# PALAEONTOLOGICAL DESKTOP ASSESSMENT OF THE PROPOSED PROSPECTING RIGHT APPLICATION FOR THE PROSPECTING OF DIAMONDS (ALLUVIAL, GENERAL & IN KIMBERLITE), COMBINED WITH A WASTE LICENSE APPLICATION, REGISTRATION DIVISION: GORDONIA AND KENHARDT, NORTHERN CAPE PROVINCE

**Compiled for:**

**Milnex CC**

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Prepared by

Banzai Environmental

5March 2020

**Declaration of Independence**

I, Elize Butler, declare that –

General declaration:

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

**Disclosure of Vested Interest**

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

**PALAEONTOLOGICAL CONSULTANT:** Banzai Environmental (Pty) Ltd

**CONTACT PERSON:** Elize Butler

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**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.

*Table 1 - NEMA Table*

| **NEMA Regs (2014) - Appendix 6** | **Relevant section in report** |
|---|---|
| 1. (1) A specialist report prepared in terms of these Regulations must contain-<br>details of-<br>the specialist who prepared the report; and<br>the expertise of that specialist to compile a specialist report including a curriculum vitae; | Page ii and iii of Report – Contact details and company and Appendix A |
| a declaration that the specialist is independent in a form as may be specified by the competent authority; | Page ii |
| 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 |
| (B) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | Section 9 |
| the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment; | N/A |
| a description of the methodology adopted in preparing the report or carrying out the specialized process inclusive of equipment and modeling used; | Section 7 |
| 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; | N/A |
| an identification of any areas to be avoided, including buffers; | N/A |
| 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 |
| a description of any assumptions made and any uncertainties or gaps in knowledge; | Section 7 |

| NEMA Regs (2014) - Appendix 6 | Relevant section in report |
|---|---|
| a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities; | Section 10 |
| any mitigation measures for inclusion in the EMPr; | N/A |
| any conditions for inclusion in the environmental authorization; | N/A |
| any monitoring requirements for inclusion in the EMPr or environmental authorization; | N/A |
| a reasoned opinion-<br>as to whether the proposed activity, activities or portions thereof should be authorized;<br>(iA) regarding the acceptability of the proposed activity or activities; and<br>if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; | Section 7 |
| a description of any consultation process that was undertaken during the course of preparing the specialist report; | Not applicable. |
| a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and | Not applicable. |
| any other information requested by the competent authority. | Not applicable. |
| 2) Where a government notice *gazetted* 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 |

## TERMINOLOGY AND ABBREVIATIONS

### Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

### Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

### Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

### Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

### Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

| Abbreviations | Description |
|---|---|
| AIA | Archaeological Impact Assessment |
| ASAPA | Association of South African Professional Archaeologists |
| CRM | Cultural Resource Management |
| DEA | Department of Environmental Affairs |
| ECO | Environmental Control Officer |
| EIA practitioner | Environmental Impact Assessment Practitioner |

| Abbreviations | Description |
|---|---|
| EIA | Environmental Impact Assessment |
| ESA | Early Stone Age |
| GPS | Global Positioning System |
| HIA | Heritage Impact Assessment |
| I&AP | Interested & Affected Party |
| LSA | Late Stone Age |
| LIA | Late Iron Age |
| MSA | Middle Stone Age |
| MIA | Middle Iron Age |
| NEMA | National Environmental Management Act |
| NHRA | National Heritage Resources Act |
| PHRA | Provincial Heritage Resources Authority |
| PSSA | Palaeontological Society of South Africa |
| SADC | Southern African Development Community |
| SAHRA | South African Heritage Resources Agency |

## EXECUTIVE SUMMARY

Banzai Environmental was appointed by **Milnex CC** to conduct the **Palaeontological Desktop Assessment** (PDA) to assess the proposed Prospecting Right application for the prospecting of Diamonds (Alluvial, General & in Kimberlite), combined with a Waste License Application, near Groblershoop. The proposed development is located on a certain portion of the Remaining Extent of the farm Zonderhuis 402, a certain portion of the Remaining Extent of the farm Onder Plaats 401, a certain portion of the Remaining Extent of Portion 1, a certain portion of Portion 6 (portion of portion 4), a certain portion of Portion 7 (portion of portion 4) and certain portion of Portion 9 (portion of portion 4) of the farm Namakwari 656, Registration Division: Gordonia and Kenhardt, Northern Cape Province. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Impact Assessment (PIA) is decisive to the discovery of fossil material within the planned development. This PIA is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The study area is underlain by the Gordonia Formation of the Kalahari Group, Tertiary Calcrete as well as the Zonderhuis and Leerkrans Formations of the Wilgenhoutsdrif Group, Areachap Group of the Namaqua-Natal Province. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Gordonia Formation of the Kalahari Group and Tertiary calcrete are low while the Palaeontological Sensitivity of the Zonderhuis and Leerkrans Formations are insignificant (Almond and Pether 2008, SAHRIS website).

