BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL DESKTOP ASSESSMENT

PROPOSED MIRACH SOLAR PV PROJECT NEAR THABAZIMBI, LIMPOPO PROVINCE

2023

COMPILED FOR:

ENVIRONAMICS ENVIRONMENTAL

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 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 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 a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and

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

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: info@banzai-group.com

SIGNATURE: 

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

Table 1:Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**The relevant section in the report**	**Comment where not applicable**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum 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 – Methods and TOR	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 6 – 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 8	-
(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	

(e) A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 8 Approach and 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 alternative	Section 1; & 9	
(g) An identification of any areas to be avoided, including buffers	Section 1; & 9	
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge	Section 4.1 – 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; & 9	
(k) Any mitigation measures for inclusion in the EMPr	Section 10	
(l) Any conditions for inclusion in the environmental authorisation	Section 1 and 11	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1; & 9	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1; & 9	

(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; & 9	-
(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 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 Blue Crane Environmental to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Mirach Solar PV Project and associated grid connection infrastructure near Thabazimbi, Limpopo 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 PDA is necessary to confirm if fossil material could potentially be present in the planned development area and to evaluate the potential impact of the proposed development on the Palaeontological Heritage of the area.

The south western corner of the Mirach Solar PV Project is underlain by Quaternary alluvium while the rest is underlain by diabase and the Nylstroom Subgroup of the Waterberg Group. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of Quaternary sands is Moderate, while that of the Waterberg Group is Low, and that of the diabase is Zero (Almond and Pether, 2009; Almond *et al*., 2013, Groenewald et al 2014). Updated Geology (Council of Geosciences) refined the geological map and indicate that the proposed development is underlain by alluvium, colluvium, elluvium and gravel as well as diabase and the Aasvoëlkop Formation of the Matlabas Subgroup (Waterberg Group). Several alternatives (Bess and substation) have been proposed for the project, but because the geology of all alternatives is the same, there is no preference for one over the others. A Low Palaeontological significance has thus been allocated to the development. It is therefore considered that the development will not lead to detrimental impacts on the palaeontological resources of the area. The proposed development may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of Palaeontological Heritage.

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).

Impact Summary

Environmental parameter	**Issues**	**Rating prior to mitigation**	**Average**	**Rating post mitigation**	**Average**
Planning Phase Mirach Solar PV	No Impact	0	No Impact	0	No Impact
Construction Stage Mirach Solar PV	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	34	Negative Medium impact	14	Negative Low impact
Mirach Solar PV	No Impact	0	No Impact	0	No Impact
Decommissioning Mirach Solar PV	No Impact	0	No Impact	0	No Impact

It is considered that the proposed Mirach Solar PV and grid corridor near Thabazimbi, Limpopo Province will not lead to detrimental impacts on the palaeontological reserves of the area. From a Palaeontological point of view the construction of the development may be authorised in its whole extent.

TABLE OF CONTENT

TABLE OF FIGURES

LIST OF TABLES

Appendix A: CV

1 INTRODUCTION

Bluecrane Environmental has been appointed to conduct the Scoping and EIA processes for the proposed Mirach Solar PV Project near Thabazimbi, Limpopo Province (Figure 1-2). The Mirach Solar PV and grid corridor Project is located on Farm Newcastle No. 53, Registration division K.Q Limpopo Province. The development area is 747 ha in extent.

The solar PV facility will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 340 MW. The development area is situated within the Thabazimbi Local Municipality and the Waterberg District Municipality.

Energy generated by the facility will be evacuated into the National Grid via a 132 kV Loop-In-Loop-Out (LILO) connection into the existing Eskom Thabazimbi Combined / Waterberg 1 132 kV overhead power line infrastructure. The Environmental Impact Assessment (EIA) assessment footprint is approximately 780 hectares in extent. A 200 m wide and up to 10 km long grid connection corridor will be assessed for placement of the grid connection infrastructure.

The proposed Mirach Solar PV Project will include the following infrastructure:

- PV modules and mounting structures
- Inverters and transformers
- Battery Energy Storage System (BESS)
- Site and internal access roads (up to 8 m wide)
- Supporting infrastructure such as operations and maintenance building/office, switch gear and relay room, staff lockers and changing room, security control, and offices.
- Temporary and permanent laydown areas
- Grid connection infrastructure, including:
    - A Loop-In-Loop-Out (LILO) connection with the existing Eskom Thabazimbi Combined / Waterberg 1 132 kV overhead power line infrastructure;
    - Three (03) facility substations up to 132 kV (one located at each PV array)
    - Internal overhead power lines connecting one substation to the other; and
    - A collector switching station (up to 132kV);

