



# PALAEONTOLOGICAL IMPACT ASSESSMENT

DEALESVILLE PV  
SOLAR FACILITY

FREE STATE  
PROVINCE

2022

COMPILED FOR:  
CTS HERITAGE



## **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 2 of Report - Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 2 - refer to <b>Appendix A</b>	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 - Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 - Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 10	-



<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>
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1;9 & 11	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 & 11	
(g) An identification of any areas to be avoided, including buffers	Section 1 & 11	
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 - Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 - Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 11	
(k) Any mitigation measures for inclusion in	Section 1 and	



Requirements of Appendix 6 - GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable .
the EMPr	12	
(l) Any conditions for inclusion in the environmental authorisation	Section 1 and 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	
(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 11	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and Environmental



<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>
		Management Plan (EMP) process.
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	



## EXECUTIVE SUMMARY

Banzai Environmental was appointed by CTS Heritage to conduct the Palaeontological Impact Assessment (PIA) to assess the Dealsville Solar Project in the Free State. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA 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 study area is underlain by Quaternary deposits, Jurassic dolerite, as well as the Tierberg Formation of the Ecca Group (Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary calcrete is High, while that of Quaternary aeolian sands are Moderate, that of Jurassic dolerite is Zero and the Tierberg Formation has a Moderate Palaeontological Sensitivity (Almond and Pether, 2009; Almond *et al.*, 2013). Recent Shape files produced by the Council of Geosciences, Pretoria) indicates that the study area is underlain by calcretes, surface limestones and Hardpan superficial sediments, the Kalahari Group, Karoo Dolerite as well as the Tierberg Formation of the Ecca Group. Topographical as well as Google Earth images indicate that the relief of the proposed project is low, and outcrops in the area are rare.

A site-specific field survey of the development footprint was conducted on foot on September 2022. No visible evidence of fossiliferous outcrops was found in the development footprint and thus an overall LOW palaeontological significance is allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area and construction of the development may be authorised in its whole extent.

If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carried out.





Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.



