Ks), which is the youngest formation of the Uitenhage Group and is represented by estuarine or shallow marine deposits. These deposits include rich marine invertebrate fauna (echinoderms and molluscs), vertebrates (plesiosaurs), microfossils (including foraminiferans and ostracods), as well as trace fossils.

The first fossils recovered from the Kirkwood Formation dates to 1845 with the discovery of fragmentary bones (partial skull with teeth) now identified as the stegosaur *Paranthodon africanus* (Atherstone, 1857; Galton and Coombs, 1981). Almost all vertebrate fossils recovered from the Kirkwood Formation are very fragmentary, and commonly only consists of isolated teeth and bones. The Kirkwood Formation is well-known for its Late Jurassic/ Early Cretaceous dinosaurs as well as diplodocid, stegosaurid, dicraeosaurid, and brachiosaurid forms, as well as coelosaur theropods and little iguanodontids. Other animal fossils include crocodiles, frogs, sphenodontid and other lizards, small mammals, and fish as well as turtles (McLachlan and McMillan 1976; Ross et al, 1999; de Klerk et al, 1998; de Klerk et al., 2000; McPhee et al., 2016). Invertebrate fossils is abundantly found in this formation and in the Kirkwood area estuarine and freshwater molluscs are found as well as crustaceans (conchostracans and ostracods) and oysters (McLachlan and McMillan 1976; MacRae 1999). Fossil plants near Kirkwood (especially along the Bezuidenhouts River) are the most well-represented in South Africa for this period (Anderson & Anderson, 1985; Bamford, 1986; MacRae, 1999; Muir et al., 2015). Studies conducted by Muir *et al* (2015) found an abundance of logs, as well as fossil charcoal on the Bezuidenhout River locality. Lignite and plant impression as well as amber, has been recovered. Plant impressions are seldom visible at the surface and are only found through the breaking of siltstones or mudrocks along bedding planes. Within the finer-grained siltstones and mudrocks plants such as Bennettitaleans, conifers, cycads, ferns and liverworts, are exposed by breaking the surrounding matrix. The Bezuidenhouts Riverbanks are especially well-known for its well-preserved plant impressions in blue-grey siltstones.



**Figure 3:** Extract of the 1:250 000 Port Elizabeth 3324 (1979) Geological Map (Council for Geosciences, Pretoria) indicating the proposed Mayogi PV development near Kirkwood in the Eastern Cape.

The proposed development is underlain by Kirkwood Formation (Uitenhage Group)



Table 2: Legend to the 1:250 000 Port Elizabeth 3324 (1979) Geological Map (Council for Geosciences, Pretoria).

Relevant sediments are indicated in a red square

KRYT CRETACEOUS	Sondagsrivier Sundays River	Ks	Ks	Groenerige grys moddersteen, sandsteen Greenish-grey mudstone, sandstone
	UITENHAGE Kirkwood	J-Kk	J-Kk	Rooierige en groenerige moddersteen, sandsteen Reddish and greenish mudstone, sandstone
	Enon	Je	Je	Konglomeraat, ondergeskikte sandsteen en moddersteen Conglomerate, subordinate sandstone and mudstone
JURA				