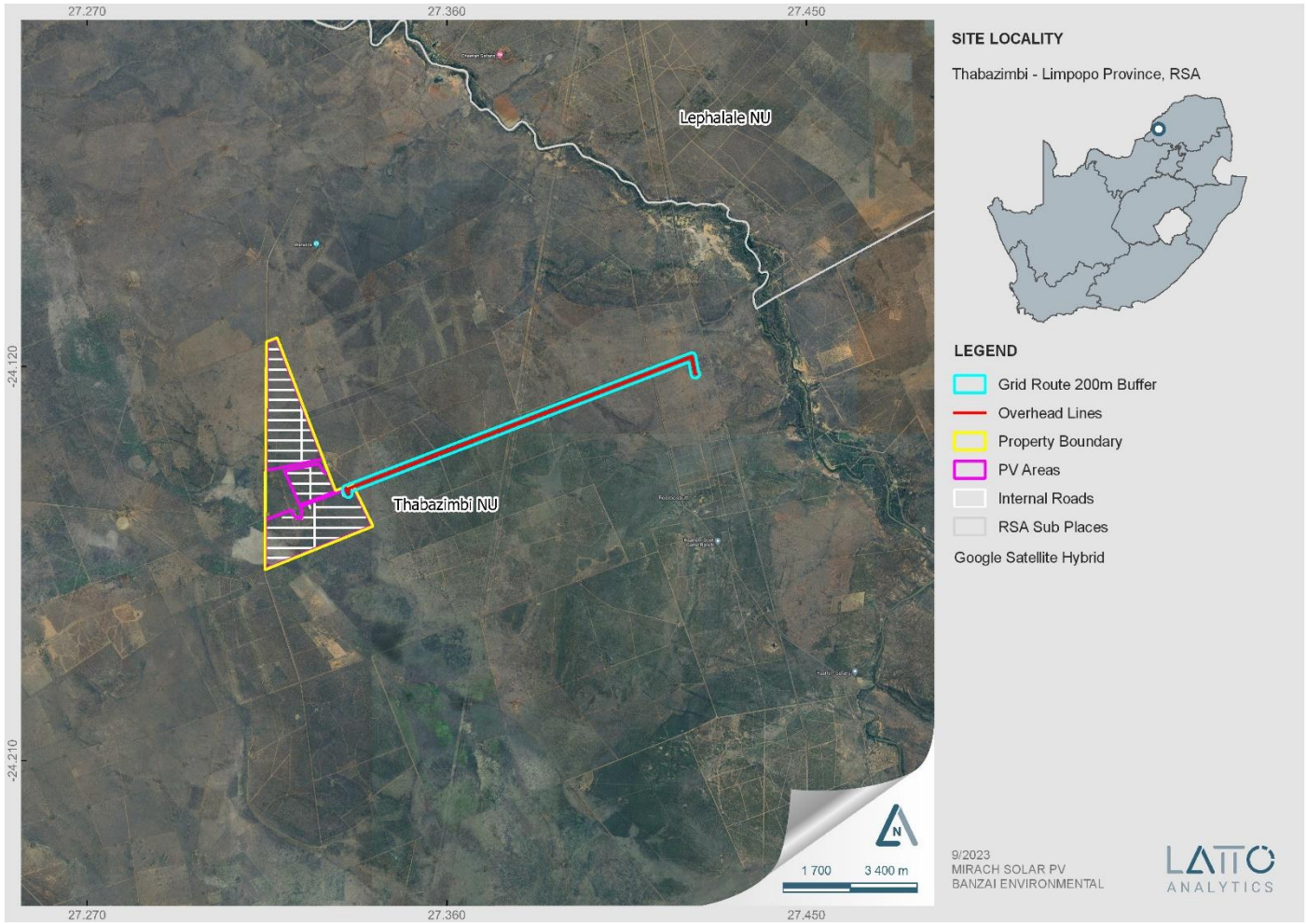


***Figure 1**: Regional Locality of the proposed Mirach Solar PV Project and associated grid corridor near Thabazimbi in Limpopo Province.*

***Figure 2**: Regional topography of the proposed Mirach Solar PV Project and associated grid corridor near Thabazimbi in Limpopo Province*

Table 2: *General site information*

Description of affected farm portions	Solar PV Facility: • Farm Newcastle No. 53 Grid Connection Corridor: • Farm Newcastle No. 53 • Portion 1 of Farm Klippan No. 52 • Farm Grootfontein No. 704 • Farm Welgevonden No. 949 Access Road: Farm Newcastle No. 53
Province	Limpopo
Local Municipality	Waterberg District Municipality
District Municipality	Thabazimbi Local Municipality
Ward numbers	1
vvvv	The town of Thabazimbi is located approximately 55 km south of the proposed development
21 Digit Surveyor General codes	Solar PV Facility: • Farm Newcastle No. 53 T0KQ00000000005300000 Grid Connection Corridor: • Farm Newcastle No. 53 T0KQ00000000005300000 • Portion 1 of Farm Klippan No. 52 T0KQ00000000005200001 • Farm Grootfontein No. 704 T0KQ00000000070400000 • Farm Welgevonden No. 949 T0KQ00000000094900000 Access Road: • Farm Newcastle No. 53 • T0KQ00000000005300000
Area under assessment	747 ha (excluding linear components)
Development footprint	650 ha (excluding linear components)

A development footprint of 650 ha (excluding linear components) has been defined based on the outcomes of the scoping phase (and results received from the independent specialists). A development layout has been produced and must be further assessed in the current EIA phase.

The properties on which the facility is to be constructed will be leased by Mirach Solar PV Project (Pty) Ltd from the property owner for the life span of the project (minimum of 25 years).

1.1 Details of the Infrastructure Proposed

The development footprint associated with Mirach Solar PV Project and Grid Connection Corridor will include specific infrastructure that will be developed as part of the facility layout.

The infrastructure to be developed is specifically related to the preferred technology to be installed to generate electricity from the solar resource, which in this case is photovoltaic technology. Photovoltaic solar energy is obtained by converting sunlight into electricity using a technology based on the photoelectric effect[1]. It is a type of renewable, inexhaustible and non-polluting energy that can be produced in installations ranging from small generators for self-consumption to large photovoltaic plants.

The design of the detailed layout has considered and adhered to the limitations of the development area and aspects such as environmentally sensitive areas, roads, fencing and servitudes on site. The total surface area proposed for the layout includes the PV panel arrays (spaced to avoid shadowing), access and maintenance roads and associated infrastructure (buildings, power inverters, power line, battery energy storage system, on-site substations, switching stations, perimeter fences and grid infrastructure).

Table 2 below provides the technical details of the Mirach Solar PV Project available at the EIA phase of the development.

Table 2: Technical details of the proposed infrastructure for the proposed Mirach Solar PV Project near Thabazimbi, Limpopo Province.

Component	Description / dimension
Type of technology	Photovoltaic solar facility
Generation capacity	Up to 340 MW
Area of the PV Array	Up to 600 ha
Structure orientation	Monofacial or Bifacial PV panels will be utilised. The panels will either be fixed to a single-axis and/or double horizontal tracking structure where the orientation of the panel varies according to

[1] The photoelectric effect is the emission of electrons or other free carriers when light shines on a material. Electrons emitted in this way can be called photo electrons.