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## **Appendix A:**

Curriculum Vitae      Elize Butler

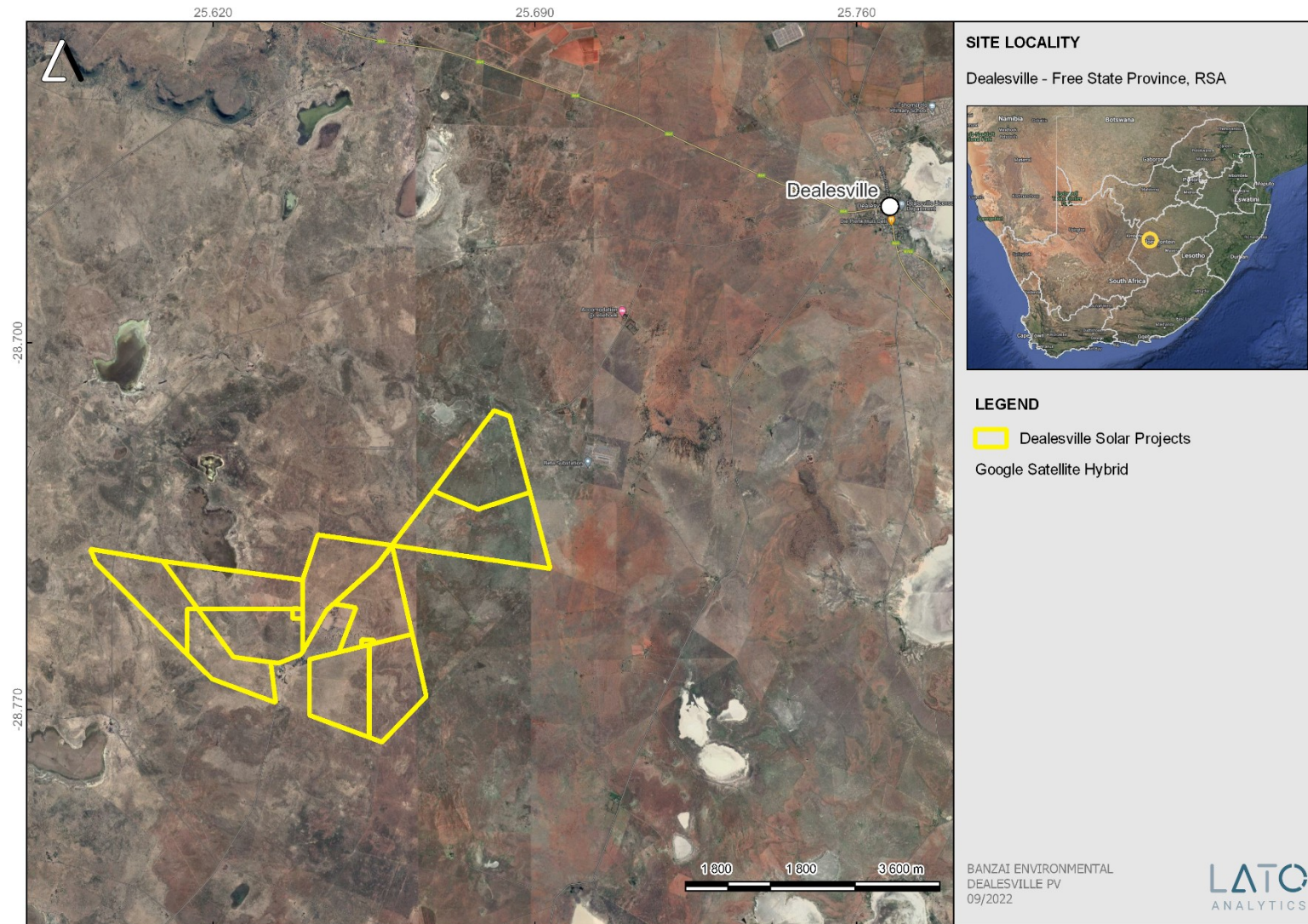


## **1 INTRODUCTION**

NOTSI PV (Pty) Ltd plans to develop a 10 x 100 MW solar PV facilities and associated infrastructure on Farm 1623 Ebenhaezer, near Dealesville in the Free State Province. The proposed solar facilities will comprise of PV arrays; auxiliary buildings; inverters; on-site substation and grid connection; cabling; battery storage; access and internal roads; temporary laydown areas; and fencing).

## **2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR**

This study has been conducted by Mrs Elize Butler. She has conducted approximately 400 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-nine years. She has experience in locating, collecting, and curating fossils. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.



