



PALAEONTOLOGICAL DESKTOP  
ASSESSMENT

KIMSWA DIAMOND PROSPECTING  
RIGHT APPLICATION NEAR  
DOUGLAS IN THE NORTHERN CAPE  
PROVINCE

REF: NC30/5/1/1/2/13176PR

March 2022

COMPILED FOR: MILNEX CC



## **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:**



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

<b>Table 1: NEMA Table</b>	
<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>Relevant section in report</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 vitae	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 9
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Desktop Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 1 and 10
(g) An identification of any areas to be avoided, including buffers	Section 5 No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the	Section 5 – Geological and Palaeontological history



<b>Table 1: NEMA Table</b>	
<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>Relevant section in report</b>
environmental sensitivities of the site including areas to be avoided, including buffers;	
(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 10
(k) Any mitigation measures for inclusion in the EMPr	Section 11
(l) Any conditions for inclusion in the environmental authorisation	Section 11
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 10
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and	
(n)(ii) If the opinion is that the proposed activity, activities, or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A
(p) A summary and copies if any comments that were received during any consultation process	N/A
(q) Any other information requested by the competent authority.	N/A
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to	Section 3 compliance with SAHRA guidelines



<b>Table 1: NEMA Table</b>	
<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>Relevant section in report</b>
be applied to a specialist report, the requirements as indicated in such notice will apply.	



## **EXECUTIVE SUMMARY**

Banzai Environmental was appointed by Milnex CC to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Prospecting Right application combined with a Waste Licence application to prospect for Diamonds Alluvial (DA), Diamonds General (D), Diamonds in Kimberlite (DK) & Diamonds (DIA) near Douglas on the Remaining Extent of the farm De Hoek 2, the Remaining Extent of the farm Marktsdrift 3, Portion 1 of the farm Roode Kop 5, Registration Division: Hopetown, Northern Cape Province. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to verify 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 sands, Tertiary to Quaternary calcretes, with a small portion in the south underlain by the Allanridge Formation (Ventersdorp Supergroup). Updated geology indicates that the development is mainly underlain by the Kalahari Group with a small portion in the south underlain by the Allanridge Formation (Platberg Group, Ventersdorp Supergroup). According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Quaternary calcretes are High (orange), the Quaternary sands has a Moderate Palaeontological Sensitivity while that of the Allanridge Formation is Low.

It is therefore considered that the proposed prospecting will not lead to detrimental impacts on the palaeontological heritage of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that suitable mitigation (recording and collection) can be carried out

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.



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Curriculum Vitae            Elize Butler



## **1 INTRODUCTION**

Milnex CC was contracted by **Kimswa Mining (Pty) Ltd** as the independent environmental consultant to undertake the Scoping and EIA process for a Prospecting Right combined with a Waste Licence application to prospect for Diamonds Alluvial (DA), Diamonds General (D), Diamonds in Kimberlite (DK) & Diamonds (DIA) near Douglas on the Remaining Extent of the farm De Hoek 2, the Remaining Extent of the farm Marktsdrift 3, Portion 1 of the farm Roode Kop 5, Registration Division: Hopetown, Northern Cape Province. Banzai Environment was in turn appointed to conduct the Palaeontological Desktop Assessment for this project (**Figure 1-2**).

Economic activity in modern-day South Africa has been centered on mining activities, their ancillary services and supplies. The country's stock exchange in Johannesburg was established in 1887, a decade after the first diamonds were discovered on the banks of the Orange River, and almost simultaneously with the gold rush on the world-famous Witwatersrand<sup>1</sup>.

In many ways, South Africa's political, social and economic landscape has been dominated by mining, given that, for so many years, the sector has been the mainstay of the South African economy. Although gold, diamonds, platinum and coal are the most well-known among the minerals and metals mined, South Africa also hosts chrome, vanadium, titanium and a number of other lesser minerals<sup>1</sup>.

In 2018 the mining sector contributed R351 billion to the South African gross domestic product (GDP). A total of 456,438 people were employed in the mining sector in 2018. Each person employed in the mining sector has up to nine indirect dependents. The mining sector has, for many years, attracted valuable foreign direct investment to South Africa. (Mineral Council, 2021) <sup>1</sup>.

Diamonds, arguably the ultimate luxury mineral, comprise an intricate lattice of carbon atoms, a crystalline structure that makes them harder than any other form in nature. This characteristic makes diamonds not only popular in jewelry, but also desirable in high-tech cutting, grinding and polishing tools (Chamber of Mines, South Africa, 12:2016) <sup>1</sup>.

According to the Chamber of Mines the country's diamond sector is far from reaching the end of its life even though diamond mining has been taking place in South Africa for almost a century and a half. The primary sources of all of South Africa's diamonds are kimberlites in ancient, vertically dipping volcanic pipes most of which were located in the vicinity of the city of Kimberley and which were initially amenable to open-cast<sup>1</sup>.

