



# PALAEONTOLOGICAL DESKTOP ASSESSMENT

## DROOGFONTEIN 4 SOLAR AND BATTERY STORAGE ENERGY FACILITY NEAR KIMBERLEY

NORTHERN CAPE PROVINCE

2022

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.

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**SIGNATURE:**



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

*Table 1: NEMA Table*

| <b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>   | <b>The relevant section in the report</b>                                    | <b>Comment where not applicable.</b> |
|---|--|--------------------------------------|
| 1.(1) (a) (i) Details of the specialist who prepared the report   | Page ii and Section 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 <b>Appendix A</b>                                       | -                                    |
| (b) A declaration that the person is independent in a form as may be specified by the competent authority                           | Page ii of the report  | -                                    |
| (c) An indication of the scope of, and the purpose for which, the report was prepared   | Section 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 11   | -                                    |
| (d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment        | Section 1 & 12   |                                      |



| <b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>  | <b>The relevant section in the report</b>              | <b>Comment where not applicable.</b> |
|--|--|--------------------------------------|
| (e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used   | Section 8<br>Approach and Methodology                  | -                                    |
| (f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives; | Section 1 & 12   |                                      |
| (g) An identification of any areas to be avoided, including buffers  | Section 1 & 12   |                                      |
| (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 –<br>Geological and Palaeontological history |                                      |
| (i) A description of any assumptions made and any uncertainties or gaps in knowledge;  | Section 8.1 –<br>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 & 12   |                                      |
| (k) Any mitigation measures for inclusion in the EMPr  | Section 1 & 12   |                                      |
| (l) Any conditions for inclusion in the environmental authorisation  | Section 1 & 12   |                                      |
| (m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation   | Section 1 & 12   |                                      |



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



| <b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>   | <b>The relevant section in the report</b>  | <b>Comment where not applicable.</b>   |
|---|--|--|
|   |  | comments regarding heritage resources that require input from a specialist have been raised. |
| (q) Any other information requested by the competent authority.   | N/A  | Not applicable.  |
| (2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply. | Section 3 compliance with SAHRA guidelines |  |



## EXECUTIVE SUMMARY

Banzai Environmental was appointed by Environamics Environmental Consultants to conduct the **Palaeontological Desktop Assessment (PDA)** to assess the proposed Remaining Extent of Farm Droogfontein no 62 near Kimberley in the Northern Cape Province. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA is necessary to confirm if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The proposed development is underlain by Quaternary Superficial Sediments and at depth by sediments of the Ecca and Ventersdorp Groups. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary Superficial Sediments is moderate (Almond and Pether; 2009). Two layout alternatives have been considered for the proposed development and recently layouts to Option B has been optimized. Option B has been identified as the most environmentally suitable for the development. The geology of the different layouts is the same as they are all underlain by Quaternary deposits. Palaeontologically there is no preferred option between the layouts.

It is therefore considered that the proposed Droogfontein 4 Solar and Battery Storage Energy Facility in the Northern Cape will not lead to detrimental impacts on the palaeontological resources of the area. The construction of the development may therefore be authorised, on either of the site alternatives, as the area 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.

If fossil remains are discovered during any phase of construction, either on the surface or uncovered by excavations the ECO/site manager in charge of these developments must be notified immediately (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)). These discoveries must be secured and the ECO/site manager must alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a professional palaeontologist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports must meet the minimum standards for palaeontological impact studies developed by SAHRA..





Impact Summary

| <b>Environmental parameter</b>                                     | <b>Issues</b>   | <b>Rating prior to mitigation</b> | <b>Average</b>         | <b>Rating post mitigation</b> | <b>Average</b>      |
|--|---|-----------------------------------|------------------------|-------------------------------|---------------------|
| Grid Connection Construction Stage<br>Loss of fossil heritage      | Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study | 32                                | Negative Medium impact | 16                            | Negative Low impact |
| Grid connection Operational Phase                                  | No Impact   |                                   | No Impact              |                               | No Impact           |
| Grid connection Decommissioning Phase                              | No Impact   |                                   | No Impact              |                               | No Impact           |
| PV Facility (including battery storage)<br>Loss of fossil heritage | Destroy or permanently seal-in fossils at or below the surface that are then no longer available for scientific study | 32                                | Negative Medium impact | 16                            | Negative Low impact |
| PV Facility (including battery storage)<br>Operational Phase       | No Impact   |                                   | No Impact              |                               | No Impact           |
| PV Facility (including battery storage)<br>Decommissioning Phase   | No Impact   |                                   | No Impact              |                               | No Impact           |

It is therefore considered that the proposed Droogfontein 4 Solar and Battery Storage Energy Facility is deemed appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area. Thus, the construction of the development may be authorised in its whole extent on either of the site alternatives proposed within the affected property.



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## Appendix A: CV



## 1 INTRODUCTION

The Droogfontein 4 Solar and Battery Storage Energy Facility on the Remaining Extent of Farm Droogfontein no 62 near Kimberley in the Northern Cape Province is proposed (**Figure 1-3**). Environamics Environmental Consultants has been appointed to conduct the Basic Assessment (BA) for the project.

*Table 2: General site information*

|  |   |
|--|---|
| Description of affected farm portions              | Remaining Extent of the Farm Droogfontein No. 62  |
| Province   | Northern Cape   |
| District Municipality                              | Frances Baard District Municipality   |
| Local Municipality                                 | Sol Plaatjie Local Municipality   |
| Ward numbers                                       | 29  |
| Closest towns                                      | The town of Kimberley is located approximately 12 km south of the proposed development  |
| 21 Digit Surveyor General codes                    | Remaining Extent of the Farm Droogfontein No. 62 - C0370000000006200000   |
| Type of technology                                 | Photovoltaic solar facility   |
| Structure Height                                   | Panels up to 3m, buildings ~ 4m, power line ~32m, BESS ~3.5m  |
| Surface area to be covered (Development footprint) | 300 ha  |
| EIA footprint                                      | 300 ha  |
| Structure orientation                              | Tracking PV with bi-facial panels. Bi-facial panels with single axis tracking is preferred over fixed-axis or double axis tracking systems and mono-facial panels due to the potential to achieve higher annual energy yields whilst minimising the balance of system (BOS) costs, resulting in the lowest levelized cost of energy (LCOE).<br><br>The development of the PV facility will take into consideration during the final design phase the use of either mono-facial or bi-facial PV panels as well as tracker vs fixed- tilt mounting structures. Both options are considered feasible for the site. |
| Generation capacity                                | Direct Current – up to 200MW<br><br>Alternate Current – up to 180MW   |



## 2. 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 projects are described below:

- PV Panel Array - To produce up to 200MW, 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.
- Battery Energy Storage System (BESS) – The battery energy storage system will make use of Lithium-ion as a preferred technology and will have a capacity of up to 40MW. The extent of the system will be 20m long, 23m high, 2.5m wide. The containers may be single stacked only to reduce the footprint. There may be up to a maximum of 40 containers of BESS. The containers will include cells, HVAC, fire, safety and control systems and will comprise of Lithium-ion technology providing a maximum capacity of 50MW in total.
- 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. A collector substation with a capacity of 132kV will also be required.

Output voltage from the inverter is approximately 480V and this is fed into step up transformers to 132kV. An onsite facility substation and switching stations 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 tie in with the existing 275kV transmission power lines located within the affected property. The power line route will be assessed within a 300m wide grid connection corridor.

Each alternative site assessed for the project includes a grid connection corridor which is 300m wide with a length of between 1km and 600m

Refer to the Figure below.



**Figure 1:** Grid connection corridor associated with each of the alternative sites proposed for the Droogfontein 4 Solar and Battery Storage Energy Facility

- Supporting Infrastructure – The following auxiliary buildings with basic services including water and electricity will be required:
  - Administration Office (~300m<sup>2</sup>);
  - Switch gear and relay room (~400m<sup>2</sup>);
  - Staff lockers and changing room (~200m<sup>2</sup>);
  - Security control (~60m<sup>2</sup>);
  - Operations & Maintenance (O&M) room; and
  - Warehouse.