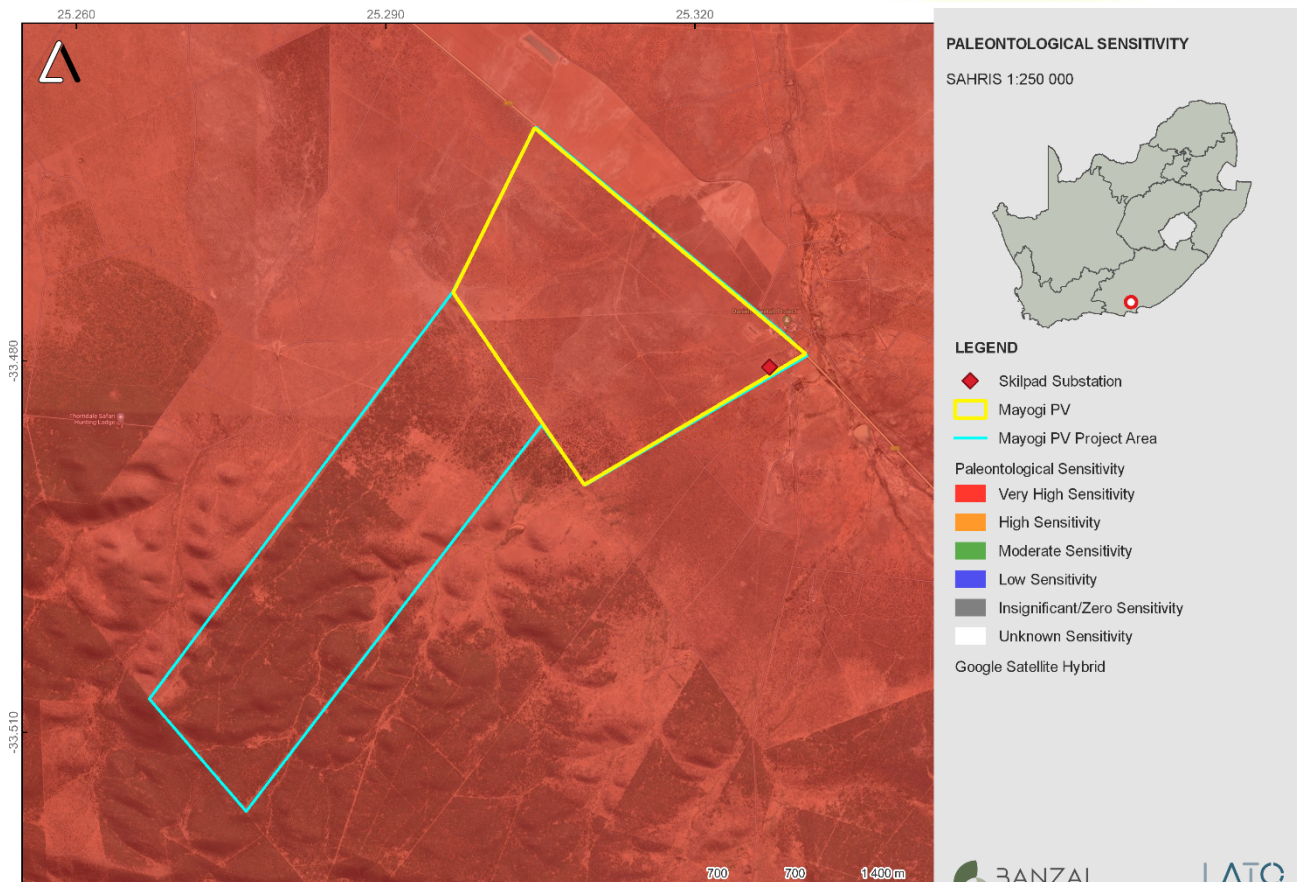