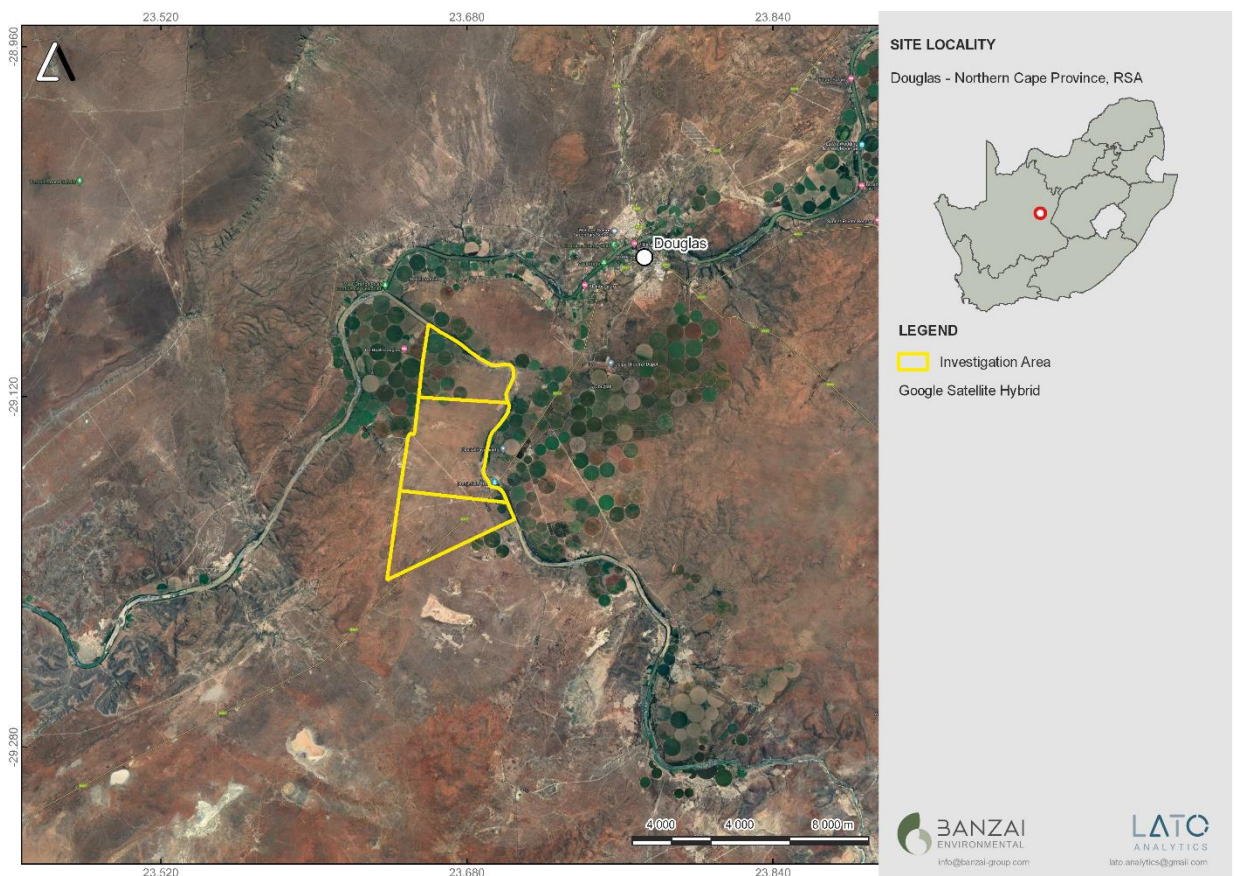
Economic growth - South Africa's total reserves remain some of the world's most valuable, with an estimated worth of R20.3- trillion. Overall, the country is estimated to have the world's fifth-largest mining sector in terms of GDP value<sup>1</sup>.



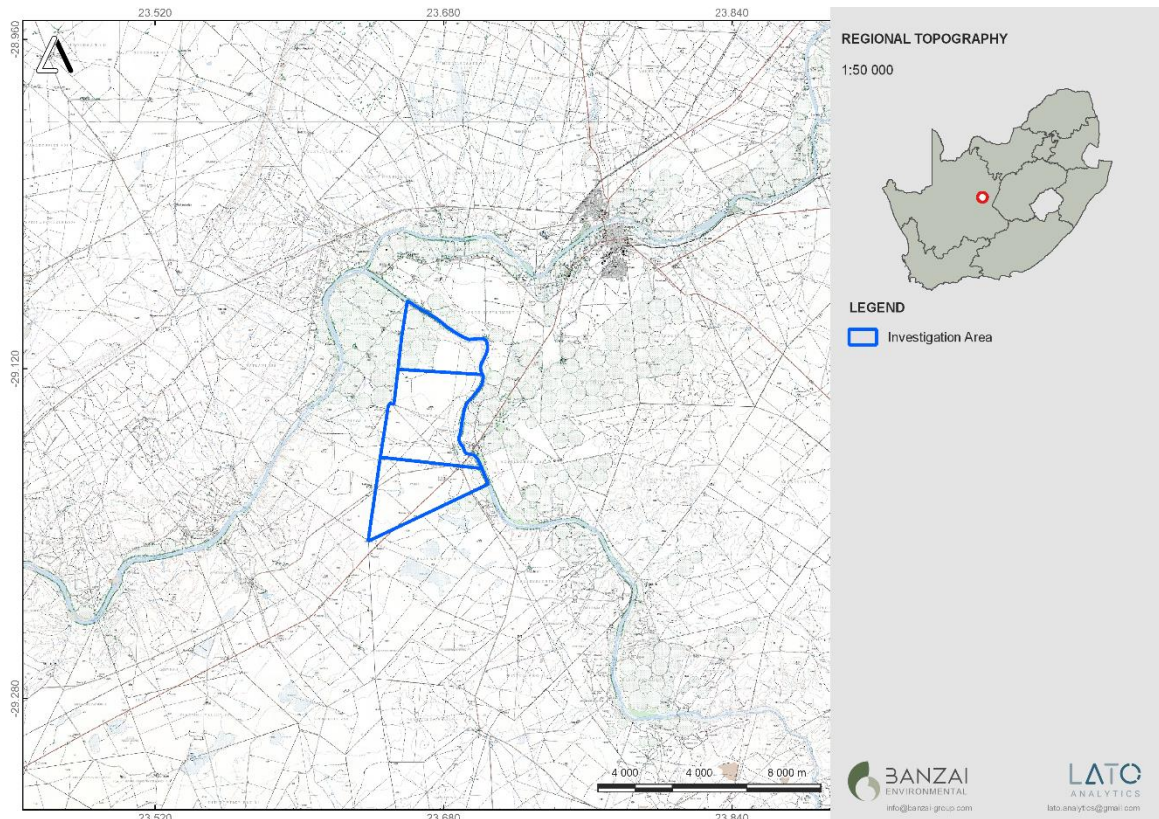
With South Africa's economy built on gold and diamond mining, the sector is an important foreign exchange earner, with gold accounting for more than one-third of exports. In 2009, the country's diamond industry was the fourth largest in the world<sup>1</sup>.

