



**PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED K147 PROVINCIAL  
ROAD CONSTRUCTION, GAUTENG PROVINCE**

**Compiled for:**

Bokamoso Landscape Architects & Environmental Consultants CC

PO Box 11375

Maroelana

0161

Prepared by

Banzai Environmental

29 November 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.

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**SIGNATURE:**

A handwritten signature in black ink, appearing to read 'Elize Butler', with a period at the end.

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

*Table 1: NEMA Table*

| <b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>  | <b>Relevant section in report</b>  | <b>Comment where not applicable.</b> |
|--|--|--------------------------------------|
| 1.(1) (a) (i) Details of the specialist who prepared the report  | Page ii and Section 2 of Report – Contact details and company and Appendix A | -                                    |
| (ii) The expertise of that person to compile a specialist report including a curriculum vita   | Section 2 – refer to <b>Appendix A</b>                                       | -                                    |
| (b) A declaration that the person is independent in a form as may be specified by the competent authority  | Page ii of the report  | -                                    |
| (c) An indication of the scope of, and the purpose for which, the report was prepared  | Section 4 – Objective  | -                                    |
| (cA) An indication of the quality and age of base data used for the specialist report  | Section 5 – Geological and Palaeontological history                          | -                                    |
| (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;  | Section 10   | -                                    |
| (d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment   | Section 1 and 11   |                                      |
| (e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used   | Section 7 Approach and Methodology   | -                                    |
| (f) details of an assessment of the 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 alternatives; | Section 1 and 11   |                                      |
| (g) An identification of any areas to be avoided, including buffers  | Section 1 and 11   |                                      |
| (h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;   | Section 5 – Geological and Palaeontological history                          |                                      |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017   | Relevant section in report                 | Comment where not applicable.  |
|--|--|--|
| (i) A description of any assumptions made and any uncertainties or gaps in knowledge;  | Section 7.1 – Assumptions and Limitation   | -  |
| (j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment  | Section 1 and 11                           |  |
| (k) Any mitigation measures for inclusion in the EMPr  | Section 12                                 |  |
| (l) Any conditions for inclusion in the environmental authorisation  | Section 12                                 |  |
| (m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation   | Section 12                                 |  |
| (n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and   | Section 1 and 11                           |  |
| (n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and   |  |  |
| (n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan | Section 1 and 11                           | -  |
| (o) A description of any consultation process that was undertaken during the course of carrying out the study  | N/A  | Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process. |
| (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.  |  | Not applicable.  |
| (2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be   | Section 3 compliance with SAHRA guidelines |  |

| Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017                     | Relevant section in report | Comment where not applicable. |
|--|----------------------------|-------------------------------|
| applied to a specialist report, the requirements as indicated in such notice will apply. |                            |                               |

## EXECUTIVE SUMMARY

Banzai Environmental was appointed by Bokomaso Landscape Architects & Environmental Consultants CC to conduct the Palaeontological Field Assessment to assess the proposed K147 Provincial Road Construction, Gauteng Province. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Impact Assessment (PIA) is necessary to determine the presence of fossil material within the planned development. This study is thus necessary to evaluate the effect of the construction on the palaeontological heritage.

The development footprint is in the Transvaal Basin and is underlain by the Timeball Hill and Hekpoort Formations (Pretoria Group, Transvaal Supergroup). The most western margin of the development falls in the Malmani Subgroup (Chuniespoort Group; Transvaal Supergroup). The igneous rock, diabase, is also present in the proposed development. The diabase would have had a thermal metamorphic effect on the adjoining Timeball Hill Formation and would decrease the chance of fossil preservation in these areas. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Malmani Subgroup is Very High, the Timeball Hill Formation is High and that of the Hekpoort Formation is Moderate while that of the Boshhoek Formation is Low. Diabase is igneous rocks and is considered to have no palaeontological significance. **Three Alternatives** are being considered for this project. These alternatives have the same Geology and there is therefore Palaeontologically **NO Preference** between the three alternatives.

