BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL DESKTOP ASSESSMENT

THE DEVELOPMENT OF THE VIRGO SOLAR POWER PLANT, NEAR KATHU, NORTHERN CAPE PROVINCE

2023

COMPILED FOR:

ENVIRONAMICS ENVIRONMENTAL

Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not 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 5 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 6 – Geological and Palaeontological history	-

(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 10	-
(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 5 Approach and Methodology	-
(f) Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative	Section 1;10	-
(g) An identification of any areas to be avoided, including buffers	Section 1 & 10	-
(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 6 – Geological and Palaeontological history	-
(i) A description of any assumptions made and any uncertainties or gaps in knowledge	Section 5.1 – 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 10	-

(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation	Section 11	-
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11	-
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 & 10	-
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and Environmental

		Management Plan (EMP) process
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding heritage resources that require input from a specialist have been raised
(q) Any other information requested by the competent authority	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Section 4 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by Environamics Environmental Consultants to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Virgo Solar Power Plant (SPP) near Kathu in the Northern Cape Province. In accordance with the National Environmental Management, 1998 (Act No. 107 of 1998) (NEMA) and to comply with the National Heritage Resources Act, 1999(Act No. 25 of 1999, section 38) (NHRA), PDA is necessary to confirm if fossil material could potentially be present in the planned development area and to evaluate the potential impact of the proposed development on the Palaeontological Heritage.

The proposed development near Kathu in the Northern Cape is underlain by Quaternary aged sediments of the Kalahari Group as well as the underlying Campbell Rand Subgroup (Ghaap Group, Transvaal Supergroup). The general low palaeontological sensitivity of the bedrocks and superficial sediments in the proposed development footprint, indicates that the development will have an overall LOW impact significance in terms of palaeontological heritage. It is therefore considered that the development will not lead to detrimental impacts on the palaeontological resources of the area. If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation can be carry out by a paleontologist.

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.

Impact Summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Planning Phase Virgo SPP	No Impact	0	No Impact	0	No Impact
Construction Stage Virgo SPP	Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study	48	Negative Medium impact	16	Negative Low impact
Operational Phase Virgo SPP	No Impact	0	No Impact	0	No Impact
Decommissioning Virgo SPP	No Impact	0	No Impact	0	No Impact

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

TABLE OF CONTENT

List of Figures

List of Tables

Appendix A: CV

1. INTRODUCTION

Virgo Solar Power Plant (RF) (Pty) Ltd plans to develop the Virgo Solar Power Plant (SPP) near Kathu in the Northern Cape Province. Environamics Consultants has been appointed to conduct the EIA Process to obtain Environmental Authorisation (EA) for the proposed Virgo (Figure 1-2).

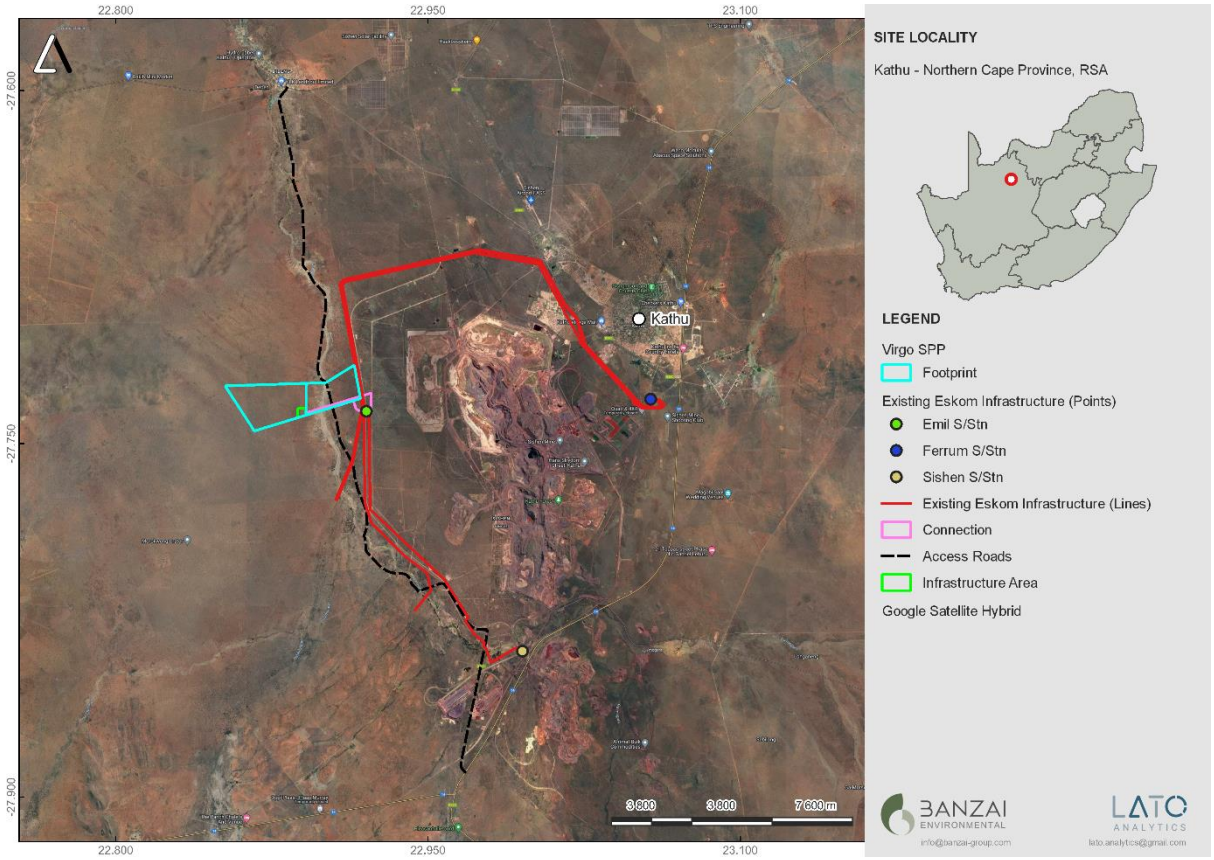

Figure 1:*Regional locality of the proposed Virgo SPP near Kathu in the Northern Cape Province.*

