



**PALAEONTOLOGICAL IMPACT ASSESSMENT**  
**FOR THE**  
**DEVELOPMENT OF THE NYARHI SOLAR POWER PLANT NEAR**  
**VILJOENSKROON, FREE STATE PROVINCE**

**Prepared for:**

**ENVIRONAMICS CC**

14 Kingfisher Street, Potchefstroom, 2531

**Prepared by**

**Banzai Environmental (Pty) Ltd**

**March 2022**

## **Declaration of Independence**

I, Elize Butler, declare that –

General declaration:

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

and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;

- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

#### **Disclosure of Vested Interest**

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

**PALAEONTOLOGICAL CONSULTANT:**

Banzai Environmental (Pty) Ltd

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**SIGNATURE:**



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

*Table 1: NEMA Table*

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	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 <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	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
	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 process inclusive of equipment and modelling used	Section 7 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 alternatives;	Section 1; 9 & 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	Section 5 – Geological and	

<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>
sensitivities of the site including areas to be avoided, including buffers;	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 1 and 11	
(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 and 11	
(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		

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(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 EMP, and where applicable, the closure plan	Section 1 and 11	-
(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.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(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 Environamics to conduct the Palaeontological Impact Assessment (PIA) to assess the Nyarhi Solar Power Plant (SPP) near Viljoenskroon in the Free State. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA 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 development is underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani (Chuniespoort Group, Transvaal Supergroup). According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Malmani Subgroup is Very High (Almond *et al*, 2013; SAHRIS website).

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 12-13 March 2022. Outcrops of weathered to well-preserved stromatolites were discovered on the whole development, but less prominent in the south of the development. Examples of exceptionally well preserved specimens were recovered from the centre portion of the development footprint. Mitigation of a sample of well-preserved stromatolites is thus recommended. By implementing mitigation measures the significance of the impact will be reduced to medium. These recommendations should be included in the Environmental Management Plan of the Nyarhi Solar Plant.

### **Recommendations:**

- The ECO must be made aware that fossils (stromatolites) of the Malmani (Chuniespoort Group, Transvaal Supergroup) has a Very High Palaeontological Significance.
- When the Nyarhi Power Plant layout has been established a walkdown of the area must be completed by a qualified Palaeontologist to catalogue and photograph well-preserved stromatolites. This action

should take place after initial vegetation clearance but *before* the ground is levelled for construction.

- An representative example of well-preserved stromatolites should be removed and placed near the offices of the PV as a informative example of fossils in the area.

It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. Thus, the construction of the development may be authorised in its whole extent.

### Impact Summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Construction Stage PV Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	64	Negative High impact	30	Negative medium impact
Operation Phase PV	No Impact		No Impact		No Impact
Decommissioning Phase PV	No Impact		No Impact		No Impact

Construction Stage Grid connection	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	64	Negative High impact	30	Negative medium impact
Operation Phase Grid connection	No Impact		No Impact		No Impact
Decommissioning Phase Grid Connection	No Impact		No Impact		No Impact

## TABLE OF CONTENT

<b>1</b>	<b>INTRODUCTION</b> .....	<b>1</b>
1.1	TECHNICAL DETAILS	5
1.2	CONSIDERATION OF ALTERNATIVES	8
1.3	LEGAL MANDATE AND PURPOSE OF THE REPORT	11
<b>2</b>	<b>QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR</b> .....	<b>13</b>
<b>3</b>	<b>LEGISLATION</b> .....	<b>13</b>
<b>4</b>	<b>OBJECTIVE</b> .....	<b>16</b>
<b>5</b>	<b>GEOLOGICAL AND PALAEOLOGICAL HISTORY</b> .....	<b>18</b>
<b>6</b>	<b>GEOGRAPHICAL LOCATION OF THE SITE</b> .....	<b>29</b>
<b>7</b>	<b>METHODS</b> .....	<b>29</b>
7.1	ASSUMPTIONS AND LIMITATIONS	29
<b>8</b>	<b>ADDITIONAL INFORMATION CONSULTED</b> .....	<b>30</b>
<b>9</b>	<b>SITE VISIT</b> .....	<b>30</b>
<b>10</b>	<b>ASSESSMENT METHODOLOGY</b> .....	<b>36</b>
10.1	METHOD OF ENVIRONMENTAL ASSESSMENT .....	36
<b>11</b>	<b>FINDINGS AND RECOMMENDATIONS</b> .....	<b>46</b>
<b>12</b>	<b>REFERENCES</b> .....	<b>47</b>

## List of Figures

<i>Figure 1: Regional Locality of the proposed Nyarhi Solar Power Plant near Viljoenskroon in the Free State.</i> .....	3
<i>Figure 2: Locality of the proposed Nyarhi Solar Power Plant near Viljoenskroon in the Free State.</i> .....	4
<i>Figure 3: Nyarhi SPP connection options.</i> .....	6
<i>Figure 4. Extract of the 1:250 000 2626 Wes-Rand (1986) Geological Map (Council for Geosciences, Pretoria) indicating the proposed Nyarhi Solar Power Plant and power line. ....</i>	21
<i>Figure 5: Stratigraphy of the Transvaal Supergroup of the Transvaal Basin. The proposed development is indicated in blue (Eriksson, et al. 2006).</i> .....	25
<i>Figure 6: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed Nyarhi SPP and grid development.</i> .....	27
<i>Figure 7: Northern portion of the proposed development. Ground surface is covered by dence grassy vehetation .....</i>	31
<i>Figure 8:Well preserved stromatolites in the centre of the development .....</i>	32
<i>Figure 9:Stromatolites outcrops on the surface of the proposed development.</i>	33
<i>Figure 10:Exceptionally well- preserved oolites .....</i>	33
<i>Figure 11: Example of well-preserved stromatolite outcrops present in the development .....</i>	34
<i>Figure 12: Southern portion of the proposed development has less outcrops...</i>	35
<i>Figure 13: Well preserved oolites and stromatolites are preserved in the purple dashed line. The concentration of fossils reduces from noth to south. ....</i>	36
<i>Figure 14:Nyarhi SPP Geographic area of evaluation with utility-scale renewable energy generation sites and power lines.....</i>	44

## List of Tables

<i>Table 1: NEMA Table</i> .....	iv
<i>Table 2: General site information</i> .....	1
<i>Table 3: Technical details for the proposed facility</i> .....	7
<i>Table 4: Listed activities (SPPs)</i> .....	11
<i>Table 5: Legend to the 2626 Wes-Rand Geological Map (1986) (Council of Geoscience)</i> .....	22
<i>Table 6: Sediments in the proposed development is indicated in bold</i> .....	23
<i>Table 7: Palaeontological Sensitivitie according tho the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website)</i> .....	28
<i>Table 8: The rating system</i> .....	37
<i>Table 9: A summary of related facilities, that may have a cumulative impact, in a 30 km radius of the Nyarhi SPP</i> .....	42
<i>Table 10: Summary of Impacts</i> .....	45

## Appendix A: CV

## 1 INTRODUCTION

The following information was provided by Environamics and Subsolar (RF) (Pty) Ltd.

Table 2: General site information

Description of affected farm portion	<p><u>Solar Power Plant</u>  Portion 1 of the Farm Die Hoek No. 114  Portion 1 of the farm Doornkom-oost No. 447  Doornplaats No. 559  <u>Power Line</u>  Portion 1 of the Farm Die Hoek No. 114  Hoekplaats No. 598  <u>Power Line: Option 2 (technically preferred)</u>  Farm Anglo No. 593  Portion 1 of the Farm Die Hoek No. 114  Farm Groot Vaders Bosch 593  Portion 2 of the farm Zuiping No. 394  Remaining Extent of the farm Zuiping No. 394</p>
Province	Free State
District Municipality	Fezile Dabi District Municipality
Local Municipality	Moqhaka Local Municipality
Ward numbers	24
Closest towns	Viljoenskroon is located approximately 28 km south-east of the proposed development
21 Digit Surveyor General codes	<p><u>Solar Power Plant</u>  Portion 1 of the Farm Die Hoek No. 114 - F03600000000011400001  Portion 1 of the farm Doornkom-oost No. 447 - F03600000000044700001  Doornplaats No. 559 - F03600000000059900000  <u>Power Line</u>  Portion 1 of the Farm Die Hoek No. 114 - F03600000000011400001  Hoekplaats No. 598 - F03600000000059800000  <u>Power Line: Option 2 (technically preferred)</u>  Farm Anglo No. 593 - F03600000000059300000  Portion 1 of the Farm Die Hoek No. 114 - F03600000000011400001  Farm Groot Vaders Bosch No. 592 - F03600000000059200000</p>

	Portion 2 of the Farm Zuiping No. 394 - F03600000000039400002 Remaining Extent of the Farm Zuiping No. 394 - F03600000000039400000
Type of technology	Photovoltaic solar facility
Structure Height	Panels ~6m, buildings ~ 6m, power line ~32m and battery storage facility ~8m height
Battery storage	Within a 4-hectare area
Surface area to be covered (Development footprint)	Approximately 246 ha
Laydown area dimensions (EIA footprint)	Assessed 290 ha
Structure orientation	The panels will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to 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 in order to capture the most sun.
Generation capacity	Up to 100MW
Expected production	320-360 GWh per annum (Expected production by 100MWdc modules Considering Bifacial and one-axis tracker)



