BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL DESKTOP ASSESSMENT

COPPER SOLAR POWER PLANT NEAR NORTHAM, LIMPOPO PROVINCE

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

Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

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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 3 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 3 – 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 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8	-

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.**
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	-	Desktop Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 4Approach 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 & 10	
(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	

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.**
(k) Any mitigation measures for inclusion in the EMPr	Section 10	
(l) Any conditions for inclusion in the environmental authorisation	Section 10	
(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

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.**
		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 2 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by Environamics Environmental Consultants to conduct the **Palaeontological Desktop Assessment** (PDA) to assess the Copper Solar Power Plant (SPP), near Northam, Limpopo Province. Under 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 approved development area and to evaluate the potential impact of the proposed changes to the development on the Palaeontological Heritage.

The Copper Solar Power Plant is underlain by Nebo Granite (Lebowa Granite Suite) of the Bushveld Complex as well as sediments of the Pretoria Group. In this area the Pretoria Group is undifferentiated. Updated geology (mapped by the Council of Geosciences, Pretoria) refines the geology and indicates that the development is underlain by Nebo Granite as well as the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup). The Palaeotechnical Report of the Limpopo Province (Groenewald et al, 2014) as well as the South African Heritage Resources Information System (SAHRIS) (Almond *et al*, 2013; SAHRIS website) allocates a Zero Palaeontological Sensitivity to the Bushveld Complex and a High to the Timeball Hill Formation. However, the igneous rocks of the Bushveld Complex probably compromised the original fossil content of the microbial stromatolites and microfossils by thermal metamorphosis.

Based on the desktop research it is concluded that fossil heritage of scientific and conservational interest in the Copper SPP Project is relatively rare. This is in contrast with the High Sensitivity allocated to the development area by the SAHRIS Palaeosensitivity Map and DFFE Screening Tool. **A medium Palaeontological Significance has been allocated for the construction phase of the SPP development pre-mitigation and a low significance post mitigation**. The construction phase will be the only development phase impacting Palaeontological Heritage and **no significant impacts are expected to impact the Operational and Decommissioning phases**. As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The **Cumulative impacts of the Copper SPP development near Northam in Limpopo is considered to be low pre-mitigation and very Low post mitigation and falls within the acceptable limits for the project**. It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. **The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.** It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

Recommendations:

- The ECO for this project must be informed that the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup has a High Palaeontological Sensitivity.
- If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance find Protocol attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: Heritage Western Cape, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. 3rd floor Protea Assurance Building, 142 Longmarket St, Cape Town City Centre, Cape Town, 8000; Private Bag X9067, Cape Town, 8000 Tel: 021 483 9598. Fax: +27 (0) 21 483 9845. Web: www.hwc.org.za) so that mitigation (recording and collection) can be carried out.
- Before any fossil material can be collected from the development site, the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the Copper SPP.

Impact Summary

Environmental parameter	**Issues**	**Rating prior to mitigation**	**Average**	**Rating post mitigation**	**Average**
Planning Stage	No Impact		No Impact		No Impact
Construction Stage Copper SPP	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	30	Negative Medium impact	14	Low impact
Operational Phase Copper SPP	No Impact		No Impact		No Impact
Decommissioning Phase Copper SPP	No Impact		No Impact		No Impact

It is therefore considered that the proposed Copper SPP will not lead to detrimental impacts on the palaeontological reserves of the area. Thus, from a palaeontological point of view the construction of the development may be authorised in its whole extent.

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1 INTRODUCTION

Copper Solar Power Plant (RF) (Pty) Ltd proposes the development of the Copper Solar Power Plant near Northam, in the Limpopo Province (Figure 1-3, Table 2-3).

Table 2: General site information

Description of affected farm portion	<u>Solar Power Plant:</u> Portion 5 of the Farm Zwartdoorns no. 421 Remaining Extent of Portion 1 of the Farm Zwartdoorns no. 421 <u>Grid Connection:</u> Remaining Extent of the Farm Nooitgedacht No. 11 Portion 1 of the Farm Nooitgedacht No. 11 Portion 32 of the Farm De Put No. 412 Portion 19 of the Farm De Put No. 412 Portion 18 of the Farm De Put No. 412 Portion 41 of the Farm De Put No. 412 Portion 21 of the Farm De Put No. 412 Remaining Extent of the Farm Tusschenkomst No. 15 Portion 1 of the Farm Tusschenkomst No. 15 Portion 2 of the Farm Tusschenkomst No. 15 Portion 3 of the Farm Tusschenkomst No. 15 Portion 1 of the Farm Spitskop No. 410 Portion 2 of the Farm Spitskop No. 410 Portion 1 of the Farm Makayskraal No. 18 Remaining Extent of Portion 1 of the Farm Zwartdoorns No. 421 Portion 2 of the Farm Zwartdoorns No. 421 Portion 3 of the Farm Zwartdoorns No. 421 Portion 5 of the Farm Grootkuil No. 409 Remaining Extent of Portion 10 of the Farm Wildebeestlaagte No. 411 Portion 12 of the Farm Wildebeestlaagte No. 411 Portion 15 of the Farm Wildebeestlaagte No. 411 Portion 17 of the Farm Wildebeestlaagte No. 411 Portion 18 of the Farm Wildebeestlaagte No. 411 Portion 19 of the Farm Wildebeestlaagte No. 411 Portion 29 of the Farm Wildebeestlaagte No. 411

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Province	Limpopo
District Municipality	Waterberg District Municipality
Local Municipality	Thabazimbi Local Municipality
Ward numbers	7
Closest towns	Northam is located approximately 2km north of the proposed development.
21 Digit Surveyor General codes	<u>Solar Power Plant:</u> Portion 5 of the Farm Zwartdoorns no. 421 T0KQ00000000042100005 Remaining Extent of Portion 1 of the Farm Zwartdoorns no. 421 T0KQ00000000042100000 <u>Grid Connection:</u> Remaining Extent of the Farm Nooitgedacht No. 11 T0JQ00000000001100000 Portion 1 of the Farm Nooitgedacht No. 11 T0JQ00000000001100001 Portion 18 of the Farm De Put No. 412 T0KQ00000000041200018 Portion 19 of the Farm De Put No. 412 T0KQ00000000041200019 Portion 21 of the Farm De Put No. 412 T0KQ00000000041200021 Portion 32 of the Farm De Put No. 412 T0KQ00000000041200032

	Portion 41 of the Farm De Put No. 412 T0KQ00000000041200041 Remaining Extent of the Farm Tusschenkomst No. 15 T0JQ00000000001500000 Portion 1 of the Farm Tusschenkomst No. 15 T0JQ00000000001500001 Portion 2 of the Farm Tusschenkomst No. 15 T0JQ00000000001500002 Portion 3 of the Farm Tusschenkomst No. 15 T0JQ00000000001500003 Portion 1 of the Farm Spitskop No. 410 T0KQ00000000041000001 Portion 2 of the Farm Spitskop No. 410 T0KQ00000000041000002 Portion 1 of the Farm Makayskraal No. 18 T0JQ00000000001800001 Remaining Extent of Portion 1 of the Farm Zwartdoorns No. 421 T0KQ00000000042100000 Portion 2 of the Farm Zwartdoorns No. 421 T0KQ00000000042100002 Portion 3 of the Farm Zwartdoorns No. 421 T0KQ00000000042100003 Portion 5 of the Farm Grootkuil No. 409 T0KQ00000000040900005 Remaining Extent of Portion 10 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100010 Portion 12 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100012 Portion 15 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100015 Portion 17 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100017 Portion 18 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100018 Portion 19 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100019

	Portion 29 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100029 Portion 30 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100030 Portion 31 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100031 Portion 32 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100032 Portion 33 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100033 Portion 48 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100048 Portion 49 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100049 Portion 69 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100069 Portion 70 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100070 Portion 112 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100112 Portion 113 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100113 Portion 173 of the Farm Wildebeestlaagte No. 411 T0KQ00000000041100173
Type of technology	Photovoltaic solar facility
Structure Height	Panels ~ 6m; Buildings ~ 6m; Power line ~ 32m; and Battery storage facility ~ 8m.
Battery storage	Within a 4-hectare area
Surface area to be covered (Development footprint)	715 ha
EIA Footprint	Assessed 739 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 250MW