	the time of the day, as the sun moves from east to west or tilted at a fixed angle equivalent to the latitude at which the site is located in order to capture the most sun. PV panels with single axis tracking is preferred over fixed-axis or double axis tracking systems due to the potential to achieve higher annual energy yields whilst minimising the balance of system (BOS) costs, resulting in the lowest levelized cost of energy (LCOE). The development of the PV facility will take into consideration during the final design phase the use of either tracker vs fixed-tilt mounting structures. Both options are considered feasible for the site.
Structure Height	• Panels: up to 6 m • Buildings: up to 12 m • Power line: up to 30 m • Fencing: up to 3 m
Area of the Battery Storage	• Alternative 1 (preferred): Located centrally next to the facility substation to the south of the site – Up to 1 ha. • Alternative 2: Located centrally next to the facility substation to the north of the site – Up to 1 ha. • Alternative 3: Placed or spread out within the PV area.
Capacity of the Battery Storage	Unspecified. To be confirmed prior to construction activity
Area of the facility substation and switching substation	• On-site facility substation (collector): up to 2 ha • Switching Station (Eskom): up to 2 ha
Capacity of the facility substation and switching substation	• On-site facility substation (collector): 132 kV • Switching Station (Eskom): 132 kV
Laydown area dimensions	Temporary laydown areas will occupy a cumulative area of up to 5 ha scattered across the development footprint while 1 ha will remain in place for the permanent laydown areas as required for facility operation. Temporary laydown areas will be rehabilitated with topsoil and allowed to grow naturally.
Area occupied by buildings	Operations and Maintenance Building/Office; switch gear and relay room; staff lockers and changing room; security control; and offices: Up to 0.5 ha
Length of grid connection corridor	Up to 13 km
Width of grid connection corridor	200 m
Width of the power line servitude	Up to 36 m
Width of internal roads	Up to 12 m wide

Length of internal roads	Up to 40 km in total

1.2 Project Specific Details

Table 3: General construction related information

Construction Phase Timeframe	Up to 24 months
Amount of construction employees	Up to 500 people may be on site at a time
Amount of employees during operation	Up to 25 permanent staff and additional contractors (number varies) for temporary ad hoc maintenance will be required
Current Land Use	Grazing
Current Land Use Zoning	Agriculture
Depth of excavation	900 mm Trench Depth

1.3 Alternatives under Assessment

The process undertaken by the Applicant for the identification of alternatives has been an iterative process and will continue to be an iterative process between the EAP and the Applicant in order to ensure that the preferred alternative proposed for authorisation is ultimately appropriate from a technical feasibility perspective as well as an environment perspective.

Table 4: Summary of alternatives considered

Alternatives considered	**Description of the Alternative relating to the development**
Site Specific Alternatives	One preferred site / development area has been identified for the development of Mirach Solar PV Project based on specific site characteristics such as the solar resource, land availability, topographical characteristics and environmental features. The development area of 650 ha is considered to be sufficient for the development of a solar facility with a contracted capacity of up to 340 MW.
Layout Alternatives	The following layout alternatives must be considered and comparatively assessed by specialists. <u>BESS:</u>

	• Alternative 1 (preferred): Located centrally next to the facility substation to the south of the site. • Alternative 2: Located centrally next to the facility substation to the north of the site. • Alternative 3: Placed or spread out within the PV area. <u>Facility Substation and Switching Station:</u> • Alternative 1 (Preferred): Back-to-back facility substation and switching substations located south of the site. • Alternative 2: Back-to-back facility substation and switching substations located north of the site.
Activity Alternatives	Only the development of a renewable energy facility is considered by Mirach Solar PV Project (Pty) Ltd. Due to the location of the site / development area and the suitability of the solar resource, only the development of a solar PV facility is considered feasible considering the natural resources available to the area and the current land-use activities undertaken within the site (i.e., agricultural activities).
Technology Alternatives	Only the development of a photovoltaic solar facility is considered due to the characteristics of the site, including the natural resources available.
Grid Connection Alternatives	Energy generated by the facility will be evacuated into the National Grid via a 132 kV Loop-In-Loop-Out (LILO) connection into the existing Eskom Thabazimbi Combined / Waterberg 1 132 kV overhead power line infrastructure. A 200 m wide and up to 13 km long grid connection corridor will be assessed for placement of the grid connection infrastructure. The final grid route will be based on feedback provided by the Eskom Grid Access Unit as the process advances.
'Do-nothing Alternative	The option to not construct the Mirach Solar PV Project. No impacts (positive or negative) are expected to occur on the social and environmental sensitive features or aspects located within or within the surrounding areas of the site. The opportunities associated with the development of the solar facility for the Thabazimbi area will however not be made available.

2. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This 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, 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, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

3. LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

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

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

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

MPRDA Regulations of 2014

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

- Contents of scoping report – Regulation 49

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

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

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

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

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

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

4. METHODS AND TERMS OF REFERENCE

This PDA assesses the development's potential impact on the fossil heritage. This Palaeontological Assessment is part of the HIA Report. The PIA's goals are to: 1) identify the palaeontological

significance of the rock formations in the footprint; 2) evaluate the palaeontological magnitude of the formations; 3) clarify the impact on fossil heritage; and 4) make recommendations for how the developer might protect and minimize potential harm to fossil heritage, according to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports".

Calculations of the palaeontological state of each rock segment and the potential impact of development on fossil history take into account the palaeontological status of the rocks, the type of development, and the amount of bedrock removed.

The Provisional DFFE Screening Tool, the SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports for the same area, Google Earth images, topographical and geological maps, as well as academic articles about specimens from the development area and Assemblage Zones, are all used to create scoping reports.
When the development footprint has a moderate to high palaeontological sensitivity, a field-based assessment is necessary. A desktop or field assessment of the exposed rock is used to evaluate the significance of the proposed development's impact, and recommendations for more research or mitigation are made. Excavations for the project often only take place during the building phase, changing the terrain and destroying or permanently encasing fossils at or below the ground surface. Then, access to Fossil Heritage will no longer be available for academic study.

When doing a site investigation, a palaeontologist examines the local development as well as the quantity and variety of fossils found there. This can be demonstrated by looking at representative fossiliferous rock exposures (most igneous and metamorphic rocks are not fossiliferous, whereas sedimentary rocks contain fossil heritage). Examined rock exposures frequently contain a sizeable portion of the stratigraphic unit, which is primarily made up of recently exposed (unweathered) rock. These exposures may be man-made (such as quarries, open building excavations, even railway and road cuttings) or natural (such as cliffs, and dongas as well as rocky outcrops along stream or river banks). It is usual practice for palaeontologists to record well-preserved fossils (GPS, and stratigraphic data) during field assessment examinations.