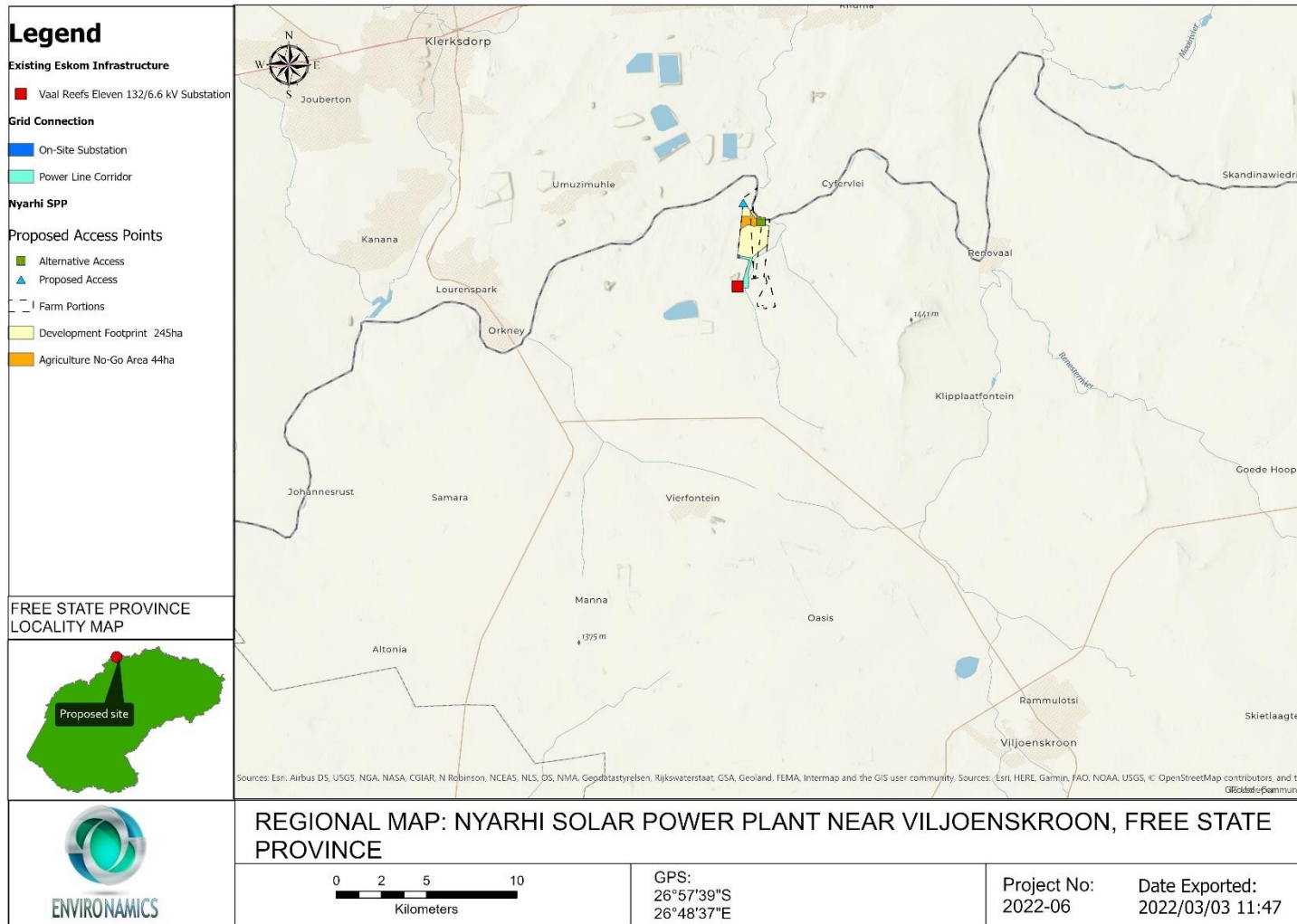


Figure 1: Regional Locality of the proposed Nyarhi Solar Power Plant near Viljoenskroon in the Free State.

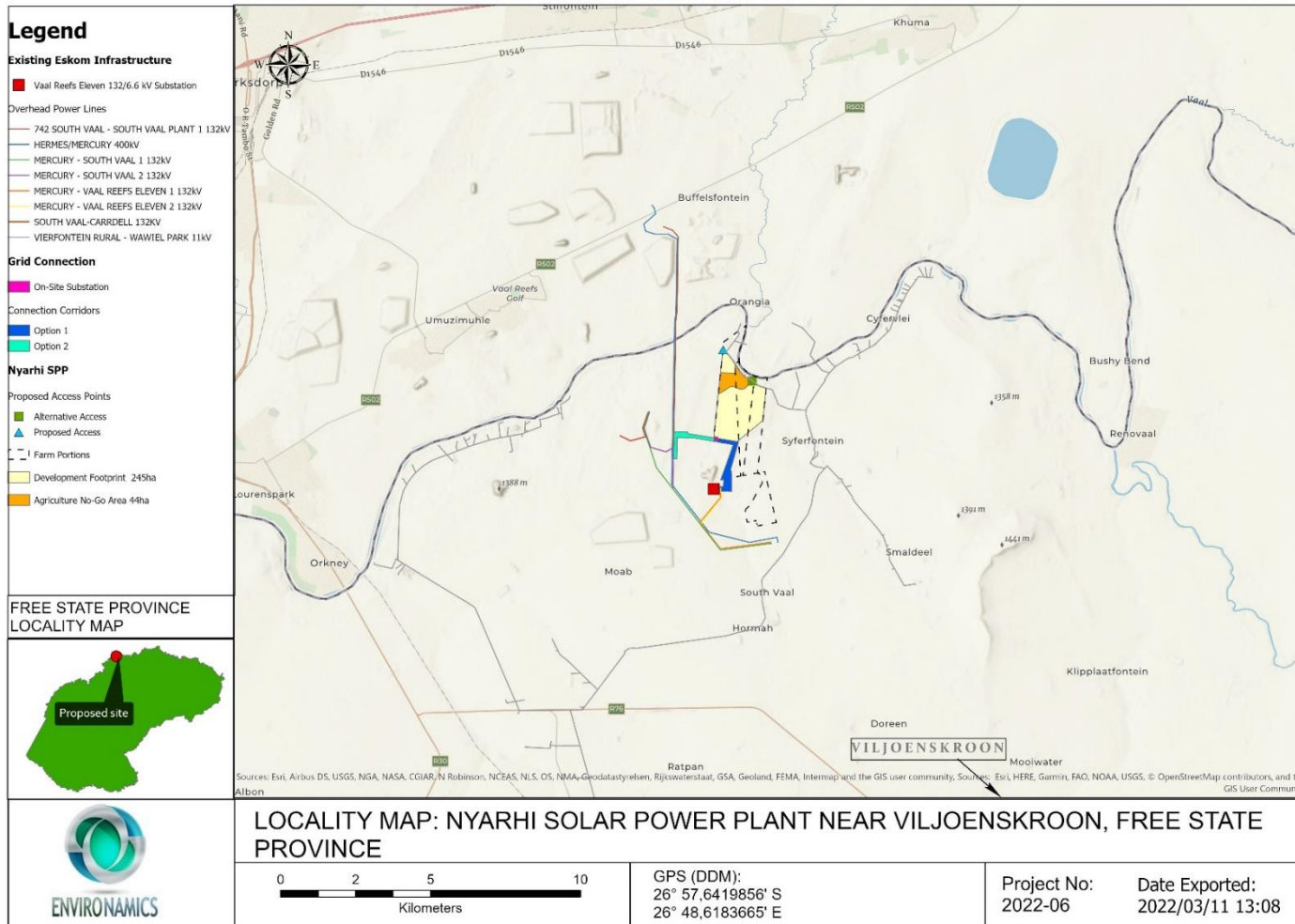


Figure 2: Locality of the proposed Nyarhi Solar Power Plant near Viljoenskroon in the Free State

## 1.1 TECHNICAL DETAILS

The term photovoltaic describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun through a process known as the Photovoltaic Effect. This refers to light energy placing electrons into a higher state of energy to create electricity. Each PV cell is made of silicon (i.e. semiconductors), which is positively and negatively charged on either side, with electrical conductors attached to both sides to form a circuit. This circuit captures the released electrons in the form of an electric current (direct current). The key components of the proposed project are described below:

- PV Panel Array - To produce up to 100MW, the proposed facility will require numerous linked cells placed behind a protective glass sheet to form a panel. Multiple panels will be required to form the solar PV arrays which will comprise the PV facility. The PV panels will be tilted at a northern angle in order to capture the most sun or using one-axis tracker structures to follow the sun to increase the Yield.
- Wiring to Inverters - Sections of the PV array will be wired to inverters. The inverter is a pulse width mode inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.
- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480V to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the inverter is 480V and this is fed into step up transformers to 132kV. An onsite substation will be required on the site to step the voltage up to 132kV, after which the power will be evacuated into the national grid via the proposed power line. Whilst Nyarhi Solar Power Plant (RF) (Pty) Ltd has not yet received a cost estimate letter from Eskom, it is expected that generation from the facility will tie in with the existing Vaal Reefs Eleven 132/6.6 kV Substation or alternatively via a Li-Lo line connection into the South Vaal – Cardell 132 KV Line or Mercury – South

Vaal 132 KV Line. The Project will inject up to 100MW into the National Grid. The installed capacity will be approximately 100MW.

A grid connection corridor, with a width of 250m wide, has been identified for the assessment and placement of the power line. The corridor is located to the east of the SPP site and is ~2.4km in length. Refer to the Figure below.