A Palaeontological Desktop Assessment was conducted for the project dated 3 October 2020. This study found that there was a Very High chance of finding fossils in the Malmani Subgroup and a High chance of finding fossils in the Timeball Hill Formation, thus triggering a field assessment. A site-specific field survey of the development footprint was thus conducted on foot and by motor vehicle on 26 October 2020. During the site visit no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological reserves of the area.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ESO (Environmental Site Officer) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ESO 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 correct mitigation (recording and collection) can be carry out by a paleontologist.

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



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## Appendix A: CV

## 1 INTRODUCTION

Central Plaza Investments 28 (Pty) Ltd on behalf of the Gauteng Department of Roads and Transport (GDRT) plans to construct the new K147 Provincial Road, Gauteng Province (Figure 1-3). This forms part of SIP 24: Human Settlements as published in GN 812 dated 24 July 2020, Presidential Infrastructure Coordinating Commission Council Strategic Integrated Projects designated in terms of Section 8(1)(a) read with Section 7(1) of the Infrastructure Development Act, as amended, 2014 (Act No. 23 of 2014).

The construction of the proposed K147 provincial road will be completed in two phases and will be about 5.5km in extent. Phase 1 will require the construction of one lane per direction from the present entrance to The Hills at Atterbury Road in the north-east to Garsfontein Road in the south-west. The second phase will comprise of the construction of one lane per direction from Delmas Road to Garsfontein Road in a north-easterly direction. All intersections along the route will be upgraded.

Three route alignments have been identified and are depicted in Figure 1:

- Red line represents the Preferred Alternative,
- Blue line represents Alternative 1 and
- Green line represents Alternative 2.

The proposed road will be constructed in the east of Tshwane in the Mooikloof area via The Hills and Mooikloof Manor linking Atterbury Road to Delmas Road. The road construction will be situated on several Portions of Rietfontein 375 JR and Portion 30 of Rietvallei 377 JR. (Figure 1-3).