- Roads – Access will be obtained via the N12 national road and various gravel farm roads within the area and affected property. 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 facilities will be required to be fenced off from the surrounding farms.

Table 3: Technical details for each the proposed facilities

| <b>Component</b>  | <b>Description / dimensions</b>   |
|---|---|
| <b>Height of PV panels</b>  | Up to 3 meters  |
| <b>Area of PV Array</b>   | Up to 200 hectares  |
| <b>Number of inverters required</b>                                   | To be determined as part of the final facility layout design.   |
| <b>Area occupied by inverter / transformer stations / substations</b> | On-site Facility Substation: up to 3ha<br>Collector Substation: up to 3ha<br>BESS: up to 5ha  |
| <b>Capacity of the on-site substation</b>                             | 33kV / 132kV  |
| <b>Capacity of the collector substation</b>                           | 33kV / 132kV  |
| <b>Capacity of the power line</b>                                     | 33kV / 132kV  |
| <b>Area occupied by both permanent and construction laydown areas</b> | Up to 3 hectares  |
| <b>Area occupied by buildings</b>                                     | <ul style="list-style-type: none"> <li>• Administration Office (~300m<sup>2</sup>);</li> <li>• Switch gear and relay room (~400m<sup>2</sup>);</li> <li>• Staff lockers and changing room (~200m<sup>2</sup>);</li> <li>• Security control (~60m<sup>2</sup>);</li> </ul> |
| <b>Width of internal roads</b>  | Between 8 and 12 meters   |
| <b>Grid connection corridor width</b>                                 | 300m  |
| <b>Grid connection corridor length</b>                                | Option A: up to 600m<br>Option B: up to 1km   |
| <b>Power line servitude width</b>                                     | Up to 32m   |
| <b>Height of fencing</b>  | Approximately 3 meters  |





## 2.1 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 and the farm portions were found favorable due to its proximity to grid connections, solar radiation, site access and relative flat terrain. These factors were then taken into consideration and avoided as far as possible, where required.

The following alternatives were considered in relation to the proposed activity and all specialists should also make mention of these:

### 2.1.1 *No-go alternative*

This alternative considers the option of 'do nothing' and maintaining the status quo. The site is currently zoned for mixed land uses, including agriculture and solar energy generation. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for these purposes. The potential opportunity costs in terms of adding solar energy generation to the current land use, which already includes solar energy generation, would be lost if the status quo persist, and therefore all positive socio-economic opportunities and associated growth will also be lost.

### 2.1.2 *Location alternatives*

Two site alternatives have been identified. Each alternative includes a grid connection corridor to enable connection of the relevant site to the national grid via a loop-in loop-out connection to an existing power line located within the affected property. The two site alternatives will be assessed on an equal level and the preferred will be indicated by all specialists considering the relevant field of study.

### 2.1.3 *Technical alternatives: BESS*

Three types of battery technologies are being considered for the proposed project: Lithium-ion (Lithium-Phosphate), Sodium-sulphur or Vanadium Redox flow battery. While there are various battery storage technologies available, the preferred alternative is the utility-scale Lithium-ion (Li-ion) battery energy storage. Li-ion batteries have emerged as the leading technology in utility-scale energy storage applications because it offers the best mix of performance specifications, such as high charge and discharge efficiency, low self-discharge, high energy density, and long cycle life (Divya KC et al., 2009).

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,



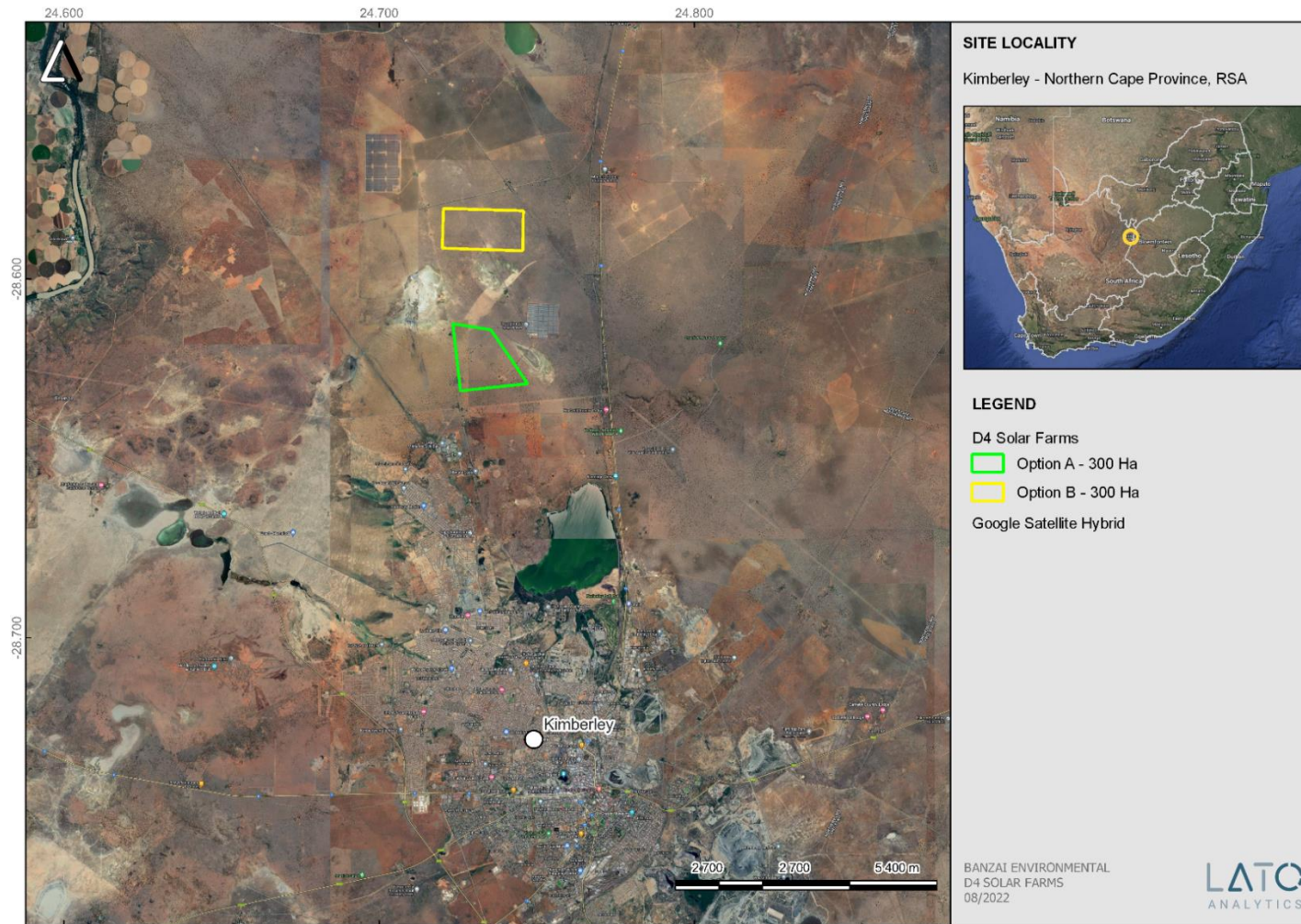
electricity reserve capacity improvement, transmission congestion relief, load following and time of use energy cost management. In essence, this technology allows renewable energy to enter the baseload and peak power generation market and therefore can compete directly with fossil fuel sources of power generation and offer a truly sustainable electricity supply option.