It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the facility may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the ECO/site manager in charge of these developments must be informed immediately. These discoveries ought to be secured (preferably *in situ*) and the ECO/site manager ought to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a professional palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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**Appendix A: CV**

# 1 INTRODUCTION

The proposed Prospecting Right application for the prospecting of Diamonds (Alluvial, General & in Kimberlite), combined with a Waste License Application, near Groblershoop. The proposed development is located on a certain portion of the Remaining Extent of the farm Zonderhuis 402, a certain portion of the Remaining Extent of the farm Onder Plaats 401, a certain portion of the Remaining Extent of Portion 1, a certain portion of Portion 6 (portion of portion 4), a certain portion of Portion 7 (portion of portion 4) and certain portion of Portion 9 (portion of portion 4) of the farm Namakwari 656, Registration Division: Gordonia and Kenhardt, Northern Cape Province (Figure1).

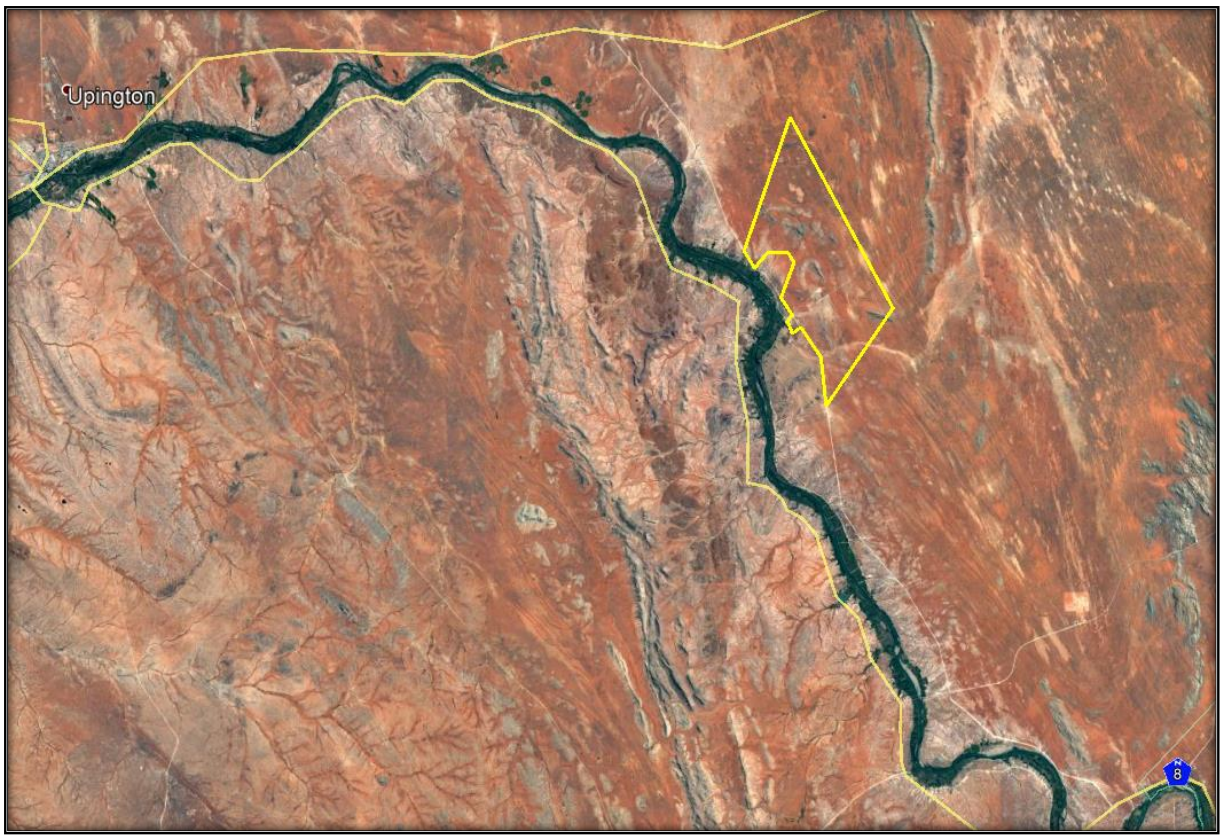



Figure 1: Locality map of the proposed Prospecting Right application for the prospecting of Diamonds (Alluvial, General & in Kimberlite), combined with a Waste License Application, Registration Division: Gordonia and Kenhardt, Northern Cape Province.The proposed development is indicated in green.

## 1.1 BACKGROND

(Information provided by Milnex CC)

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 (Kaap) Valley glacial system and subsequent reworking an alluvial deposition by major rivers. These rivers included the proto- Vaal, - Orange, - Harts, and -Riet Rivers and their modem antecedents. Past and present work has shown that the majority of the alluvial diamonds found in gravel deposits along all of the Orange River terraces are, typically, found in two distinct gravel horizons. These comprise an upper, deflation deposit (locally known as Rooikoppie gravels) overlying fluvial-alluvial units, often known as Primary gravels.