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Table 2: General site information	
Description of affected farm portion	Solar power plant: Portion 2(Rozenvlei) of the farm Bishops Wood No. 476 Grid connection corridor: Portion 2 of the farm Bishops wood 2/476 Remaining Extent of the Farm Lanham No. 539 Portion 1 of the farm Fritz No. 540 Portion 10 of the farm Fritz No. 540 Remaining Extent of the Farm Woon No. 469 Portion 3 of the farm Woon No. 469 Portion 2 of the farm Fritz No. 540 Portion 5 of the farm Fritz No. 540 Portion 9 of the farm Fritz No. 540
Province	Northern Cape
District Municipality	John Taolo Gaetswe District Municipality
Local Municipality	Gamagara Local Municipality
Ward numbers	5
Closest towns	Kathu is located approximately 14km east of the proposed development.
21 Digit Surveyor General codes	Solar Power Plant: Portion 2 (Rozenvlei) of the farm Bishops Wood No. 476 C04100000000047600002 Grid connection corridor: Portion 2 of the farm Bishops wood No. 476 C04100000000047600002 Remaining Extent of the Farm Lanham No. 539 C04100000000053900000 Portion 1 of the farm Fritz No. 540 C04100000000054000001

	Portion 10 of the farm Fritz No. 540 C04100000000054000010 Remaining Extent of the Farm Woon No. 469 C04100000000046900000 Portion 3 of the farm Woon No. 469 C04100000000046900003 Portion 2 of the farm Fritz No. 540 C04100000000054000002 Portion 5 of the farm Fritz No. 540 C04100000000054000005 Portion 9 of the farm Fritz No. 540 C04100000000054000009
Type of technology	Photovoltaic solar facility
Structure Height	Panels ~ 6m; Buildings ~ 6m; Power line ~ 32m; and Battery storage facility ~ 8m.
Battery storage	Within an estimated4-hectare area
Surface area to be covered (Development footprint)	Approximately 600 ha[1]
Laydown area dimensions (EIA footprint)	Assessed 949 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 350MW

[1] The development footprint is subject to change following specialist input.