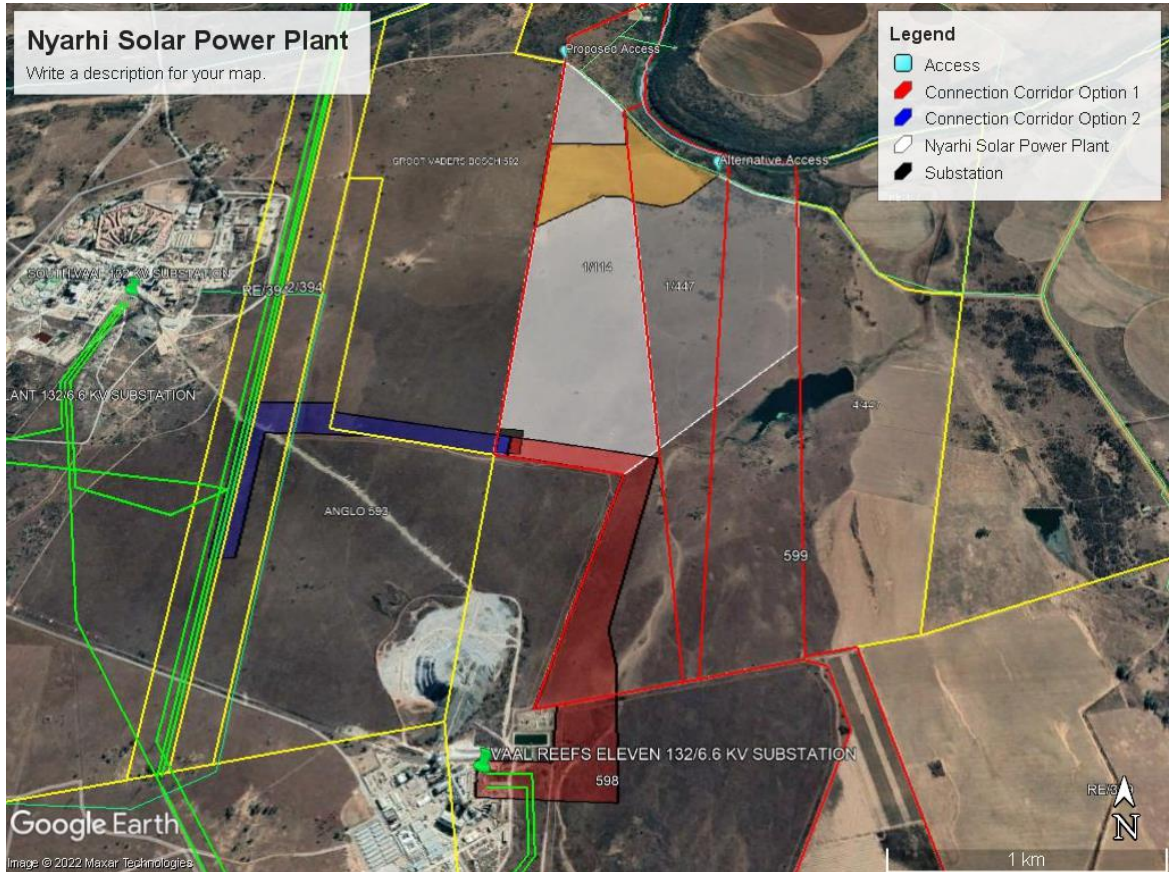


Figure 3: Nyarhi SPP connection options

- Electrical reticulation network – An internal electrical reticulation network will be required and will be laid ~2-4m underground as far as practically possible.
- Supporting Infrastructure – The following auxiliary buildings with basic services including water and electricity will be required on site:
  - Office (~200m<sup>2</sup>);
  - Switch gear and relay room (~400m<sup>2</sup>);

- Staff lockers and changing room (~200m<sup>2</sup>); and
- Security control (~60m<sup>2</sup>)
- Battery storage – A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m<sup>3</sup> of batteries and associated operational, safety and control infrastructure.
- Roads – Access will be obtained via the Stokkiesdraai road to the north of the site. An internal site road network will also be required to provide access to the solar field and associated infrastructure. The access and internal roads will be constructed within a 25-meter corridor.
- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a height of 2.5 meters will be used.

Table 3: Technical details for the proposed facility

Component	Description / dimensions
Height of PV panels	6 meters
Area of PV Array	246 Hectares (Development footprint)
Number of inverters required	Minimum 40
Area occupied by inverter / transformer stations / substations / BESS	Central inverters+ LV/MV trafo: 20 m <sup>2</sup> HV/MV substation with switching station: 15 000 m <sup>2</sup> BESS: 4 000 m <sup>2</sup>
Capacity of on-site substation	132kV
Capacity of the power line	132kV
Area occupied by both permanent and construction laydown areas	Permanent Laydown Area: 290 Hectares Construction Laydown Area: ~2000 m <sup>2</sup>
Area occupied by buildings	Security Room: ~60 m <sup>2</sup> Office: ~200 m <sup>2</sup> Staff Locker and Changing Room: ~200 m <sup>2</sup>

<b>Battery storage facility</b>	Maximum height: 8m Maximum volume: 1740 m <sup>3</sup>
<b>Length of internal roads</b>	Approximately 15 km
<b>Width of internal roads</b>	Between 6 & 12 meters
<b>Proximity to grid connection</b>	Approximately 1.6 kilometers
<b>Grid connection corridor width</b>	Up to 250m, with some areas being ~100m wide
<b>Grid connection corridor length</b>	Approximately 2.4 km
<b>Power servitude width</b>	32m
<b>Height of fencing</b>	Approximately 2.5 meters

## 1.2 CONSIDERATION OF ALTERNATIVES

*The DEAT 2006 guidelines on 'assessment of alternatives and impacts' proposes the consideration of four types of alternatives namely, the no-go, location, activity, and design alternatives. It is however, important to note that the regulation and guidelines specifically state that only 'feasible' and 'reasonable' alternatives should be explored. It also recognizes that the consideration of alternatives is an iterative process of feedback between the developer and EAP, which in some instances culminates in a single preferred project proposal. An initial site assessment was conducted by the developer the affected properties and the farm portions were found favorable due to its proximity to grid connections, solar radiation, ecology and relative flat terrain. These factors were then taken into consideration and avoided as far as possible. The following alternatives were considered in relation to the proposed activity and all specialists should also make mention of these:*

### No-go alternative

This alternative considers the option of 'do nothing' and maintaining the status quo. The site is currently zoned for agricultural and mining land uses. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for agricultural and purposes. The potential opportunity costs in terms of alternative land use income through rental for energy facility and the supporting

social and economic development in the area would be lost if the status quo persist.

#### Location alternatives

No other possible sites were identified on Portion 1 of the Farm Die Hoek No. 114, Portion 1 of the farm Doornkom-oost No. 447 and the Farm Doornplaats No. 559. This site is referred to as the preferred site. Some limited sensitive features occur on the site. The size of the site makes provision for the exclusion of any sensitive environmental features that may arise through the BA proses.

#### Technical alternatives: Powerlines

It is expected that generation from the facility will tie in with the existing Vaal Reefs Eleven 132/6.6 kV Substation or alternatively via a Li-Lo line connection into the South Vaal – Cardell 132 KV Line or Mercury – South Vaal 132 KV Line (technically preferred option)

#### Battery storage facility

It is proposed that a nominal up to 500 MWh Battery Storage Facility for grid storage would be housed in stacked containers, or multi-storey building, with a maximum height of 8m and a maximum volume of 1,740m<sup>3</sup> of batteries and associated operational, safety and control infrastructure. Three types of battery technologies are being considered for the proposed project: Lithium-ion, Sodium-sulphur or Vanadium Redox flow battery. The preferred battery technology is Lithium-ion.

Battery storage offers a wide range of advantages to South Africa including renewable energy time shift, renewable capacity firming, electricity supply reliability and quality improvement, voltage regulation, electricity reserve capacity improvement, transmission congestion relief, load following and time of use energy cost management. In essence, this technology allows renewable energy to enter the base load and peak power generation market and therefore can compete directly with fossil fuel sources of power generation and offer a truly sustainable electricity supply option.

#### Design and layout alternatives

Design alternatives will be considered throughout the planning and design phase and specialist studies are expected to inform the final layout of the proposed development.

#### Technology alternatives

There are several types of semiconductor technologies currently available and in use for PV solar panels. Two, however, have become the most widely adopted, namely crystalline silicon (Mono-facial and Bi-facial) and thin film. The technology that (at this stage) proves more feasible and reasonable with respect to the proposed solar facility is crystalline silicon panels, due to it being non-reflective, more efficient, and with a higher durability. However, due to the rapid technological advances being made in the field of solar technology the exact type of technology to be used, such as bifacial panels, will only be confirmed at the onset of the project.