Although mitigation is often done prior to construction, it may take place if potentially fossiliferous bedrock is revealed. Fossil collection and documentation are examples of mitigation. A permit from SAHRA must be obtained before beginning any fossil excavation, and the material must be stored at an authorized facility. When mitigation is properly used, it is possible to have a positive impact by raising awareness of the palaeontological past of the area.

By physically evaluating bedrock outcrops to determine their lithology and fossil richness and crisscrossing the development footprint, one can assess an area's fossil potential. Because the

presence of fossils at the surface is so unexpected, an average sample size of the region is investigated. To be clear, however, the lack of fossils in a development footprint does not automatically suggest that there is no palaeontologically important material present on the site (on or below the ground surface).

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;
- Describe of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Describe location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area;
- Identify sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluate 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 impacts 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
- Detail the implications of specialist findings for the proposed development (such as permits, licenses etc).

4.1 Assumptions and Limitations

The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas

of South Africa have never been examined by palaeontologists, and data is typically dependent solely on aerial pictures. Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented.

Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological formations are used for Desktop studies, it is commonly assumed that exposed fossil exists within the footprint. As a result, a field assessment will improve the accuracy of the desktop evaluation.

5. GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the Mirach Solar PV Project near Thabazimbi, Limpopo Province is depicted on the 1:250 000 Thabazimbi 2426 (1974) Geological Map (Council for Geosciences, Pretoria) (Figure 3, Table 5). The south western corner of the development is underlain by Quaternary alluvium (yellow, single bird figure) while the rest of the development (PV and corridor) is underlain by diabase (di, green) and the Nylstroom Subgroup (W1l, brown) (Waterberg Group).

According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of Quaternary sands is Moderate, that of the diabase is Zero (grey) and that of the Nylstroom Subgroup is Low (blue) (Almond and Pether, 2009; Almond *et al*., 2013, Groenewald et al 2014) (Figure 4, Table 6). Updated Geology (Council of Geosciences) refined the geological map and indicate that the proposed development is underlain by alluvium, colluvium, elluvium and gravel as well as diabase and the Aasvoëlkop Formation of the Matlabas Subgroup (Waterberg Group) (Figure 5).

The superficial deposits (represented by yellow on the geological maps (Qs) are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of clay, gravel, sand, silt, that form relatively thin, discontinuous patches of sediments or larger spreads onshore. These sediments comprise of channel, floodplain and stream deposits, talus gravels and glacial drift sediments. Quaternary deposits are very important because palaeoclimatic changes are reflected in the different geological formations (Hunter et al., 2006). Most Quaternary geomorphologic features in southern Africa were formed during the climate changes (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Quaternary but states that climatic changes during the Quaternary, specifically the last 1.8 Ma, were the most drastic relative to all climate variations in the past. Climate variations that occurred in the Quaternary were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Caenozoic superficial deposits although they sometimes comprise significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