Mining is a cornerstone of the economy, making a significant contribution to economic activity, job creation and foreign exchange earnings. Mining and its related industries are critical to South Africa's socio-economic development<sup>1</sup>.

<sup>1</sup>Information provided by Milnex cc



**Figure 1:** Google Earth (2022) image indication the regional locality of the proposed Prospecting Right development.



**Figure 2:** Locality Map of the proposed Prospecting Right development.

The extensive diamondiferous gravels of the Lower Vaal, Harts, and Middle Orange River ("MOR") valleys are associated with remnants of outwash deposits formed during the retreat of the ancient Ghaap (Kaa) Valley glacial system and subsequent reworking and alluvial deposition by major rivers. These rivers included the proto- Vaal, - Orange, - Harts, and -Riet Rivers and their modern antecedents. The glacial system is identified as a prominent ice lobe emanation from the central Dwyka (Carboniferous) ice sheet of central Gondwana which utilized the structurally controlled through flanking the Ghaap Escarpment.

The geological settings of the diamondiferous gravel deposits vary from thick remnant palaeo- river terraces and channels of late- Cretaceous age through to young surface deflation or Rooikoppie deposits of 1-2 meters thick. The river deposits, which in part reworked glacial outwash deposits, all appear to have a common or similar origin as seasonal ephemeral flood deposits. Large elongated channels containing gravel sequences were probably created initially by glacial scoring (as for example on Holpan and Klipdam). Locally, bedrock features including large boulders (glacial erratics) protruding from and released by the Dwyka diamictites of the floor rocks, and fractures and potholes found on Ventersdorp bedrock played an important role in diamond concentration of the older alluvial deposits. Well-developed splays (e.g., Windsorton and Waldecks Plant on the Vaal River), dykes, faults and contrasting rock competencies also lead to grade enhancement in younger deposits. Locally plunge and scour pools lead to high concentration of diamonds (The Southern African Institute of Mining and Metallurgy, 2007).





The following information was obtained from Milnex CC

<b>Table 2: Project information</b>	
Farm Name:	<p>The remaining extent of the farm De Hoek 2 Registration Division: Hopetown Extent: 744.8688 hectares</p> <p>The remaining extent of the farm Marktsdrift 3 Registration Division: Hopetown RD Extent: 1825.3115 hectares</p> <p>Portion 1 of the farm Roode Kop 5 Registration Division: Hopetown RD Extent: 1639.2181 hectares</p>
Application area (Ha)	4209.3984 hectares
Magisterial district:	Pixley Ka Seme District Municipality Thembelihle Local Municipality
Registration Division	Hopetown
Distance and direction from nearest town	This area lies south of the Vaal-Orange Confluence. Douglas is the nearest town to the prospecting site. The capital of the Northern Cape Kimberley is about 100 km to the east in the Northern Cape Province.
21 digit Surveyor	C03300000000000200000 C03300000000000300000 C03300000000000500001
Minerals Applied for	Diamonds Alluvial (DA) Diamonds General (D) Diamonds in Kimberlite (DK) Diamonds (DIA)

## 2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present 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-five 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.



### 3 LEGISLATION

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

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

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

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- 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 is 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 PALAEOONTOLOGICAL HISTORY

The proposed Prospecting Right Application is depicted on the 2922 Prieska (1995) Geological map (Council of Geoscience, Pretoria) (**Figure 3**). The proposed development is underlain by Quaternary sands (Qs, yellow), Tertiary to Quaternary calcretes (T-Qc, dark yellow), with a small portion in the south underlain by the Allanridge Formation (Ra-dark, green) (Ventersdorp Supergroup). Updated geology (**Figure 4**) indicates that the development is mainly underlain by the Kalahari Group with a small portion in the south underlain by the Allanridge Formation (Platberg Group, Ventersdorp Supergroup). According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Quaternary calcretes are High (orange), the Quaternary sands has a Moderate Palaeontological Sensitivity while that of the Allanridge Formation is Low (blue) (**Figure 5**).

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

The Quaternary deposits are very important because palaeoclimatic changes 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).