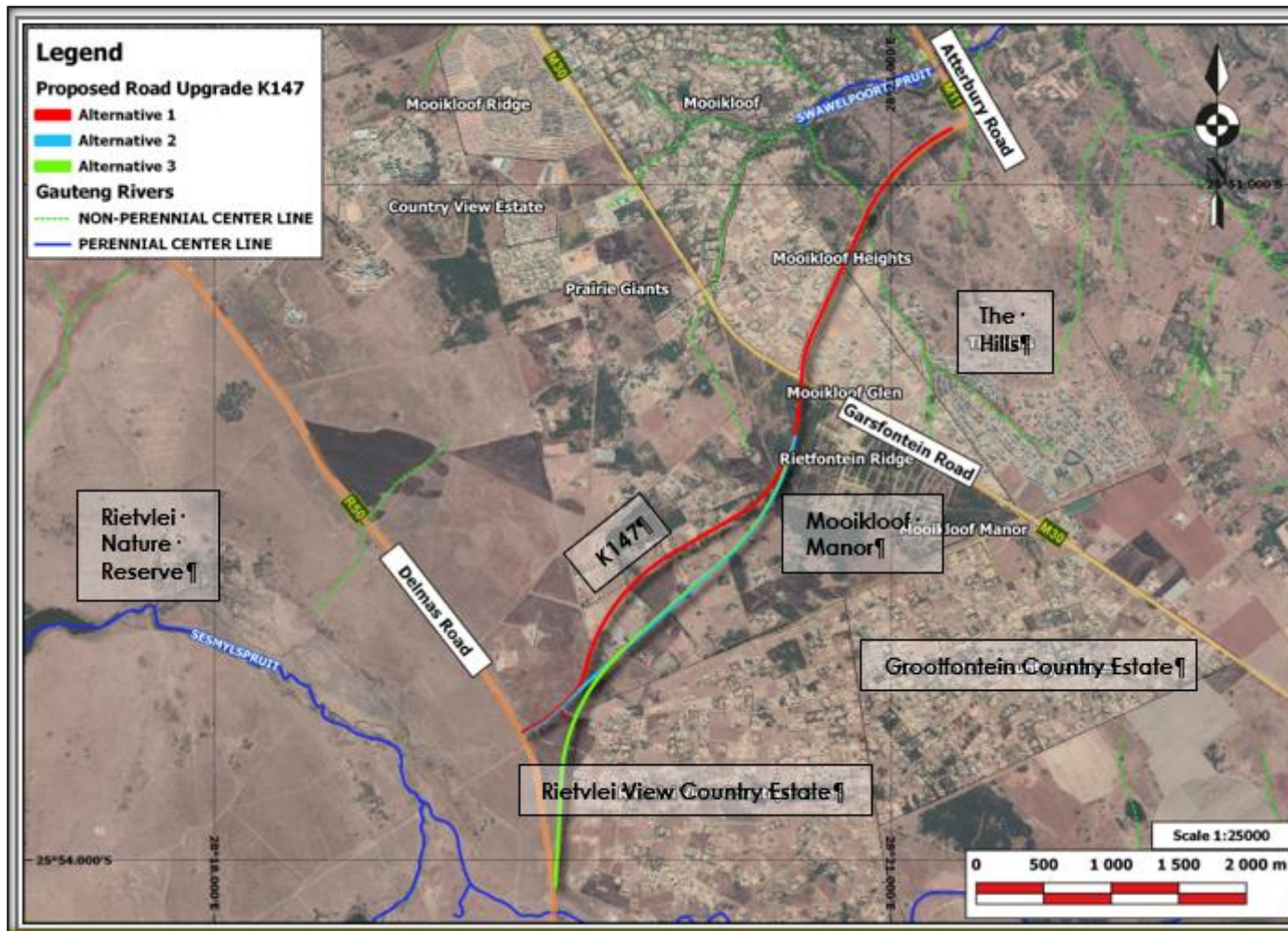


Figure 1: Google Earth Image (2020) indicating the locality of the proposed K147 Provincial Road Construction, Gauteng Province



Figure 2: Close-up Google Earth Image (2020) indicating the locality of the proposed K147 Provincial Road Construction, Gauteng Province.