**Figure 1:** Regional locality of the Dealesville PV Projects in the Free State Province.



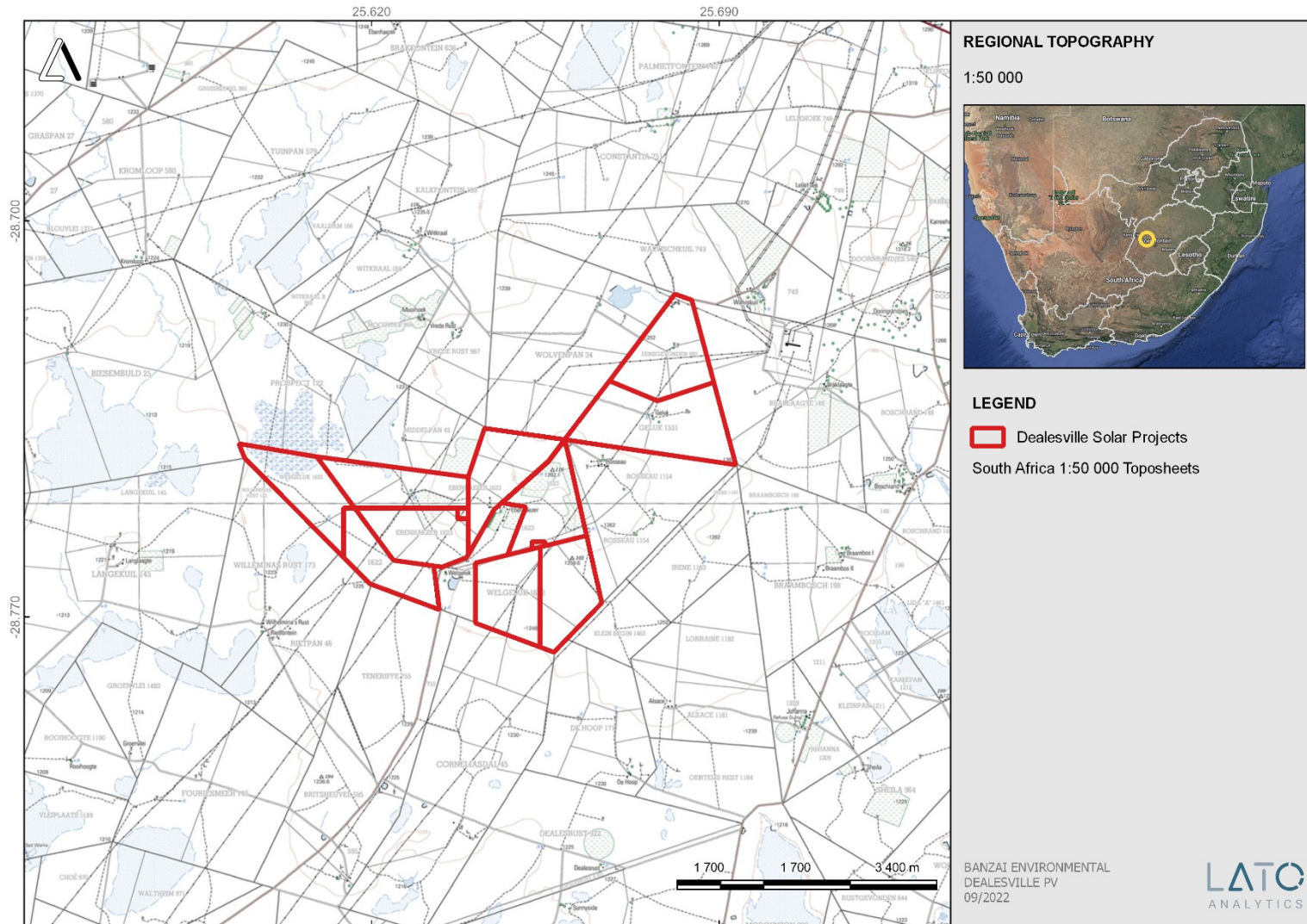


Figure 2: Locality Map of the Dealesville PV Projects in the Free State Province.



### **3 LEGISLATION**

#### **National Heritage Resources Act (25 of 1999)**

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

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

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

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

MPRDA Regulations of 2014

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





- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

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

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

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

**This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act.**

According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

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



#### **4 OBJECTIVE**

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

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

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

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

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

##### **General Requirements:**

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.



- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:
  - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
  - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
  - c. **Cumulative impacts** 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 GEOLOGICAL AND PALAEOLOGICAL HISTORY**

The Dealesville PV Projects in the Free State is depicted on the 1:250 000 2824 (1993) Kimberley Geological Map (Council of Geoscience, Pretoria). The study area is underlain by Quaternary deposits (Qc and Qs, yellow), Jurassic dolerite (Jd, red), as well as the Tierberg Formation (Pt, orange) of the Ecca Group (Karoo Supergroup) (**Figure 3, Table 2**). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary calcrete (Qc; calcrete, calcified pan dune and surface limestone) is High, Qs (sand, red and grey aeolian sand) is Moderate, that of Jurassic dolerite is Zero and the Tierberg Formation (Pt; orange;



shale, siltstone and sandstone) has a Moderate Palaeontological Sensitivity (Almond and Pether, 2009; Almond *et al.*, 2013; **Figure 4**). Recent Shape files produced by the Council of Geosciences, Pretoria) is depicted in **Figure 5**. Topographical as well as Google Earth images indicate that the relief of the proposed project is low, and outcrops in the area are rare.

The Quaternary deposits reveal palaeoclimatic changes in the different geological formations (Hunter *et al.*, 2006). The climatic fluctuations in the Cenozoic Era were responsible for the formation of most geomorphologic features in southern Africa (Maud, 2012). Various warming and cooling events occurred in the Cenozoic but climatic changes during the Quaternary, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past Barnosky (2005). Climate 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). Netterberg (1978, 1980) revived the South African calcretes and found that the calcretes comprise of glaebular calcrete (with separate nodules), hardpan calcrete that contain solid limestone and honeycomb calcrete (fusing with glaebules). These calcretes are locally conglomeratic with clasts of exotic pebbles and reworked calcretes. The calcretes could contain mammalian teeth, bones and horn cores, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens, and peats are recovered as well as trace fossils like vertebrate tracks, termite and insect burrows, termitaria (termite heaps/ mounds) as well as rhizoliths (root casts). Reworked Stone Age artifacts (Plio-Pleistocene) have been found in Quaternary alluvium. Some of these calcretes may be diamondiferous.