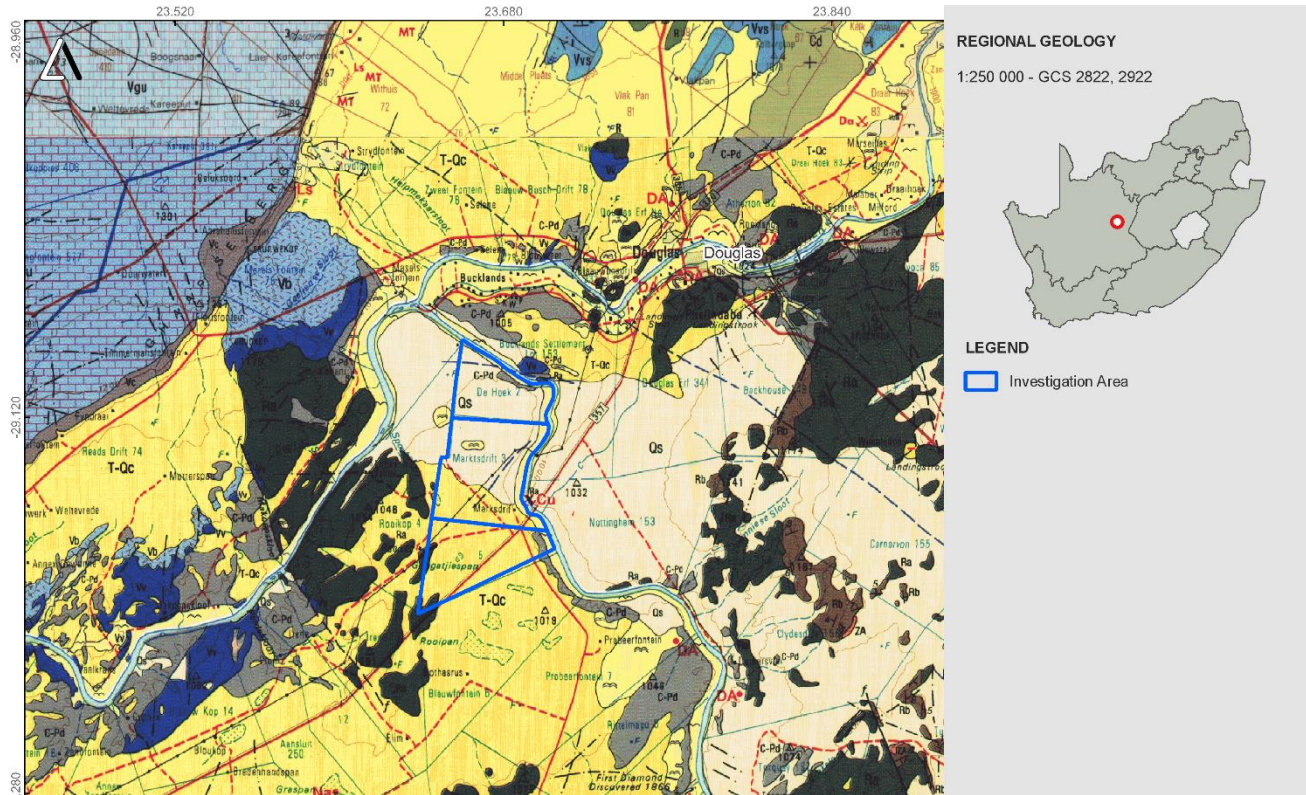


The Late Tertiary to Quaternary calcretes (T-Qc) may be stratigraphically comparable to the Pleistocene or Late Pliocene Mokalanen Formation of the Kalahari Group (**Figure 7**), while others may be younger (Partridge et al. 2006, Moen 2007). These sediments include layers of nodular or structureless calcretes overlying the Namaqua-Natal Province basement rocks. Quaternary alluvium is present closer to the Orange River and could contain fossils of Miocene age (Hendy 1984, Schneider & Marias 2004) but is not present in the proposed development.

Four basins developed on the Kaapvaal Craton about 3000 to 2100 million years ago. The Ventersdorp Supergroup was the third Basin to develop and provides an exceptional volcano-sedimentary supracrustal record. The Ventersdorp Supergroup comprise of the biggest and most wide-spread system of volcanic rocks in the Kaapvaal Craton.

Some of the best exposures of the Ventersdorp Supergroup are in the Northern Cape Province. This Supergroup consists of the Klipriviersberg Group (oldest) which is overlain by the Platberg Group, followed by the sedimentary Bothaville Formation (Rb) and the volcanic Allanridge Formation (Ra) (uppermost Ventersdorp unit, youngest Formation and present in the development). The Allanridge Formation comprise mostly of light-greenish grey porphyritic lava, dark-green amygdaloidal lava, and pyroclastic rocks. The lavas are approximately 2700 million years old and comprise of basaltic andesites. The Allanridge Formation is not known to be fossiliferous.

The Platberg Group is subdivided in four formations i.e., the Kameeldoorns-, Goedgenoeg-, Makwassie-, and Rietgat Formations (Rr). These formations consist of heterogenous rock varying from chemical and classic sediments, to felsic and mafic volcanics. These rocks were deposited in linear vault troughs during graben development (Visser et al, 1975-1976, Buck, 1980). These deep intermontane grabens formed in older underlying andesitic terranes and formed areas of debris and scree flows as well as alluvial fan deposits. In these fine-grained chemical and terrigenous sediments, ooids and stromatolites accumulated under lacustrine conditions (Buck, 1980). In time fluvial processes prevailed causing widespread prograding of alluvial fans across basins. The Rietgat Formation consist of alternating sedimentary and volcanic rocks which varies in thickness across the basin.



**Figure 3:** Extract of the 1:250 000 Prieska 2922 (1995) Geological map (Council of Geoscience, Pretoria) indicating the proposed development in blue

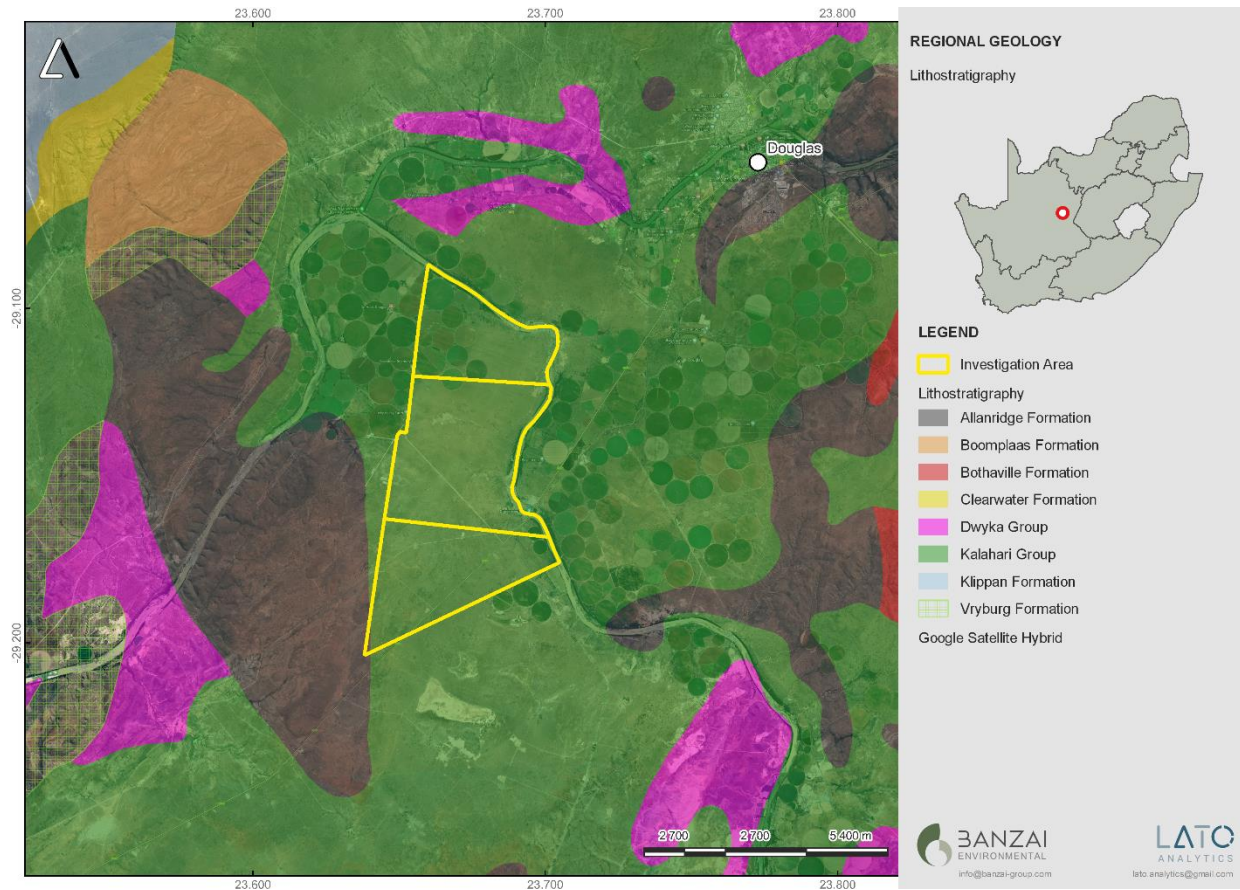
The proposed development is underlain by Quaternary sands (Qs, yellow), Tertiary to Quaternary calcretes (T-Qc, dark yellow), as well as the Allanridge Formation (Ra-dark green) (Ventersdorp Supergroup).