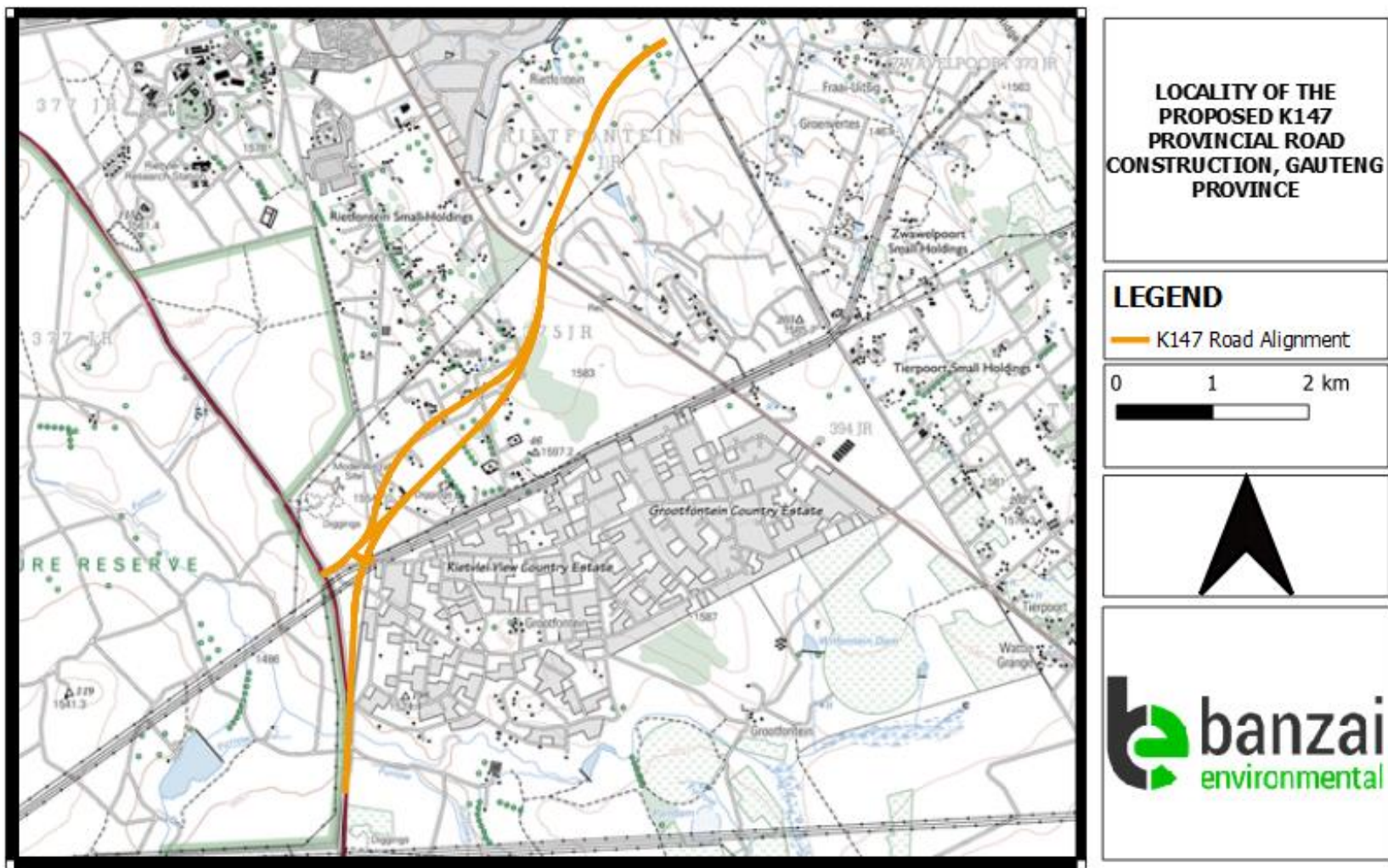


Figure 3: Locality of the proposed K147 Provincial Road Construction, Gauteng Province

## 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.

## 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<sup>2</sup> 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 000m<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 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 PALAEOLOGICAL HISTORY

The proposed K147 Provincial Road Construction, Gauteng Province is depicted on the 1:250 000 2528 Pretoria Geological map (Council of Geoscience) (Figure 4, Table 2). The development footprint is in the Transvaal Basin and is mainly underlain by the Timeball Hill (Vt) and Hekpoort (Vha) Formations (Pretoria Group, Transvaal Supergroup). The most western margin of the development falls in the Malmani Subgroup (Vmd; Chuniespoort Group; Transvaal Supergroup). The igneous rock (di), diabase, is also present in the proposed development. The diabase would have had a thermal metamorphic effect on the adjoining Timeball Hill and Boshhoek Formations and would decrease the chance of fossil preservation in the Timeball Hill Formation. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Malmani Subgroup is Very High, the Timeball Hill Formation is High and that of the Hekpoort Formation is Moderate while that of the Boshhoek Fm is Low. Diabase is igneous rocks and is considered to have no palaeontological significance. The Timeball Hill Formation as well as Malmani Subgroup is known for its stromatolites while subunits in the Pretoria Group (Transvaal Supergroup) containing stromatolites possibly also contain organic-walled microfossils (Groenewald, 2014).

The Hekpoort Formation consists of subaerial volcanic rocks that include (basalts, pyroclastics) as well as minor lacustrine shales. To date no fossils have been recorded from this Formation although organic-walled microfossils may be present. The Boshhoek Formation (Vb) comprise of the quartzite, sandstones, conglomerats, diamictite (alluvial fans, slumps) (Groenewald *et al.*, 2014) and underlies a small portion of the development footprint. Fossils is not known from this Formation. The Timeball Hill Formation comprises of conglomerates, diamictite, quartzite, minor lavas with lacustrine and fluvio-deltaic mudrocks, whereas the overlying Klapperkop Member of the Timeball Hill Formation consist of conglomerate, quartzite, shale, and siltstone (Groenewald 2014). Catuneanu & Eriksson (2002) is of the opinion that the Timeball Hill Formation was deposited within a deep marine basin (Figure 5).

The Timeball Hill Formation is known to include stromatolites. The lower part of this Formation is associated with thin carbonate interbeds within turbidite sequences (Catuneanu & Eriksson 2002). Stromatolites have not been documented from the overlying fluvio-deltaic Klapperkop Quartzite Member.