The older gravel sequence formed deposits of considerable thickness, often in excess of 15m and consisting of rapidly aggraded (or dumped) material. The sequence is compacted and frequently cemented with secondary calcrete. Basal gravels, typically, comprise the lower half to one third of the fluvial-alluvial sedimentary sequence and rest directly on the bedrock. The unit (around 5m thick) generally comprises a poorly sorted assemblage of large boulders (up to 45 cm in diameter at the base of the unit), cobbles and pebbles set in a sandy matrix that is considered to have been deposited by a large, high-energy braided system that would be readily capable of transporting diamonds.

The overlying suspended gravels represent gravel bars that have migrated down the river system and have not incised into the bedrock. The units have also been shown to contain diamonds. Diamond grades are usually lower than for the basal deposits owing to their being diluted by finer-grained pebble, sand and silt lenses. The thickness of the suspended gravel unit varies from 3 – 7m and may represent large volumes of material.

Due to nature of the alluvial diamond deposit, samples are not taken for assay as would be normal practice to evaluate hard rock precious or base-metal prospects. The diamond distribution pattern grade of alluvial diamonds is also of such a nature that there is no repeatability of sample results, even from adjacent samples.

Bulk samples will have to be taken to determine the average sample grade. By taking of the bulk samples, the applicant foresees to determine the grade of the diamond deposits as the number of carats contained in 100 tons (cpht) of gravel and to determine the average diamond sizes.

During these activities the applicant will then find out the size and value distribution of trenches. Diamond distribution patterns of alluvial deposits varies to such a nature that there is no repeatability of sample results even from adjacent samples.

Alluvial diamond deposits can only be sampled through bulk sampling comprising thousands of cubic meters of gravel. Given the extent of the area and the grades expected to be very low, the applicant will have to process bulk samples of approximately 207 900 tonnes.

The appointed geologist will advise where the samples will be taken. Bulk samples will not be taken along a systematic grid as in the case of drilling. As the anticipated mining plan for the properties will be based on high volumes (low grades), the bulk samples will have to address average recovery. As indicated, the bulk sampling exercise has to be conducted to determine the grades (cpht), the diamond size distribution and thereafter to sell the diamonds to determine the diamond values.

The plant/ bulk sampling technique will be that of a typical South African alluvial diamond mining operation. The method is a strip mining process with oversize material and tailings recovered from the plant will be used as backfill material prior to final rehabilitation. Gravels are excavated, loaded and transported to the treatment facility using dump trucks.

The bulk sampling operation will be conducted using a fleet of conventional open pit mining equipment compromising of dump trucks supported by appropriate excavators and front-end- loaders. All equipment is planned to be diesel driven.

Before excavation commences vegetation will be cleared from the proposed bulk sampling block. These will be done as per environmental regulations. Top soil will then be removed and stored separately for later used for rehabilitation.

The bulk samples will be made in the form of box cuts the dimensions of these individual box cuts will on average be 30m long x 30m wide. It is estimated that the bulk samples will be 5 m in depth. Gravel will be removed by excavators and will be loaded directly into dump trucks. Ore will be hauled to the screening plant. The material will be screened where after the screened material will be moved to the processing plant where the gravel will be processed. Concentrate will be moved to the sorting plant were the concentrate will be sorted.

It is estimated that pitting and trenching will take approximately 48 months.

## 2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-six years. She has experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 14 years. She has been conducting PIAs since 2014.