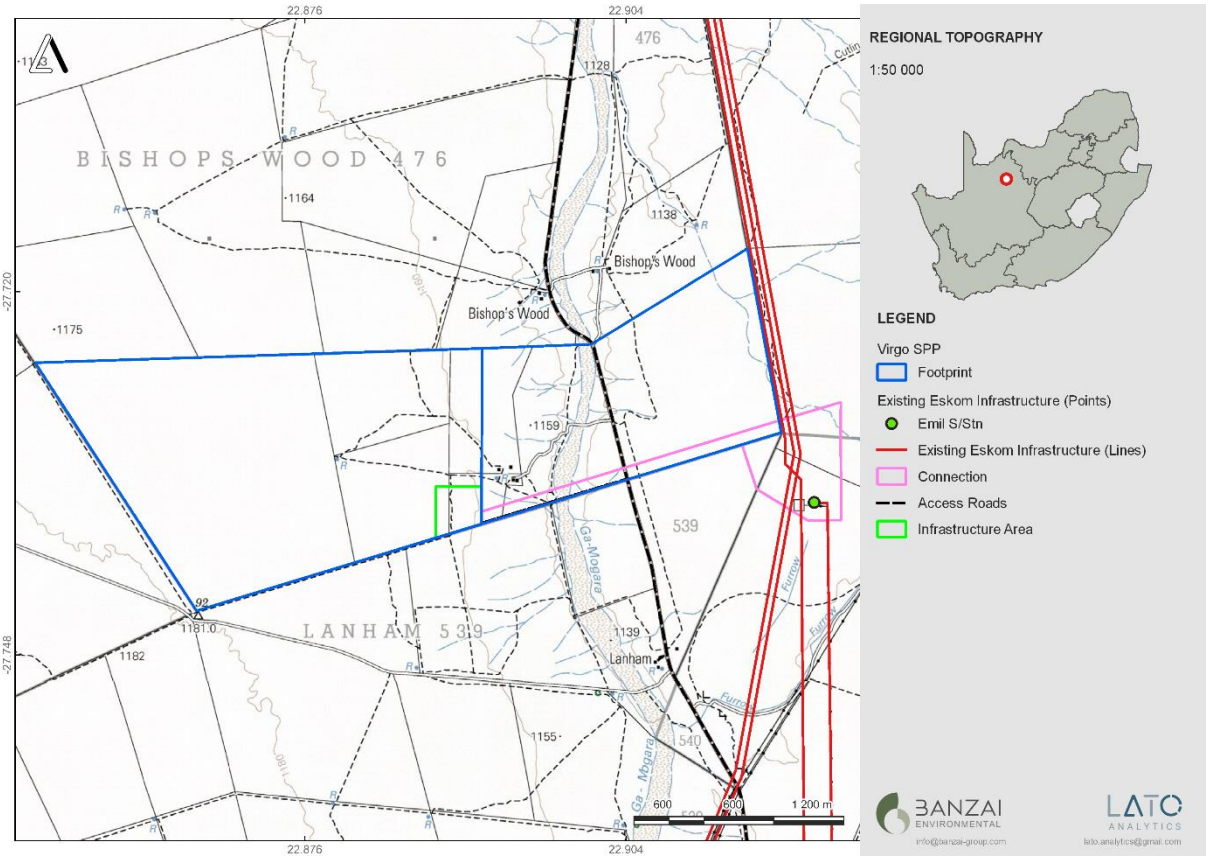


***Figure 2**: Locality map of the proposed Virgo SPP near Kathu in the Northern Cape Province.*

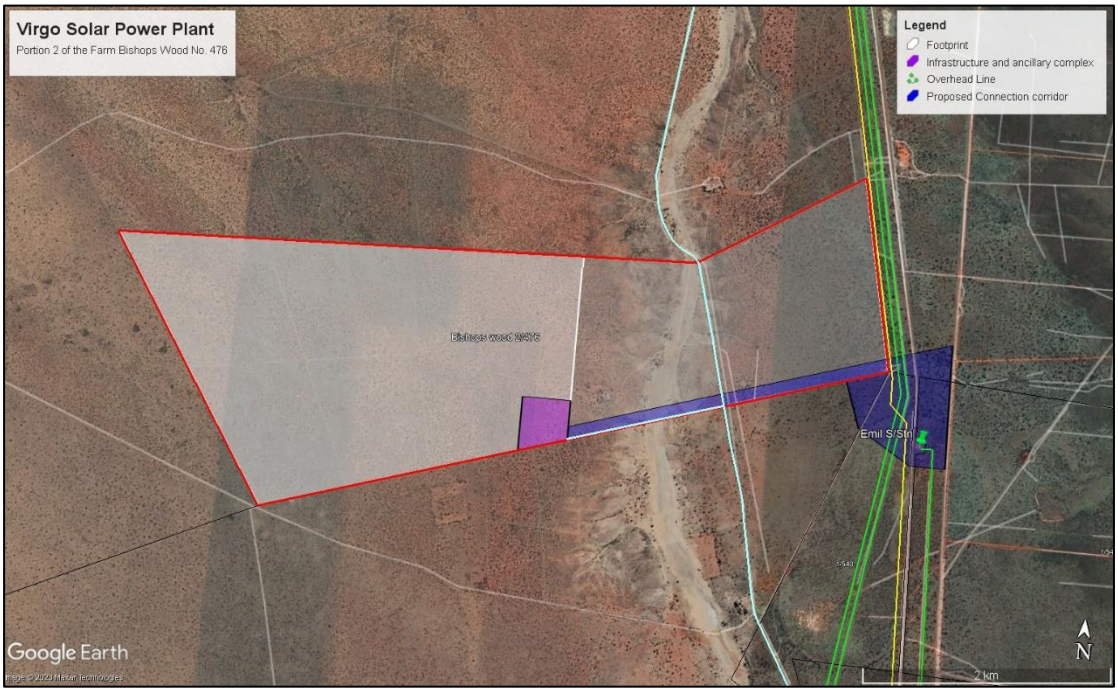
1.1 Technical Details

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 350MW, 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. It is expected that generation from the facility will connect to the national grid via the Existing Eskom Emil 132kv substation. The grid connection route will be assessed within a 101 m to 1174 m wide and 4,2 km long corridor. The connection power line will be constructed within the limits of the grid connection corridor. The Project will inject up to 350 MW into the National Grid.



Virgo SPP powerline corridor

- 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 – Two access routes are proposed. Access route 1 will be obtained via a public gravel road off of the R380 regional road to the north of the site. Access route 2 will be obtained via a public gravel road off of the N14 regional road to the south of the site. 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	600 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 Substation: 1.5 ha (IPP step-up and Eskom switching/collector) BESS: 4 ha
Capacity of on-site substation	132kV
Capacity of the power line	132kV
Area occupied by both permanent and construction laydown areas	Permanent Laydown Area: 600 Hectares Construction Laydown Area: ~5 ha
Area occupied by buildings	Infrastructure & Ancillary Complex: 15 ha
Battery storage facility	Maximum height: 8m Maximum volume: 1740 m^3 Capacity ~up to 500MWh
Length of access roads	To be confirmed with the layout of the facility
Width of access roads	8 m – 10 m
Length of internal roads	To be confirmed with the layout of the facility
Width of internal roads	4 m – 6 m
Length of perimeter roads	To be confirmed with the layout of the facility
Width of perimeter roads	8 m – 12 m
Grid connection corridor width	101 m to 1174 m
Grid connection corridor length	~4.2 km (4216 m)

Power line servitude width	32m
Height of fencing	Approximately 2.5 m

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 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 Portion 2 (Rozenvlei) of the farm Bishops Wood No. 476. 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

It is expected that generation from the facility will connect to the national grid via the Existing Eskom Emil 132kv substation. The grid connection route will be assessed within a 101 m to

1174 m wide and 4,2 km long corridor. The connection power line will be constructed within the limits of the grid connection corridor. The Project will inject up to 350MW 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 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.

2. LEGAL MANDATE AND PURPOSE OF THE REPORT

The National Environmental Management Act identifies listed activities (in terms of Section 24) which are likely to have an impact on the environment. These activities cannot commence without obtaining an EA from the relevant competent authority. Sufficient information is

required by the competent authority to make an informed decision and the project is therefore subject to an environmental assessment process which can be either a Basic Assessment Process or a full Scoping and Environmental Impact Assessment process.

The EIA Regulations No. 324, 325, and 327 outline the activities that may be triggered and therefore require EA. The following listed activities with special reference to the proposed development is triggered:

Table 4:Listed activities

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 and perimeter roads will vary between 8 and 12 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 350 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.

3. 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.

4. 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^2 in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m^2 in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

5. METHODS AND TERM OF REFERENCE

The aim of a desktop study is to evaluate the possible risk to palaeontological heritage in the proposed development. This includes all trace fossils as well as all fossils in the proposed

footprint. All possible information is consulted to compile a desktop study and this includes the following: all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps. As the Palaeontological Sensitivity of the proposed Virgo SPP is Moderate only a desktop assessment was conducted for this project.

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

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

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study,
- Description and location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area.
- Identification of sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:

a. Direct impacts are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.