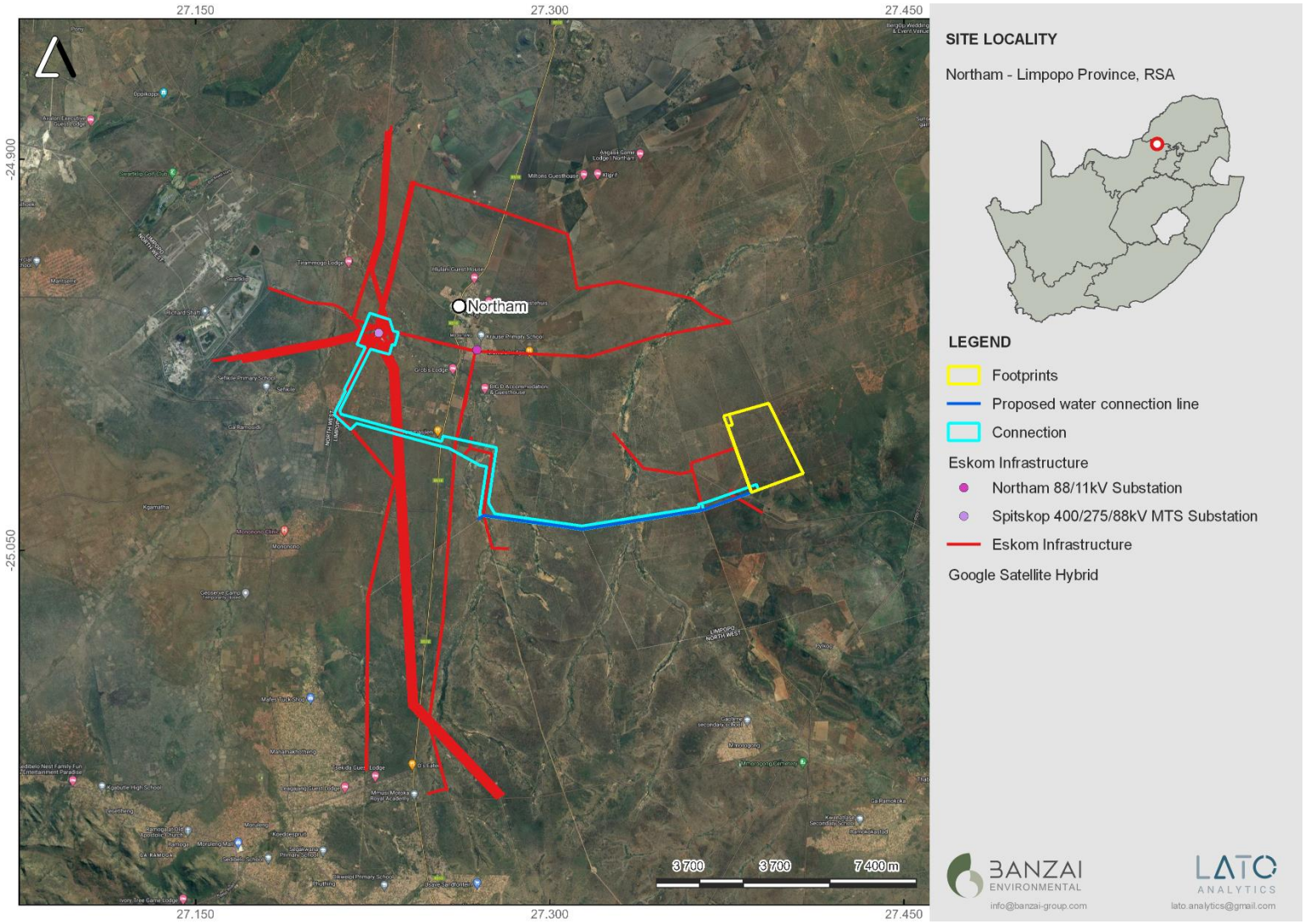


Figure 1: *Regional locality of Copper SPP, near Northam, Limpopo Province.*

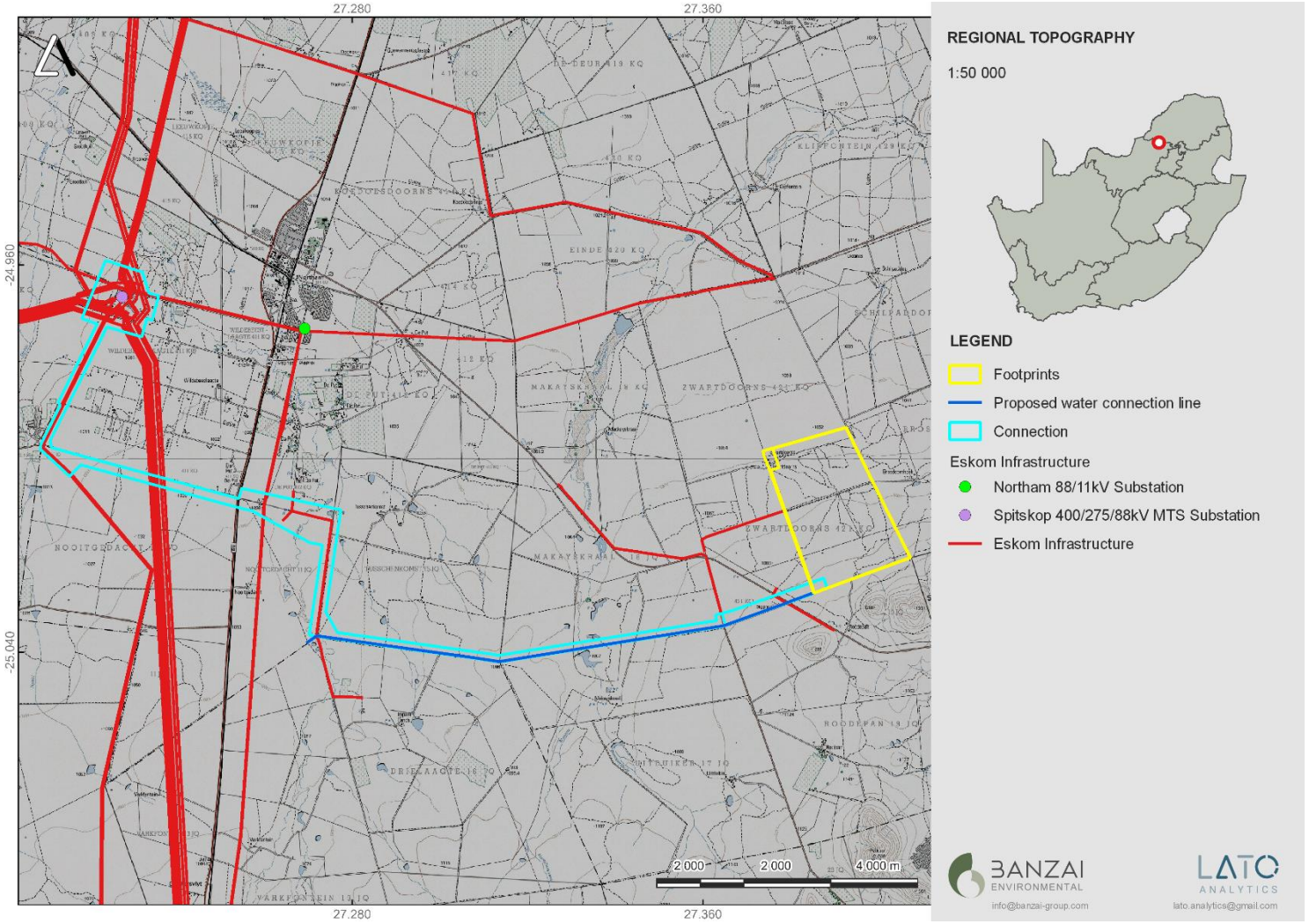


***Figure 2**: Locality of the Copper SPP, near Northam, Limpopo Province.*

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 250MW, 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. Generation from the facility will tie in with a newly proposed collector substation to be connected to the national grid via one of the existing Eskom 275kV or 400kV lines from Spitskop 400/275/88/kV MTS Substation or directly to the Spitskop 400/275/88/kV MTS Substation. The connection power line will be constructed within the limits of the grid connection corridor. The Project will inject up to 250MW into the National Grid. Refer to the figure below.