Various authors have described fossilized hyena burrows in Late Pleistocene alluvial sediments of the Modder River (Broom 1909 a, b; Cooke 1955; Churchill *et al.* 2000; Rossouw 2006). Fossilized hyena lairs are occasionally located outside the present river valleys along localized spring deposits and calcified pan dunes (Scott & Brink 1991). Fossiliferous sediments (local peat deposits) occur within calcified pan dunes in this region (Horowitz *et al.* 1978; Scott and Klein 1981; Butzer 1984). These types of pans formed when the prevailing winds blew aeolian sands (unconsolidated material) into newly formed lunettes on the lee side of the deflation hollows and sometimes provided a site for hyena burrows and prehistoric human habitation.

Pleistocene vertebrate fossils and plant microfossils are associated with spring and pan deposits [e.g., Florisbad, (northwest of Bloemfontein, Baden Baden (north of Dealesville,) Liebenbergspan (Voigts Post), Deelpan between Bloemfontein and



Petrusburg) (Brink 1987, 1988; Scott & Rossouw 2005)]. Florisbad has been declared a Provincial Heritage Site while Erfkroon is another valuable fossil site along the Modder River (15 km southwest of the southern end of the development site). Fossils in these areas occur over large areas in erosion gullies. Stone artefacts from the earlier part of the Middle Stone Age and the Later Stone Age have also been uncovered and are sometimes associated with bones (Churchill et al. 2000). The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past.

The **Karoo igneous province** (Jd-red) is one of the world's classic continental basalt (CFB) provinces. This province consists of intrusive and extrusive rocks that occur over a large area (Duncan et al, 2006). Generally, the flood basalts do not contribute to prominent volcanic structures, but instead are formed by successive eruptions from a set of fissures that form sub-horizontal lava flows (sills and dykes) varying in thickness. This lava caps the landscape on which they erupted. As the Karoo is an old flood basalt province it is today preserved as erosional fragments of a more extensive lava cap that covered much of southern Africa in the geological past. It is estimated that the Karoo lava outcrop currently covered at least 140 000 km<sup>2</sup> while it was larger in the past [~2 000 000 km<sup>2</sup> (Cox 1970, 1972)].

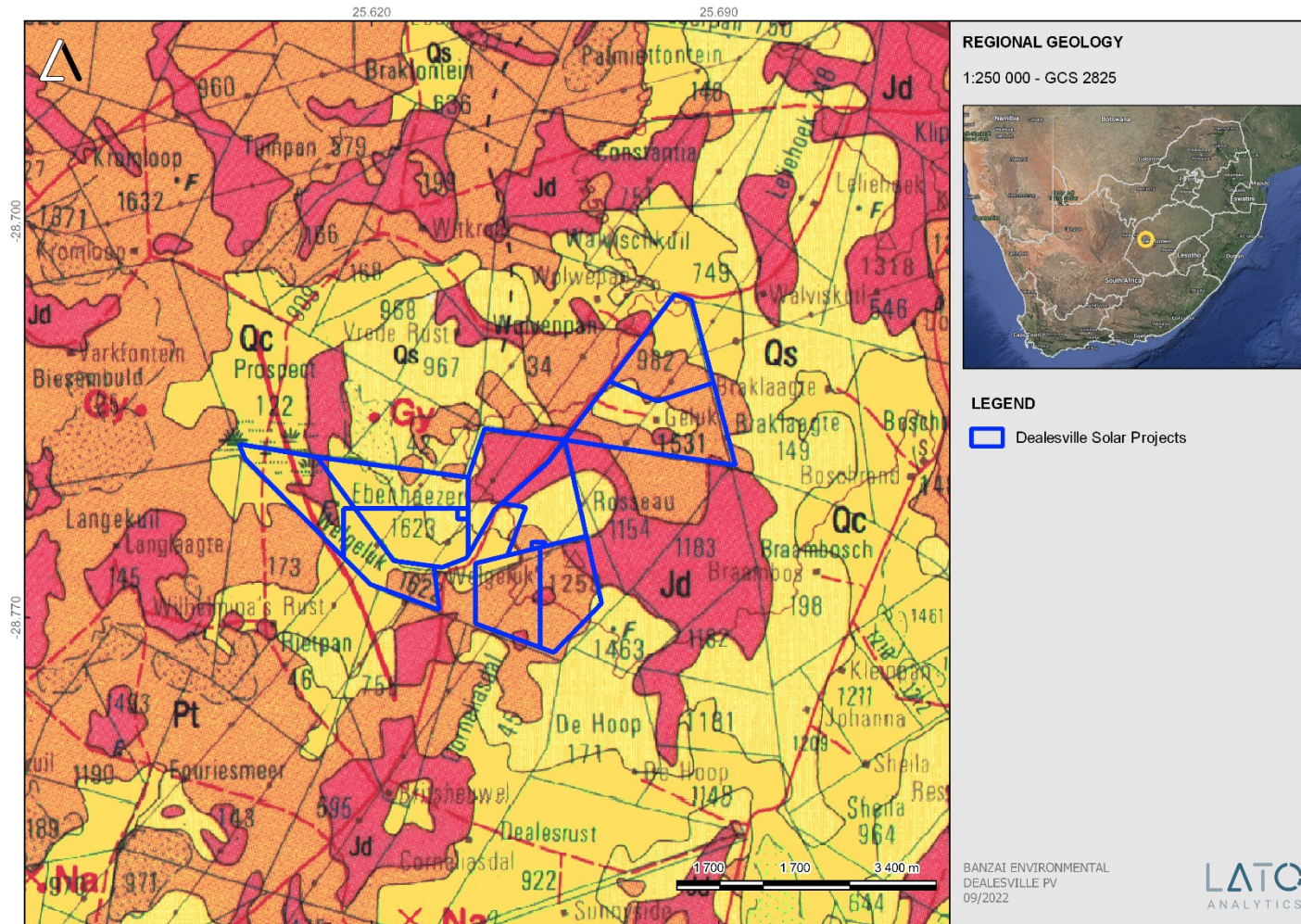
The Karoo Igneous Province contains a large volume of flood basalts as well as silicic volcanic rocks. These units are comprised of rhyodacite and rhyolitic magma and crops out along the Lebombo monocline. Individual units span up to 60 km and sometimes show massive pyroclastic structures and are thus classified as rheoignimbrites. The basal lavas lie conformable on the Clarens Formation but in specific localities sandstone erosion occurred before the volcanic eruptions took place. Lock *et al* (1974) found evidence in the Eastern Cape that in the early stages of volcanism magma interacted with ground water to produce volcanoclastic deposits as well as phreatic and phreatomagmatic diatremes. Eales *et al* (1984) also found evidence of aqueous environments during early volcanism by the existence of pillow lavas and associated hyaloclastite breccias and thin lenses of fluviatile sandstones interbedded with the lowermost magmas.