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

c. Cumulative impacts are impacting that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.

- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5.1 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.

6. GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the proposed Virgo SPP near Kathu in the Northern Cape Province is depicted on the Kuruman 2722 (1979) Geological Map (Council for Geosciences, Pretoria) (Figure 4). This map indicates that the proposed Virgo SPP is entirely mantled by Pleistocene to Recent aeolian sands of the Gordonia Formation while calcretes (surface limestones) of the Mokolanen Formation (Kalahari Group (Tl, dark yellow) is also present in the area. Underlying these superficial deposits is Precambrian bedrocks comprising of cherts, dolomites and possible iron

formations of the Transvaal Supergroup. These sediments are too deep and will not be affected by the Virgo SPP development The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Gordonia Formation (Kalahari Group) is Moderate (Figure 4; Almond and Pether, 2009; Almond *et al*., 2013).

Although a short explanation is printed on the Geological Map itself, a detailed sheet explanation is not supplied with the map. This map is now out of print and outdated. Recently, revisions to the stratigraphic subdivision and alignments of the Precambruim rocks present in the Kathu area has been completed. This study follows the recent stratigraphic account for the Transvaal Supergroup by Eriksson *et al.* (2006) as the older geological versions are not always clear.
The study area is located on the western side of the Maremane Dome (a major N-S trending anticline within the Early Proterozoic bedrocks of the Ghaap Group, Transvaal Supergroup). The Maremane Dome comprises of carbonate rocks of the Campbell Rand Subgroup (Ghaap Group, Transvaal Supergroup) overlain by the Kalahari Group.

In the past the shallow marine carbonates of the Campbell Rand Subgroup (Ghaap Group) were included in the Ghaapplato Formation. It is about 2.6 to 2.5 Ga (billion years old) and was deposited on the shallow submerged shelf of the Kaapvaal Craton. This carbonate platform is very thick (approximately 1.6 -2.5 km) and comprise of cherts with minor tuffs and siliciclastic rocks as well as dolostones and dolomitic limestones.

Frequent changes in sea level were caused by changing depositional cycles in shallow water facies. Stromatolitic limestones and dolostones, oolites, laminated calcilutites, cherts, with subordinate siliclastics (shales, siltstones) and minor tuffs (Beukes 1980, Beukes 1986, Sumner 2002, Eriksson *et al.* 2006, Sumner & Beukes 2006) are present in this area. The Campbellrand carbonate bedrocks in the area are karstified and most likely not exposed at the surface.

At the western side of the Maremane Dome (Campbell Rand carbonates, Asbesheuwels Banded Iron Formation and Koegas quartzites and iron formation) a major unconformity exists at the base of the Palaeoproterozoic Elim Group (basal Keis Supergroup), This unconformity (about 2.2-2.0 Ga) cuts the folded Ghaap Group succession and is associated with the development of manganese and iron ores. These ores are extensively mined in the Sishen – Postmasburg region of Griqualand West. These ores are associated with the palaeokarst-related Manganore Formation overlying the Campbell Rand Subgroup carbonates of the Maremane Dome as well as the Gamagara Formation at the base of the Elim Group. In the past the Elim Group was included in the Olifantshoek Group (Schalkwyk 2005, Van Niekerk 2006, Da

Silva 2011, Cairncross & Beukes 2013, Smith & Beukes 2016). In the greater Kathu region, the Postmasburg group comprise of basaltic to andesitic lavas of the Ongeluk Formation (dated to 2.2 Ga) that crops out south of the Gamagara River.

The late Cretaceous to Late Caenozoic aeolian sands, clays, calcretes and gravels of the Kalahari Group Group is approximately Ca 65 – 2.5 million years old (Ma). Studies north west of the proposed development site has shown that the Kalahari Group sediments that overlies the Precambrian rocks are about 80 m thick (Haddon, 2005). The earliest Kalahari beds are assigned to the Wessels Formation (basal gravels) and Budin Formation (calcareous clays) and is probably Late Cretaceous in age (Partridge *et al.* 2006; Figure 6).

The top 15 m of the Kalahari sediments consist of clays, calcretised siltstones, and pebbly horizons with the occurrence of solution hollows along joint surfaces (10 m from the surface). Calcretised silcretes with *in situ* brecciation are present close to the surface. Thick pedogenic calcretes (Plio-Pleistocene Mokalanen Formation) are mapped along the Ga-Mogara drainage line and underlies the Kalahari sands in the region. These deposits indicate the seasonally arid climates over the last five million years (Truter *et al.* 1938; Boardman and Visser 1958). Surface limestones may be up to 20 m thick and are locally conglomeratic with clasts of reworked calcrete and foreign pebbles. These limestones might be secondarily silicified.

Pleistocene Kalahari sands (Gordonia Formation) has been described to mantle thick calcretes and downwasted surface gravels (Almond 2013). He described a range of calcrete types namely gravelly, brecciated, silicified, honeycomb and karstified facies, the latter with an associated sand- or gravel-infilled solution hollows

The late Cretaceous to Recent Kalahari Group has been reviewed by the following authors: Thomas (1981), Dingle *et al.* (1983), Thomas & Shaw 1991, Haddon (2000) and Partridge *et al.* 2006. The Quaternary Gordonia Formation (Kalahari Group) are dated as Late Pliocene/Early Pleistocene to Recent times by the Middle to Later Stone Age stone tools recovered from them (Dingle et al (1983). The fossil assemblages of the Quaternary are generally Low in diversity and occur over a wide range and mostly has a Moderate Paleontologically Sensitivity. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods, and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and

insect's burrows and mammalian trackways. Amphibian and crocodile skeletons have been uncovered where the depositional settings in the past were wetter.