**Table 3:** Legend of the 1:250 000 Prieska 2922 (1995) Geological map (Council of Geoscience, Pretoria)

		GROUP GROEP	FORMATION FORMASIE	Outcrop Dagsoom	Suboutcrop Subdagsoom	
QUATERNARY KWARTÊR		KALAHARI	Gordonia			Alluvium
						Qs Sand and sandy soil Sand en sanderige grond
						Qg Red wind-blown sand and dunes Rooi windgewaaide sand en duine
						Scree, surface rubble Glooiingspuin, oppervlakpuin
						Terrace gravel Terrasgruis
TERTIARY TERSIER						T-Qc Calcrete Kalkreet
JURASSIC JURA						Jd Dolerite Doleriet
PERMIAN PERM	KAROO SUPERGROUP/ SUPERGROEP	ECCA	Tierberg			Pp Shale, mudstone Skalie, moddersteen
			Whitehill			Pt Shale, siltstone, sandstone Skalie, sliiksteen, sandsteen
			Prince Albert Prins Albert			Pw White-weathering carbonaceous shale Witverwerende koolstofhoudende skalie
			DWYKA			C-Pd Tillite, sandstone, mudstone, shale Tilliet, sandsteen, moddersteen, skalie
CARBONIFEROUS KARBOON						
RANDIAN RANDIUM	VENDERSDORP SUPERGROUP/ SUPERGROEP	PLATBERG	Allanridge			Ra Basaltic lava, amygdaloidal in places; pyroclastic rocks Basaltiese lava, plek-plek amandelhoudend; piroklastiese gesteentes
			Bothaville			Rb Alternating layers of dark, fine-grained quartzite, arkose and grey siltstone Afwisselende lae van donker, fynkorrelrige kwartsiet, arkose en grys sliiksteen
			Makwassie			Rd Leucocratic, coarse-grained gneissic granite; numerous amphibolitic inclusions (  ); adamellite porphyry Leukokratiese, grofkorrelrige gneissige graniet; talryke amfibolitiese insluitels (  ); adamellietporfier
						Rm Quartz-feldspar porphyry Kwarts-veldspaatporfier