The **Tierberg Formation** (Pt, orange, Figure 3) consists of a recessive-weathering, thick, mudrock-dominated succession. These rocks comprise mostly of dark, often grey to brown, well-laminated, carbonaceous shales with subordinate thin, fine-grained sandstones (Prinsloo 1989, Le Roux 1993, Viljoen 2005, Johnson et al., 2006). The Early to Middle Permian Tierberg shales were deposited in a series of offshore, quiet water environments below wave base and include basin plain, distal turbidite fan and distal pro-delta in ascending order



(Viljoen 2005, Almond in Macey et al. 2011). Towards the top of the formation thin coarsening-upwards cycles occur with confined evidence of ripples and common calcareous concretions as well as soft-sediment deformation. Thin volcanic ash layers (water-lain tuffs) are known in these sediments. The Ecca Basin were a restricted, brackish water environment. The Tierberg mudrocks are often baked to a dark grey hornfels with a reddish-brown crust close to the contact with Karoo dolerite intrusions (Prinsloo 1989). The Tierberg formation is known for its rare trace fossils assemblages (Anderson 1976; De Beer et al. 2002; Viljoen 2005; Johnson et al. 2006). These trace fossil assemblages comprise of arthropod trackways and associated resting impressions, possible gastropod horizontal epichnial furrows, fish swimming trails, and burrows of different sizes. Vascular plants (including petrified wood, more abundant in the upper portion of the formation (Ryan 1967; Wickens 1996) and palynomorphs of *Glossopteris* flora have been found while insects, crustaceans, shelly marine invertebrates, and fish fossils as well as microfossils have been identified (Zawada 1992, Bosch 1993).