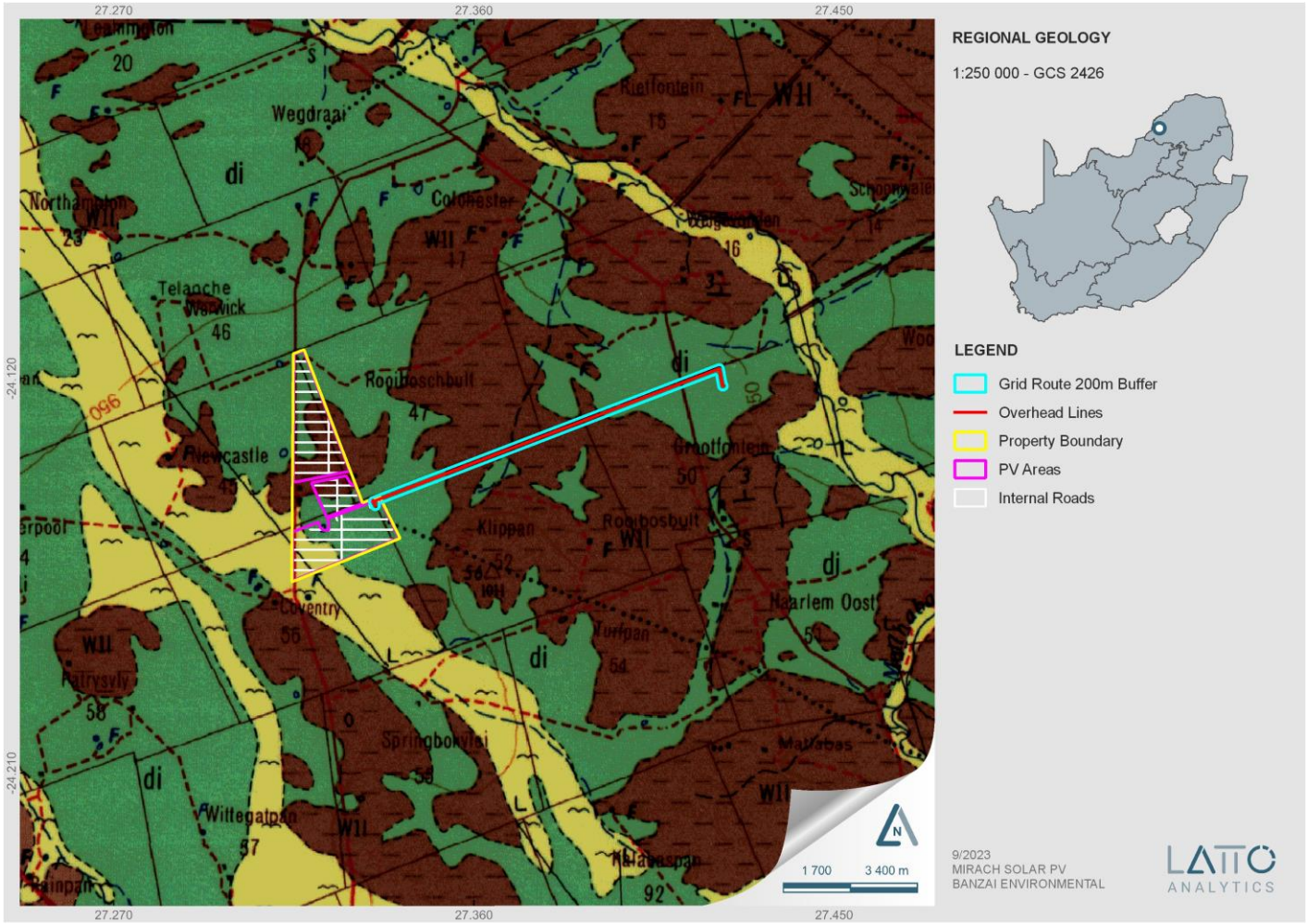
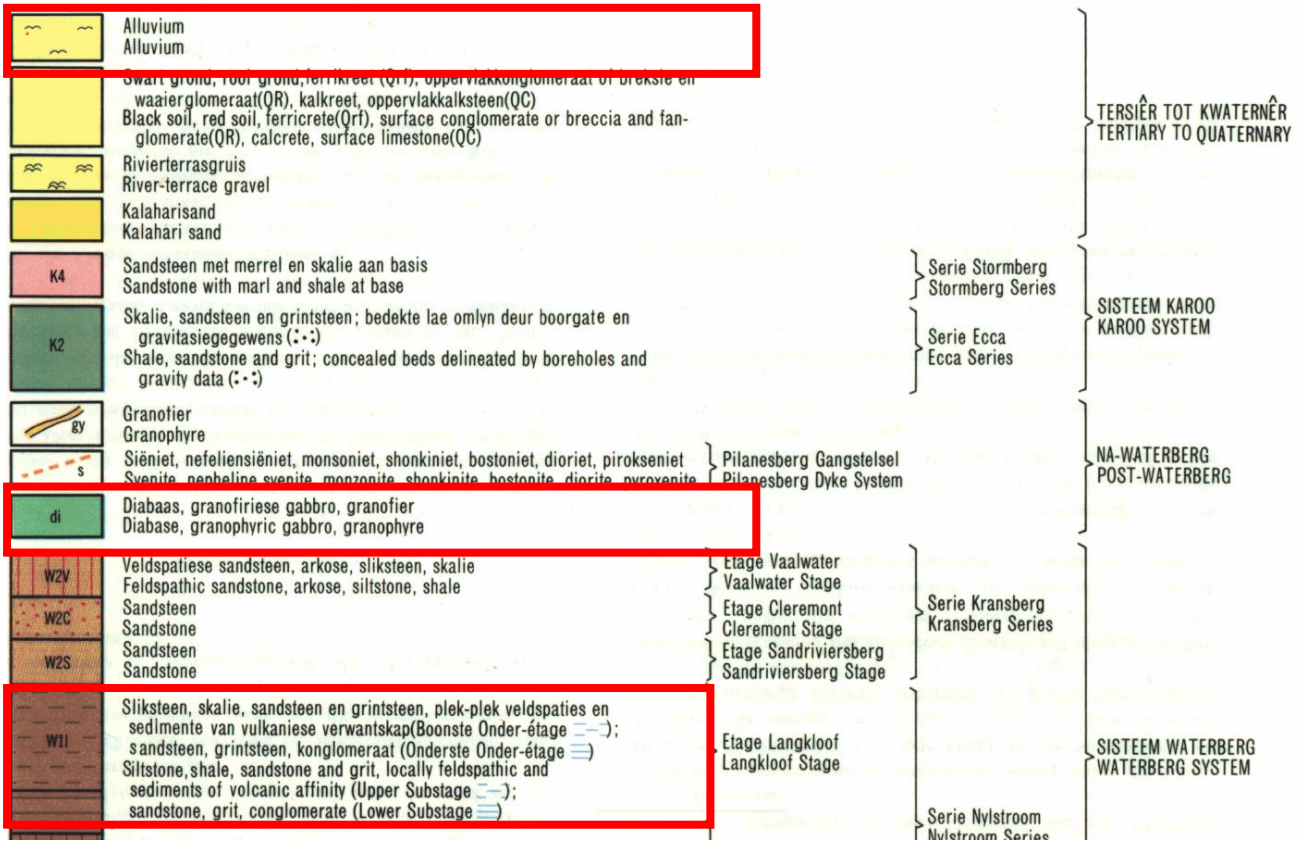


***Figure 3**: Extract of the 1:250 000 Thabazimbi 2426 (1974) Geological Map (Council for Geosciences, Pretoria) indicating that the proposed Mirach Solar PV Project near Thabazimbi, Limpopo Province is underlain by Quaternary alluvium (yellow, single bird figure), diabase (di, green), as well as Nylstroom Subgroup (W1l, brown) (Waterberg Group).*

Table 5: Legend to the Thabazimbi 2426 (1974) Geological Map (Council for Geosciences, Pretoria).

Relevant lithology is indicated in red polygons.