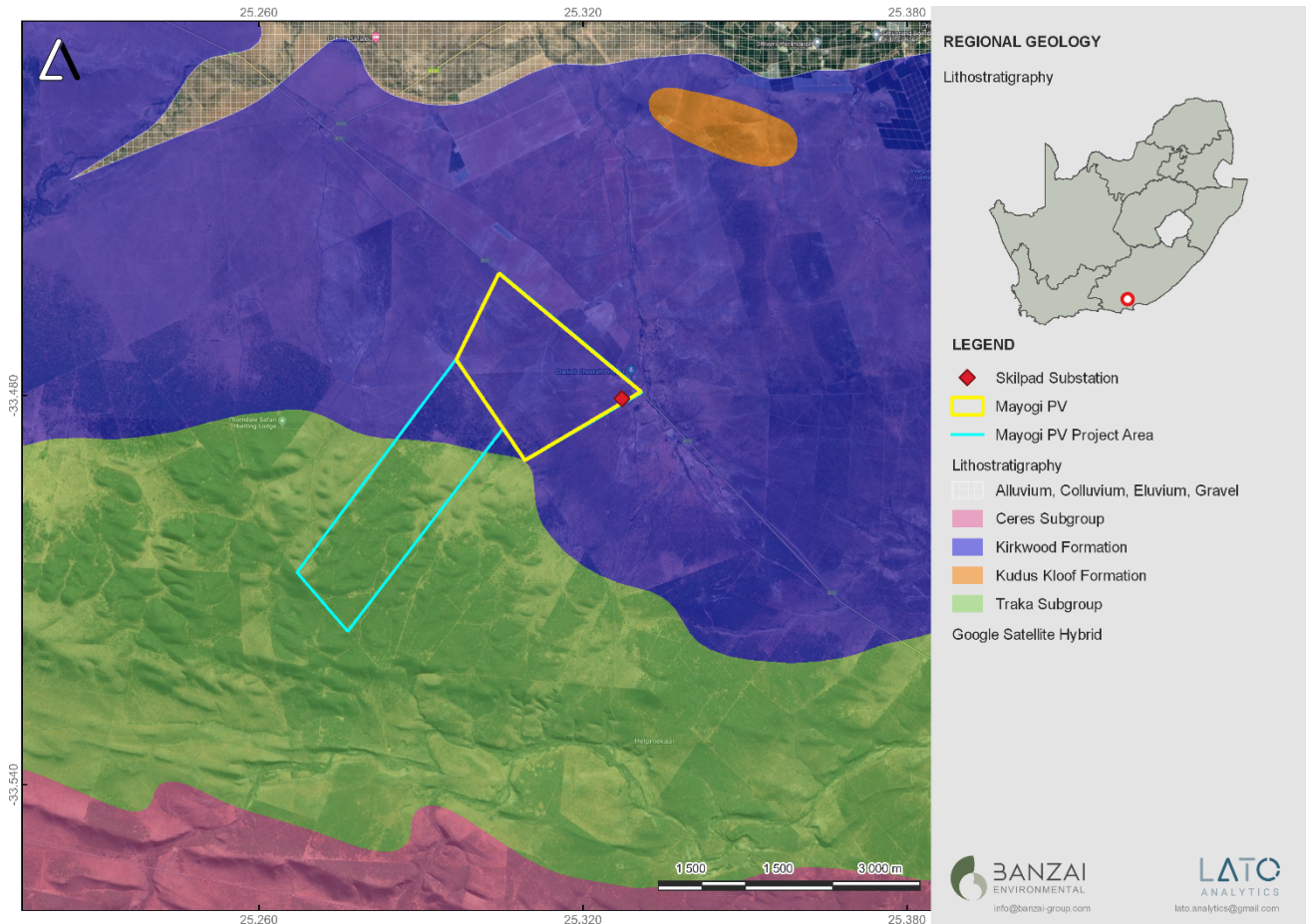