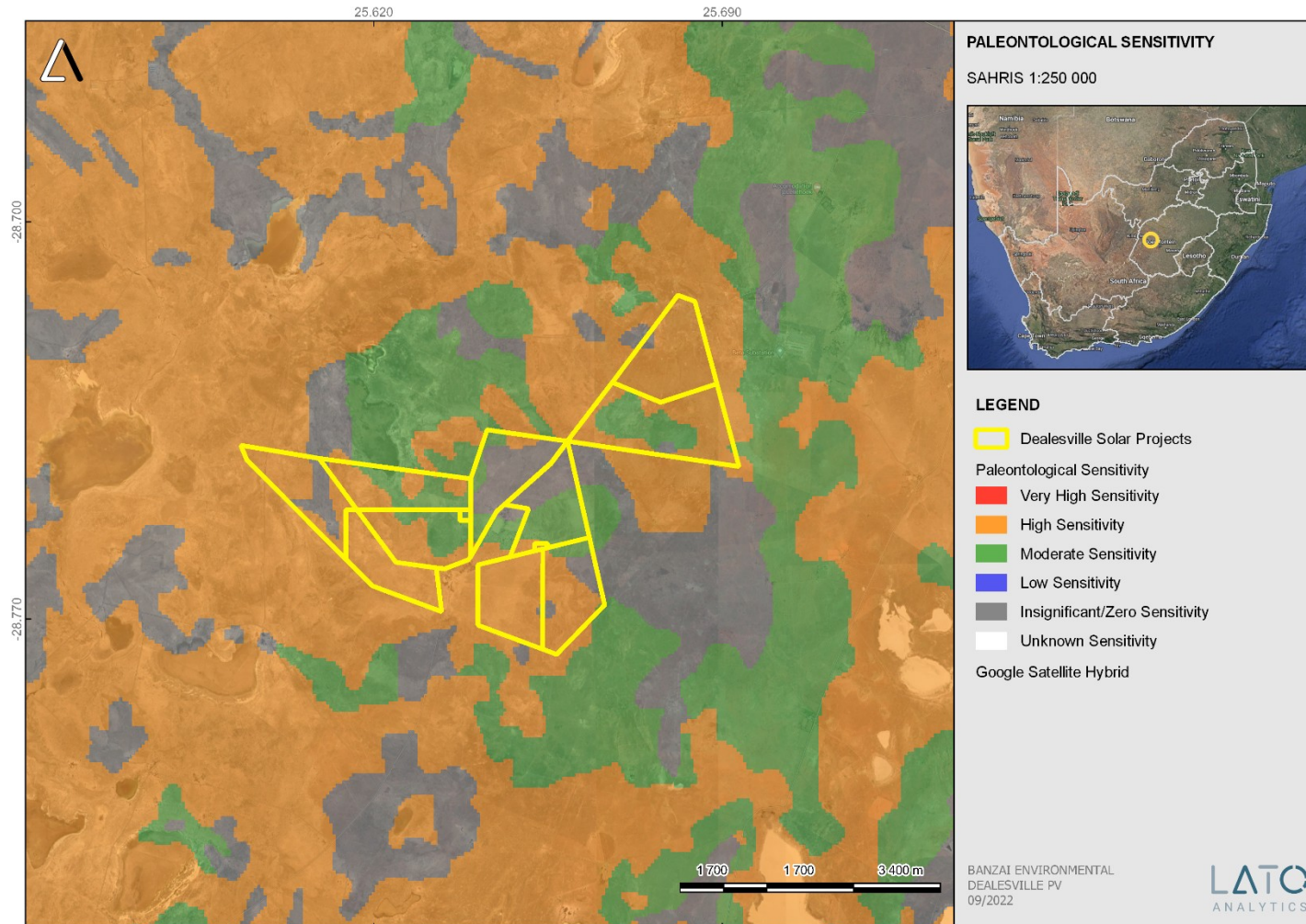
**Figure 3.** Extract of the 1:250 000 Kimberley 2824 Geological map (1993) (Council of Geoscience, Pretoria) indicating the geology of the Dealesville PV Projects in the Free State Province. The study area is underlain by Quaternary sediments (Os, and Qc yellow), Jurassic dolerite (Jd, red), and the Tierberg Formation (Pt, orange).



Table 2: Legend to the 1:250 000 Kimberley 2824 Geological map (1993) (Council of Geoscience, Pretoria).