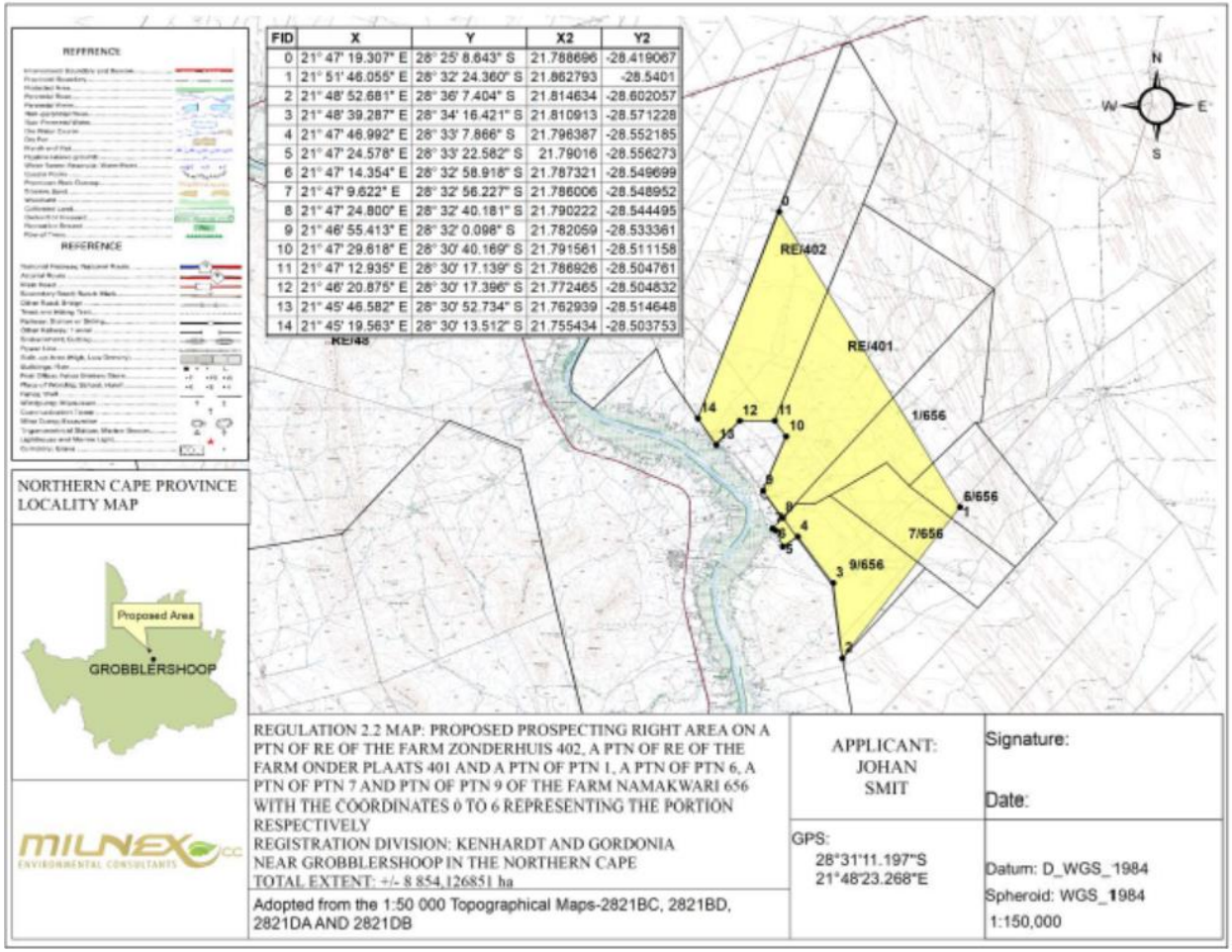



Figure 2: Locality map of the proposed development.

## 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**".

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

This Palaeontological Impact Assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, a 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 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity which will change the character of a site—
    a. (exceeding 5 000 $m^2$ in extent; or
    b. involving three or more existing erven or subdivisions thereof; or
    c. involving three or more erven or divisions thereof which have been consolidated within the past five years; or
    d. the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
    e. the re-zoning of a site exceeding 10 000$m^2$ in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

## 4 OBJECTIVE

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

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the aims of the PIA are: 1) to

**identify** the palaeontological status of the exposed as well as rock formations just below the surface in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a PIA are as follows:

**General Requirements:**

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Description and location of the proposed development and provide geological and topographical maps;
- Provide Palaeontological and geological history of the affected area;
- Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
    a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
    b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
    **c. Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided);
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

## 5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The study area is underlain by the Gordonia Formation of the Kalahari Group, Tertiary Calcrete as well as the Zonderhuis and Leerkrans Formations of the Wilgenhoutsdrif Group, Areachap Group of the Namaqua-Natal Province (Figure 3). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Gordonia Formation of the Kalahari Group and Tertiary calcrete are low while the Palaeontological Sensitivity of the Zonderhuis and Leerkrans Formations are insignificant (Almond and Pether 2008, SAHRIS website).

The Cenozoic Kalahari Group is the most widespread body of terrestrial sediments in southern Africa. The Cenozoic sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge et al., 2006). The youngest formation of the Kalahari group is the Gordonia Formation which is generally termed Kalahari sand and comprises of red aeolian sands that covers most of the Kalahari Group sediments. The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters. Quaternary alluvium, aolian sands, surface limestone, silcrete, and terrace gravels are also included in the Kalahari Group (Kent 1980).

Partridge *et al*., (2006) describes numerous types of superficial deposits of Late Caenozoic (Miocene to Pliocene to Recent) age throughout the Karoo Basin. Sands and gravel in the development footprint has a possible fluvial origin. The fossil assemblages of the Kalahari are generally very low in diversity and occur over a wide range and thus the palaeontological diversity of this Group is low (SAHRIS website). 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 remains have been uncovered where the depositional settings in the past were wetter.