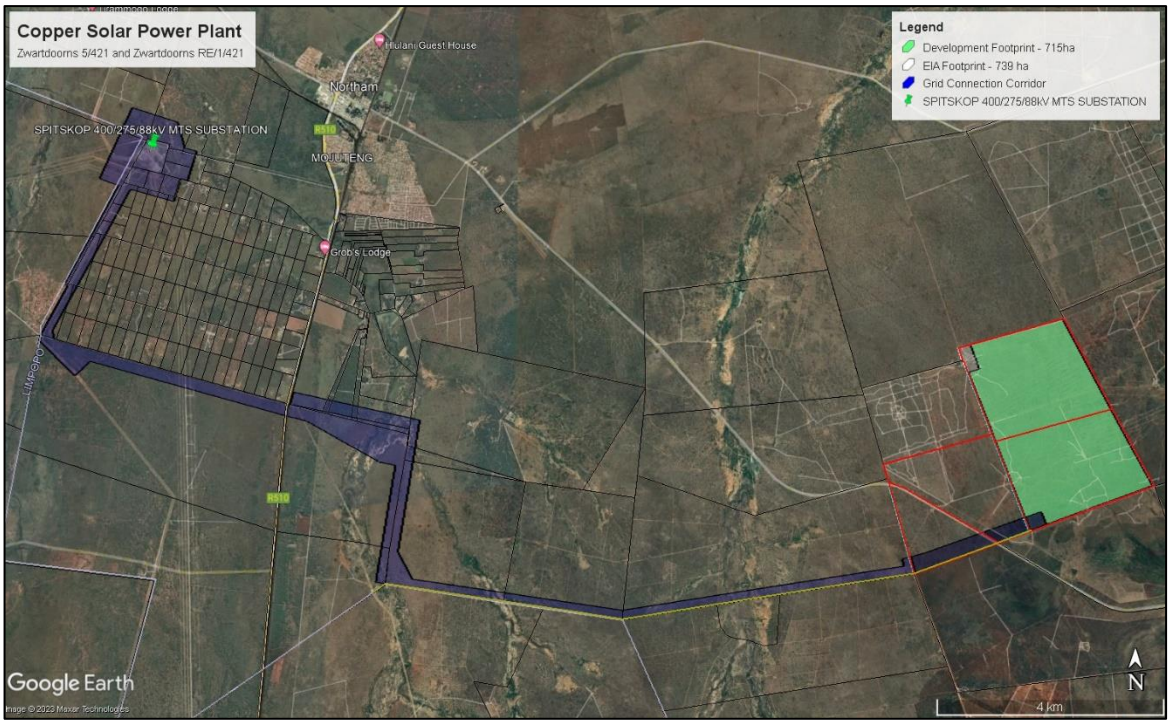


***Figure 3**: Grid connection Corridor for the Copper SPP.*

Electrical reticulation network

An internal electrical reticulation network will be required and will be lain ~2-4m underground as far as practically possible.

Supporting Infrastructure

All associated infrastructure will be constructed within the limits of the infrastructure and ancillary complex which will include an on-site substation, Battery Energy Storage System, Operations and Maintenance buildings etc.

Battery storage

A Battery Storage Facility with a maximum height of 8m and a maximum volume of 1,740 m^3 of batteries and associated operational, safety and control infrastructure.

Roads

Access will be obtained from the D1235 road. There will be a service road for direct access to the facility from the D1235 road. And a service road for the water pipeline. An internal site road network will also be required to provide access to the solar field and associated infrastructure.

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	715 Hectares (Development footprint)
Number of inverters required	Minimum 50
Area occupied by inverter / transformer stations / substations / BESS	Central inverters+ LV/MV trafo: 750 m^2 HV/MV substation with switching station: 1,5 ha BESS: 4 ha (within the Infrastructure & Ancillary Complex)
Capacity of on-site substation	132kV
Capacity of the power line	132kV
Area occupied by both permanent and construction laydown areas	Permanent Laydown Area: 715 Hectares Construction Laydown Area: ~5 ha
Area occupied by buildings	Infrastructure & Ancillary Complex: ~20 ha
Battery storage facility	Maximum height: 8m Maximum volume: 1740 m^3 Capacity ~up to 150MWh
Length of access roads	TBC
Width of access roads	8 m - 10 m
Length of internal roads	TBC
Width of internal roads	4 m – 6 m
Length of perimeter roads	TBC
Width of perimeter roads	4 m – 6 m
Grid connection corridor width	417 m up to 1.5 km
Grid connection corridor length	~ 25 km
Power line servitude width	32 m
Height of fencing	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:

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 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 the Remaining Extent of Portion 1 and Portion 5 of the Farm Zwartdoorns No. 421. 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 EIA proses.

Technical alternatives: Powerlines

Generation from the facility will tie in with a newly proposed collector substation to be connected to the national grid via one of the existing Eskom 275kV or 400kV lines from Spitskop 400/275/88/kV MTS Substation or directly to the Spitskop 400/275/88/kV MTS Substation. The connection power line will be constructed within the limits of the grid connection corridor. The Project will inject up to 250MW into the National Grid.

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^3 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.

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.

2 LEGAL MANDATE AND PURPOSE OF THE REPORT

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.

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)	• *"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."* • Activity 11(i) is triggered as the proposed photovoltaic solar facility will transmit and distribute electricity of 132 kilovolts outside an urban area.
GNR. 327 (as amended in 2017)	Activity 28(ii)	• *"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."*

		• 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.
GNR. 327 (as amended in 2017)	Activity 24(ii)	• *"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;* • Activity 24(ii) is triggered as the access road will be 8-10 meters in width.
GNR. 327 (as amended in 2017)	Activity 56 (ii):	• *"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…"* • 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.
GNR. 325 (as amended in 2017)	Activity 1	• *"The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more."* • Activity 1 is triggered since the proposed photovoltaic solar facility will generate up to 250 megawatts electricity through the use of a renewable resource.
GNR. 325 (as amended in 2017)	Activity 15	• *"The clearance of an area of 20 hectares or more of indigenous vegetation."* • More than 20 hectares of indigenous vegetation will be cleared.

The activities triggered under Listing Notice 1 and 2 (Regulation 327 & 325) 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. The listed activities indicated above are subject to change with the input from specialists.

2.1 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
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

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

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

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

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

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

- the re-zoning of a site exceeding 10 000 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

3 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 400 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-nine 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.

4 METHODS AND TERMS OF REFERENCES

This study forms part of the Heritage Impact Assessment Report. 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.

All possible information is consulted to compile a scoping report, and this includes the following: Provisional DFFE Screening Tool, SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical and geological maps as well as scientific articles of specimens from the development area and Assemblage Zones.

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.

During a site investigation the palaeontologist does not only survey the development but also tries to determine the density and diversity of fossils in the development area. This is confirmed by examining representative exposures of fossiliferous rocks (sedimentary rocks contain fossil heritage whereas igneous and metamorphic rocks are mostly unfossiliferous). Rock exposures that are investigated usually contains a large portion of the stratigraphic unit, can be accessed easily and comprise of unweathered (fresh) exposed rock. These exposures may be natural (rocky outcrops in stream or river banks, cliffs, dongas) but could also be artificial (quarries, open building excavations and even railway and road cuttings). It is common practice for palaeontologist to log well-preserved fossils (GPS, and stratigraphic data) during field assessment studies.

Mitigation usually precedes construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils, a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact is possible as 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 of sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    a. Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.

b. Indirect impacts of an activity are indirect or induced changes that may occur as a result of the activity.

c. Cumulative impacts are 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
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

4.1 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.