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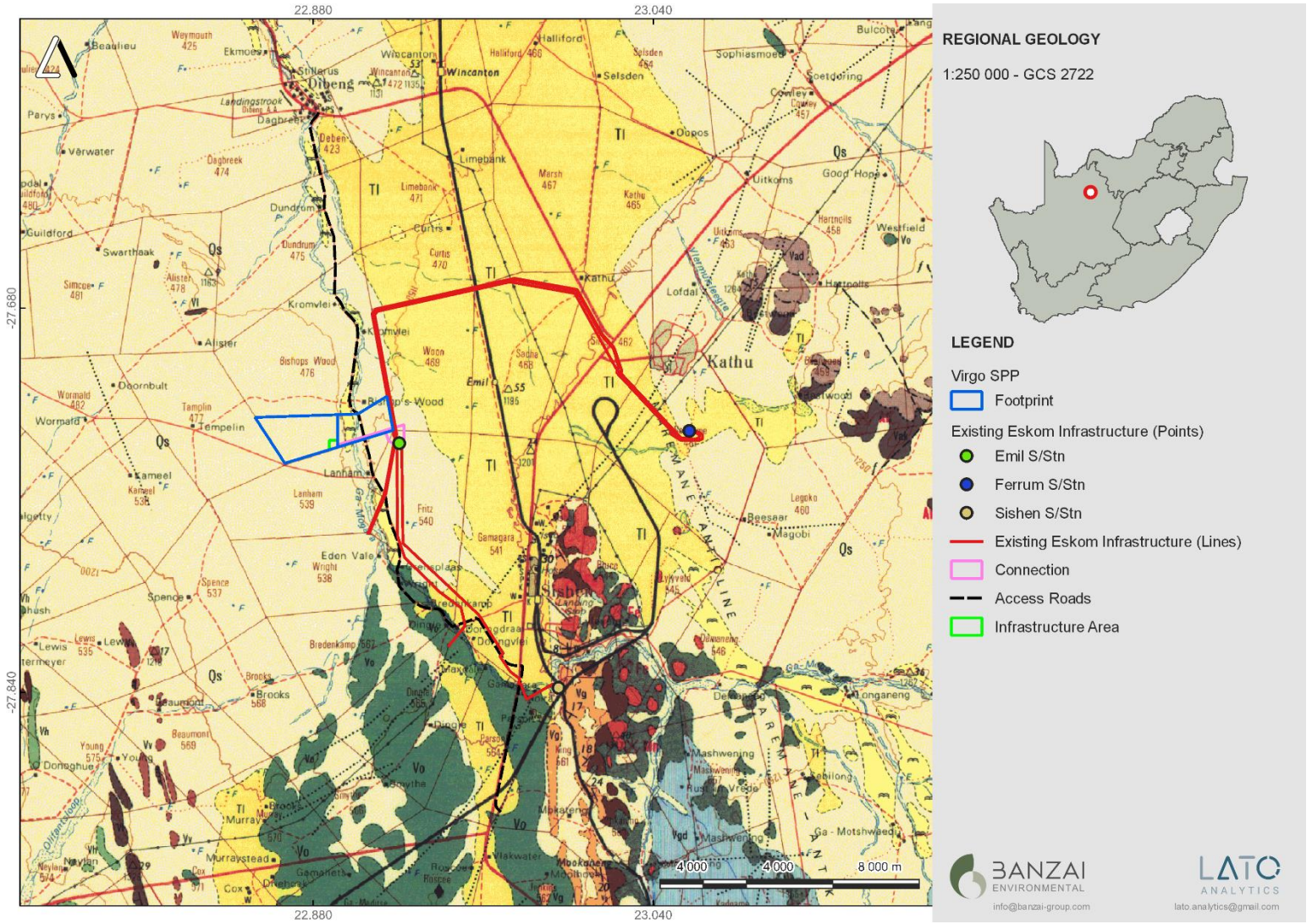

***Figure 3**: Extract of the 1:250 000 Kuruman 2722 (1979) Geological Map (Council for Geosciences, Pretoria) indicates that the Virgo SPP near Kathu in the Northern Cape Province is underlain by the Kalahari Group.*