Almond and Pether 2008 allocated a low significance to the Kalahari Group because fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. In the past palaeontologists did not focus on Cenozoic superficial deposits although they sometimes comprise of significant fossil biotas. However, Groenewald and Groenewald (2014) allocated a high palaeontological sensitivity to the Cenozoic aged terrestrial organisms which are important indicators of palaeo-environmental conditions.

**Namaqua-Natal Metamorphic Province**

The development footprint is underlain by the Mid Proterozoic (Mokolian) basement rocks of the Namaqua-Natal Metamorphic Province. The Namaqua-Natal Province is primarily highly metamorphosed sediments and volcanic rocks (e.g. gneisses, schists, quartzites, amphibolites) plus major granitic and gabbroic (norite) intrusions, are dated between 2050 and 1000 Ma (million years ago).

The Wilgenhoutsdrif Group is a volcanogenic group. The basal (mostly sedimentary) unit of this group is the Zonderhuis Formation is overlain by the mainly volcanogenic Leerkrans Formation. The base is badly exposed which workers interpreted as thrust or as a depositional unconformity. The Zonderhuis Formation comprise of a light purple quartzite and is approximately 300 thick which is overlain by grey, brown and greenish schist and phyllite which is interbedded by quartzites form sharp contacts. Ferruginous quartzite, siderite dolomite and argillaceous limestone also occur in places. Ferruginous chert (black to red) forms ridges and is present in association with greenstones.

The Leerkrans Formation consists of cyclical repetitions of clastic sedimentary and volcanic rocks. Rhyolite is overlain by a greenstone unit in which lapilli calcite-filled amygdales and pillows are preserved. Metabasic intrusions occur in sill-like bodies, while immature sediments overlie the volcanic rocks.

The Proterozoic granite-gneiss basement rocks of the Namaqua-Natal Metamorphic Province do not contain any fossils because they are igneous in origin or too highly metamorphosed (Almond & Pether 2008), and their palaeontological sensitivity is correspondingly low (Almond & Pether 2008, Almond 2008).

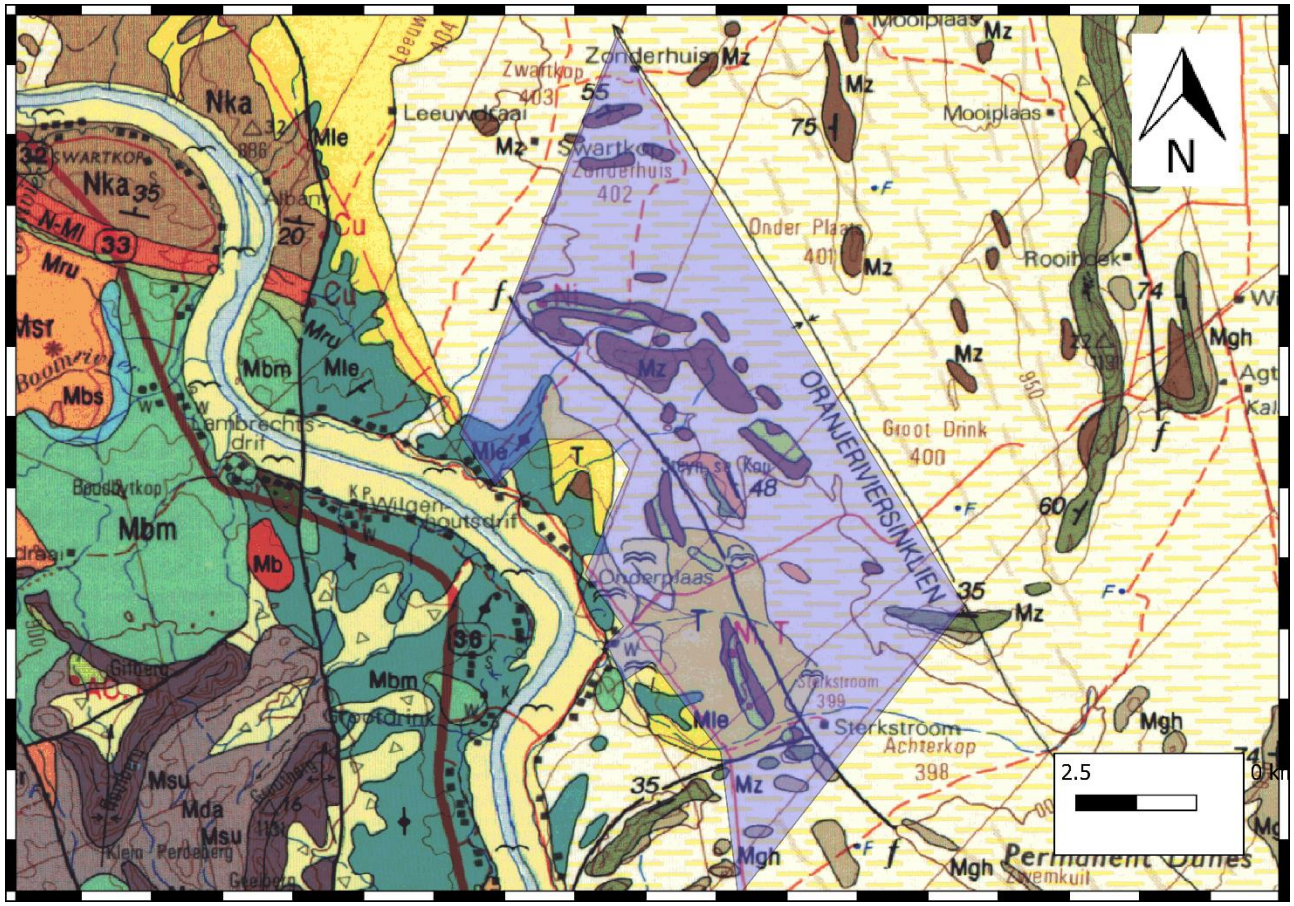
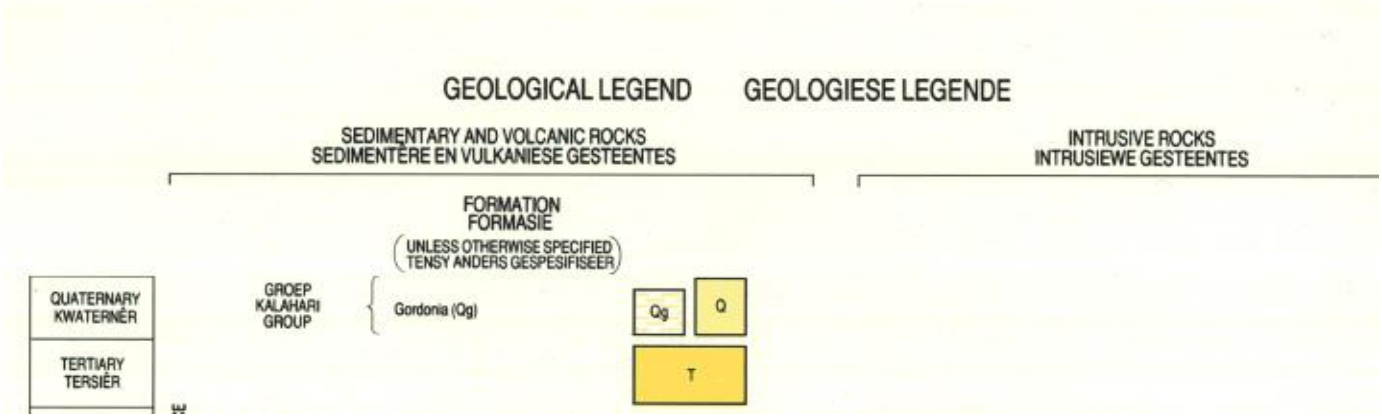