Qa	Alluvial diamondiferous gravel Alluviale diamantdraende gruis
Qc	Calcrete, calcified pandune and surface limestone Kalkkreet, verkalkte panduin en oppervlakkalksteen
~	Alluvium and scree Alluvium en glooiingspuin
Qs	Sand: Red and grey aeolian dune sand Sand: Rooi en grys eoliese duinsand
	Kimberlite pipe ( ◆ ), fissure ( —◇— ) Kimberlietyp ( ◆ ), -spleet ( —◇— )
Jd	Dolerite: dolerite dyke shown as ( — ) Doleriet: dolerietgang aangetoon deur ( — )
Pa	Mudstone, sandstone Moddersteen, sandsteen
Ppr	Shale Skalie
Pt	Shale, siltstone, sandstone Skalie, slikssteen, sandsteen
Pw	White-weathering carbonaceous shale Witverwerende koolstofhoudende skalie
C-Pd	Tillite, sandstone, mudstone, shale Tilliet, sandsteen, moddersteen, skalie





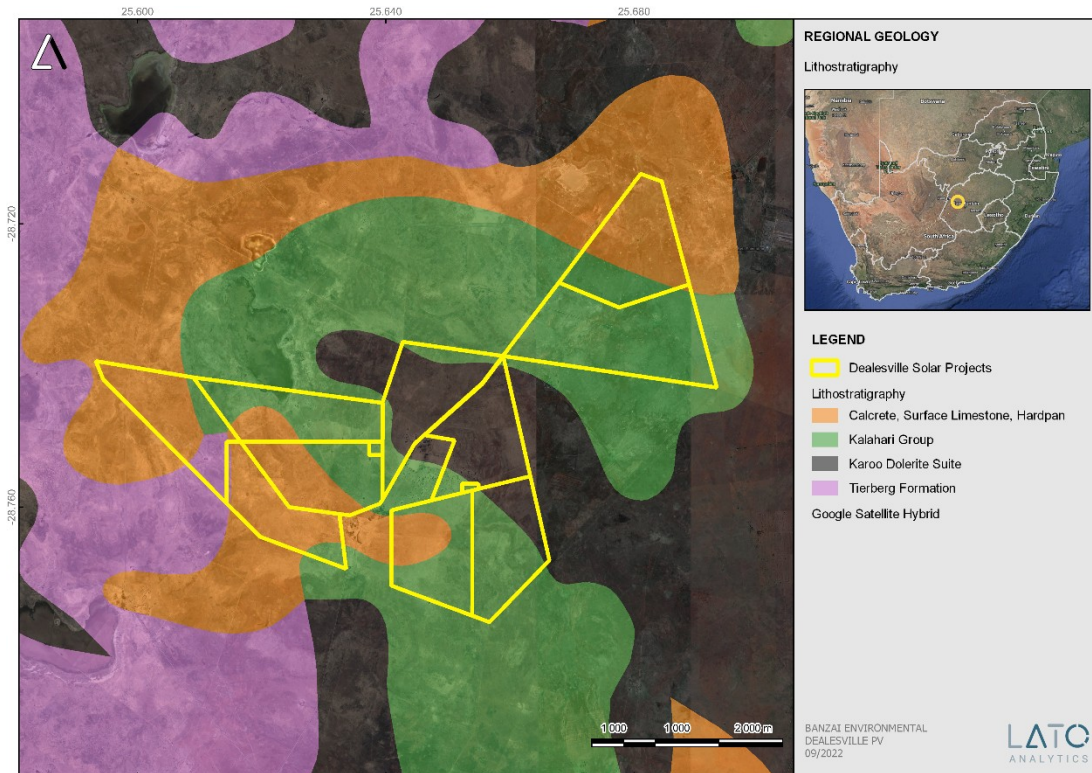


**Figure 4:** Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the Dealesville PV Projects in the Free State Province.



Table 3: 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
<b>ORANGE/ YELLOW</b>	<b>HIGH</b>	<b>Desktop study is required and based on the outcome of the desktop study; a field assessment is likely</b>
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.



**Figure 5:** Updated Geology (Council of Geosciences, Pretoria) indicates that the Dealesville PV Projects in the Free State Province is underlain by calcretes, surface limestones and Hardpan superficial sediments, the Kalahari Group, Karoo Dolerite as well as the Tierberg Formation of the Ecca Group.



## **6 GEOGRAPHICAL LOCATION OF THE SITE**

The proposed Dealesville PV Project is located about 16 km south west of the center of Dealesville in the Free State. Dealesville is the agricultural service centre for the surrounding agricultural communities. This town is the third largest town in the municipality. Dealesville includes Dealesville town and Tswaraganang (informal settlement). The R64 passes through Dealesville and connects Kimberley and Bloemfontein. The R64 is the only tarred road in the area while farm roads connect the surrounding agricultural communities to the town.