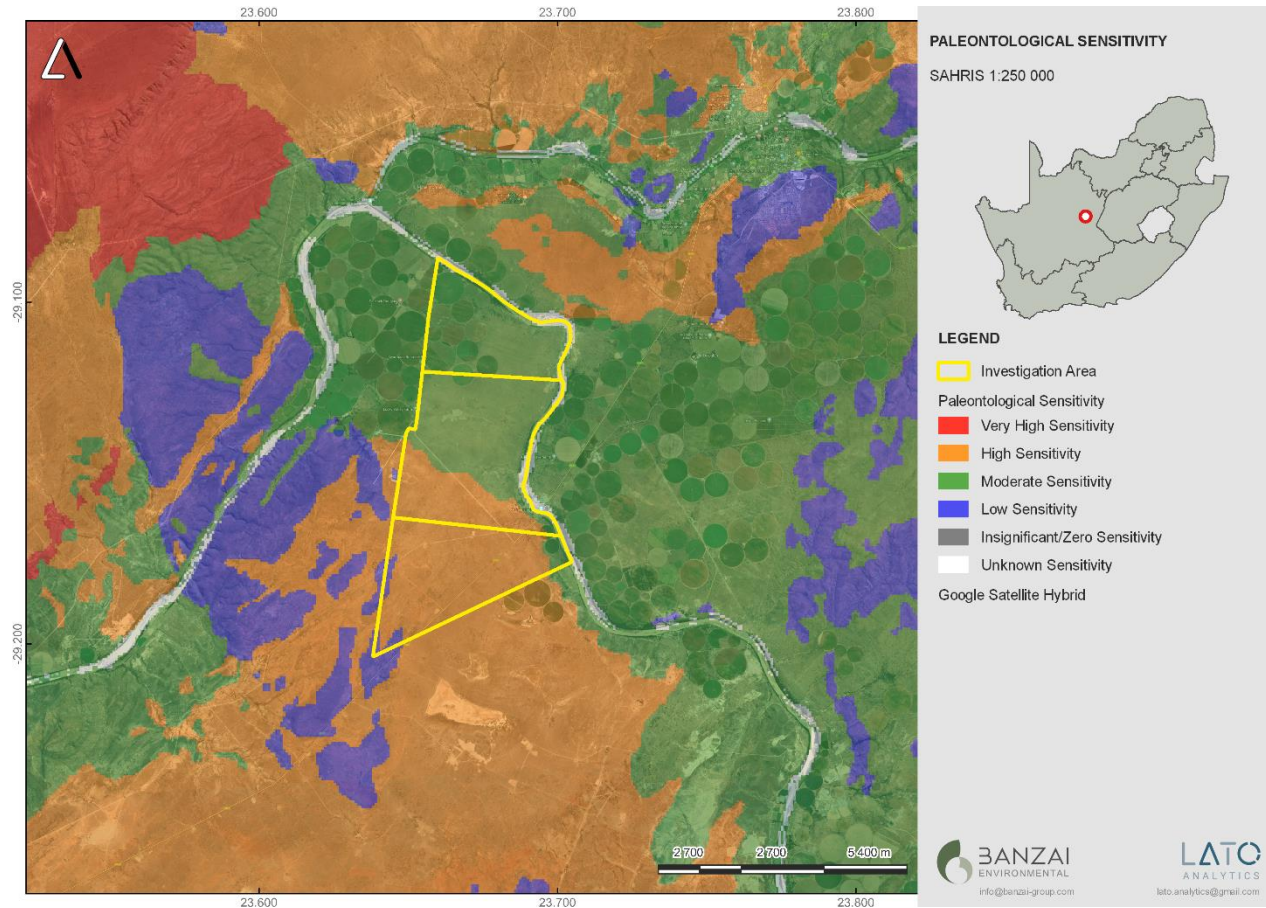


**Figure 4:** Updated geology (Council for Geosciences, Pretoria) of the proposed development indicates that the development is mainly underlain by the Kalahari Group, with a minute portion of the Allanridge Formation (Platberg Group Ventersdorp Supergroup) in the southern tip





According to the SAHRIS Palaeosensitivity map (**Figure 5**) the proposed development is underlain by sediments with a High (orange), Moderate (green), Low (blue) Palaeontological Significance.



**Figure 5:** Extract of the 1 in 250 000 SAHRIS PalaeoMap (Council of Geosciences) indicating the Palaeontological Sensitivity of the proposed development.