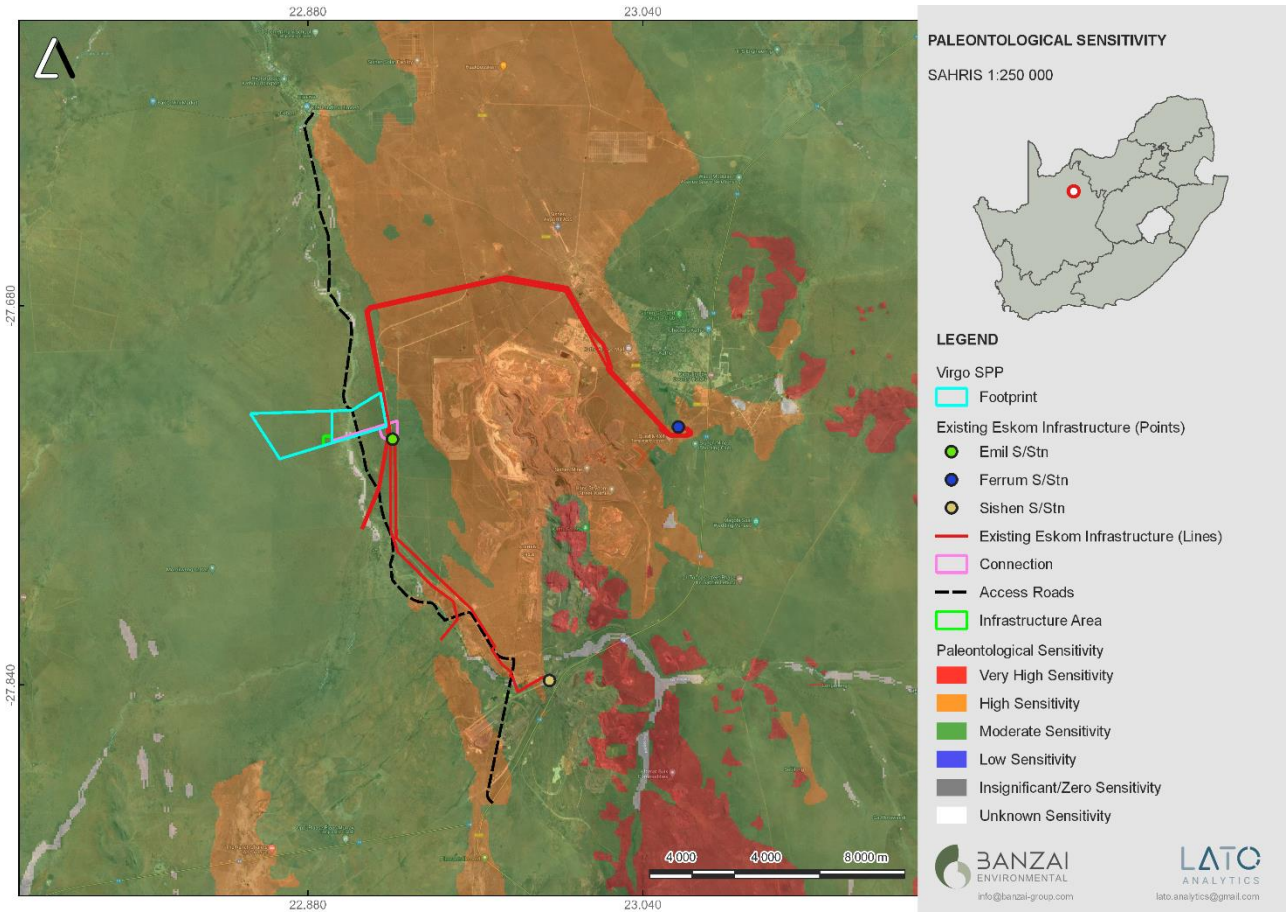

***Figure 4**: Extract of the SAHRIS PalaeoMap (Council of Geosciences, Pretoria) indicating the proposed Virgo SPP near Kathu in the Northern Cape Province.*

*Table 5**:** Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website).*

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**Field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	**Desktop study is required and based on the outcome of the desktop study; a field assessment is likely**

GREEN	MODERATE	Desktop study is required
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The SAHRIS Palaeosensitivity map (Figure 4) indicates that the proposed development is underlain by sediments with a Moderate (green) Palaeontological Sensitivity.

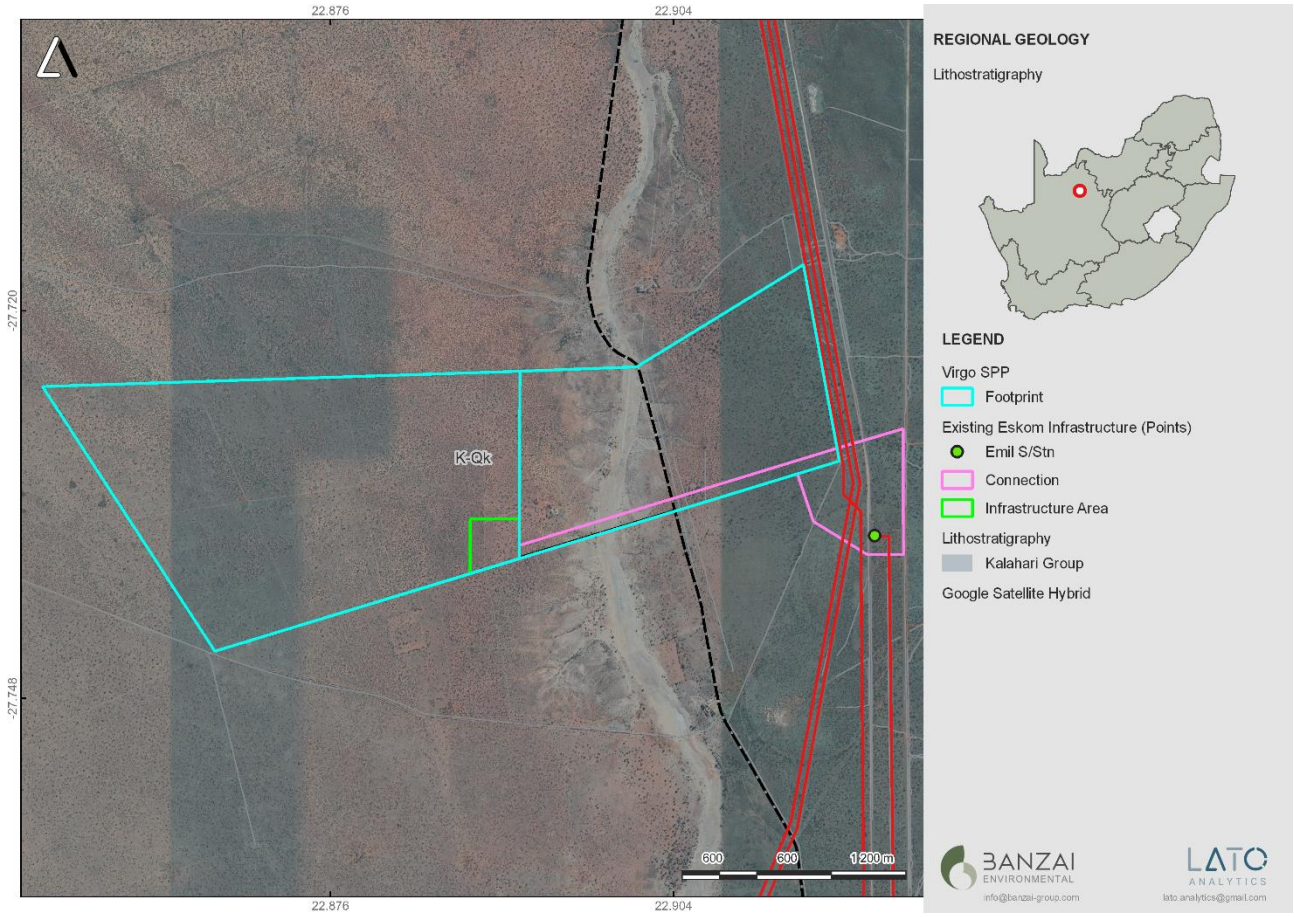

Figure 5: *Updated Geology (Council of Geosciences, Pretoria) of the proposed Virgo SPP indicates that the development is underlain by the Kalahari Group.*