### 1.3 LEGAL MANDATE AND PURPOSE OF THE REPORT

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

Table 4: Listed activities (SPPs)

Relevant notice:	Activity No (s)	Description of each listed activity as per project description:
GNR. 327 (as amended in 2017)	Activity 11(i)	<ul style="list-style-type: none"> <li>• <i>“The development of facilities or infrastructure for the transmission and distribution of electricity (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts.”</i></li> <li>• Activity 11(i) is triggered as the proposed photovoltaic solar facility will transmit and distribute electricity of 132 kilovolts outside an urban area.</li> </ul>
GNR. 327 (as amended in 2017)	Activity 28(ii)	<ul style="list-style-type: none"> <li>• <i>“Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare.”</i></li> <li>• Activity 28(ii) is triggered as portions of the affected farm has been previously used for grazing and the property will be re-zoned to “special” use.</li> </ul>

GNR. 327 (as amended in 2017)	Activity 24(ii)	<ul style="list-style-type: none"> <li>• <i>“The development of a road (ii) with reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 meters;</i></li> <li>• Activity 24(ii) is triggered as the internal roads will vary between 6 and 12 meters in width.</li> </ul>
GNR. 327 (as amended in 2017)	Activity 56 (ii):	<ul style="list-style-type: none"> <li>• <i>“The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres...”</i></li> <li>• Activity 56 (ii) is triggered as the existing access to the affected property does not have a reserve and will need to be widened by more than 6 metres.</li> </ul>
GNR. 325 (as amended in 2017)	Activity 1	<ul style="list-style-type: none"> <li>• <i>“The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more.”</i></li> <li>• Activity 1 is triggered since the proposed photovoltaic solar facility will generate up to 100 megawatts electricity through the use of a renewable resource.</li> </ul>
GNR. 325 (as amended in 2017)	Activity 15	<ul style="list-style-type: none"> <li>• <i>“The clearance of an area of 20 hectares or more of indigenous vegetation.”</i></li> <li>• More than 20 hectares of indigenous vegetation will be cleared.</li> </ul>

The activities triggered under Listing Notice 1, 2 and 3 (Regulation 327, 325 & 324) for the project implies that the development is considered as potentially having an impact on the environment and therefore require the implementation of appropriate mitigation measures. Based on the location of the entire extent of the project within the Klerksdorp REDZ, the process to be followed will be as per GNR 114, as gazetted on 16 February 2018. Therefore, the SPPs and PL is subject to a Basic Assessment process and not a full EIA process, as well as a shortened timeframe for the processing of the Application for Environmental Authorisation by the Department of Forestry, Fisheries and the Environment (DFFE).

## **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, 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, 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**

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

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

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

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

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA

must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

**General Requirements:**

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:
  - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
  - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.

## 5 GEOLOGICAL AND PALAEOONTOLOGICAL HISTORY

The geology of the proposed Nyarhi Solar Power Plant and grid connection is indicated on the 1: 250 000 Wes-Rand 2626 (1986) Geological Map (Council for Geosciences, Pretoria) (**Figure 4**). The proposed development is underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani Subgroup (blue-green - Vmd) (Chuniespoort Group, **Figure 4-5; Table 5-6**) within the Transvaal Supergroup. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Malmani Subgroup is Very High (**Figure 6, Table 7**) (Almond *et al*, 2013; SAHRIS website).

The Malmani Subgroup carbonates of the Transvaal Basin comprise of an assortment of stromatolites (microbial laminates), ranging from supratidal mats to intertidal columns and large subtidal domes (Eriksson *et al.* 2006). Stromatolites are layered mounds, columns and sheet-like sedimentary rocks. These structures were originally formed by the growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe. Cyanobacteria are prokaryotic cells (simplest form of modern carbon-bases life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils. These algae photosynthesised in the low oxygen atmosphere and deposited layer upon layer of calcium sulphate, magnesium sulphate and calcium carbonate as well as other compounds to form these domes. Researchers have examined and classified the stromatolite structures but seldomly find preserved algal cells. The oxygen atmosphere that we depend on today was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.

Stromatolites and oolites from the Transvaal Supergroup have been described by various authors (Eriksson and Altermann, 1998). Detailed descriptions of South African Archaean stromatolites are available in the literature (Altermann, 2001; Buick, 2001; and Schopf, 2006). The Malmani stromatolites literature includes articles by Truswell and Eriksson (1972, 1973, 1975), Eriksson and MacGregor (1981), Eriksson and Altermann (1998), Sumner (2000), Schopf (2006).



The Malmani Subgroup succession is about 2 km-thick and consists of a series of formations of oolitic and stromatolitic carbonates (limestones and dolomites), black carbonaceous shales and minor secondary cherts. The Malmani Dolomites also consist of historic lime mines, and palaeocave fossil deposits. Dolomite (limestone rock) forms in warm, shallow seas from slow gathering remainders of marine microorganisms and fine-grained sediment. Dolomites of the Malmani Subgroup has a higher magnesium content than other limestones. These materials contain high levels of calcium carbonate and are often referred to as *carbonates*.

Currently very few palaeontologists study stromatolites but geologists find the stromatolites interesting because they reveal the change from a reducing environment (that is an oxygen-poor) to an oxidizing environment (oxygen-rich). This transition is known as the Great Oxygen Event (Eroglu et al., 2017).

The Vaalriver lies just north of the proposed Nyarhi Solar Power Plant. Quaternary alluvium is deposited in this area. The Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt, and clay, and they form relatively thin, often discontinuous patches of sediments or larger spreads onshore.

The Quaternary deposits are of most importance due to the palaeoclimatic changes that are reflected in the different geological formations (Hunter et al., 2006). During the climate fluctuations in the Cenozoic Era most geomorphologic features in southern Africa were formed (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Cenozoic but states that climatic changes during the Quaternary Period, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past. Climate variations that occurred in the Quaternary Period were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

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 of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn cores, 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).

The Vryheid Formation (Ecca Group, Karoo Supergroup) is present to the south and east of the proposed Nyarhi Solar Power Plant. The Vryheid Formation is characterized by light grey, fine to coarse sandstone and siltstone sediments. The dark coloured siltstones can be accredited to the existence of carbon enrichment and coal beds. Infrequent coal seams, deltaic mudrocks and sandstones as well as coastal and fluvial deposits are present in this formation. These sediments were probably deposited on a sandy shoreline that stretched out beyond massive swamplands. In these swamps, plants accumulated and formed the coal deposits that are mined today (Johnson et al, 2006).

The Vryheid Formation is world renowned for the occurrence of coal beds formed by the accumulation of plant material over long periods of time. Numerous plant fossils have been described from this formation by Bamford (2011). The Vryheid Formation is also characterised by its trace fossil assemblages of the non-marine *Mermia* Ichnofacies, insect fossils track ways, fish and small crustaceans. The *Mesosaurus* reptile may also be present.

The Hekpoort Formation of the Pretoria Group is present to the east of the development. The Hekpoort formation consists of Basaltic andesite and pyroclastic rocks and is volcanic in origin. No fossils has been recorded from this Formation.