Figure 3: Extract of the 1:250 000 2820 Upington Geological map (Council of Geoscience) of the proposed development (development footprint indicated in purple). The development footprint is area is underlain by the Gordonia Formation of the Kalahari Group, Tertiary Calcrete as well as the Zonderhuis and Leerkrans Formations of the Wilgenhoutsdrif Group, Areachap Group of the Namaqua-Natal Province Map drawn by QGIS 2.18.28.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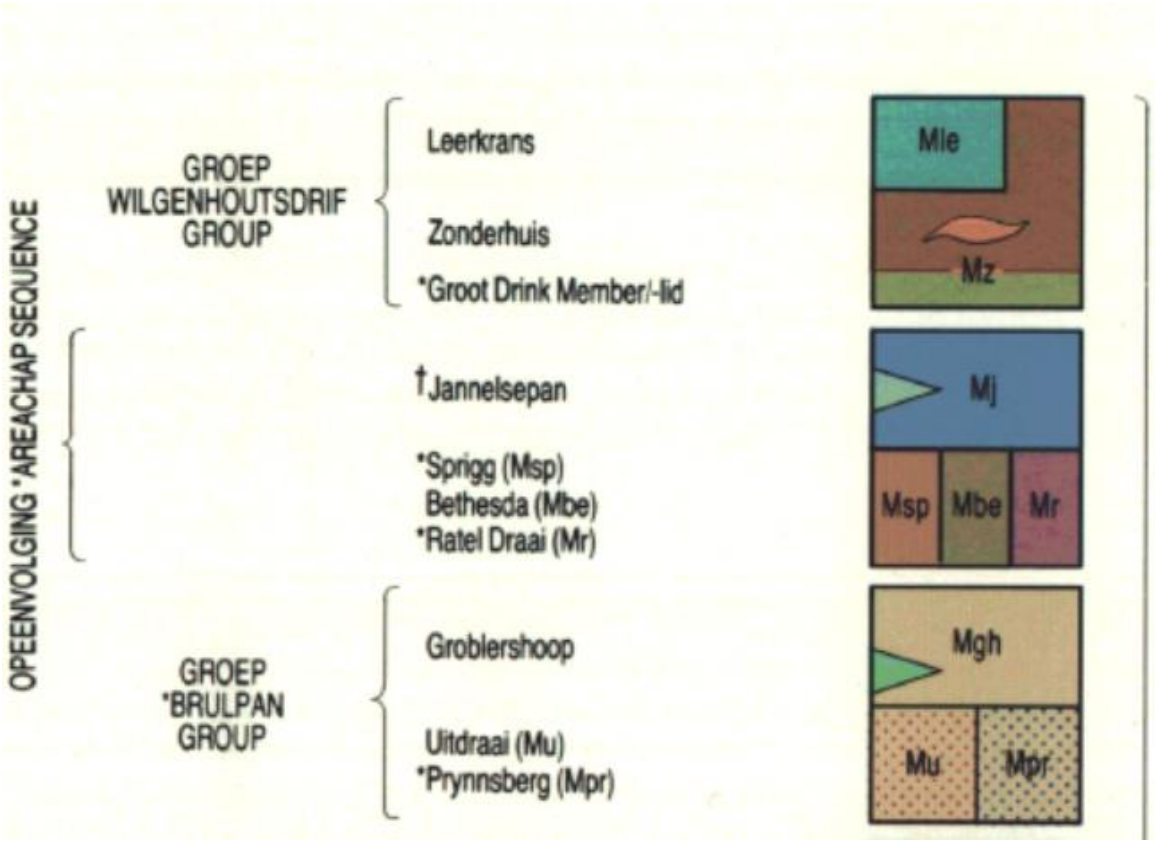
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Bethesda (Mbe)
*Ratel Draai (Mr)
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Uitdraai (Mu)
*Prynnsberg (Mpr)
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Mu
Mpr