The Dealesville area is known for its electrical infrastructure with the Beta Substation located south-west of the town and the Perseus Substation north-west of Dealesville. These substations are connected through power lines and large pylons that dominate the landscape. The Kentani Cluster are located north and east of the Dealesville PV Project (this study) and is located in less than 10 km to one of the two substations (Holland, 2015).

The Dealesville area has a flat topography with elevations between 1200 m and 1320 m above mean sea level (AMSL). Scattered Karoo koppies are present in the Dealesville area. Holland (2015) describes the topography as flat and influenced by the Modder River south of the proposed development. A large number of endorheic pans is also present in the immediate surrounding landscape (Holland, 2015).

Two vegetation types, namely the Western Free State Clay Grassland and Vaal-Vet Sandy Grassland are present in the Dealesville development area.

## **7 METHODS**

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.

### **7.1 Assumptions and Limitations**

The focal point of geological maps is the geology of the area and the sheet explanations of the Geological Maps were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information



of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Areas with similar 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 and thus this study has been commissioned.

## **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 CTS Heritage.
- 1:250 000 Kimberley 2824 Geological map (1993) (Council of Geoscience, Pretoria).
- Updated Shape files produced by the Council of Geosciences, Pretoria.
- PIAs in the Dealsville district include that of Butler, 2022, Rossouw, 2015 (see references)





## 9 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot (September 2022). The proposed development is located on agricultural land with a flat topography. No fossiliferous exposures were observed during this field trip. The proposed development is mantled by thick grassy vegetation.



**Figure 6:** General overview of the proposed Dealesville PV Project indicates a very flat topography mantled by thick vegetation and some trees.





**Figure 7:** Surface calcrete on the development.



**Figure 8:** Unfossiliferous Quaternary outcrop near the pan in the east of the development





## 10 ASSESSMENT METHODOLOGY

### 10.1 Method of Environmental Assessment

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

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

### 10.2 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 4: The rating system

<b>NATURE</b>		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
<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

**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	The anticipated impact will have moderate



	impact	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.

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

Table 5: Summary of Impacts

Impacts	Extent	Duration	Magnitude	Reversibility	Irreplaceable loss	Cumulative effect	Impact
Pre-mitigation	1	4	3	4	4	2	45
Post mitigation	1	4	1	4	4	2	15



## 11 FINDINGS AND RECOMMENDATIONS

The study area is underlain by Quaternary deposits, Jurassic dolerite, as well as the Tierberg Formation of the Ecca Group (Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary calcrete is High, while that of Quaternary aeolian sands are Moderate, that of Jurassic dolerite is Zero and the Tierberg Formation has a Moderate Palaeontological Sensitivity (Almond and Pether, 2009; Almond *et al.*, 2013). Recent Shape files produced by the Council of Geosciences, Pretoria) indicates that the study area is underlain by calcretes, surface limestones and Hardpan superficial sediments, the Kalahari Group, Karoo Dolerite as well as the Tierberg Formation of the Ecca Group. Topographical as well as Google Earth images indicate that the relief of the proposed project is low, and outcrops in the area are rare.

A site-specific field survey of the development footprint was conducted on foot on September 2022. No visible evidence of fossiliferous outcrops was found in the development footprint and thus an overall LOW palaeontological significance is allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area and construction of the development may be authorised in its whole extent.

If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that mitigation (recording and collection) can be carried out.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

## 12 CHANCE FINDS PROTOCOL

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



### 12.1 Legislation

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

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

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

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

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

### 12.2 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town)





8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.

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

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## APPENDIX A - ELIZE BUTLER CV

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

**Butler, E., 2022.** Palaeontological Desktop Assessment (PDA) assessing the proposed Prospecting Right Application without bulk sampling for the Prospecting of



Diamonds Alluvial (DA), Diamonds General (D), Diamonds in Kimberlite (DK) & Diamonds (DIA) on the Remaining Extent of the Farm Goede Hoop 547, Remaining Extent of the Farm 548, Remaining Extent of Portion 2 and Portion 3 of the Farm Skeyfontein 536, Registration Division: Hay, Northern Cape Province. Banzai Environmental (Pty) Ltd, Bloemfontein.

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

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

**Butler, E., 2022.** Palaeontological Impact Assessment for the Witteberge Sand Mine on the remainder of farm Elandskrag Plaas 269 located in the Magisterial District of Laingsburg and Central Karoo District Municipality in the Western Cape. Banzai Environmental (Pty) Ltd, Bloemfontein.

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