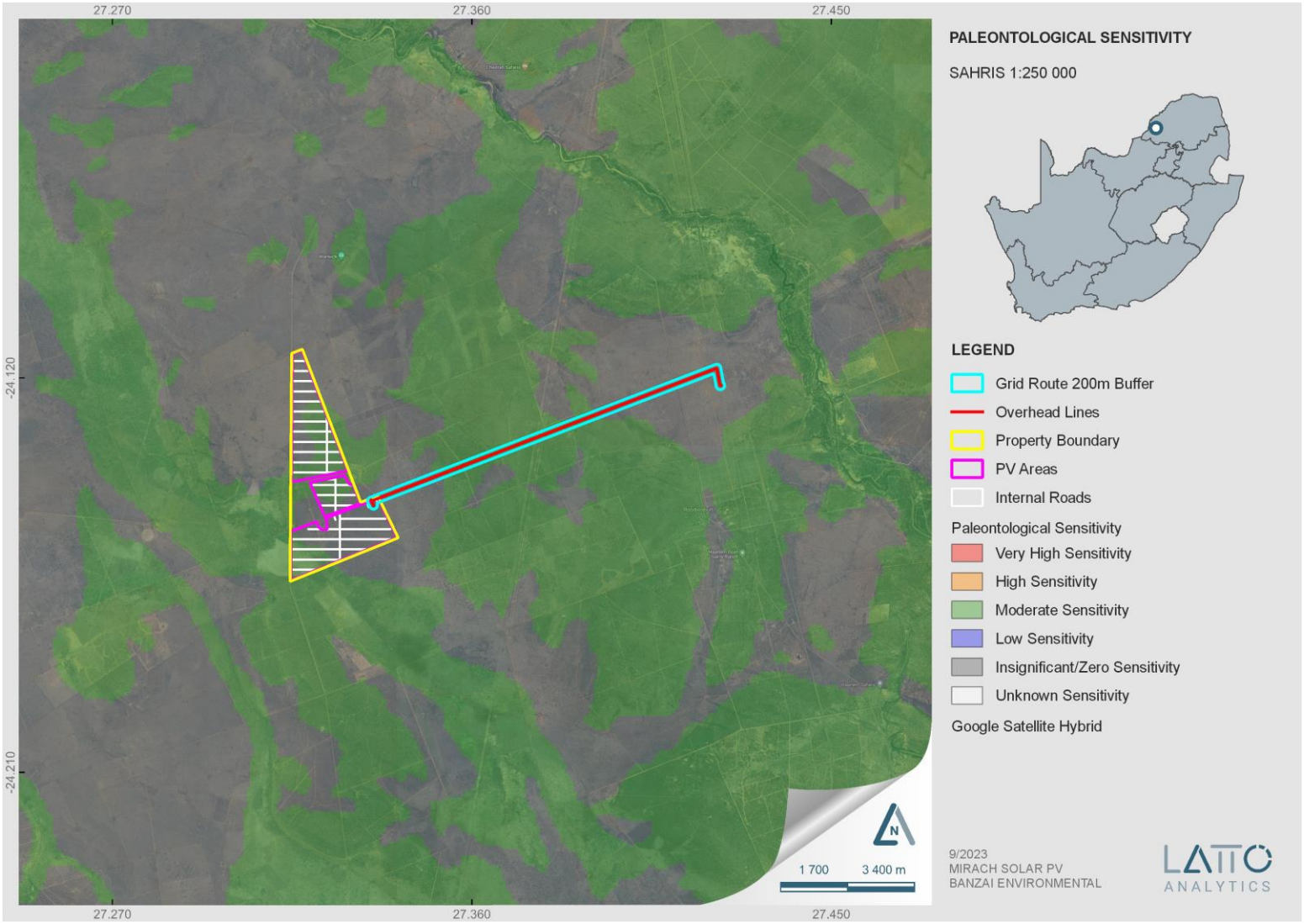


***Figure** 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap (Council of Geosciences, Pretoria) indicating the proposed Mirarch Solar PV Project near Thabazimbi, Limpopo Province.*

Table 6: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website).

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

The SAHRIS Palaeosensitivity map (Figure 4) indicates that the proposed development is underlain by sediments with a Moderate (green), Low (blue) and Zero (grey) Palaeontological Sensitivity

Diabase is igneous rocks and are thus considered to have no palaeontological significance. However, the existence of the diabase rocks would have had a thermal metamorphic effect on the adjoining Waterberg Group and would decrease the chance of fossils preservation in this Group.

The main Waterberg Basin is situated in the Limpopo Province (South Africa) and extends into eastern Botswana. Extensive research on the Waterberg Group has been conducted by Jansen (1982), Callaghan et al. (1991), Callaghan and Brandl (1991) and Callaghan (1993). It is estimated that the Waterberg Group is about 2700 to 7000 m or more thick. The Waterberg Group lies unconformably on the Transvaal Supergroup, the Archaeon Kaapvaal Craton as well as the Bushveld Complex, while the Blouberg Formation is overlain by the Mogalakwena Formation. The Waterberg Group has yet not been dated but dolerite intrusions in the upper Waterberg Group is dated at c. 1879 to 1872 Ma (Hanson et al., 2004).

The Waterberg Group is subdivided in the Nylstroom (oldest), Mastabas and Kransberg (youngest) Subgroups (Table 7). All three Subgroups exhibits upwards-fining. The Waterberg Group is characterized by its dark greyish red colour. The red colour suggests an oxidizing environment when adequate free oxygen was available to oxides ferruginous minerals, creating the formation of "red beds". These rocks are very hard and chemically resistant, producing remarkable cliffs with a high topography (McCarthy and Rubidge 2005).

The Waterberg Group may contain trace fossils. Microbial mats have been recorded from younger sediments in the Waterberg Group in the Main Waterberg Basin, but to date not in the Nylstroom Basin. The black shales south-west of Potchefstroom comprises of overlapping laminated basal mounds that may be stromatolitic and spheroidal, indicating possible planktonic fossil algae (Nixon et al.,1988). These structures ranges in size from 3.5 - 17 mm high and up to 10 mm in diameter and may be present in the development.