**LEGEND**

**Qg**- Gordonia Formation of the Kalahari Group-dashed yellow lines-Red brown windblown sand and dunes

**T-**Tertiary-green-Calcrete

**Mz-**Zonderhuis Formation, Wilgenhoutsdrif Group, Areachap Sequence-Brown and light green-Phylite, schist, carbonate rocks, conglomerate, lenses of serpentinite; purples massive quartzite

**Mle-** Leerkrans Formation, Wilgenhoutsdrif Group, Areachap Sequence –Turquoise-Metabasalt, felsic lavas, greenschist, conglomerate ferruginous chert

**Mining**

Ni-Nickel,

**T-Talc**

## 6 GEOGRAPHICAL LOCATION OF THE SITE

The property is located approximately 37km North of Groblershoop in the Northern Cape Province and will be approximately 8854.1269 ha in extent

## 7 METHODS

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

### 7.1 Assumptions and Limitations

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 never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is sourced to provide information on the existence of fossils in an area which was 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.**

## 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);
- 1: 250 000 2820 Upington Geological map (Council of Geoscience);
- A Google Earth map with polygons of the proposed development was obtained from Milnex CC.;
- 1:50 000 Topographical Maps 2821 BC; 2821 BD; 2821 DA; 2821BD;

## 9 IMPACT ASSESSMENT METHODOLOGY

### 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 following project phases:

- 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 1:** *The rating system*

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

**Table 1 Continues**

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| **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 |

| | | |
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| | | remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation. |

**Table 1 Continues**

| | | |
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| **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 |

**Table 1 Continues**

| **SIGNIFICANCE** | | |
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| 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:<br>(**Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**<br>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 |

The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur but are regarded as having a low probability. The significance of the impact occurring will be low.

## 10 FINDINGS AND RECOMMENDATIONS

The study area is underlain by the Gordonia Formation of the Kalahari Group, Tertiary Calcrete as well as the Zonderhuis and Leerkrans Formations of the Wilgenhoutsdrif Group, Areachap Group of the Namaqua-Natal Province (Figure 3). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Gordonia Formation of the Kalahari Group and Tertiary calcrete are low while the Palaeontological Sensitivity of the Zonderhuis and Leerkrans Formations are insignificant (Almond and Pether 2008, SAHRIS website).

It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the facility may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the ECO/site manager in charge of these developments must be informed immediately. These discoveries ought to be secured (preferably *in situ*) and the ECO/site manager ought to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a professional palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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**Appendix A – Elize Butler CV**

**CURRICULUM VITAE**

**ELIZE BUTLER**

**PROFESSION:** Palaeontologist

**YEARS' EXPERIENCE**: 26 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

Registered as a PhD fellow at the Zoology Department of the UFS
2013 to current

**Dissertation title:** A new gorgonopsian from the uppermost D*aptocephalus Assemblage Zone*, in the Karoo Basin of South Africa

**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

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|---|---|
| Research Assistant | National Museum, Bloemfontein 1993 – 1997 |
| Principal Research Assistant and Collection Manager | National Museum, Bloemfontein 1998–currently |

## TECHNICAL REPORTS

**TECHNICAL REPORTS**


1. **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.
2. **Butler, E. 2014.** Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.
3. **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.
4. **Butler, E. 2015.** Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.
5. **Butler, E. 2015.** Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.
6. **Butler, E. 2015.** Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.
7. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.
8. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.
9. **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.
10. **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.
11. **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.