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the proposed Copper Solar Power Plant near Northam in Limpopo is depicted on the 1: 250 000 Thabazimbi 2426 (1974) and the Rustenburg 2526 (1981) Geological Map (Council for Geosciences, Pretoria) (Figure 4, Table 5). These maps indicate that the north-western portion of the development is underlain by Nebo Granite (Mn, brick colour) (Lebowa Granite Suite) while the rest of the development footprint is underlain by undifferentiated Pretoria Group (Transvaal Supergroup) (Vro, green). The most western portion of the proposed water collection line and grid connection is furthermore, underlain by the Rustenburg layered Suite (Bushveld Complex) (Figure 4-5, Table 5). Updated geology (mapped by the Council of Geosciences, Pretoria) refines the geology and indicates that the development is underlain by Nebo Granite as well as the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup) (Figure 6). The Palaeotechnical Report of the Limpopo Province

(Groenewald et al, 2014) (Table 6) as well as the South African Heritage Resources Information System (Figure 7, Table 7) (SAHRIS) (Almond *et al*, 2013; SAHRIS website) allocates a Zero Palaeontological Sensitivity to the Lebowa Granite Suite of the Bushveld Complex and a High Palaeontological Sensitivity to the Timeball Hill Formation (Table 5). However, the igneous rocks of the Bushveld Complex probably compromised the original fossil content of the microbial stromatolites and microfossils by thermal metamorphosis.

The Bushveld Complex comprise of the largest mafic intrusion in the world and underlie an area of almost 65 000 km^2. The maximum thickness of these rocks is almost 8 km while individual layers can be followed for about 150 km. This intrusion is world renowned for the ore reserves of platinum-group elements namely chromium and Copper. The Bushveld Complex is divided in 4 groups namely the Lebowa Granite Suite, Rashoop Granophyre Suite, Rustenburg Layered Suite and Rooiberg Group (Table 5). The latter Group of felsic and minor volcanic rocks may be genetically closer related to the Bushveld event as to the Transvaal Supergroup (Hutton and Schweitzer, 1995). The Rustenburg Layered Suite reveals a complete differentiation sequence of magma and is made up of various rock layers ranging from dunite, gabbro, norite, and pyroxenite, and anorthosite to magnetite and apatite-rich diorite.

The Timeball Hill Formation mantled by the superficial sediments comprises of conglomerates, diamictite, quartzite, minor lavas with lacustrine and fluvio-deltaic mudrocks, while the overlying Klapperkop Member of the Timeball Hill Formation consist of conglomerate, quartzite, shale and siltstone (Groenewald 2014). Catuneanu & Eriksson (2002) is of the opinion that the Timeball Hill Formation was deposited within a deep marine basin.

The Timeball Hill Formation is known to contain stromatolites and are associated with thin carbonate interbeds within turbidite sequences in the lower part of the formation (Catuneanu & Eriksson 2002). Stromatolites have not been recorded from the overlying fluvio-deltaic Klapperkop Quartzite Member. Other subunits in the Pretoria Group comprising stromatolites possibly also contain organic-walled microfossils.

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. The oxygen atmosphere that we depend on 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, 1995; Altermann 2001; Buick, 2001; and Schopf, 2006).

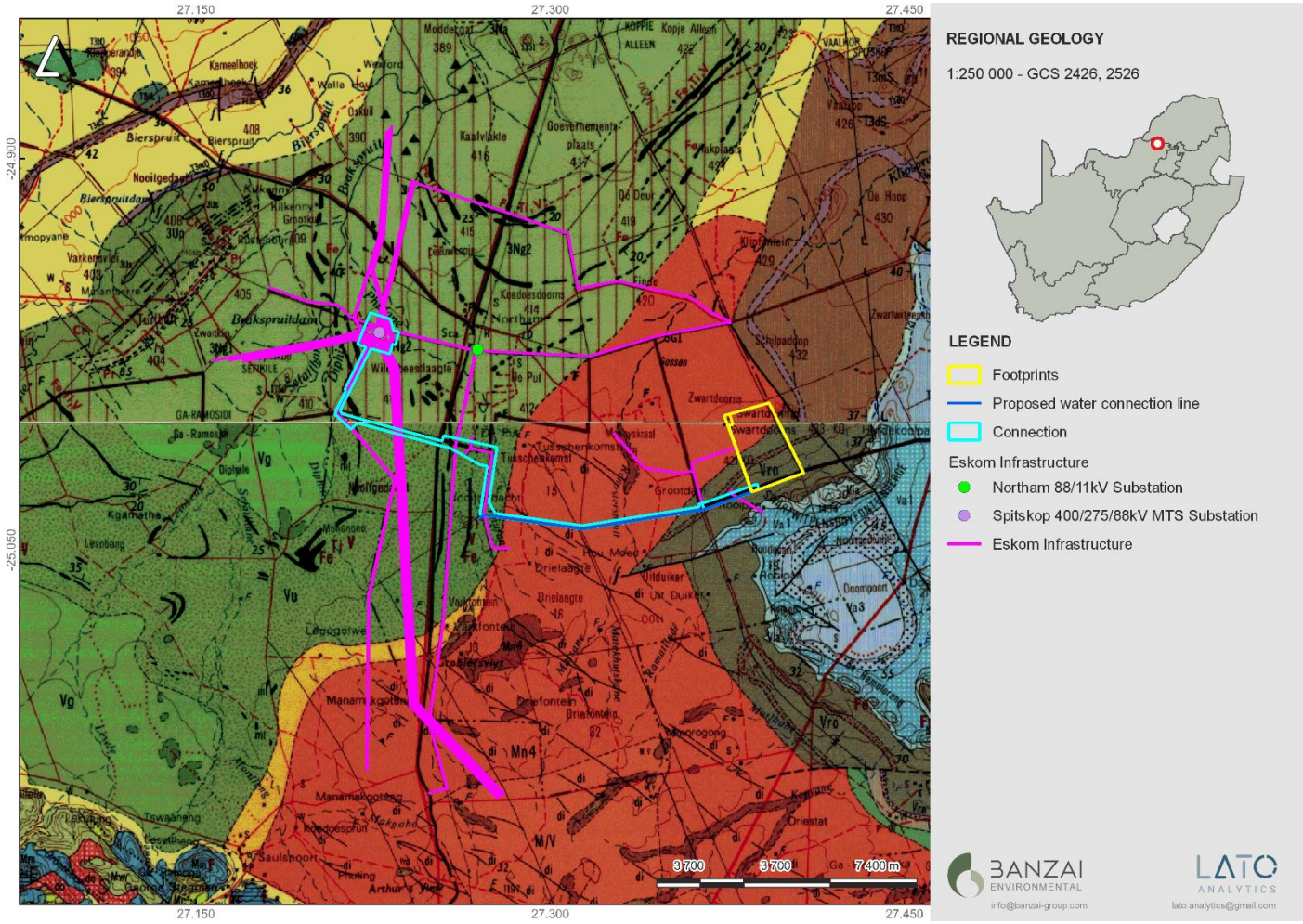
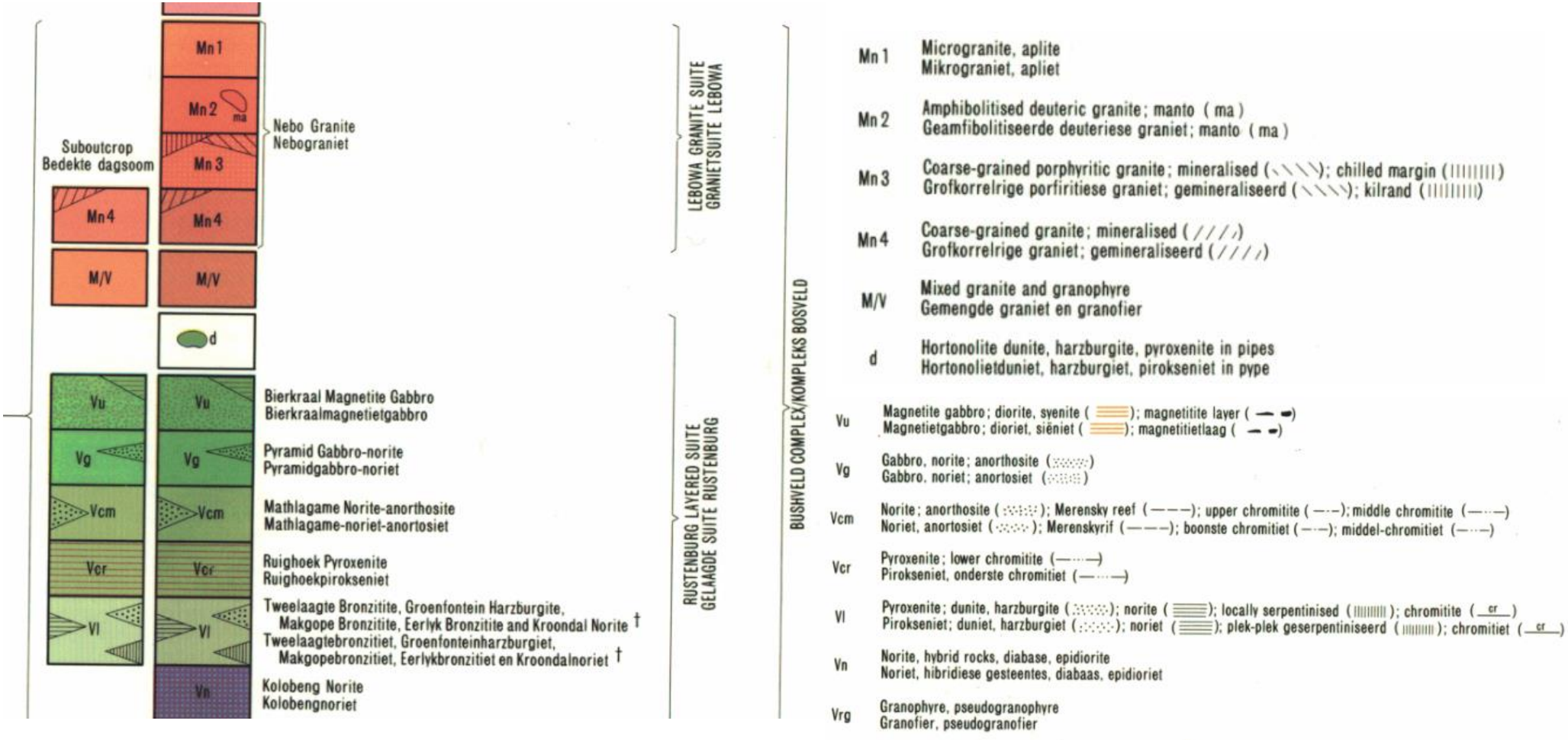