#### *2.1.4 Design and layout alternatives*

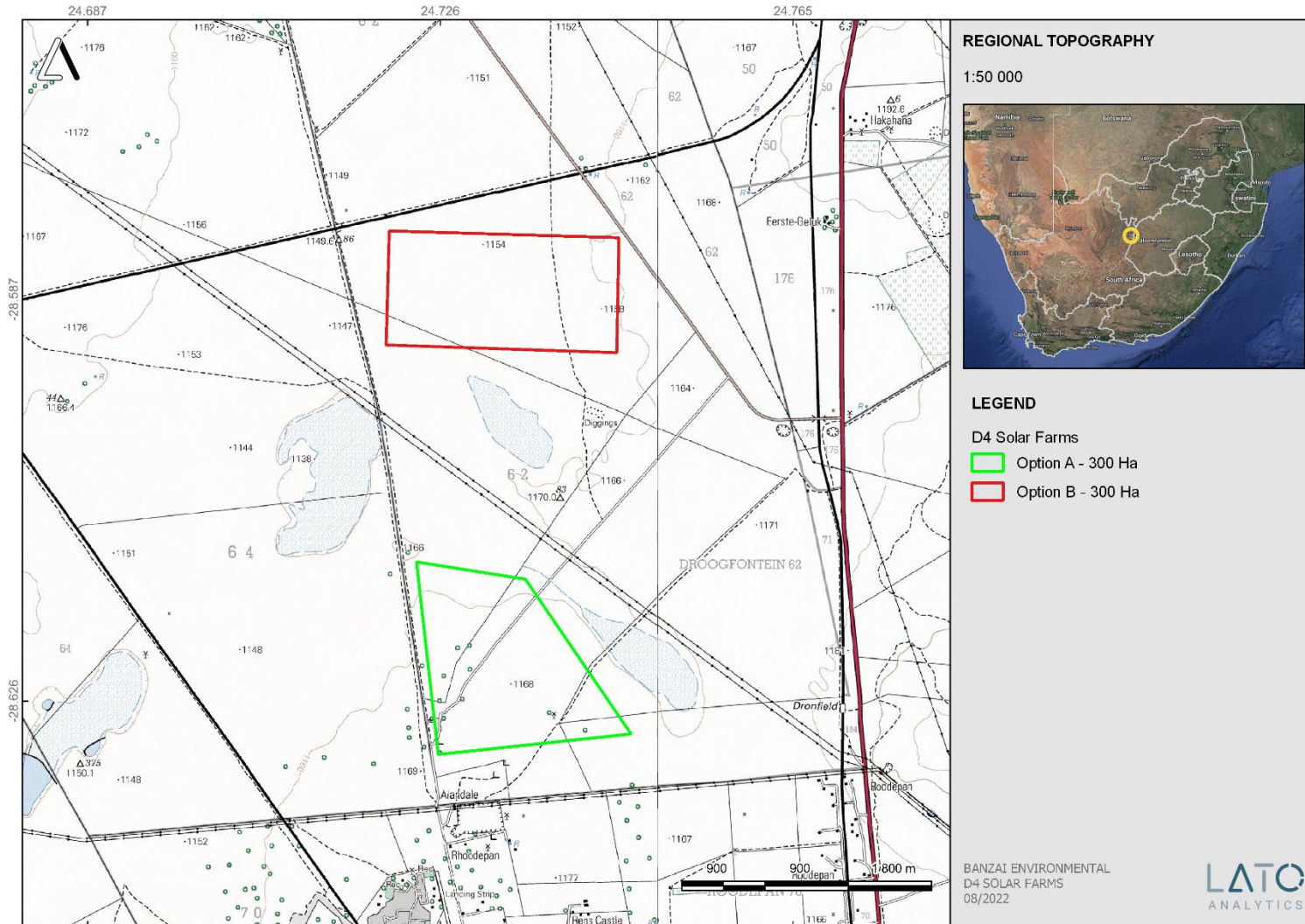
Design alternatives will be considered throughout the planning and design phase and specialist studies are expected to inform the final layout of the proposed development.

#### *2.1.5 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. 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.



**Figure 2:** Regional locality of the two site alternatives under assessment for the Droogfontein 4 Solar and Battery Storage Energy Facility on the Remaining Extent of Farm Droogfontein no 62 near Kimberley in the Northern Cape Province



**Figure 3:** Locality of the two site alternatives under assessment for the Droogfontein 4 Solar and Battery Storage Energy Facility on the Remaining Extent of Farm Droogfontein no 62 near Kimberley in the Northern Cape Province.



## 2.2 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)   | <ul style="list-style-type: none"> <li>“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.”</li> <li>Activity 11(i) is triggered as the proposed photovoltaic solar facility will transmit and distribute electricity of 132 kilovolts outside an urban area.</li> </ul>  |
| GNR. 327 (as amended in 2017) | Activity 14      | <ul style="list-style-type: none"> <li>“The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.”</li> <li>Activity 14 is triggered as hazardous goods (including diesel, petrol, oils, hydraulic oil, paints, grease and sealants) will need to be stored for the project with a combined capacity of more than 80 cubes but less than 500 cubes. It is planned that storage for 100 cubes of hazardous goods will need to be stored and handled.</li> </ul> |
| GNR. 327 (as amended in 2017) | Activity 24 (ii) | <ul style="list-style-type: none"> <li>“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.”</li> <li>Activity 24 (ii) is triggered as internal and external roads will be developed and will have a width of approximately 8 m, but up to 12m.</li> </ul>   |



|                                  |                      |   |
|----------------------------------|----------------------|---|
| GNR. 327<br>(as amended in 2017) | Activity 28(ii)      | <ul style="list-style-type: none"> <li>• <i>“Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 1998 and where such development (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare.”</i></li> <li>• Activity 28(ii) is triggered as portions of the affected farm has been previously used for agricultural activities and the property will be re-zoned to “special” use.</li> </ul> |
| GNR. 327<br>(as amended in 2017) | Activity 56<br>(ii): | <ul style="list-style-type: none"> <li>• <i>“The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre (ii) where no reserve exists, where the existing road is wider than 8 metres...”</i></li> <li>• Activity 56 (ii) is triggered as the existing access to the affected property does not have a reserve and will need to be widened by more than 6 metres.</li> </ul>  |
| GNR. 325<br>(as amended in 2017) | Activity 1           | <ul style="list-style-type: none"> <li>• <i>“The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more.”</i></li> <li>• Activity 1 is triggered since the proposed photovoltaic solar facility will generate up to 240 megawatts of electricity through the use of a renewable resource.</li> </ul>  |
| GNR. 325<br>(as amended in 2017) | Activity 15          | <ul style="list-style-type: none"> <li>• <i>“The clearance of an area of 20 hectares or more of indigenous vegetation.”</i></li> <li>• More than 20 hectares of indigenous vegetation will be cleared. The development footprint will be over 300 hectares in extent.</li> </ul>  |

The activities triggered under Listing Notice 1 & 2 (Regulation 327 & 325) for the project implies that the developments are considered as potentially having an impact on the environment and therefore require the implementation of appropriate mitigation measures. The project is located in the Kimberley Solar Renewable Energy Development Zone. Therefore, the project is subject to a Basic Assessment process, as well as the 57-day timeframe for the processing of the Application for Environmental Authorisation by the Department of Forestry, Fisheries and the Environment (DFFE).



### 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 may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

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

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





- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

## 5. OBJECTIVE

The objective of a Palaeontological Desktop Assessment (PDA) 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 PDA 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 area;
- 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).

## 6. GEOLOGICAL AND PALAEOLOGICAL HISTORY

The Droogfontein 4 Solar and Battery Storage Energy Facility near Kimberley in the Northern Cape is depicted on the 1: 250 000 Kimberley 2824 (1993) Geological Map (Council for Geosciences, Pretoria (**Figure 4, Table 5**).