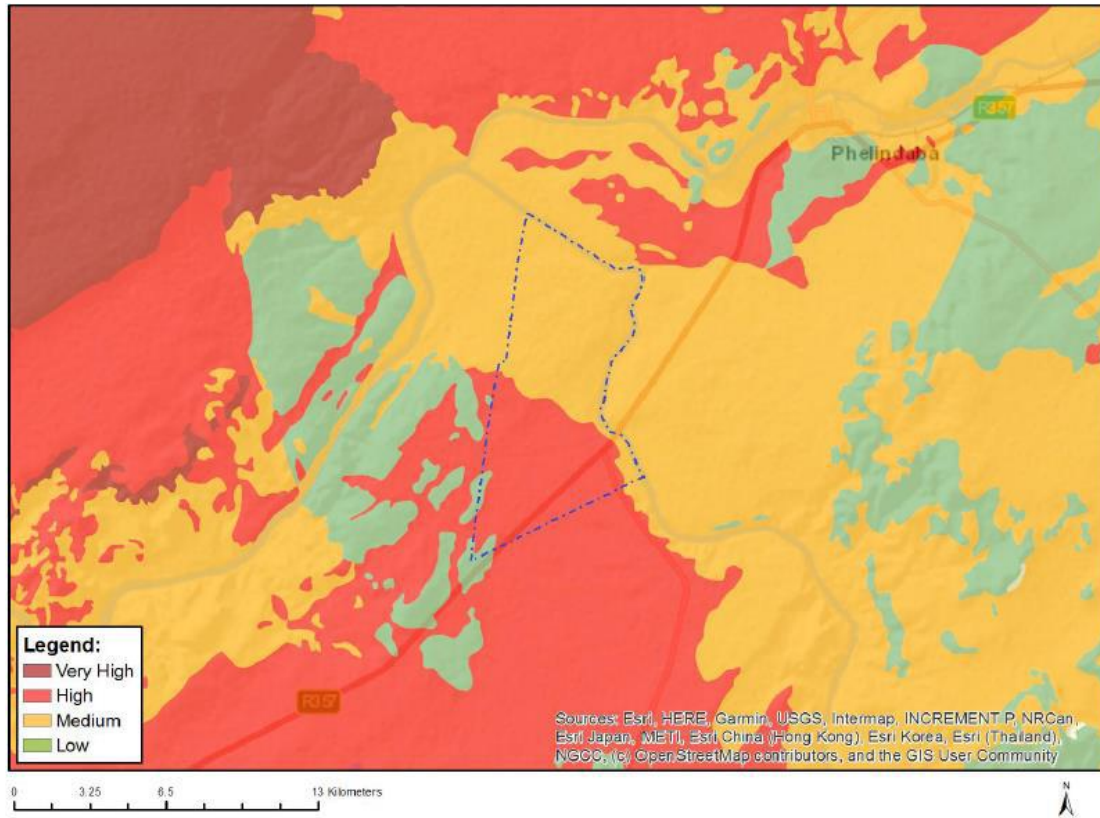


**Table 4:** SAHRIS Palaeosensitivity ratings table.

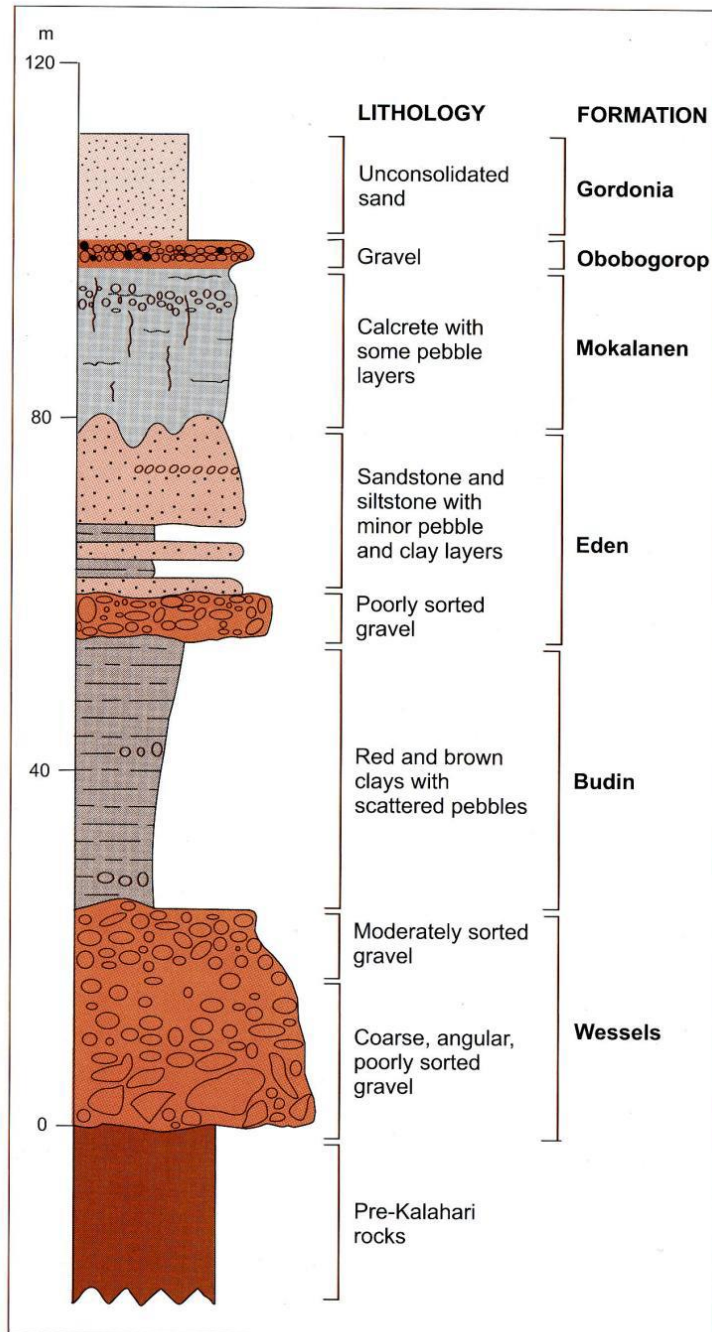
The relevant sensitivities are highlighted

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>
<b>GREEN</b>	<b>MODERATE</b>	<b>Desktop study is required</b>
<b>BLUE</b>	<b>LOW</b>	<b>No palaeontological studies are required however a protocol for finds is required</b>
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 6:** Environmental Screening tool indicates that the Palaeontological Sensitivity of the proposed development is High (bright red), Medium (yellow) and Low (green).



**Figure 7:** Stratigraphy of the Kalahari Group (Image taken from Partridge et al., 2006). Calcretes and aeolian sands of the Gordonia Formation possibly corresponds to the Mokalanen Formation.

## 6 GEOGRAPHICAL LOCATION OF THE SITE

The property is located approximately 10km Southwest of Douglas in the Northern Cape Province (Figure 1-2).



**Table 5: Farm GPS co-ordinates.**

Farms	Longitude	Latitude	Longitude	Latitude
	29° 5' 12.905" S	23° 39' 35.745" E	29° 9' 6.365" S	23° 41' 21.121" E
	29° 5' 25.485" S	23° 39' 57.104" E	29° 9' 12.572" S	23° 41' 18.675" E
	29° 5' 45.542" S	23° 40' 35.900" E	29° 9' 17.862" S	23° 41' 19.263" E
	29° 5' 58.851" S	23° 40' 54.635" E	29° 9' 23.864" S	23° 41' 22.082" E
	29° 6' 10.190" S	23° 41' 13.807" E	29° 9' 27.926" S	23° 41' 26.464" E
	29° 6' 17.468" S	23° 41' 28.600" E	29° 9' 37.918" S	23° 41' 30.663" E
	29° 6' 21.014" S	23° 41' 39.004" E	29° 9' 40.314" S	23° 41' 34.345" E
	29° 6' 19.973" S	23° 41' 50.675" E	29° 9' 41.463" S	23° 41' 41.072" E
	29° 6' 19.208" S	23° 42' 0.086" E	29° 9' 42.256" S	23° 41' 46.682" E
1) The remaining extent of the farm De Hoek 2 Registration Division: Hopetown Extent: 744.8688 hectares	29° 6' 19.724" S	23° 42' 7.955" E	29° 9' 45.017" S	23° 41' 51.856" E
	29° 6' 20.605" S	23° 42' 9.373" E	29° 9' 49.399" S	23° 41' 55.853" E
	29° 6' 23.153" S	23° 42' 13.481" E	29° 9' 57.084" S	23° 42' 0.124" E
2) The remaining extent of the farm Marktsdrift 3 Registration Division: Hopetown RD Extent: 1825.3115 hectares	29° 6' 30.126" S	23° 42' 15.519" E	29° 10' 6.253" S	23° 42' 4.505" E
	29° 6' 36.396" S	23° 42' 15.701" E	29° 10' 7.423" S	23° 42' 5.065" E
	29° 6' 41.000" S	23° 42' 15.184" E	29° 10' 19.337" S	23° 42' 10.333" E
	29° 6' 46.548" S	23° 42' 12.761" E	29° 10' 33.448" S	23° 42' 17.559" E
3) Portion 1 of the farm Rood Kop 5 Registration Division: Hopetown RD Extent: 1639.2181 hectares	29° 7' 3.147" S	23° 42' 3.612" E	29° 10' 47.690" S	23° 41' 43.327" E
	29° 7' 8.375" S	23° 42' 1.574" E	29° 12' 13.370" S	23° 38' 17.212" E
	29° 7' 17.316" S	23° 42' 3.175" E	29° 10' 31.116" S	23° 38' 34.289" E
	29° 7' 22.273" S	23° 42' 5.503" E	29° 9' 56.470" S	23° 38' 40.073" E
	29° 7' 26.319" S	23° 42' 7.404" E	29° 9' 53.206" S	23° 38' 40.617" E
	29° 7' 38.384" S	23° 42' 5.155" E	29° 9' 46.629" S	23° 38' 41.718" E
	29° 7' 47.779" S	23° 41' 58.105" E	29° 8' 17.490" S	23° 38' 57.432" E
	29° 8' 1.020" S	23° 41' 46.429" E	29° 8' 12.705" S	23° 39' 0.986" E
	29° 8' 9.043" S	23° 41' 37.168" E	29° 8' 14.012" S	23° 39' 8.487" E
	29° 8' 13.914" S	23° 41' 34.012" E	29° 8' 4.511" S	23° 39' 10.207" E
	29° 8' 19.773" S	23° 41' 30.826" E	29° 7' 12.997" S	23° 39' 17.005" E
	29° 8' 42.722" S	23° 41' 25.234" E	29° 6' 14.824" S	23° 39' 24.508" E