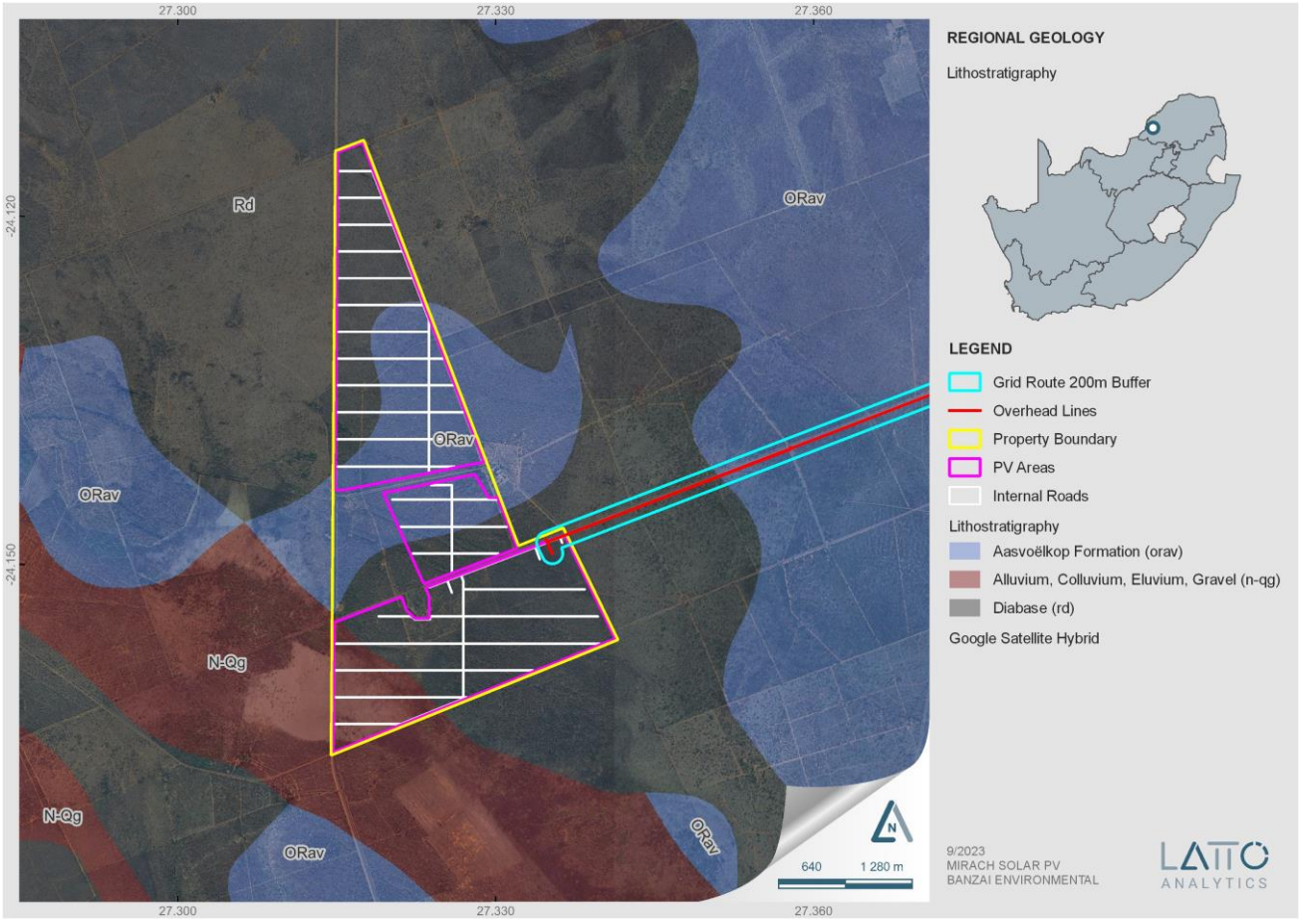


***Figure 5**: Updated Geology (Council of Geosciences, Pretoria) of the proposed Mirarch Solar PV Project near Thabazimbi, Limpopo Province indicates that a portion of the development is underlain by the alluvium, colluvium, eluvium and gravel while the rest is underlain by diabase and the Aasvoëlkop Formation of the Waterberg*

Table 7:Palaeotechnical Report of the Limpopo Province (Groenewald et al, 2014).

ALLUVIAL DEPOSITS				mmm; Q-a; Q-sc; Q8. Several symbols used for alluvium, colluvium and scree		Recent sandy and clayey deposits allong water courses	Wide range of fossils possible, including mammalian bones and teeth, tortoise remains, ostrich egg etc	Alluvial deposits associated with recent water courses of main rivers and streams. These sediments are presently not well studied and records of fossil occurrences are mainly associated with archaeological reports
	WATERBERG	Kransberg (!kr1)		Vaalwater (Mv; !vw) Cleremont (Mc; !c) Sandriviersberg & Mogalakwena (Msm)		Continental "red beds" - predominantly braided stream deposits (sandstones, conglomerates with minor mudrocks), Also beach, tidal flat, lacustrine, aeolian and possible marine shelf sediments Musekwa Member also refered to as Musekwa Formation. 400m thick volcanic assemblage Early to Mid Proterozoic (Mokolian) c. 2 to 1.7 Ga	Earliest known terrestrial cyanobacterial mats recorded from playa lake deposits of the Makgabeng Fm (Waterberg Group) (1.8 Ga) on the Makgabeng Plateau, Waterberg	Early Proterozoic "red beds" provide evidence for the development of an oxygenated atmosphere after c. 2Ga Glentig Formation was previously included within the uppermost Pretoria Group (1: 1 million map) but is now regarded as a proto-Waterberg / Soutpansberg unit.
		Matlabas		Aasvoëlkop (Mam; !as) & Makgabeng (!mk) Skilpadkop (!sk) & Setlaole (Mss)				
		Nylstroom		Alma (Ma; !al) Swaershoek (Msw; !sw)				
				Glentig (Vgl)				
	SOUTPANSBERG			Stayt (Ms) Sibasa (!si) & Tshifhefhe (Mt; !t) Mf Wyllies Poort (Mwy; !wy) Nzhelele (Mnz; !nz) Mabaligwe (Mmb; !ma) Blouberg (Mbl)	Musekwa (!mw) lava			