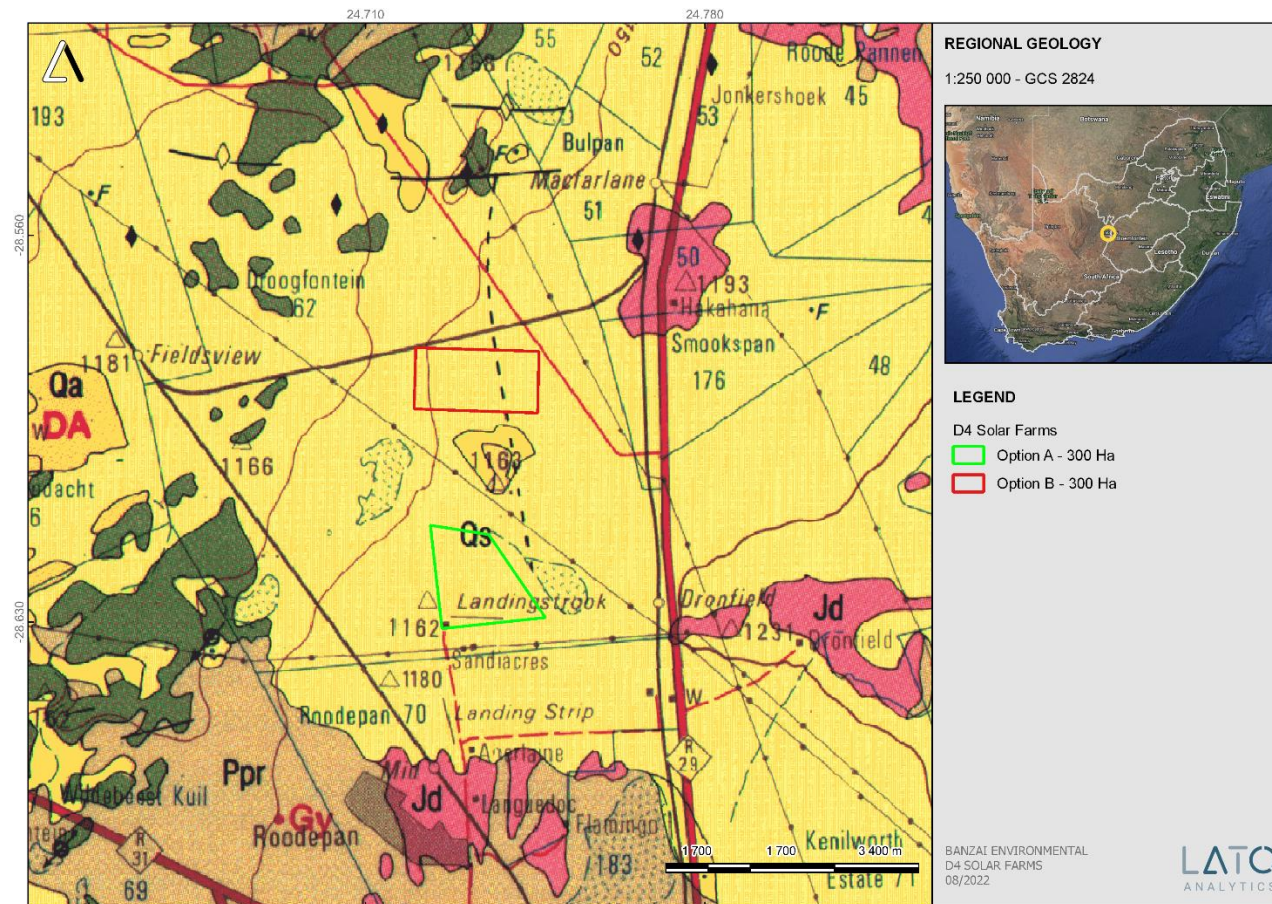
The proposed development is underlain by Quaternary to Recent red and grey aeolian dune sand (Qs, yellow) (Qs) and at depth by sediments of the older Karoo and Ventersdorp Supergroup. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Quaternary sands is Medium (**Figure 5**). The geology has recently been updated (Council of Geosciences, Pretoria) and now indicates that the proposed Droogfontein 4 Solar and Battery Storage Energy Facility is underlain by the sediments of the Kalahari Group (**Figure 6**). These sediments overlay the older Karoo and Ventersdorp Supergroup sediments.

The Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt, and clay, and they form relatively thin, often discontinuous patches of sediments or larger spreads onshore.

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



The sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge et al., 2006). The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters (De Witt et al., 2000; Johnsen et al, 2006). The Gordonia dune sands 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 boundary of the Pliocene-Pleistocene has been extended back from 1.8 Ma to 2.588 Ma placing the Gordonia Formation almost entirely within the Pleistocene Epoch. The fossil assemblages of the Kalahari are generally low in diversity and occur over a wide range. 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 cores as well as mammalian teeth (Klein, 1984). 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.



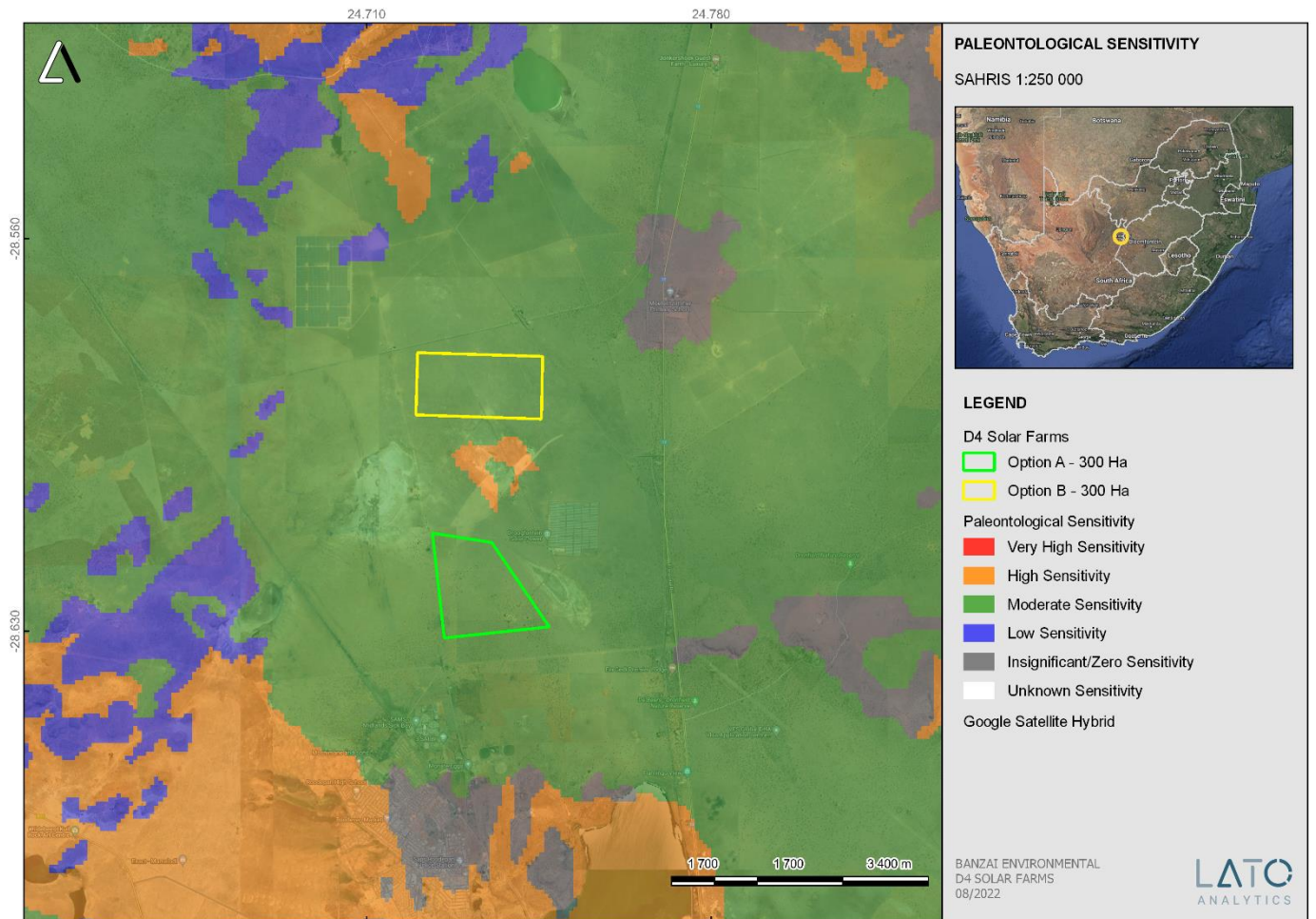
**Figure 4:** Extract of the 1:250 000 Kimberly 2824 (1986) Geological Map (Council for Geosciences, Pretoria) indicating the two alternative sites proposed for the Droogfontein 4 Solar and Battery Storage Energy Facility near Kimberly in the Northern Cape.