## 7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological impact assessment reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps. Scientific research articles of research conducted in the area is also sourced and included in the Impact Assessment.

### 7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. 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 used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.



## 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 Milnex cc.
- 1:250 000 Prieska 2922 Geological map (1995) (Council of Geoscience, Pretoria)
- Shape files produced by the Council of Geosciences (Pretoria).

## 9 IMPACT ASSESSMENT METHODOLOGY

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 following project phases:

- Construction.
- Operation; and
- 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 6: The rating system**

<b>NATURE</b>		
The Nature of the Impact is the possible destruction of fossil heritage		
<b>GEOGRAPHICAL EXTENT</b>		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
<b>PROBABILITY</b>		
This describes the chance of occurrence of an impact.		



1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).

**DURATION**

This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.

1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.

**INTENSITY/ MAGNITUDE**

Describes the severity of an impact.

1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to



		function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

**REVERSIBILITY**

This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.

1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.

**IRREPLACEABLE LOSS OF RESOURCES**

This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.

1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.

**CUMULATIVE EFFECT**

This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.



1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects

**SIGNIFICANCE**

**Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula:**

**(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity = X.**

**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





## **9.1 Summary of Impact Tables**

Loss of fossil heritage will be a negative impact. Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures, the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur and are regarded as having a Low probability. As fossil heritage will be destroyed the impact is irreversible. The significance of the impact occurring will be low.





**Table 7: Summary of Impact Tables**

	Site	Probability	Duration	Magnitude	Reversibility	Irreparable Loss	Cumulative Effect	Significance
	1	2	4	1	4	4	2	17

## 10 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary sands, Tertiary to Quaternary calcretes, with a small portion in the south underlain by the Allanridge Formation (Ventersdorp Supergroup). Updated geology indicates that the development is mainly underlain by the Kalahari Group with a small portion in the south underlain by the Allanridge Formation (Platberg Group, Ventersdorp Supergroup). According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Quaternary calcretes are High (orange), the Quaternary sands has a Moderate Palaeontological Sensitivity while that of the Allanridge Formation is Low.

It is therefore considered that the proposed prospecting will not lead to detrimental impacts on the palaeontological heritage of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that suitable mitigation (recording and collection) can be carried out

It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.



## **11 CHANCE FIND PROTOCOL**

The following procedure will only be followed if fossils are uncovered during excavation.

### **11.1 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 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 construction activities accidentally uncover 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.

### **11.2 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**

### **CURRICULUM VITAE**

#### **ELIZE BUTLER**

**PROFESSION:** Palaeontologist

**YEARS' EXPERIENCE:** 30 years in Palaeontology

**EDUCATION:** B.Sc Botany and Zoology, 1988  
University of the Orange Free State

B. Sc (Hons) Zoology, 1991  
University of the Orange Free State

Management Course, 1991  
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009  
University of the Free State

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

#### **MEMBERSHIP**

Palaeontological Society of South Africa (PSSA) 2006-currently

#### **EMPLOYMENT HISTORY**

Part-time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part-time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–2023

#### **TECHNICAL REPORTS**

BANZAI ENVIRONMENTAL (PTY) LTD.  
Reg No. 2015/332235/07





**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.

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

**Butler, E. 2015.** Palaeontological impact assessment of the proposed consolidation, re-division, and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2015.** Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.

**Butler, E. 2015.** Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.

**Butler, E. 2015.** Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.

**Butler, E. 2015.** Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.

**Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.

**Butler, E. 2016.** Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.



**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City of Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.

**Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.

**Butler, E. 2016.** Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's River valley Local Municipality, Eastern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.

**Butler, E. 2016.** Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment for the proposed development of four Leeuwerberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.

**Butler, E. 2016.** Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, KwaZulu Natal. Bloemfontein.



**Butler, E. 2016.** Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.

**Butler, E. 2016:** Palaeontological desktop assessment of the establishment of the proposed residential and mixed-use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of The Proposed Development of The New Open Cast Mining Operations on The Remaining Portions Of 6, 7, 8 And 10 Of the Farm Kwaggafontein 8 In the Carolina Magisterial District, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mhashe Local Municipality. Bloemfontein.

**Butler, E. 2017.** Palaeontological assessment of the proposed development of a 3000 MW Combined Cycle Gas Turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed development of the new open cast mining operations on the remaining portions of 6, 7, 8 and 10 of the farm Kwaggafontein 8 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.

**Butler, E. 2017.** Palaeontological impact assessment of the proposed construction of the Lehae training and fire station, Lenasia, Gauteng Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.



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

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the Lephale coal and power project, Lephale, Limpopo Province, Republic of South Africa. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.

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

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

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

**Butler, E. 2017.** PIA site visit and report of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

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