Table 3: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website).

Colour	Sensitivity	Required Action
<b>RED</b>	<b>VERY HIGH</b>	<b>Field assessment and protocol for finds is required</b>
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The SAHRIS Palaeosensitivity map (**Figure 4**) indicates that the proposed development is underlain by sediments with a Very High (red) Palaeontological Sensitivity.



**Figure 5:** Updated Geology (Council of Geosciences, Pretoria) of the proposed Mayogi Solar Facility indicates that development is underlain by the Kirkwood Formation of the Uitenhage Group. The rest of the farm is underlain by the Traka Subgroup.

## 6. GEOGRAPHICAL LOCATION OF THE SITE

The proposed Mayogi PV Facility is located on the R75, about 20km south-west of Kirkwood in the Eastern Cape Province (Figure 1-2).

## 7. METHODS

The aim of a desktop study is to evaluate the possible risk to palaeontological heritage in the proposed development. This includes all trace fossils as well as all fossils in the proposed footprint. All possible information is consulted to compile a desktop study, and this includes the following: all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

### 7.1 Assumptions and Limitations



The focal point of geological maps is the geology of the area and the sheet explanations of the Geological Maps were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is also used to provide information on the existence of fossils in an area which has not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. A field-assessment was conducted to improve the accuracy of the desktop assessment.

## 8. ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- A Google Earth map with polygons of the proposed development was obtained from SiVEST.
- 1:250 000 Port Elizabeth (1979) Geological Map (Council for Geosciences, Pretoria)
- Updated geological shape files (Council for Geosciences, Pretoria)

## 9. SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on the weekend of the weekend of 20 January 2023. No fossiliferous outcrops were identified during the site visit.





**Figure 7:** Scattered Calcrete deposits throughout the development.



**Figure 8:**Area mantled by red soil of the Kirkwood formation.

## 10. ASSESSMENT METHODOLOGY

### 10.1 Method of Environmental Assessment

The environmental assessment aims to identify the various possible environmental impacts that could result from the proposed activity. Different impacts need to be evaluated in terms of their significance and in doing so highlight the most critical issues to be addressed.

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e., site, local, national, or global whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table below.

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 total number of points scored for each impact indicates the level of significance of the impact.

### 10.2 Impact Rating System

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

*Table 4: The rating system*

<b>NATURE</b>		
The Nature of the Impact is the possible destruction of fossil heritage		
<b>GEOGRAPHICAL EXTENT</b>		
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.
<b>PROBABILITY</b>		
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).
<b>DURATION</b>		
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.
<b>REVERSIBILITY</b>		
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.
<b>IRREPLACEABLE LOSS OF RESOURCES</b>		
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.
<b>CUMULATIVE EFFECT</b>		
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
<b>SIGNIFICANCE</b>		
<p>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:</p> <p><b>[(Extent (1) + probability (4) + reversibility (4) + irreplaceability (4) + duration (4) + cumulative effect (1)] x magnitude/intensity (2).</b></p> <p>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.</p>		
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



(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity

Table 5: Summary of Impacts.							
Impacts	Extent	Duration	Magnitude	Reversibility	Irreplaceable loss	Cumulative effect	Impact
Pre-mitigation	1	4	3	4	4	2	45
Post mitigation	1	4	2	4	4	2	30

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

## 11. FINDINGS AND RECOMMENDATIONS

The proposed Mayogi Solar PV Facility is underlain by Kirkwood Formation (Uitenhage Group). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Kirkwood Formation (Uitenhage Group) is Very High (Almond and Pether, 2009; Almond *et al.*, 2013). Recent updated Geology (Council of Geosciences) corresponds with the geological map and indicates that the proposed development is underlain by the Kirkwood Formation.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on the weekend of 20 January 2023. No fossiliferous outcrop was detected in the proposed development area. A Medium Palaeontological Significance has been allocated to the Mayogi PV development. It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

Recommendations:

- The ECO for this project must be informed that the Kirkwood Formation of the Uitenhage Group 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: Eastern Cape Provincial Heritage Resources Authority (ECPHRA), 16 Commissioner Street, East London, 5201, South Africa. Tel: 043 745 0888. Fax: 043 745 0889., email: [info@ecphra.org.za](mailto:info@ecphra.org.za); Web: <https://www.ecphra.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 Mayogi Solar PV Facility.

#### CHANCE FINDS PROTOCOL

The following procedure will only be followed if fossils are uncovered during the excavation phase of the development.

#### Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act No 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 thereof) of plants or animals embedded in rock. These organisms lived 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 uncovers fossil material.

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



### 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](http://www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.
- Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.
- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- If the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO. Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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## APPENDIX A

### CURRICULUM VITAE

#### ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 30 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 1998–2022

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