The propose development is underlain by Quaternary red and grey aeolian dune sand.



Table 5: Legend of the 2824 Kimberly (2000) Geological Map (Council for Geosciences, Pretoria)

|                          |                                      | GROUP<br>GROEP | SUBGROUP<br>SUBGROEP | FORMATION<br>FORMASIE         | MEMBER<br>LID |   |
|--------------------------|--------------------------------------|----------------|----------------------|-------------------------------|---------------|---|
| QUATERNARY<br>KWARTÊR    |                                      |                |                      |                               | Qs            | Qa Alluvial diamondiferous gravel<br>Alluviale diamantdraende gruis                                       |
|                          |                                      |                |                      |                               |               | Qc Calcrete, calcified pandune and surface limestone<br>Kalkreet, verkalkte panduin en oppervlakkalksteen |
|                          |                                      |                |                      |                               | Qa            | Alluvium and scree<br>Alluvium en glooiingspuin   |
|                          |                                      |                |                      |                               | Qc            | Qs Sand: Red and grey aeolian dune sand<br>Sand: Rooi en grys eoliese duinsand                            |
| CRETACEOUS<br>KRYT       |                                      |                |                      |                               |               | Kimberlite pipe (♦), fissure (—♦—)<br>Kimberlietyp (♦), -spleet (—♦—)                                     |
| JURASSIC<br>JURA         |                                      |                |                      |                               |               | Jd Dolerite: dolerite dyke shown as (—♦—)<br>Doleriet: dolerietgang aangetoon deur (—♦—)                  |
| PERMIAN<br>PERM          | KAROO SEQUENCE<br>KAROO OPEENVOLGING | BEAUFORT       | ADELAIDE             | Tierberg                      | Pa            | Pa Mudstone, sandstone<br>Moddersteen, sandsteen  |
|                          |                                      |                |                      |                               | Pt            | Pt Shale, siltstone, sandstone<br>Skalie, sliesteen, sandsteen  |
|                          |                                      |                |                      |                               | Pw            | Pw White-weathering carbonaceous shale<br>Witverwerende koolstofhoudende skalie                           |
|                          |                                      |                |                      |                               | Ppr           | Ppr Shale<br>Skalie   |
|                          |                                      |                |                      |                               | C-Pd          | C-Pd Tillite, sandstone, mudstone, shale<br>Tilliet, sandsteen, moddersteen, skalie                       |
| CARBONIFEROUS<br>KARBOON |                                      | ECCA           | Whitehill            | Prince Albert<br>Prins Albert | di            | di Diabase dyke (—♦—)<br>Diabaasgang (—♦—)  |
|                          |                                      |                |                      |                               | DWYKA         |   |



**Figure 5:** Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the Droogfontein 4 Solar and Battery Storage Energy Facility

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

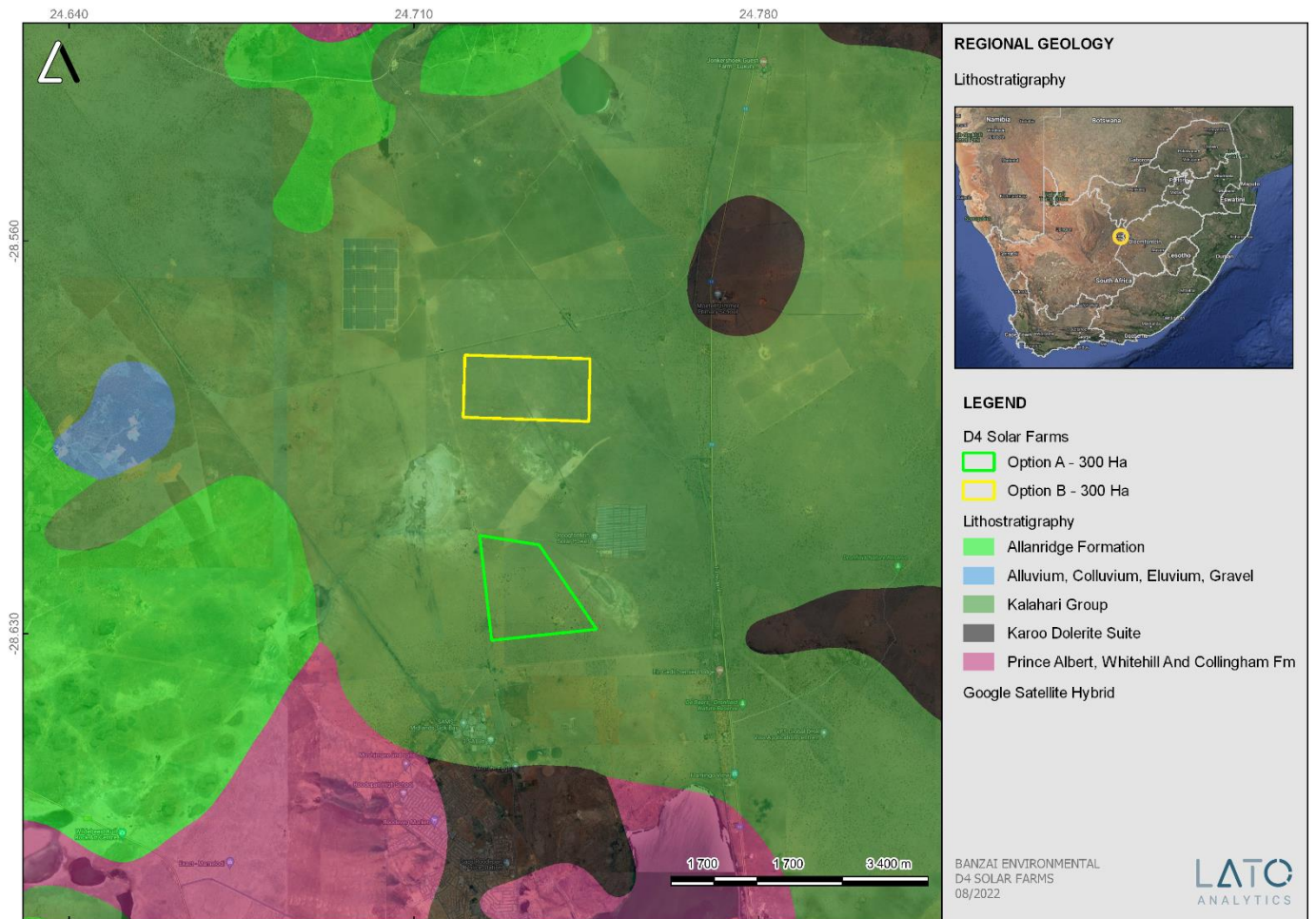
| Colour        | Sensitivity | Required Action   |
|---------------|-------------|---|
| RED           | VERY HIGH   | Field assessment and protocol for finds is required   |
| ORANGE/YELLOW | HIGH        | Desktop study is required and based on the outcome of the desktop study, a field assessment is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



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

According to the SAHRIS Palaeosensitivity map (**Figure 5**) the proposed development is underlain by sediments with a moderate (green) Palaeontological Sensitivity.