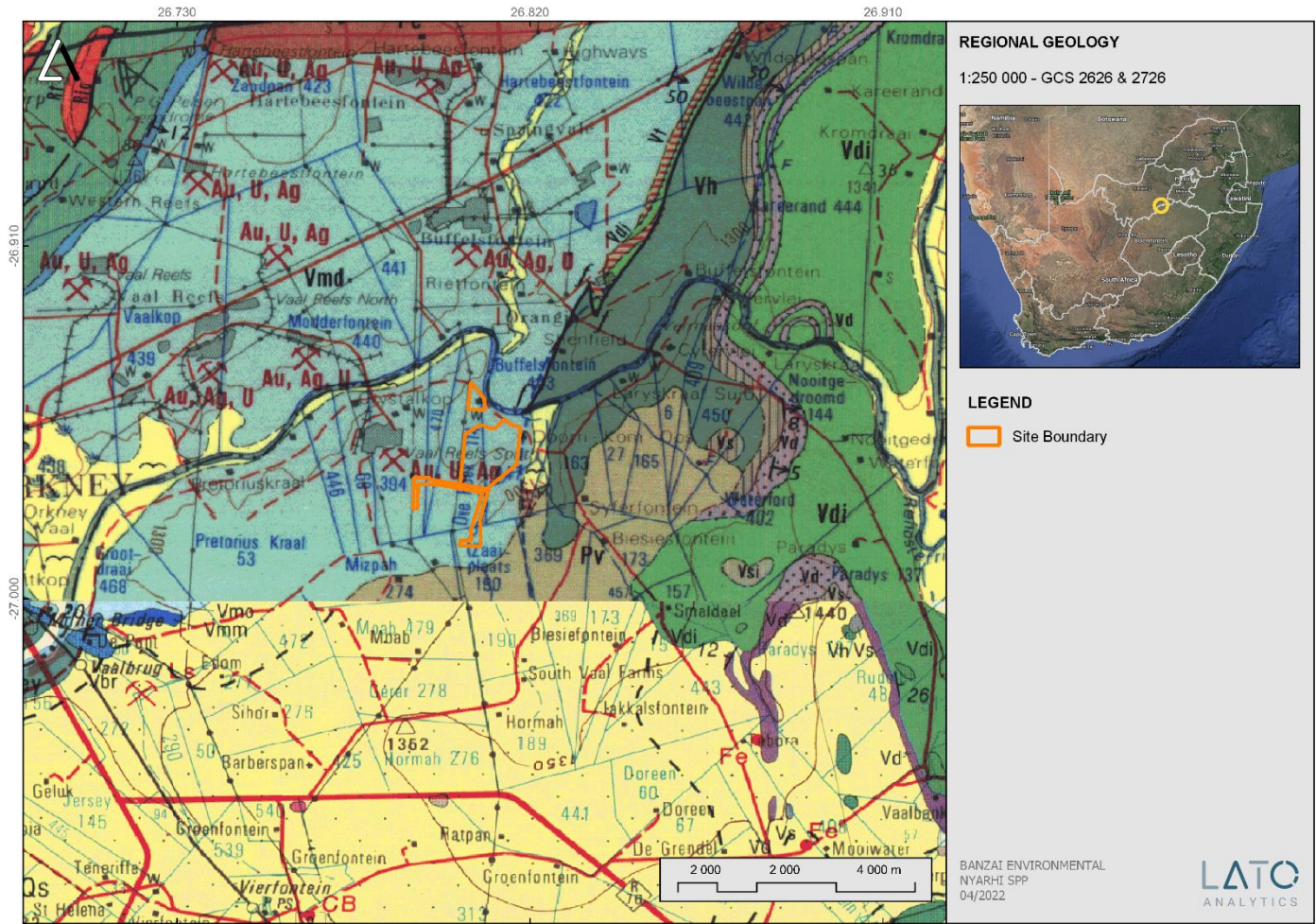
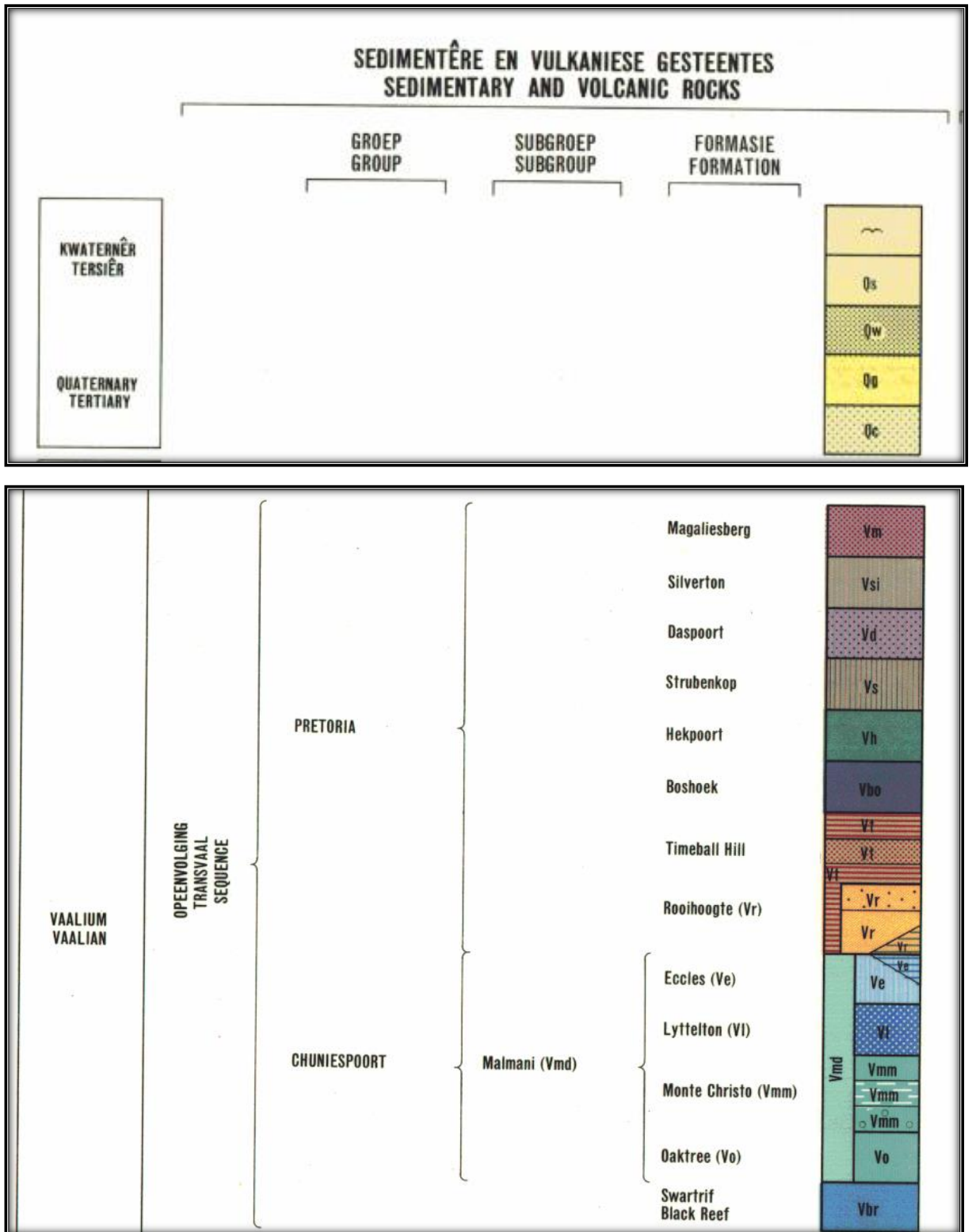
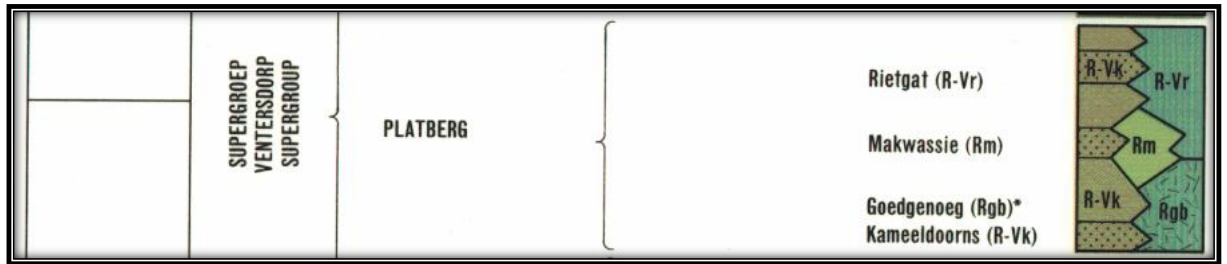


Figure 4. Extract of the 1:250 000 2626 Wes-Rand (1986) Geological Map (Council for Geosciences, Pretoria) indicating the proposed Nyarhi Solar Power Plant and power line. .

Table 5: Legend to the 2626 Wes-Rand Geological Map (1986) (Council of Geoscience).





The proposed development is underlain by Precambrian dolomites and associated marine sedimentary rocks allocated to the Malmani Subgroup (blue-green - Vmd) (Chuniespoort Group, Transvaal Supergroup)

*Table 6: Sediments in the proposed development is indicated in bold*  
*(2626 West Rand Geological Map, Groenewald et al., 2014, Johnstone, 2006)*

Synbol	Group/Formation	Lithology	Fossils
Q		Alluvium surface deposits	Resemble modern animals. Mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells. Plants: foliage, wood, pollens, peats and trace fossils
Pv	Vryheid Formation, Ecca Group, Karoo Supergroup	Sandstone, Shale, coal	Plant fossils (Glossopteris Flora), occasional insects, conchostracans, low diversity trace

			fossil assemblages.
Vh	Hekpoort Formation, Pretoria Group, Transvaal Supergroup	Andesite, agglomerate, tuff	No fossils
<b>Vmd</b>	<b>Chuniespoort Group, Malmani Subgroup</b>	<b>Dolomite, chert</b>	Stromatolites organic-walled microfossils
R-Vr	Rietgat Formation, Platberg Group, Ventersdorp Supergroup	Amagdaloidal lava, agglomerate, tuff	Stromatolites in borehole cores