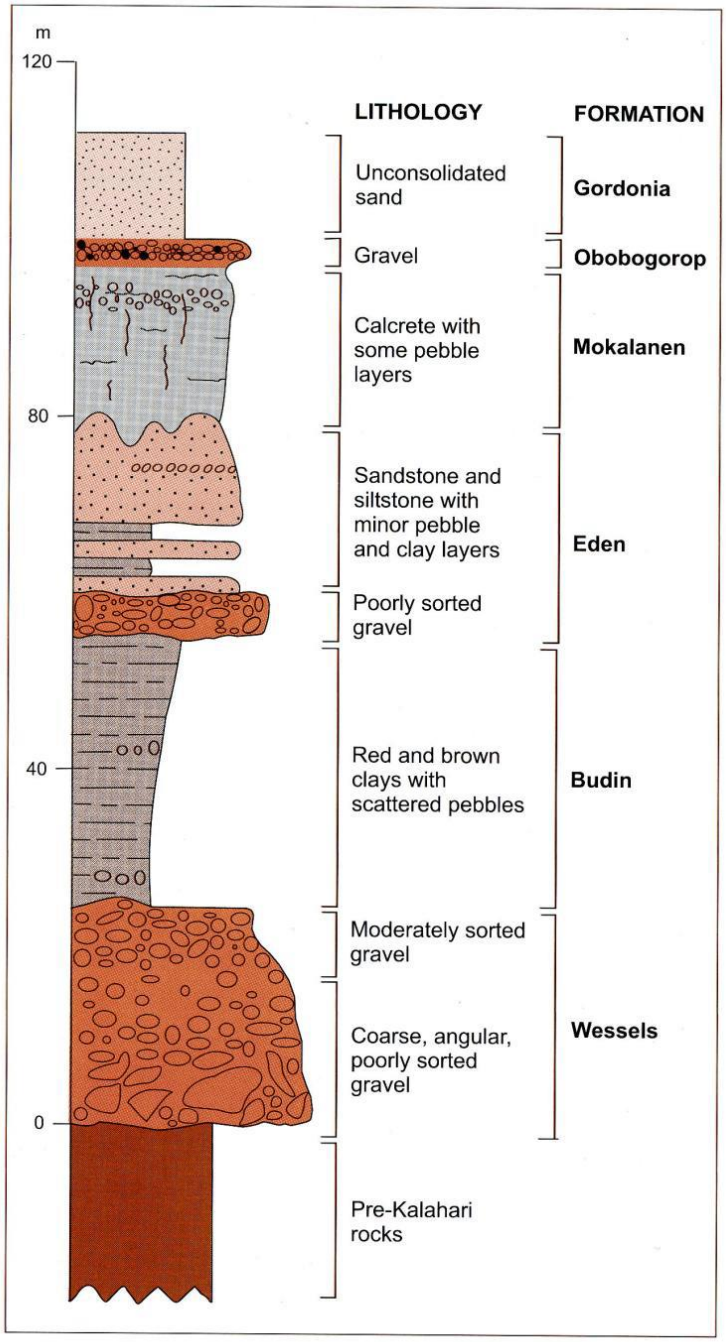

***Figure 6**: Stratigraphy of the Kalahari Group (Image taken from Partridge et al., 2006). Calcretes and aeolian sands of the Gordonia Formation possibly corresponds to the Mokalanen Formation*