12. **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.
13. **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.
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57. **Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed development of the Lephalale coal and power project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.
58. **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.
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78. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.

**79. Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

80. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.

81. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.

82. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Rustplaas near Piet Retief, Mpumalanga. Bloemfontein.

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85. **Butler, E. 2018.** Palaeontological Impact Assessment of the authorisation and amendment processes for Manangu mine near Delmas, Victor Khanye local municipality, Mpumalanga. Bloemfontein.

86. **Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.

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89. **Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.

90. **Butler, E. 2018.** Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.

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94. **Butler, E. 2018.** Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.

95. **Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.
96. **Butler, E. 2018.** Palaeontological desktop assessment of the proposed housing development on portion 237 of farm Hartebeestpoort 328. Bloemfontein.
97. **Butler, E. 2018.** Palaeontological desktop assessment of the proposed New Age Chicken layer facility located on holding 75 Endicott near Springs in Gauteng. Bloemfontein.
98. **Butler, E. 2018** Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.
99. **Butler, E. 2018.** Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.
100. **Butler, E. 2018.** Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein
101. **Butler, E. 2018.** Palaeontological Impact Assessment of the proposed diamonds Alluvial & Diamonds General Prospecting Right Application near Christiana on the Remaining Extent of Portion 1 of the Farm Kaffraria 314, Registration Division HO, North West Province. Bloemfontein.
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104. **Butler, E. 2018.** Palaeontological Exemption Letter for the proposed reclamation and reprocessing of the City Deep Dumps in Johannesburg, Gauteng Province. Bloemfontein.
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**119. E. Butler. 2019.** Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:
120. **E. Butler. 2019**. Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province
121. **E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo
122. E. **Butler. 2019.** Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape
123. **E. Butler. 2019**. Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province
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131. **E. Butler. 2019**. Palaeontological Desktop Assessment for The Proposed 920 Kwp Groenheuwel Solar Plant Near Augrabies, Northern Cape Province
132. **E. Butler. 2019.** Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province
133. **E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province
134. **E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London
135. **E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km Of the Merensky-Kameni 132KV Powerline
136. **E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape
137. **E. Butler. 2019.** Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.
138. **E. Butler. 2019.** Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaininng Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng
139. **E. Butler. 2019.** Palaeontological Desktop Assessment Of The Proposed Upgrade Of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction
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147. **E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed New Railway Bridge, and Rail Line Between Hotazel And The Gloria Mine, Northern Cape Province
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149. **E. Butler.** 2019. Palaeontological Desktop Assessment Of The Proposed Diamond Mining Permit Application Near Kimberley, Sol Plaatjies Municipality, Northern Cape Province
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153. **E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed seepage interception drains at Duvha Power Station, Emalahleni Municipality, Mpumalanga Province
154. **E. Butler.** 2019. Palaeontological Desktop Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.
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157. **E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed feldspar prospecting rights and mining application on portion 4 and 5 of the farm Rozynen 104, Kakamas South, Kai! Garib Municipality, Zf Mgcawu District Municipality, Northern Cape

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166. **E. Butler.** 2019. Palaeontological Desktop Assessment for five Proposed Black Mountain Mining Prospecting Right Applications, Without Bulk Sampling, in the Northern Cape.
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172. **E. Butler.** 2019. Palaeontological Exemption Letter of the Proposed Mamatwan Mine Section 24g Rectification Application, near Hotazel, Northern Cape Province
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CONFERENCE CONTRIBUTIONS

**NATIONAL**

**PRESENTATION**

Butler, E., Botha-Brink, J., and F. Abdala. A new gorgonopsian from the uppermost *Dicynodon Assemblage Zone*, Karoo Basin of South Africa.18 the Biennial conference of the PSSA 2014.Wits, Johannesburg, South Africa.

**INTERNATIONAL**

Attended the Society of Vertebrate Palaeontology 73th Conference in Los Angeles, America. October 2012.

**CONFERENCES: POSTER PRESENTATION**

**NATIONAL**

Butler, E., and J. Botha-Brink. Cranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle. University of the Free State Seminar Day, Bloemfontein. South Africa. November 2007.

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Butler, E., and J. Botha-Brink. The biology of the South African non-mammaliaform cynodont *Galesaurus planiceps*.15th Conference of the PSSA, Howick, South Africa. August 2008.

**INTERNATIONAL VISITS**

| | |
|---|---|
| Natural History Museum, London | July 2008 |
| Paleontological Institute, Russian Academy of Science, Moscow | November 2014 |