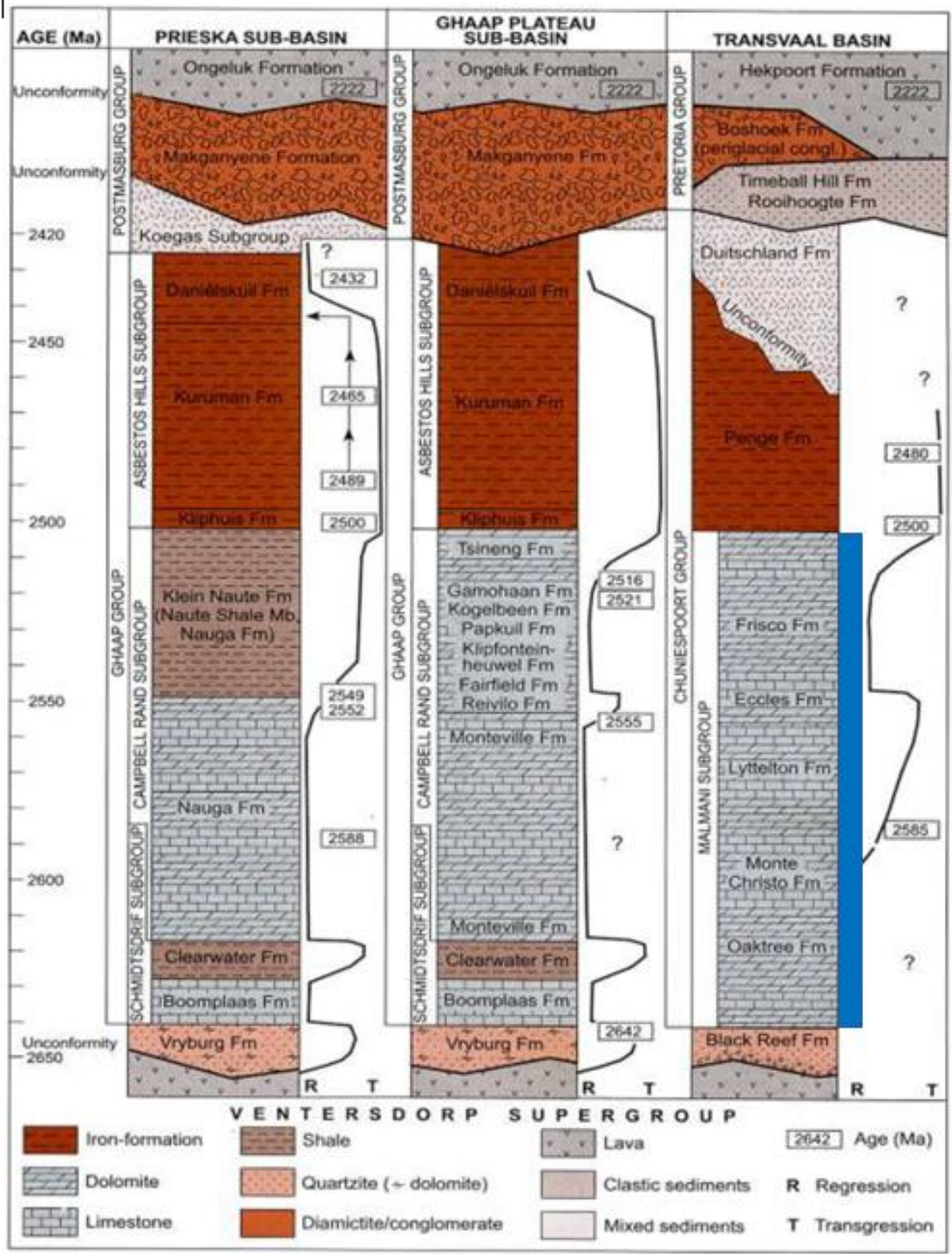


Figure 5: Stratigraphy of the Transvaal Supergroup of the Transvaal Basin. The proposed development is indicated in blue (Eriksson, et al. 2006).

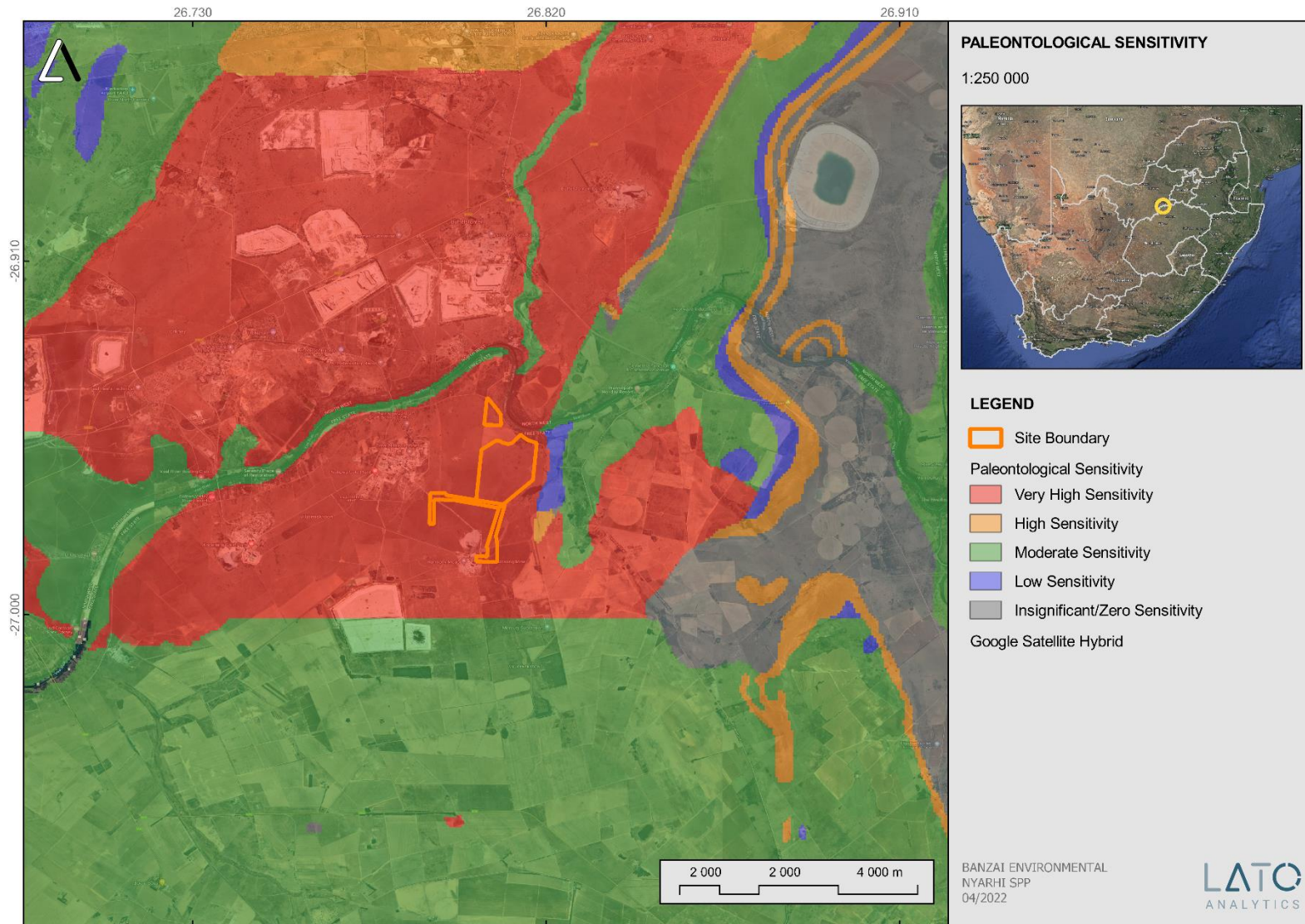




Figure 6: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed Nyarhi SPP and grid development.

Table 7: 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 proposed Nyarhi Solar Power Plant is indicated in orange, yellow and purple. According to the SAHRIS Palaeosensitivity map (**Figure 6, Table 7**) the proposed development is underlain by sediments with a Very High (red) Palaeontological Significance.

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

## 6 GEOGRAPHICAL LOCATION OF THE SITE

The Nyarhi SPP is located on Portion 1 of the Farm Die Hoek No. 114, Portion 1 of the farm Doornkom-oost No. 447, Doornplaats No. 559 while the power line is located on Portion 1 of the Farm Die Hoek No. 114 and Hoekplaats No. 598 in the Fezile Dabi District Municipality, Moqhaka Local Municipality (**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 include 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 will thus 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 Environmaics.
- 1:250 000 2626 Wes-Rand (1986) Geological Map (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 12-13 March 2022. Outcrops of weathered to well-preserved stromatolites were discovered on the whole development. It is important to note that a small portion of a stromatolite is usually exposed at the surface while the largest part of the specimen is below surface. Stromatolite abundancy in the development footprint is indicated in **Figure 13**.



*Figure 7: Northern portion of the proposed development. Ground surface is covered by dense grassy vegetation*



*Figure 8: Well preserved stromatolites in the centre of the development  
GPS coordinates -26.957236S; 26.811521E*



*Figure 9:Stromatolites outcrops on the surface of the proposed development.*

GPS coordinates -26.959743S 26.815940E



*Figure 10:Exceptionally well- preserved oolites*

GPS coordinates -26.961130S 26.813895E



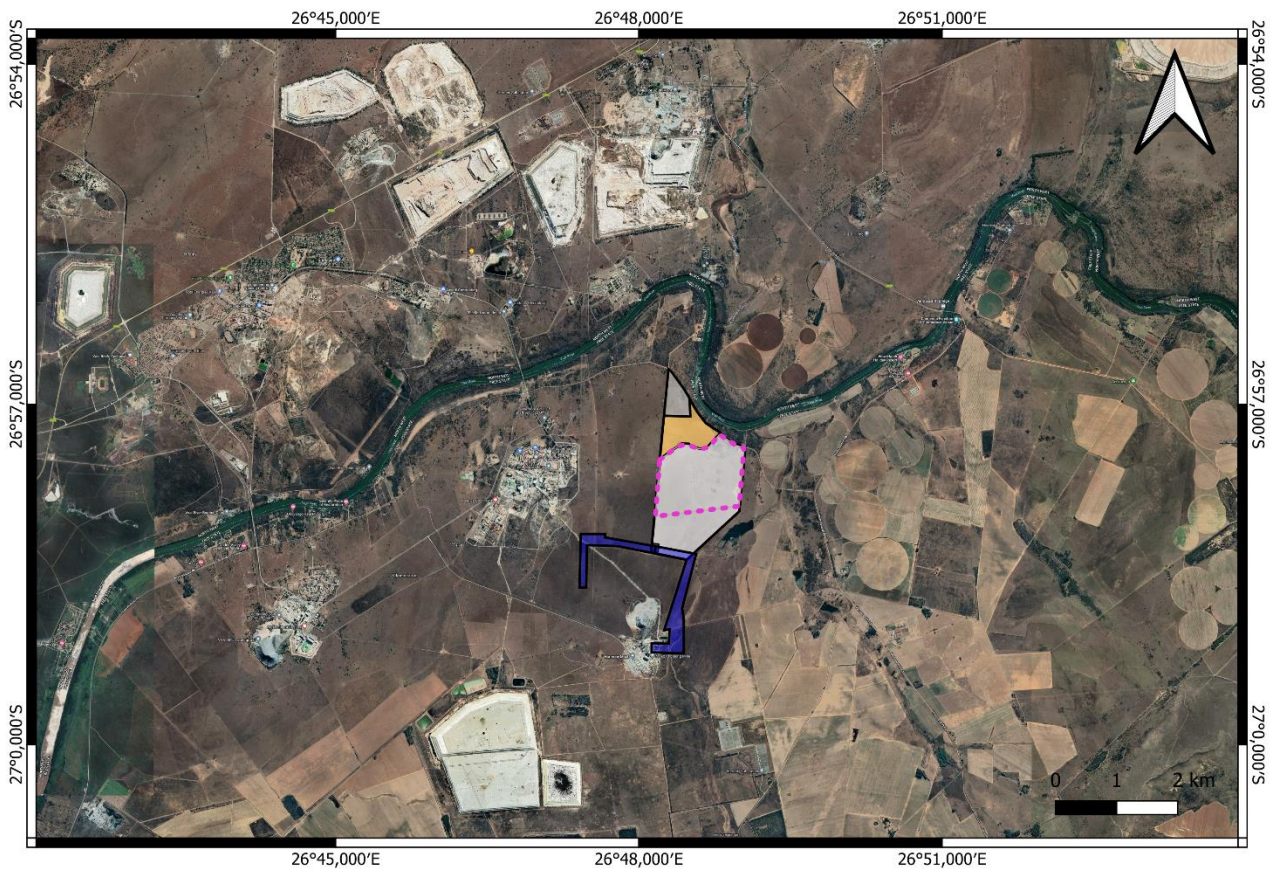
*Figure 11: Example of well-preserved stromatolite outcrops present in the development*