***Figure 4**: Extract of the 1: 250 000 Thabazimbi 2426 (1974) and the Rustenburg 2526 (1978) Geological Maps (Council for Geosciences, Pretoria) indicates that the Copper SPP is underlain by the* by Nebo Granite (Mn, brick colour) (Lebowa Granite Suite) while the rest of the development footprint is underlain by undifferentiated Pretoria Group (Transvaal Supergroup) (Vro, green).

Table 5: Legend of the 1: 250 000 Rustenburg 2526 (1978) Geological Maps (Council for Geosciences, Pretoria) *indicating the geology of the proposed Copper Solar Power Plant near Northam, in Limpopo.*



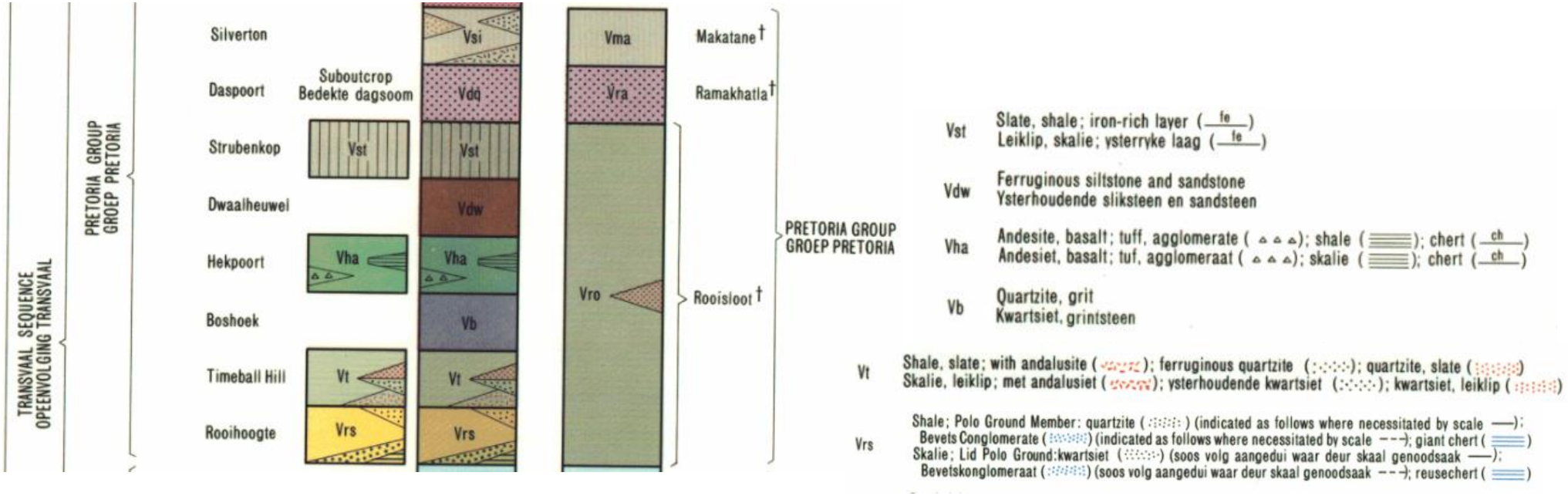

TRANSVAAL SEQUENCE
OPEENVOLGING TRANSVAAL
PRETORIA GROUP
GROEP PRETORIA
Silverton
Daspoort
Strubenkop
Dwaalheuwel
Hekpoort
Boshoek
Timeball Hill
Rooihoogte
Suboutcrop
Bedekte dagsoom
Vsi
Vdq
Vst
Vdw
Vha
Vb
Vt
Vrs
Vma
Vra
Vro
Makatane †
Ramakhatla †
Rooisloot †
PRETORIA GROUP
GROEP PRETORIA
Vst
Slate, shale; iron-rich layer (fe)
Leiklip, skalie; ysterryke laag (fe)
Vdw
Ferruginous siltstone and sandstone
Ysterhoudende sliksteen en sandsteen
Vha
Andesite, basalt; tuff, agglomerate; shale; chert (ch)
Andesiet, basalt; tuf, agglomeraat; skalie; chert (ch)
Vb
Quartzite, grit
Kwartsiet, grintsteen
Vt
Shale, slate; with andalusite; ferruginous quartzite; quartzite, slate
Skalie, leiklip; met andalusiet; ysterhoudende kwartsiet; kwartsiet, leiklip
Vrs
Shale; Polo Ground Member: quartzite (indicated as follows where necessitated by scale —);
Bevets Conglomerate (indicated as follows where necessitated by scale – – –); giant chert
Skalie; Lid Polo Ground:kwartsiet (soos volg aangedui waar deur skaal genoodsaak —);
Bevetskonglomeraat (soos volg aangedui waar deur skaal genoodsaak – – –); reusechert

Table 6: Modified Extract of the Palaeotechnical Report of the Limpopo Province (Groenewald, et al., 2014).

BUSHVELD MAGMATIC PROVINCE / BUSHVELD COMPLEX diabase (Vdi) unnamed granophyre (VC) Rashoop Granophyre Suite (Vra) Croydon Subsuite (Vc) Dwars River Subsuite (Vdr) Dsjate Subsuite (Vds) Roossenekal Subsuite (Vrs) Lebowa Granite Suite (Vlg) Shelter Norite (Vsn)		Vdi; VC; Vra; Vc; Vdr; Vds; Vrs; Vlg; Vsh; Vsh1; Vmn; Vme; Vzo; Z; Z23; Z26; Vcr; Vdj; Vds; Vmt1;		Intrusive igneous rocks Late Vaalian / Early Proterozoic 2.06 Ga Mafic intrusives of Rustenberg Layered Suite Intrusive granites & granophyres	No fossils recorded	Bushveld Complex has been described as "One of the great geological wonders of the world" – the largest layered igneous complex in the world with the richest reserves of platinum group metals known anywhere. Intruded between Magaliesberg Fm quartzites (Pretoria Group) and the Rooiberg Group volcanics.
		Dwaalheuwel (Vdw, Vhd)		Alluvial sandstones, conglomerates and mudrocks	No fossils recorded	ALERT FOR POTENTIALLY FOSSILIFEROUS LATE CAENOZOIC CAVE BRECCIAS WITHIN OUTCROP AREA OF CARBONATE SUBUNITS – i.e. LIMESTONES & DOLOMITES (breccias not individually mapped)
		Hekpoort (Vh, Vhd, Vha)		Volcanics (basalts, pyroclastics) with minor lacustrine shales	No fossils recorded	
		Boshoek (Vb)		Sandstones, conglomerats, diamictite (alluvial fans, [illegible])	No fossils recorded	
		Timeball Hill (Vt; Vti)	Klapperkop (Vkp)	Lacustrine and fluvio-deltaic mudrocks with diamictite, conglomerates, quartzite, minor lavas. Shale, siltstone, conglomerate, quartzite	Stromatolites	
		Rooihoogte (Vt)		Basal breccio-conglomerates, quartzites, mudrocks, carbonates (alluvial fan, lakes, karst infill)	No fossils recorded	
		Duitschland (Vd)		Conglomerate	No fossils recorded	
		Penge (Vp; Vpe)		Iron-rich shale	Stromatolites	

The Palaeotechnical Report (Groenewald et al., 2014) indicates that the Copper Solar Power Plant is underlain by sediments with a Zero (grey) and High (orange) Palaeontological Sensitivity (Table 7).