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



**Figure 6:** Updated Geology (Council of Geosciences, Pretoria) of the proposed Droogfontein 4 Solar and Battery Storage Energy Facility

This map indicates that the development is underlain by the Kalahari Group.





Table 7: Fossil Heritage from the Northern Cape [extracted from the Palaeotechnical report of the Northern Cape (Almond and Pether, 2009)].

|   |  |   |   |
|---|--|---|---|
| <p><b>15. FLUVIAL, LACUSTRINE &amp; TERRESTRIAL DEPOSITS</b><br/>(most too small to be indicated on small scale geological maps)</p> <p>including eg Kwaggaskop Fm</p> <p>(Q)</p> | <p>Fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes, tufa, cave deposits</p> <p>Late Cretaceous to Holocene<br/>c. 65 Ma → 0 Ma</p> | <p>Bones and teeth of mammals (eg proboscideans, rhinos, bovids, horses, micromammals), reptiles, fish, freshwater molluscs, petrified wood, trace fossils (eg termitaria), rhizoliths, diatom floras</p>   | <ul style="list-style-type: none"> <li>• Scattered records, many poorly studied (eg from ancient drainage systems)</li> <li>• Include equivalents of famous Arrisdrift Miocene fauna from S. Namibia</li> <li>• Threatened by alluvial diamond mining (eg Gariep, Vaal river gravels)</li> <li>• Orange River Man (100-50 Ka, <i>H. heidelbergensis</i>)</li> </ul> |
| <p><b>14. KALAHARI GROUP</b></p> <p>(K-Q)</p>   | <p>Fluvial gravels, sands, lacustrine and pan mudrocks, evaporites, aeolian sands, pedocretes (especially calcrete)</p> <p>Late Cretaceous to Recent<br/>&lt;90 Ma → 0 Ma</p>      | <p>Palynomorphs, root casts (rhizomorphs) and burrows (eg termitaria), rare vertebrate remains (mammals, fish, ostrich egg shell etc), diatom-rich limestones, freshwater stromatolites, freshwater and terrestrial shells (gastropods, bivalves), ostracods, charophytes</p> | <p>Fossils mainly associated with ancient pans, lakes and river systems</p> <p>Palaeontology poorly studied</p>   |

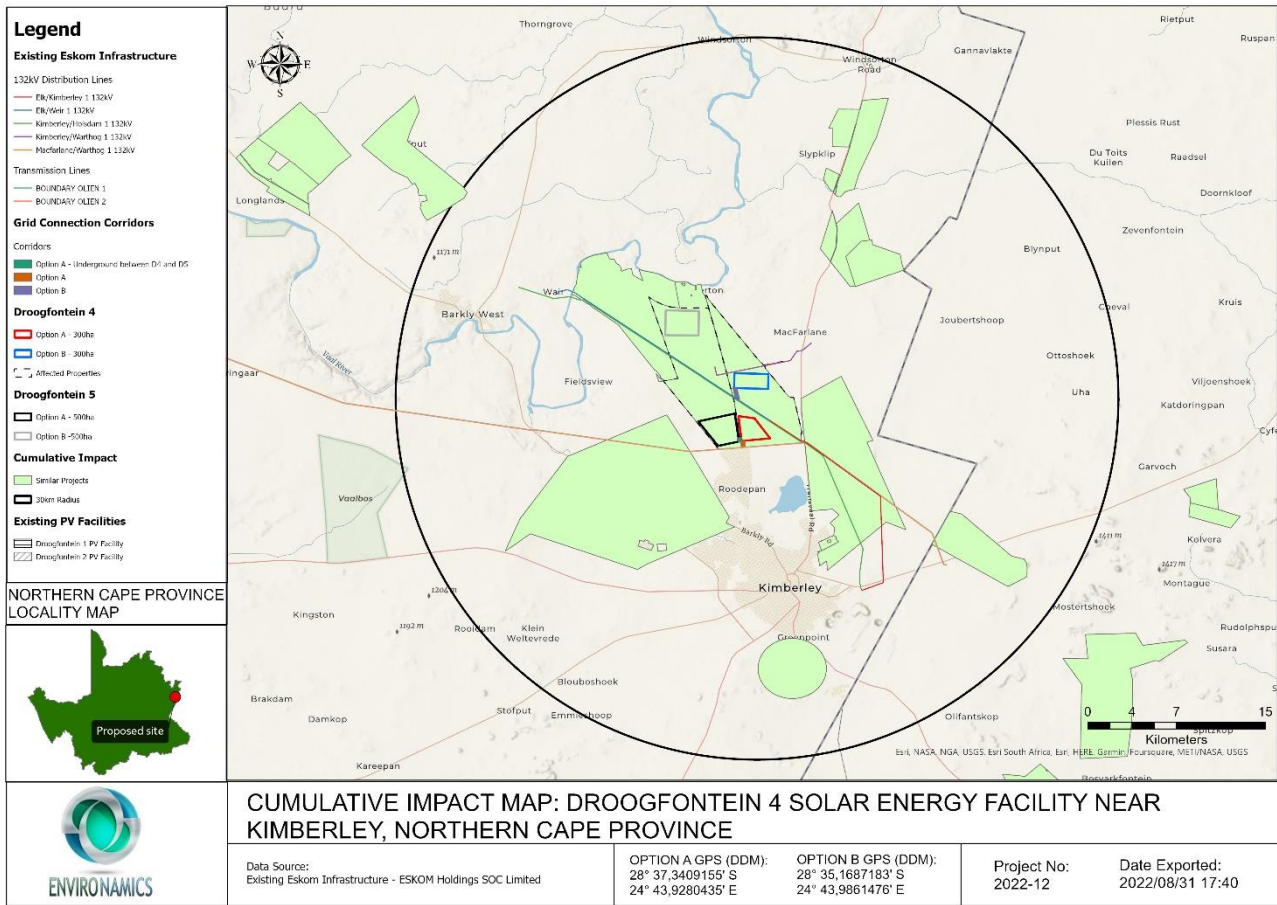


Figure 7: Cumulative Impact Map indicating the similar Solar Power plants and grid connections in a 30 km radius of Droogfontein 4 Solar and Battery Storage Energy Facility.

Solar Facilities to the east of the Droogfontein 4 Solar and Battery Storage Energy Facility will have a Zero to High Palaeontological Sensitivity. However, it is important to note that the quality of preservation of these different sites will most probably vary and it is therefore 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.



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

| Site name           | Distance from study area | Proposed generating capacity | DEFF reference      | EIA process      | Project status   |
|---------------------|--------------------------|------------------------------|---------------------|------------------|------------------|
| Droogfontein 1      | <1km                     | 150MW                        | 12/12/20/2024/1/1   | Scoping and EIA  | Approved         |
| Droogfontein 2      | <1km                     | 150MW                        | 14/12/16/3/3/1/2369 | Scoping and EIA  | Approved         |
| Kabi Kimberly PV    | ~1km                     | 150MW                        | 12/12/20/2124       | Basic Assessment | Approved         |
| De Beers Kenilwood  | ~8km                     | 150MW                        | 12/12/20/2138       | Basic Assessment | Approved         |
| Kimberly Airport    | ~18km                    | 100MW                        | 12/12/20/2148       | Basic Assessment | Approved         |
| Platfontein         | ~12km                    | 75 MW                        | 12/12/20/225/1      | Scoping and EIA  | Approved         |
| Kenilworth          | ~2km                     | 100 MW                       | 12/12/20/2440       | Scoping and EIA  | Withdrawn/Lapsed |
| Inyanga PV Facility | ~20km                    | 75 MW                        | 12/12/20/2581       | Scoping and EIA  | Withdrawn/Lapsed |
| Morgenzon PV 1      | ~17km                    | 75 MW                        | 12/12/20/2581       | Basic Assessment | In Process       |
| PV Plant 198        | ~15km                    | 19 MW                        | 14/12/16/3/3/1/423  | Basic Assessment | In Process       |
| Zoutpan PV          | ~17km                    | 75 MW                        | 14/12/16/3/3/1/505  | Basic Assessment | Approved         |
| Kimberly PV Phase 1 | ~15km                    | 0 MW                         | 14/12/16/3/3/2/264  | Scoping and EIA  | Withdrawn/Lapsed |
| Kimberly PV Phase 2 | ~15km                    | 0 MW                         | 14/12/16/3/3/2/265  | Scoping and EIA  | Withdrawn/Lapsed |
| Kimberly PV Phase 3 | ~15km                    | 0 MW                         | 14/12/16/3/3/1/266  | Scoping and EIA  | Withdrawn/Lapsed |