GPS coordinates -26.960860S 26.814467E





*Figure 12: Southern portion of the proposed development has less to no outcrops*



*Figure 13: Well preserved oolites and stromatolites are preserved in the purple dashed line. The concentration of fossils reduces from north to south.*

## 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.

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 8: The rating system*

<b>NATURE</b>		
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).

#### **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.
<b>INTENSITY/ MAGNITUDE</b>		
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.

### **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
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**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.

## CUMULATIVE IMPACT

Table 9:A summary of related facilities, that may have a cumulative impact, in a 30 km radius of the Nyarhi SPP

Site name	Distance from study area	Proposed generating capacity	DEFF reference	EIA process	Project status
Paleso SPP <sup>1</sup>	9km	150MW	14/12/16/3/3/1/2365	Basic Assessment	Approved
Siyanda SPP	8km	150MW	14/12/16/3/3/1/2369	Basic Assessment	Approved
Thakadu SPP	1km	150MW	14/12/16/3/3/1/2476	Basic Assessment	In Process
Noko SPP	21km	150MW	14/12/16/3/3/1/2474	Basic Assessment	In Process

<sup>1</sup> Environamics was the EAP responsible for the Basic Assessments for the Paleso, Siyanda, Noko and Thakadu Solar Power Plants.



Kabi Vaalkop PV 3	6km	75 MW	12/12/20/2513/3	Scoping and EIA	Approved
Kabi Vaalkop PV 2	7km	75 MW	12/12/20/2513/2	Scoping and EIA	Approved
Kabi Vaalkop PV <sup>2</sup>	7.5km	75 MW	12/12/20/2513/4	Scoping and EIA	Approved
Kabi Vaalkop PV 1	7km	75 MW	12/12/20/2513/1	Scoping and EIA	Approved
Buffels Solar PV 1	5 km	100MW	14/12/16/3/3/2/777	Scoping and EIA	Approved
Buffels Solar PV 2	6 km	100 MW	14/12/16/3/3/2/778	Amendment	Approved
Rietvlei solar	16 km	-	14/12/16/3/3/2/450	Scoping and EIA	Withdrawn/Lapsed
Genesis Orkney Solar (Pty) Ltd	23 km	100MW	14/12/16/3/3/2/954	Scoping and EIA	Approved
Afropulse 538 Pty Ltd	13 km	50MW	12/12/20/2280	BAR	Withdrawn/Lapsed

<sup>2</sup> The application was only for transmission infrastructure (i.e. substation and power lines) and not a PV solar power plant.

It is unclear whether other projects not related to renewable energy is or has been constructed in this area, - SOUTH VAAL, and whether other projects are proposed. In general, development activity in the area is focused on agriculture and mining. It is quite possible that future solar farm development may take place within the general area.

The next section of this report will aim to evaluate the potential for solar projects for this area in the foreseeable future.

The cumulative Impacts of the area will include approved Solar Power facilities within a 30 km radius of the project site. As mentioned, the SPP are all underlain by general similar geology and thus the Impact on these developments will be similar.

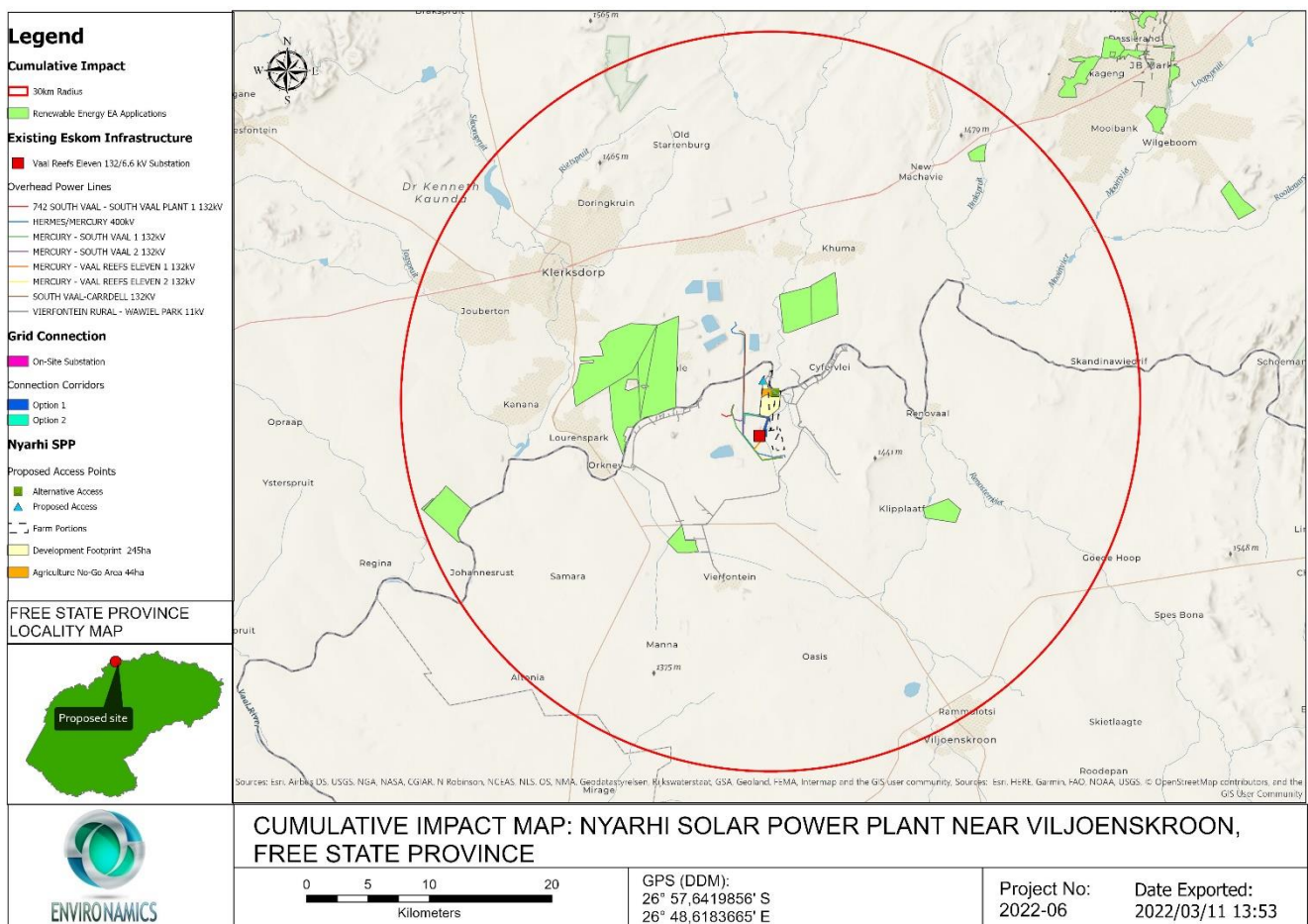


Figure 14: Nyarhi SPP Geographic area of evaluation with utility-scale renewable energy generation sites and power lines

Table 10: Summary of Impacts

	Extent	Duration	Magnitude	Reversibility	Irreplaceable loss	Cumulative effect	Impact
Pre-mitigation	1	4	3	4	4	3	Negative High 64
Post-mitigation	1	4	2	4	4	2	Negative Medium 30

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

## 11 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Precambrian dolomites and associated marine sedimentary rocks that are allocated to the Malmani (Chuniespoort Group, Transvaal Supergroup). According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Malmani Subgroup is Very High (Almond *et al*, 2013; SAHRIS website).

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 12-13 March 2022. Outcrops of weathered to well-preserved stromatolites were discovered on the whole development, but less prominent in the south of the development. Examples of exceptionally well preserved oolites were recovered from the centre portion of the development footprint. Mitigation of a sample of well-preserved stromatolites and oolites is thus recommended. By implementing mitigation measures the significance of the impact will be reduced to medium. Mitigation should take place after initial vegetation is cleared away but *before* the ground is levelled for construction. These recommendations should be included in the Environmental Management Plan of the Nyarhi Solar Plant.