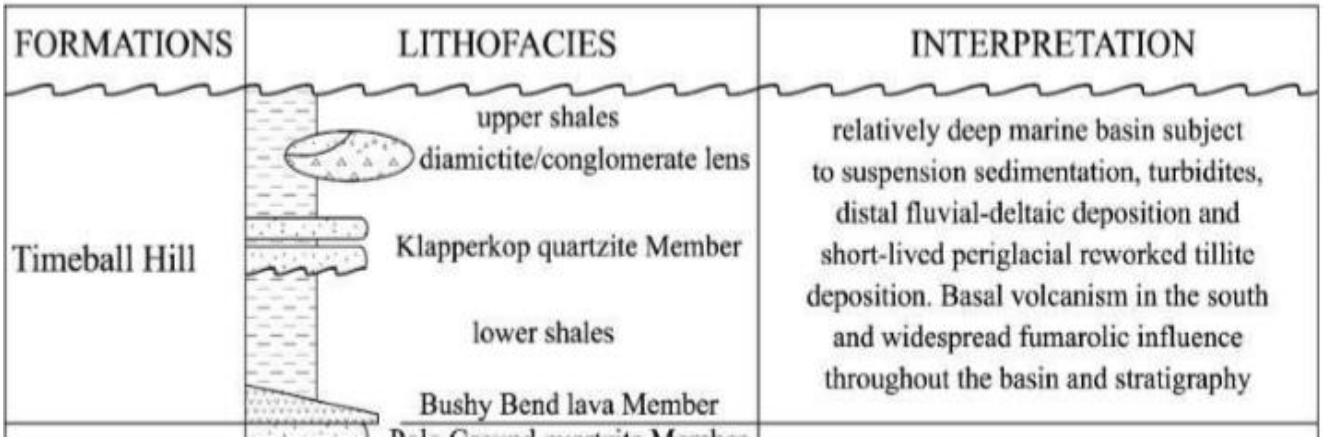


***Figure 5**: Stratigraphy and depositional settings if the Timeball Hill Formation at the base of the Pretoria succession (Catuneanu and Eriksson 2002).*

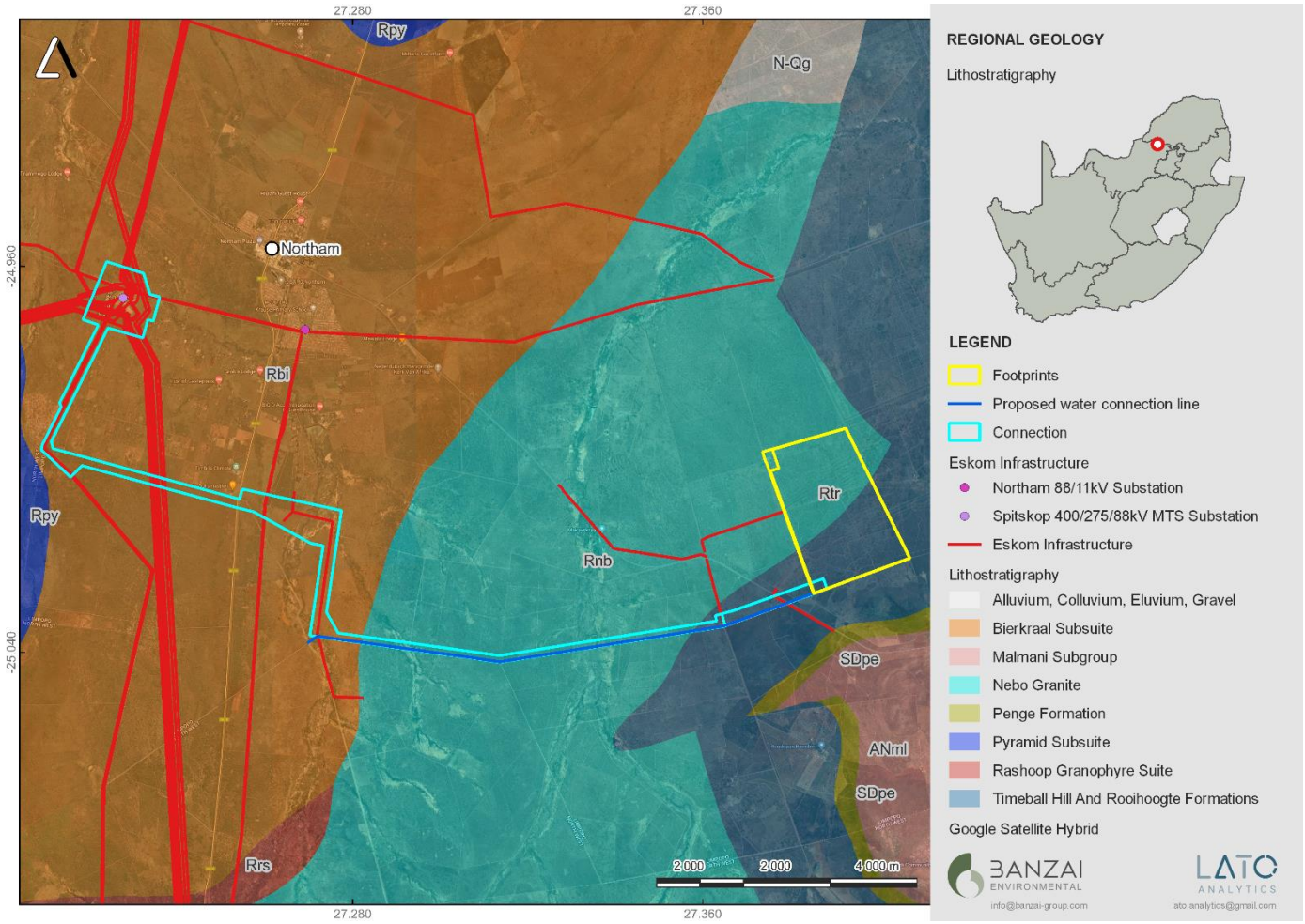


***Figure 6:** The updated Geology (Council of Geosciences, Pretoria) indicates that the proposed development is underlain by the Nebo Granite as well as the Timeball Hill and Rooihoogte Formations.*