6. CUMULATITIVE EFFECTS ASSESSMENT

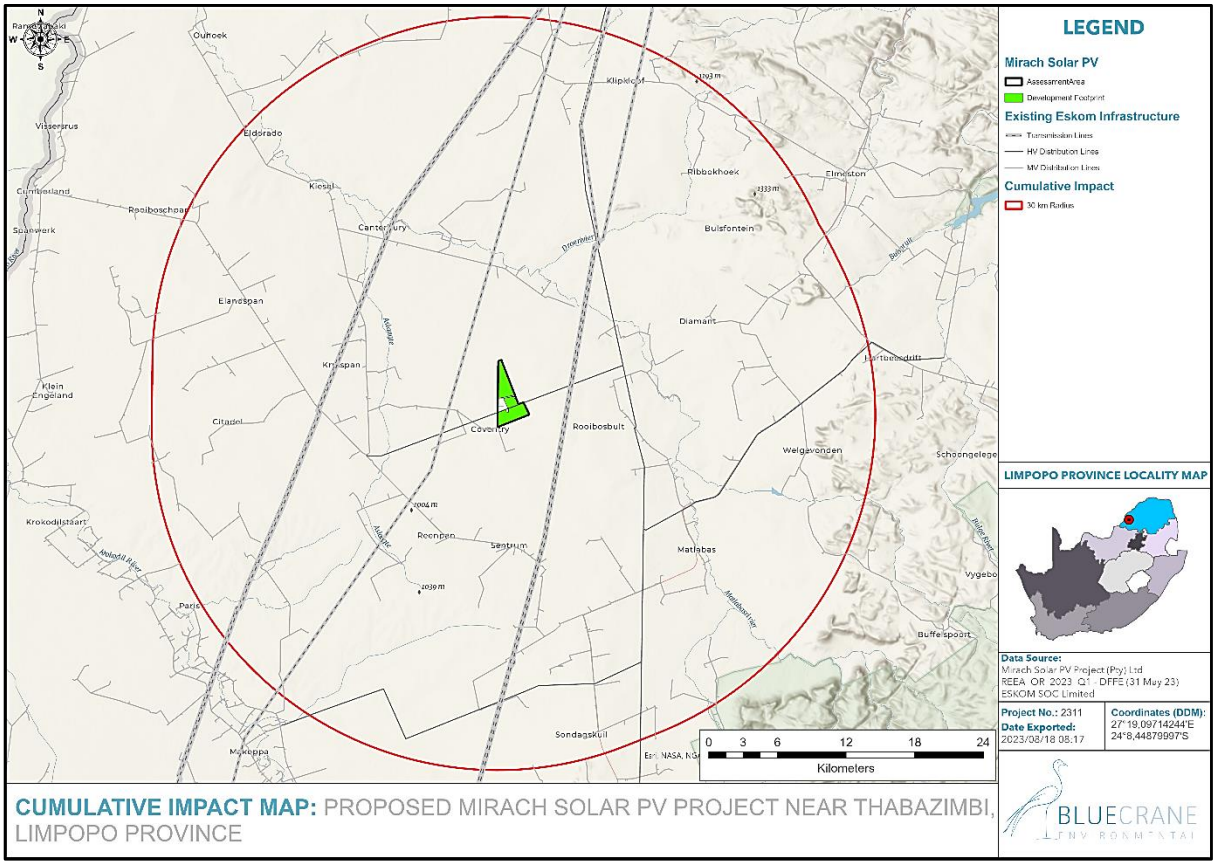


***Figure 6**: Cumulative impact map*

The geographic area of evaluation is the spatial boundary in which the cumulative effects analysis was undertaken. The spatial boundary evaluated in these cumulative effects analysis generally includes the area within a 30 km radius surrounding the proposed development

No additional Renewable Energy developments have been identified within a 30 km radius of the proposed project.

7. 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 Bluecrane.
- Updated geology of the proposed development (Council for Geosciences, Pretoria).

- PIAs in the Thabazimbi District includes that of Fourie, 2020, and Bamford, 2014 (see references).

8. IMPACT ASSESSMENT METHODOLOGY

The environmental impact 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 its significance and in doing so highlight the most critical issues to be addressed. 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.

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

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.

Table 8: Summary of Impacts

SPECIALIST STUDY	IMPACT	PRE-MITIGATION RATING	POST MITIGATION RATING	SUMMARY OF MITIGATION MEASURES
Palaeontological Impact Assessment	Disturbance, damage or destruction of legally protected fossil heritage within the development footprint during the construction phase	34	14	If fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations ECO in charge of these developments must be notified immediately. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that suitable mitigation (*e.g.,* recording and collection) can be carry out by a palaeontologist. .

9.FINDINGS AND RECOMMENDATIONS

The south western corner of the Mirach Solar PV Project is underlain by Quaternary alluvium while the rest is underlain by diabase and the Nylstroom Subgroup of the Waterberg Group. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of Quaternary sands is Moderate, while that of the Waterberg Group is Low, and that of the diabase is Zero (Almond and Pether, 2009; Almond *et al*., 2013, Groenewald et al 2014). Updated Geology (Council of Geosciences) refined the geological map and indicate that the proposed development is underlain by alluvium, colluvium, elluvium and gravel as well as diabase and the Aasvoëlkop Formation of the Matlabas Subgroup (Waterberg Group). Several alternatives (Bess and substation) have been proposed for the project, but because the geology of all alternatives is the same, there is no preference for one over the others. A Low Palaeontological significance has thus been allocated to the development. **It is therefore considered that the development will not lead to detrimental impacts on the palaeontological resources of the area. The proposed development may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of Palaeontological Heritage.**

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).

10. CHANCE FINDS PROTOCOL

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

10.1 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.

10.2 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately stop working and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately report the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within 24 hours of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.
- Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.
- The site must be secured to protect it from any further damage. No attempt should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.

- 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	National Museum, Bloemfontein
and Collection Manager	1998–2022

TECHNICAL REPORTS

Butler, E. 2014. Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.
Butler, E. 2014. Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.
Butler, E. 2015. Palaeontological impact assessment of the proposed consolidation, re-division, and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.
Butler, E. 2015. Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.
Butler, E. 2015. Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.
Butler, E. 2015. Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.
Butler, E. 2015. Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.
Butler, E. 2015. Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.
Butler, E. 2015. Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.
Butler, E. 2015. Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.
Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.
Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
Butler, E. 2015.Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.
Butler, E. 2015. Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
Butler, E. 2016. Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.

Butler, E. 2016. Palaeontological Impact Assessment of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.
Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City of Johannesburg, Gauteng Province. Bloemfontein.
Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.
Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.
Butler, E. 2016. Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannah South Africa. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.
Butler, E. 2016. Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Savannah South Africa. Bloemfontein.
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.
Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.
Butler, E. 2016. Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
Butler, E. 2016. Palaeontological Impact Assessment for the proposed development of four Leeuwberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.
Butler, E. 2016. Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.
Butler, E. 2016. Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, KwaZulu Natal. Bloemfontein.
Butler, E. 2016. Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
Butler, E. 2016: Palaeontological desktop assessment of the establishment of the proposed residential and mixed-use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.
Butler, E. 2017. Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment of The Proposed Development of The New Open Cast Mining Operations on The Remaining Portions Of 6, 7, 8 And 10 Of the Farm Kwaggafontein 8 In the Carolina Magisterial District, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.
Butler, E. 2017. Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.
Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.
Butler, E. 2017. Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mbhashe Local Municipality. Bloemfontein.
Butler, E. 2017. Palaeontological assessment of the proposed development of a 3000 MW Combined Cycle Gas Turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the new open cast mining operations on the remaining portions of 6, 7, 8 and 10 of the farm Kwaggafontein 8 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.
Butler, E. 2017. Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.
Butler, E. 2017. Palaeontological impact assessment of the proposed construction of the Lehae training and fire station, Lenasia, Gauteng Province. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the Lephalale coal and power project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.
Butler, E. 2017. Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.
Butler, E. 2017. Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.
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