### **Recommendations:**

- The ECO must be made aware that fossils (stromatolites) of the Malmani (Chuniespoort Group, Transvaal Supergroup) has a Very High Palaeontological Significance.
- When the Nyarhi Power Plant layout has been established a walkdown of the area must be completed by a qualified Palaeontologist to catalogue and photograph well-preserved stromatolites. This action should take place after initial vegetation clearance but *before* the ground is levelled for construction.
- If a well preserved stromatolite outcrop falls in the development footprint the stromatolites ought to be cordoned off and a buffer of 30m should be placed around the outcrop.

- An representative example of well-preserved stromatolites should be removed and placed near the offices of the PV as a informative example of fossils in the area.

It is therefore considered that the proposed development is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. Thus, the construction of the development may be authorised in its whole extent.

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## APPENDIX A – ELIZE BUTLER CV

### ELIZE BUTLER

**PROFESSION:** Palaeontologist  
**YEARS' EXPERIENCE:** 28 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 Bloemfontein	National Museum,
and Collection Manager	1998–currently

## TECHNICAL REPORTS

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**Butler, E. 2014.** Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoot, Northern Cape Province. 2014. Bloemfontein.

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**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.

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**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.

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**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.

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**Butler, E. 2017.** Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.

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**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.

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

**Butler, E. 2017.** PIA site visit and report 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.

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

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

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

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

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.

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

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

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**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed development of the H<sub>2</sub> Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.

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

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.

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

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

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

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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General (D), Diamonds (Dia) and Diamonds In Kimberlite (Dk) near Prieska On Portion 7, a certain Portion of the Remaining Extent of Portion 9 (Wouter), Portion 11 (De Hoek), Portion 14 (Stofdraai) (Portion of Portion 4), the Remaining Extent of Portion 16 (Portion Of Portion 9) (Wouter) and the Remaining Extent of Portion 18 (Portion of Portion 10) of the Farm Lanyon Vale 376, Registration Division: Hay, Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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**Butler, E., 2021.** Palaeontological Desktop Assessment to assess the proposed Gariiep Road upgrade near Groblershoop, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Ngwedi Solar Plant which forms part of the authorised Paleso Solar Powerplant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Noko Solar Power Plant and power line which forms part of the authorised Paleso Solar Powerplant near Orkney in the North West. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Proposed Power Line as part of the Paleso Solar Power Plant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Thakadu Solar Plant which forms part of the authorised Paleso Solar Powerplant near Viljoenskroon in the Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the proposed Farming Expansions on Portions 50 of the Farm Rooipoort 555 JR, Portion 34 of the Farm Rooipoort 555 JR, Portions 20 and 49 of the Farm Rooipoort 555 JR and Portion 0(RE) of the Farm Oudou Boerdery 626 JR, Tshwane Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the proposed Saselamani CBD on the Remainder of Tshikundu's Location 262 MT, and the Remainder of Portion 1 of Tshikundu's Location 262 MT, Collins Chabane Local Municipality, Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed expansions of the existing Molare Piggery infrastructure and related activities on Portion 0(Re) of the farm Arendsfontein 464 JS, Portion 0(Re) of the farm Wanhoop 443 JS, Portion 0(Re) of the farm Eikeboom 476 JS and Portions 2 & 7 of the farm Klipbank 467 JS within the jurisdiction of the Steve Tshwete Local Municipality, Mpumalanga Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Nchwaning Rail Balloon Turn Outs at Black Rock Mine Operations (BRMO) near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Black Rock Mining Operations (BRMO) new rail loop and stacker reclaimer Project at Gloria Mine near Hotazel in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2020.** Palaeontological Desktop Assessment for the proposed Nchwaning Rail Balloon Turn Outs at Black Rock Mine Operations (BRMO) near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed utilization of one Borrow Pit for the planned Clarkebury DR08034 Road Upgrade, Engcobo Local Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Kappies Kareeboom Prospecting Project on Portion 1 and the Remainder of the farm Kappies Kareeboom 540, the Remainder of Farm 544, Portion 5 of farm 534 and Portion 1 of the farm Putsfontein 616, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Kameel Fontein Prospecting Project on the Remainder of the farm Kameel Fontein 490, a portion of the farm Strydfontein 614 and the farm Soetfontein 606, ZF Mgcawu District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Lewis Prospecting Project on Portions of the Farms Lewis 535, Spence 537, Wright 538, Symthe 566, Bredenkamp 567, Brooks 568, Beaumont 569 and Murray 570,

John Taolo Gaetsewe District Municipality in the Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the Construction of the Ganspan Pering 132kV Powerline, Phokwane Local Municipality, Frances Baard District Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the Longlands Prospecting Project on a Portion of the farm Longlands 350, Frances Baard District Municipality, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed development of 177 new units in the northern section of Mpongo Park in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Qhumanco Irrigation Project, Chris Hani District Municipality Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Raphuti Settlement Project on Portions of the Farm Weikrans 539KQ in the Waterberg District Municipality of the Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Senqu Rural Project, Joe Gqabi District Municipality, Senqu Local Municipality, in the Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed new Township development on portion of the farm Klipfontein 716 and farm Ceres 626 in Bloemfontein, Mangaung Metropolitan Municipality, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the ECDOT Borrow Pits and WULA near Sterkspruit, Joe Gqabi District Municipality in the Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed SANRAL Stone Crescent Embankment Stabilisation Works along the N2 on the farm Zyfer Fonteyn 253 (Portion 0, 11 and 12RE) and Palmiet Rivier 305 (Portion 34, 36) near Grahamstown in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the Klein Rooipoort Trust Citrus Development, in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed Victoria West water augmentation project in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Campbell Sewer, Internal Reticulation, Outfall Sewer Line and Oxidation Ponds,

located on ERF 1, Siyancuma Local Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Development and Upgrades within the Great Fish River Nature Reserve, Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for proposed Parsons Power Park a portion of Erf 1. within the Nelson Mandela Bay Municipality in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed expansion of the farming operations on part of portions 7 and 8 of farm Boerboonkraal 353 in the Greater Tubatse Local Municipality of Sekhukhune District, Limpopo Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment to assess the proposed low-level pedestrian bridge, in Heilbron, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment to assess the proposed township developments in Hertzogville, Malebogo, in Heilbron, Free State. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed construction of Malangazana Bridge on Farm No.64 Nkwenkwana, Engcobo Local Municipality, Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment to assess the proposed Construction of Middelburg Integrated Transport Control Centre on Portion 14 of Farm 81 Division of Middelburg, Chris Hani District Municipality in the Eastern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment for the Witteberge Sand Mine on the remainder of farm Elandskrag Plaas 269 located in the Magisterial District of Laingsburg and Central Karoo District Municipality in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Impact Assessment (PIA) to assess the proposed Agrizone 2, Dube Trade Port in KwaZulu Natal Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2021.** Palaeontological Desktop Assessment assessing the proposed Prospecting Right application without bulk sampling for the prospecting of Chrome ore and platinum group metals on the Remaining Extent of the farm Doornspruit 106, Registration Division: HO; North West Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the proposed Ennerdale Extension 2 Township Establishment on the Undeveloped Part of Portion 134 of the Farm Roodepoort 302IQ, City of Johannesburg Metropolitan Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the Construction of the ESKOM Mesong 400kV Loop-In Loop-Out Project, Ekurhuleni Municipality, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the Proposed Vinci Prospecting Right Application on the Remainder of the Farm Vinci 580, ZF Mgcawu District Municipality, in the Northern Cape Province, Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the proposed Farm 431 Mining Right Application (MRA), near Postmasburg, ZF Mgcawu District Municipality, in the Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Impact Assessment for the Leeuw Braakfontein Colliery Expansion Project (LBC) in the Amajuba District Municipality, KwaZulu-Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the proposed reclamation of the 5L23 TSF in Ekurhuleni, Gauteng Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the Proposed Mogalakwena Mine Infrastructure Expansion (near Mokopane in the Mogalakwena Local Municipality, Limpopo Province). Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment for the proposed 10km Cuprum to Kronos Double Circuit 132kV Line and Associated Infrastructure in Copperton in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Impact Assessment for the proposed Hoekplaas WEF near Victoria West in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment (PDA) assessing the proposed Prospecting Right Application without bulk sampling for the Prospecting of Diamonds Alluvial (DA), Diamonds General (D), Diamonds in Kimberlite (DK) & Diamonds (DIA) on the Remaining Extent of the Farm Goede Hoop 547, Remaining Extent of the Farm 548, Remaining Extent of Portion 2 and Portion 3 of the Farm Skeyfontein 536, Registration Division: Hay, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Impact Assessment for the proposed extension of Duine Weg Road between Pellsrus and Marina Martinique as well as a Water Use Authorisation (WUA) for the project. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Proposed Mimosa Residential Development and Associated Infrastructure on Fairview Erven, in Gqeberha (Port Elizabeth), Nelson Mandela Bay Metropolitan Municipality, Eastern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Impact Assessment for the Witteberge Sand Mine on the remainder of farm Elandskrag Plaas 269 located in the Magisterial



District of Laingsburg and Central Karoo District Municipality in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

**Butler, E., 2022.** Palaeontological Desktop Assessment to assess the Palaeontology for the Somkhele Anthracite Mine's Prospecting Right Application, on the Remainder of the Farm Reserve no 3 No 15822 within the uMkhanyakude District Municipality and the Mtubatuba Local Municipality, KwaZulu Natal. Banzai Environmental (Pty) Ltd, Bloemfontein.