|                      |       |       |                    |                 |                  |
|----------------------|-------|-------|--------------------|-----------------|------------------|
| Hanskopfontein       | ~17km | 75 MW | 14/12/16/3/3/2/307 | Scoping and EIA | Approved         |
| Tiger Solar Facility | ~18km | 25 MW | 14/12/16/3/3/2/402 | Scoping and EIA | In Process       |
| Table Farm PV        | ~30km | 0 MW  | 14/12/16/3/3/2/527 | Scoping and EIA | Withdrawn/Lapsed |

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

The proposed Droogfontein 4 Solar and Battery Storage Energy Facility is located on the Remaining Extent of the Farm Droogfontein No. 62 near Kimberley in the Northern Cape Province (**Figure 1-3**).

## 8. METHODS

The aim of a desktop study is to evaluate the possible risk to palaeontological heritage in the proposed development area. 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.

### 8.1 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, but is not deemed as required based on the sensitivity of the area as per the palaeo sensitivity map of SAHRA.



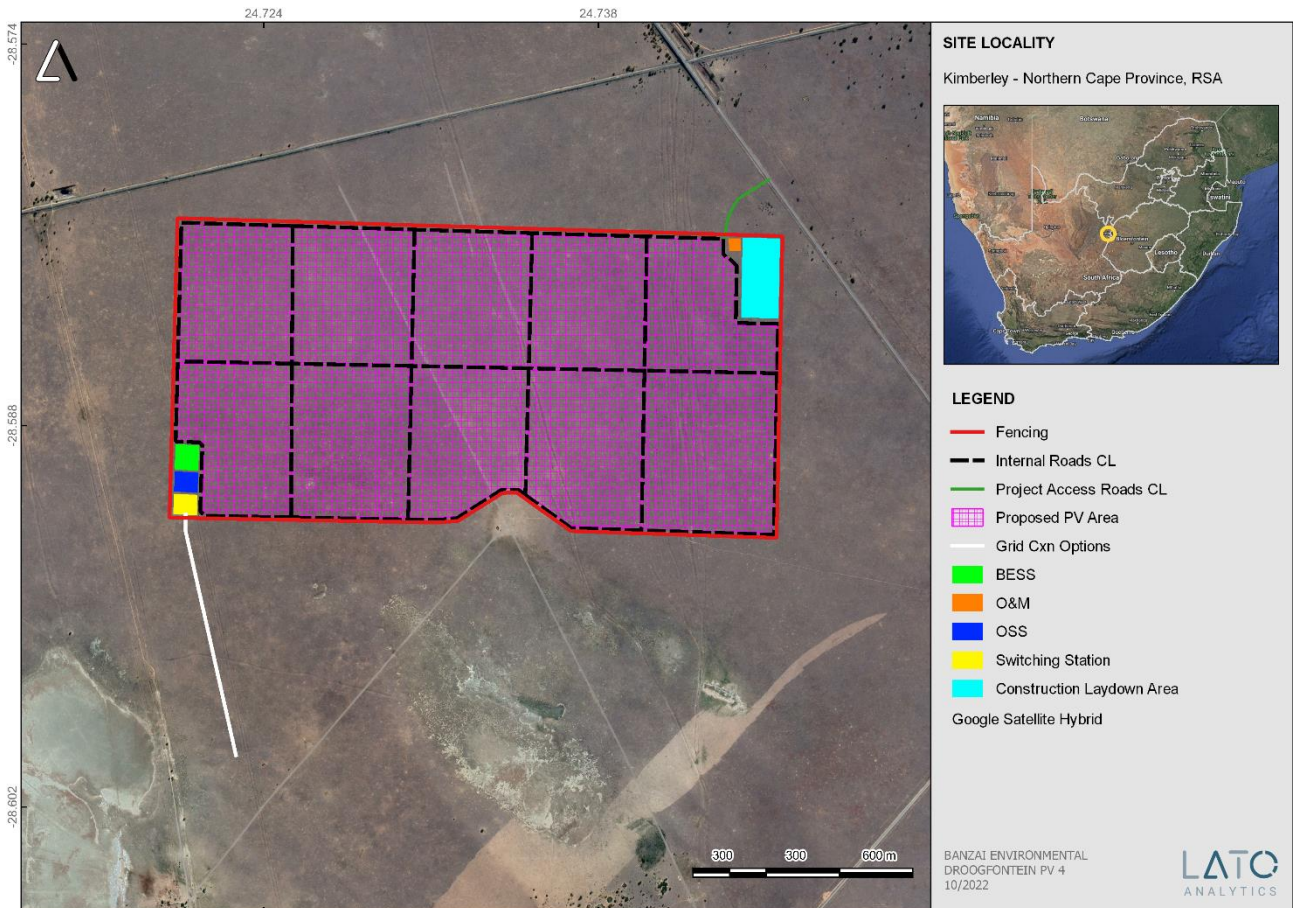
## 9. ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