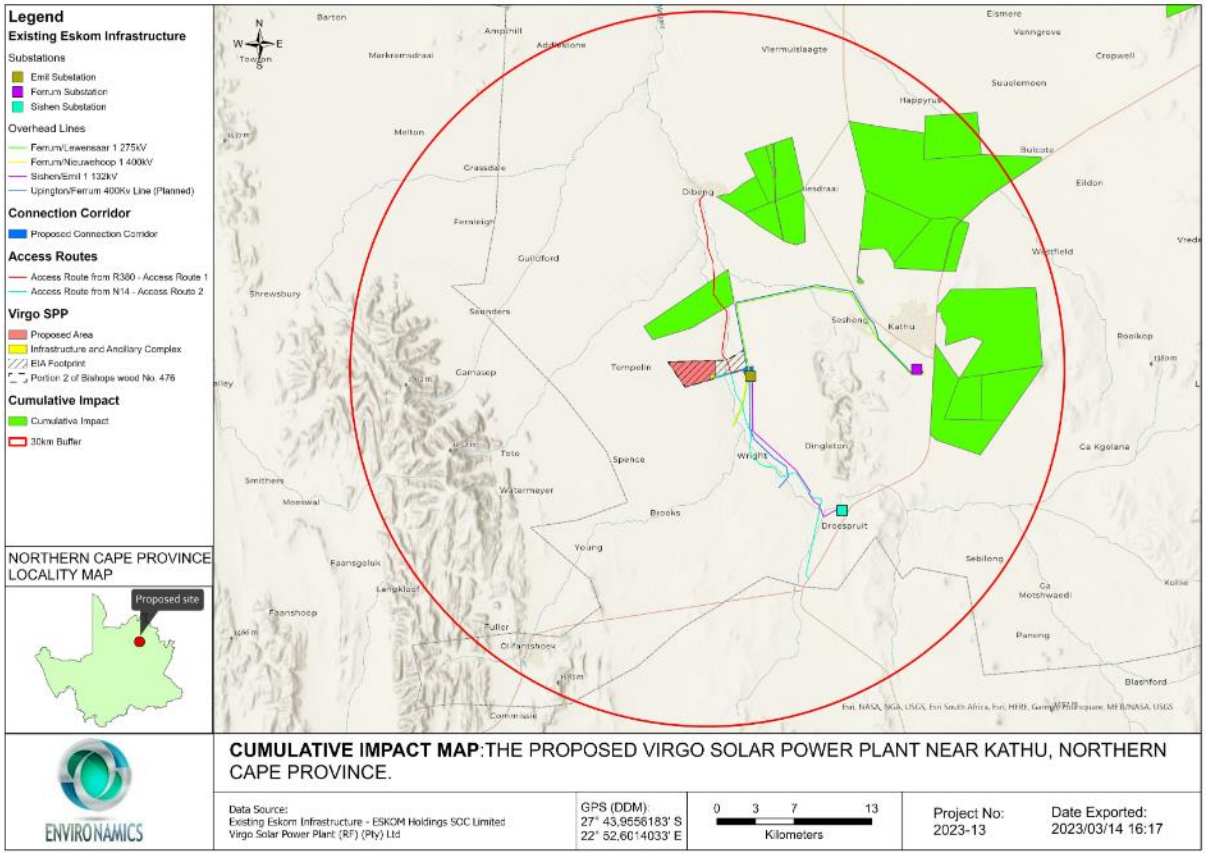

***Figure 7**: Virgo SPP Geographic area of evaluation with utility-scale renewable energy generation sites and power lines for the Virgo SPP.*

Solar Facilities to the north, east and south of the Virgo SPP will have a Low to Very High Palaeontological Sensitivity (Figure 4). 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 Low and Medium.

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 the Northern Cape 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 socio-economic 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.

Table 6: A summary of related facilities, that may have a cumulative impact, in a 30 km radius of the Virgo SPP

Site name	Distance from study area	Proposed generating capacity	DEFF reference	EIA process	Project status
Portion 6 of Wincanton 472	7.12km	74 MW	12/12/20/1860	Scoping and EIA	Approved
Bestwood	17.7km	-	12/12/20/1906	Scoping and EIA	Approved
The Farm Kathu 465	10km	3 MW	12/12/20/1994	Scoping and EIA	Approved
Mogara solar	18km	75 MW	14/12/16/3/3/2/1082	Scoping and EIA	Approved
Hyperion solar development 1	14.6km	75 MW	14/12/16/3/3/2/1109	Scoping and EIA	Approved
Hyperion solar development 2	21km	75 MW	14/12/16/3/3/2/1110	Scoping and EIA	Approved
Hyperion solar development 3	16km	75 MW	14/12/16/3/3/2/1111	Scoping and EIA	Approved
Hyperion solar development 4	21km	75 MW	14/12/16/3/3/2/1112	Scoping and EIA	Approved
San Solar Energy Facility	7km	75 MW	14/12/16/3/3/2/273	Scoping and EIA	Approved
Portion 2 of the Farm Legoko 460	19,5km	75 MW	14/12/16/3/3/2/819	Scoping and EIA	Approved
Portion 1 of the farm Legoko 460 and farm Sekgame 461	19.5km	75 MW	14/12/16/3/3/2/820	Scoping and EIA	Approved
The Remainder of the Farm 460	22.4km	75 MW	14/12/16/3/3/2/911	Scoping and EIA	Approved

The Remaining Extent of Portion 1 of The Farm Lime Bank no. 471	12km	115 MW	14/12/16/3/3/2/935	Scoping and EIA	Approved
Libra Solar Power Plant	2.3km	350 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.

7. GEOGRAPHICAL LOCATION OF THE SITE

Kathu lies within a flat-lying semi-arid region (1200 – 1300m amsl) and is located between the the low-lying Kurumanheuwels in the east and the Langberge mountain range in the west. This Kathu area is drained by the Ga-Mogara River which flows into the Kuruman River to the north of Hotazel (Figure 1-2).

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 Environamics.
- Updated geology of the proposed development (Council for Geosciences, Pretoria).
- PIAs in the Kathu district (Almond, 2010, 2012,2013,2014,2015; see references)

9. 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 10.

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 7: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.

10. FINDINGS AND RECOMMENDATIONS

The proposed development near Kathu in the Northern Cape is underlain by Quaternary aged sediments of the Kalahari Group as well as the underlying Campbell Rand Subgroup (Ghaap Group, Transvaal Supergroup), The general low palaeontological sensitivity of the bedrocks and superficial sediments in the proposed development footprint, indicates that the proposed development will have an overall LOW impact significance in terms of palaeontological heritage. It is therefore considered that the development is will not lead to detrimental impacts on the palaeontological resources of the area. If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the Chance Find Protocol must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation can be carry out by a paleontologist.

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.

11. CHANCE FINDS PROTOCOL

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

Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the National Heritage Resources Act (Act No 25 of 1999) (NHRA). According to Section 3 of the Act, all Heritage resources include "all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens".

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

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

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

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

Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately stop working and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately report the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111

Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.

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

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APPENDIX

CURRICULUM VITAE Elize Butler

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 30 years in Palaeontology

EDUCATION: B.Sc Botany and Zoology, 1988

University of the Orange Free State

B.Sc (Hons) Zoology, 1991

University of the Orange Free State

Management Course, 1991

University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009

University of the Free State

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

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

TECHNICAL REPORTS

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Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.
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Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.
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Butler, E. 2017. Palaeontological Desktop Assessment 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.
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Butler, E. 2018. Palaeontological field Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.
Butler, E. 2018. Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.
Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.
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