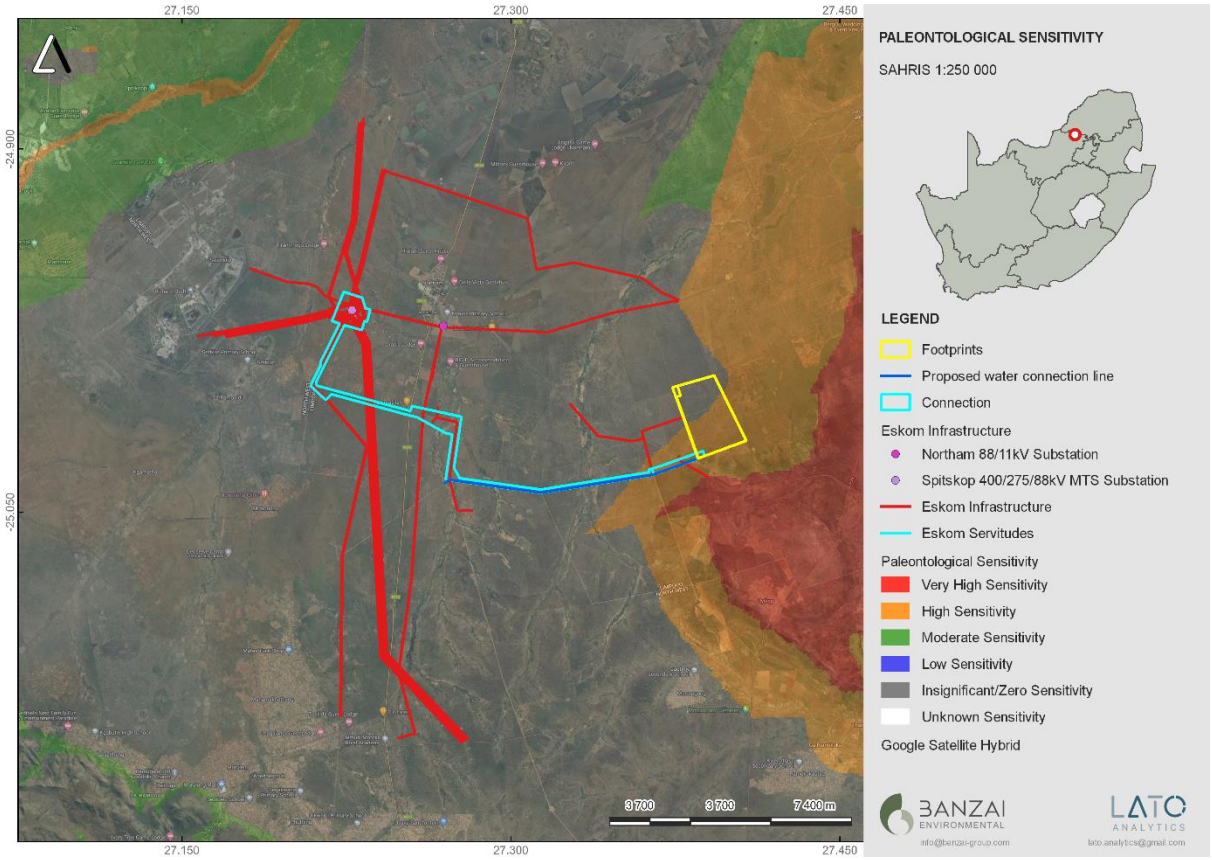
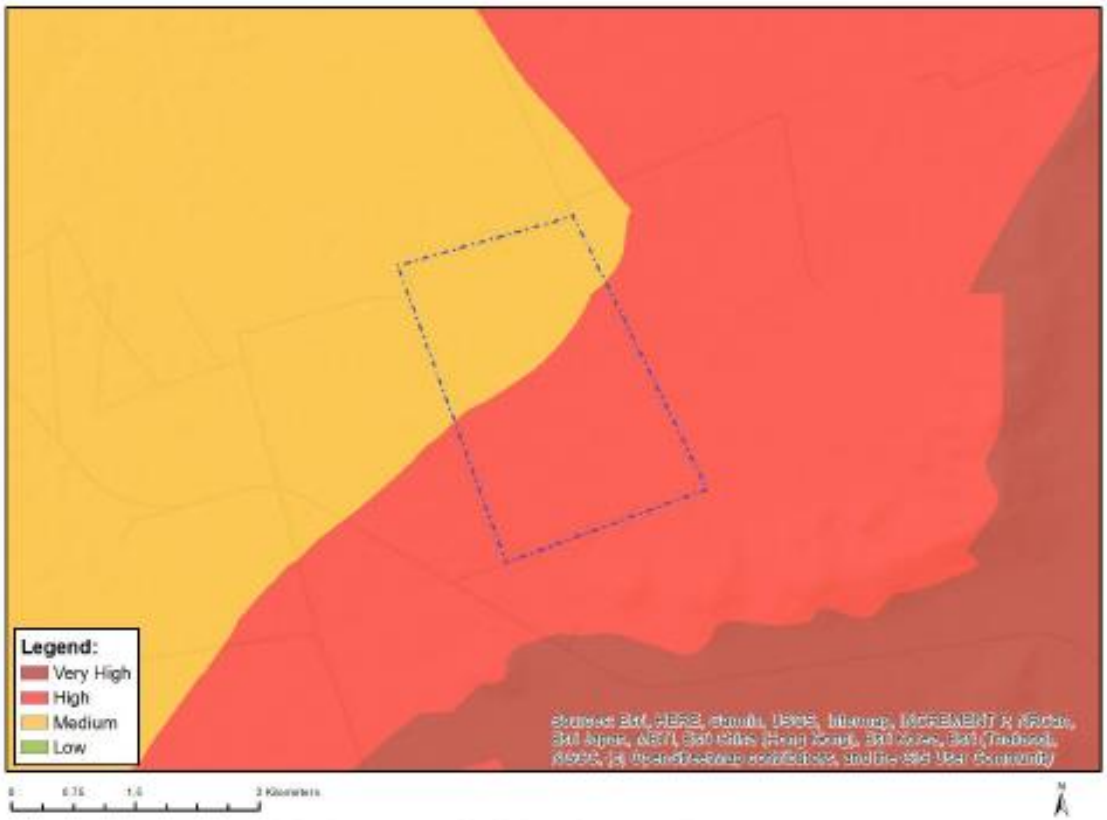


***Figure 7**: Extract of the 1: 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicates that the study area is underlain by sediments of a* Zero (grey) and High (orange) Palaeontological Sensitivity.

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.

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Features with a High paleontological sensitivity
Medium	Features with a Medium paleontological sensitivity

***Figure 8**: Palaeontological Sensitivity of the Copper SPP site by the National Environmental Web-bases Screening Tool.*

The National Environmental Web-based Screening Tool indicates that the Palaeontological Sensitivity of the Copper SPP study area is High (red), and Moderate (orange).

Cumulative Effects

The term "Cumulative Effect" has for the purpose of this report been defined as: the summation of effects over time which can be attributed to the operation of the project itself, and the overall effects on the ecosystem of the site that can be attributed to the project and other existing and planned future projects.

The geographic area of evaluation is the spatial boundary in which the cumulative effects analysis was undertaken. The spatial boundary evaluated in this cumulative effects analysis generally includes an area of a 30km radius surrounding the proposed development – refer to below.

The geographic spread of PV solar projects, administrative boundaries and any environmental features (the nature of the landscape) were considered when determining the geographic area of investigation. It was argued that a radius of 30km would generally confine the potential for cumulative effects within this particular environmental landscape. The geographic area includes projects located within Limpopo Province. A larger geographic area may be used to analyse cumulative impacts based on the specific temporal or spatial impacts of a resource. For example, the socioeconomic cumulative analysis may include a larger area, as the construction workforce may draw from a much wider area. The geographic area of analysis is specified in the discussion of the cumulative impacts for that resource where it differs from the general area of evaluation described above.

A temporal boundary is the timeframe during which the cumulative effects are reasonably expected to occur. The temporal parameters for these cumulative effects analysis is the anticipated lifespan of the Proposed Project, beginning in 2024 and extending out at least 20 years, which is the minimum expected project life of the proposed project. Where appropriate, particular focus is on near-term cumulative impacts of overlapping construction schedules for proposed projects in the area of evaluation.