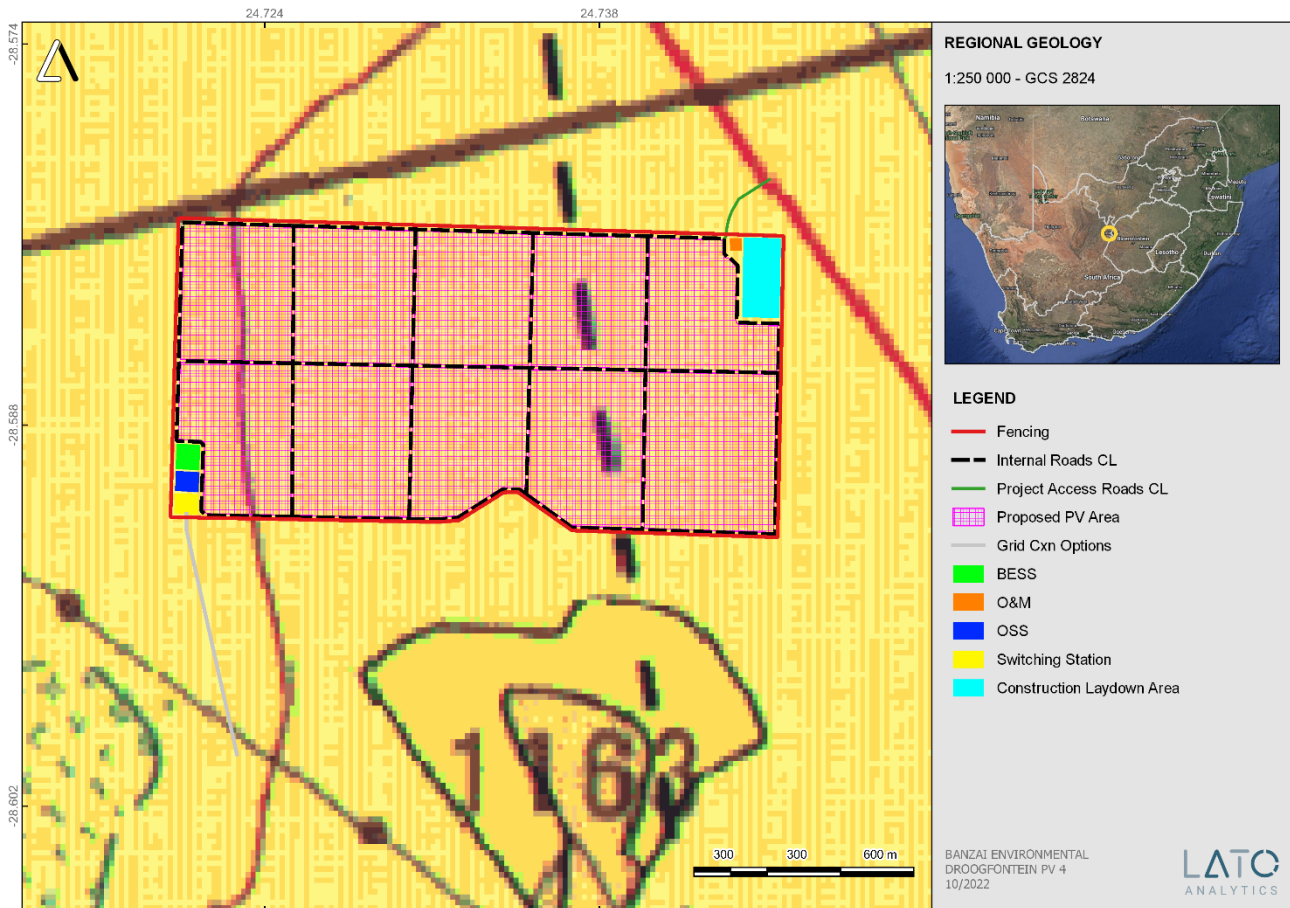
- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- A Google Earth map with polygons of the proposed development was obtained from Environamics.
- 1:250 000 Kimberly 2824 (1993) Geological Map (Council for Geosciences, Pretoria)
- PIAs in the immediate area of the proposed development includes that of Butler 2020a and 2020b, Fourie 2020

## 10. OPTIMIZED INFRASTRUCTURE

The infrastructure of the Droogfontein PV 4 has been updated.



**Figure 8:** Optimized layout of option B.



**Figure 9:** Extract of the 1:250 000 Kimberly 2824 (1986) Geological Map (Council for Geosciences, Pretoria) indicating the Optimized layout of option B of the proposed Droogfontein 4 Solar and Battery Storage Energy Facility near Kimberly in the Northern Cape.

## 11. IMPACT ASSESSMENT METHODOLOGY

### METHOD OF ENVIRONMENTAL ASSESSMENT

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

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

| <b>NATURE</b>  |                            |   |
|--|----------------------------|---|
| Loss of Fossil Heritage.   |                            |   |
| <b>GEOGRAPHICAL EXTENT</b>   |                            |   |
| This is defined as the area over which the impact will be experienced. |                            |   |
| 1  | Site                       | The impact will only affect the site.   |
| 2  | Local/district             | Will affect the local area or district.   |
| 3  | Province/region            | Will affect the entire province or region.  |
| 4  | International and National | Will affect the entire country.   |
| <b>PROBABILITY</b>   |                            |   |
| This describes the chance of occurrence of an impact.                  |                            |   |
| 1  | Unlikely                   | The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence). |
| 2  | Possible                   | The impact may occur (Between a 25% to 50% chance of occurrence).                           |
| 3  | Probable                   | The impact will likely occur (Between a 50% to 75% chance of occurrence).                   |



|   |             |  |
|---|-------------|--|
| 4   | Definite    | Impact will certainly occur (Greater than a 75% chance of occurrence).   |
| <b>DURATION</b>   |             |  |
| This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity. |             |  |
| 1   | Short term  | The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).                      |
| 2   | Medium term | The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).  |
| 3   | Long term   | The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).  |
| 4   | Permanent   | The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.   |
| <b>INTENSITY/ MAGNITUDE</b>   |             |  |
| Describes the severity of an impact.  |             |  |
| 1   | Low         | Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.   |
| 2   | Medium      | Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).   |
| 3   | High        | Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.  |
| 4   | Very high   | Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation. |
| <b>REVERSIBILITY</b>  |             |  |





|   |                               |  |
|---|-------------------------------|--|
| This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.   |                               |  |
| 1   | Completely reversible         | The impact is reversible with implementation of minor mitigation measures.         |
| 2   | Partly reversible             | The impact is partly reversible but more intense mitigation measures are required. |
| 3   | Barely reversible             | The impact is unlikely to be reversed even with intense mitigation measures.       |
| 4   | Irreversible                  | The impact is irreversible and no mitigation measures exist.                       |
| <b>IRREPLACEABLE LOSS OF RESOURCES</b>  |                               |  |
| This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.   |                               |  |
| 1   | No loss of resource           | The impact will not result in the loss of any resources.                           |
| 2   | Marginal loss of resource     | The impact will result in marginal loss of resources.                              |
| 3   | Significant loss of resources | The impact will result in significant loss of resources.                           |
| 4   | Complete loss of resources    | The impact is result in a complete loss of all resources.                          |
| <b>CUMULATIVE EFFECT</b>  |                               |  |
| This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.   |                               |  |
| 1   | Negligible cumulative impact  | The impact would result in negligible to no cumulative effects.                    |
| 2   | Low cumulative impact         | The impact would result in insignificant cumulative effects.                       |
| 3   | Medium cumulative impact      | The impact would result in minor cumulative effects.                               |
| 4   | High cumulative impact        | The impact would result in significant cumulative effects                          |
| <b>SIGNIFICANCE</b>   |                               |  |
| 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.  |

*\*\*Each specialist should use the rating system supplied to conduct their impact assessment*

*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                 | 3                 | 32     |
| Post-Mitigation | 1      | 4        | 1         | 4             | 4                 | 3                 | 16     |

## 12. FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary Superficial Sediments and at depth by sediments of the Ecca and Ventersdorp Groups. According to the PalaeoMap on the South African Heritage Resources Information



System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary Superficial Sediments is moderate (Almond and Pether; 2009). Two layout alternatives have been considered for the proposed development and recently layouts to Option B has been optimized. Option B has been identified as the most environmentally suitable for the development. The geology of the different layouts is the same as they are all underlain by Quaternary deposits. Palaeontologically there is no preferred option between the layouts.

It is therefore considered that the proposed Droogfontein 4 Solar and Battery Storage Energy Facility in the Northern Cape will not lead to detrimental impacts on the palaeontological resources of the area. The construction of the development may therefore be authorised, on either of the site alternatives, as the area 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.

If fossil remains are discovered during any phase of construction, either on the surface or uncovered by excavations the ECO/site manager in charge of these developments must be notified immediately (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)). These discoveries must be secured and the ECO/site manager must alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a professional palaeontologist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports must meet the minimum standards for palaeontological impact studies developed by SAHRA.



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## Appendix A – Elize Butler CV

### CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 29 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<br>University of the Free State Zoology 1992 |
| Research Assistant                                     | National Museum, Bloemfontein 1993 – 1997                           |
| Principal Research Assistant<br>and Collection Manager | National Museum, Bloemfontein<br>1998–currently                     |

## TECHNICAL REPORTS

**Butler, E. 2014.** Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.

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- 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.
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**Butler, E., 2021.** Palaeontological Impact Assessment for the proposed East Orchards Poultry Farm, Delmas/Botleng Transitional Local Council, Mpumalanga. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

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

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

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

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

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

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

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

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

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**Butler, E., 2021.** Palaeontological Desktop Assessment for the proposed Campbell Sewer, Internal Reticulation, Outfall Sewer Line and Oxidation Ponds, located on ERF 1, Siyancuma Local Municipality in the Northern Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.



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

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

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

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

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

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

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

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