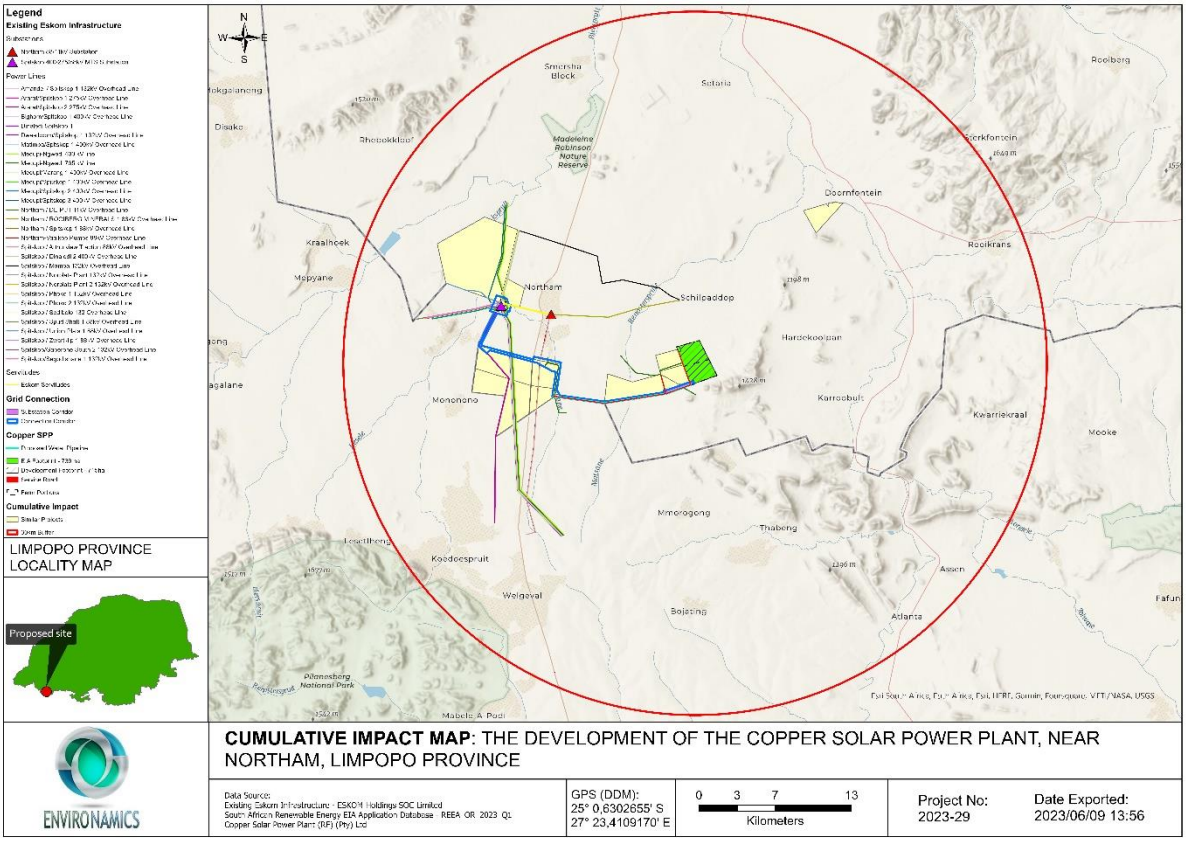


***Figure 9**: Cumulative Impact Map: Proposed Copper SPP near Northam, in Limpopo Province.*

Table 8: A summary of related facilities, that may have a cumulative impact, in a 30 km radius of the Copper SPP.

Site	Distance from Study Area	Proposed generating capacity	DEFF Reference	EIA Process	Project status
Portion 10 of the farm Wildebeestlaagte 411 KQ, Thabazimbi (Spitskop solar park)	15km	40 MW	12/12/20/2129	Scoping and EIA	Approved
Portion 5 of the farm Grootkuil 409 K.Q	17km	30 MW	12/12/20/2526	Scoping and EIA	In process
Farm Liverpool 543 KQ Portion 2	14,8km	10 MW	14/12/16/3/1/969	BAR	Approved
Farm Liverpool 543 KQ Portion 2	14,8km	10 MW	14/12/16/3/3/1/969	BAR	Approved
Spitskop Solar Park	15km	0 MW	14/12/16/3/3/2/702	Scoping and EIA	In process
Portion 1 of the farm Makayskraal No. 18 and Portion 2 of the farm Zwartdoorns No. 421, Limpopo Province	1km	250 MW	To be confirmed	Scoping and EIA	In process
Portion 3 and 4 of the farm Zwartdoorns No. 421	0km	250 MW	To be confirmed	Scoping and EIA	In process
Portion 1 and RE of farm Nooitgedacht No. 11, Limpopo Province situated within the Thabazimbi Local Municipality area of jurisdiction.	11km	500 MW	To be confirmed	Scoping and EIA	In process

It is unclear whether other projects not related to renewable energy is or has been constructed in this area, 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 general Palaeontological Sensitivity of the area is Low to High (see SAHRIS Palaeomap (Figure 6). However, it is important to note that the quality of preservation of these different sites will most probably vary and it is thus

difficult to allocate a Cumulative Sensitivity to the projects. If all the mitigation measures are carried out, a conservative estimate of the Cumulative impacts on fossil Heritage will vary between Zero and Very High.

6 GEOGRAPHICAL LOCATION OF THE SITE

Northam is located approximately 2km north of the proposed development (Figure 1-3).

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 Environamics.
- 1:250 000 Pretoria 2528 (1978) and the 2626 (1974) Thabazimbi Geological Map (Council for Geosciences, Pretoria).
- Palaeotechnical report of the Limpopo Province (Groenewald et al, 2014)
- Updated Geology (Council for Geosciences, Pretoria).

8 IMPACT ASSESSMENT METHODOLOGY

The environmental assessment aims to identify the various possible environmental impacts that could results 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 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 4.1.

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 Rating System

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

- planning
- construction
- operation
- decommissioning

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

Table 9:The rating system.

NATURE		
Loss of fossil heritage.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be

		mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		

This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.

74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

Table 10: Summary of Impacts

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

	Extent	Duration	Magnitude	Reversibility	Irreplicable loss	Cumulative effect	Impact
Pre-mitigation	1	4	2	4	4	2	30
Post-mitigation	1	4	1	4	4	1	14

9 FINDINGS AND RECOMMENDATIONS

The Copper Solar Power Plant is underlain by Nebo Granite (Lebowa Granite Suite) of the Bushveld Complex as well as sediments of the Pretoria Group. In this area the Pretoria Group is undifferentiated. Updated geology (mapped by the Council of Geosciences, Pretoria) refines the geology and indicates that the development is underlain by Nebo Granite as well as the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup). The Palaeotechnical Report of the Limpopo Province (Groenewald et al, 2014) as well as the South African Heritage Resources Information System (SAHRIS) (Almond *et al*, 2013; SAHRIS website) allocates a Zero Palaeontological Sensitivity to the Bushveld Complex and a High to the Timeball Hill Formation. However, the igneous rocks of the Bushveld Complex probably compromised the original fossil content of the microbial stromatolites and microfossils by thermal metamorphosis.

Based on the desktop research it is concluded that fossil heritage of scientific and conservational interest in the Copper SPP Project is relatively rare. This is in contrast with the High Sensitivity allocated to the development area by the SAHRIS Palaeosensitivity Map and DFFE Screening Tool. A medium Palaeontological Significance has been allocated for the construction phase of the SPP development pre-mitigation and a low significance post mitigation. The construction phase will be the only development phase impacting Palaeontological Heritage and no significant impacts are expected to impact the Operational and Decommissioning phases. As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The Cumulative impacts of the Copper SPP development near

Northam in Limpopo is considered to be low pre- mitigation and very Low post mitigation and falls within the acceptable limits for the project. It is therefore considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

Recommendations:

- The ECO for this project must be informed that the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup has a High Palaeontological Sensitivity.
- If Palaeontological Heritage is uncovered during surface clearing and excavations, the Chance find Protocol attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: Heritage Western Cape, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. 3rd floor Protea Assurance Building, 142 Longmarket St, Cape Town City Centre, Cape Town, 8000; Private Bag X9067, Cape Town, 8000 Tel: 021 483 9598. Fax: +27 (0) 21 483 9845. Web: www.hwc.org.za) so that mitigation (recording and collection) can be carried out.
- Before any fossil material can be collected from the development site, the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the Copper SPP.

10 CHANCE FINDS PROTOCOL

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

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

10.1 Legislation

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

This informational document is intended for workmen and foremen on the construction site. It describes the actions to be taken when mining or construction activities accidentally uncovers 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.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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Appendix A – Elize Butler CV

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	30 years in Palaeontology
EDUCATION:	B.Sc Botany and Zoology, 1988 University of the Orange Free State
	B. Sc (Hons) Zoology, 1991 University of the Orange Free State
	Management Course, 1991 University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009 University of the Free State

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part-time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part-time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

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