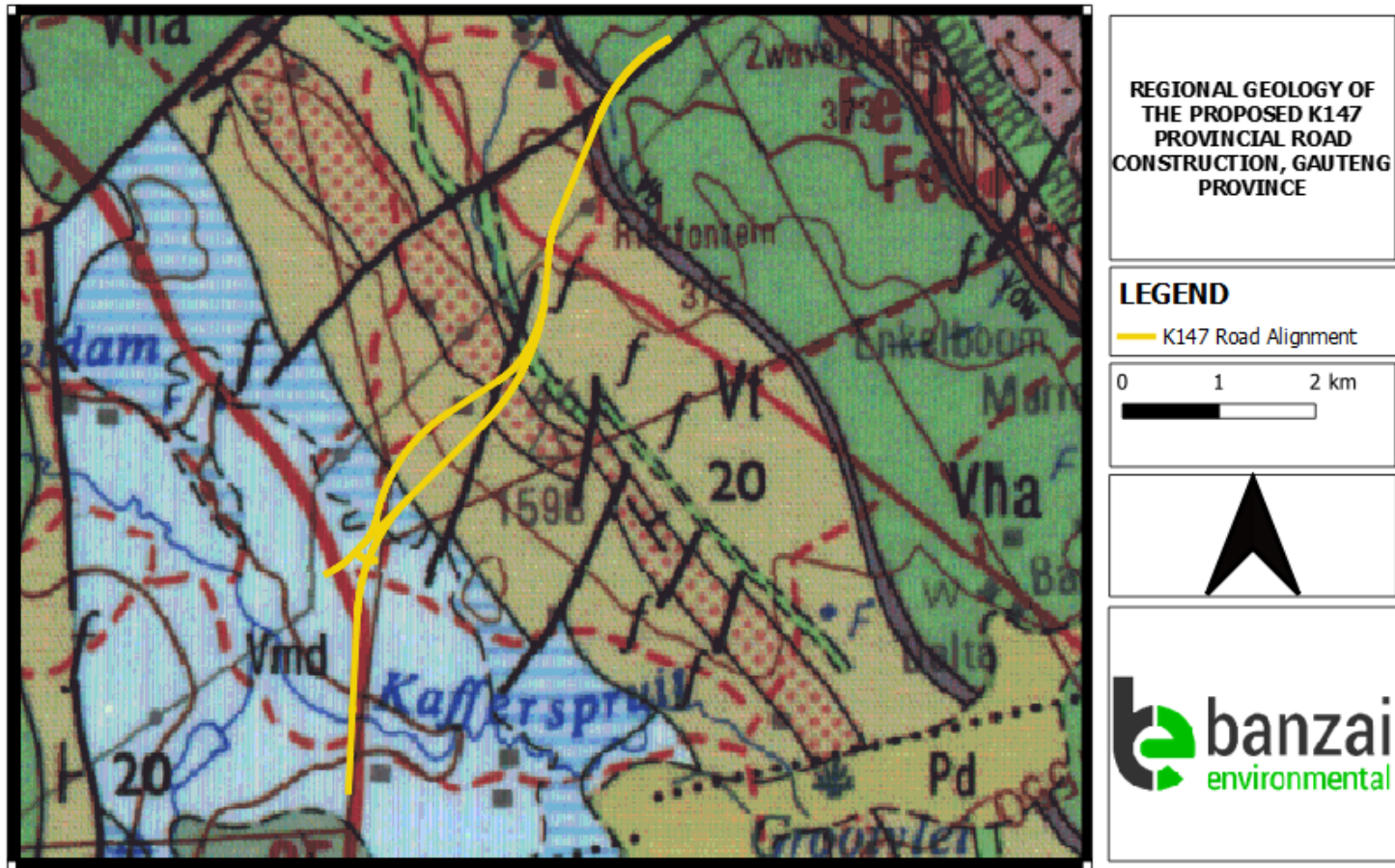


Figure 4: Extract of the 1:250 000 2528 Pretoria Geological map (Council of Geoscience) indicating the locality of the proposed K147 Provincial Road Construction, Gauteng Province. Map drawn by QGIS 2.18.28.

Table 2: Geology and lithology of the development area

| Complex | Supergroup/Group/Suite                   | Formation            | Lithology  | Fossil Heritage   |
|---------|--|----------------------|--|---|
|         | Karoo Supergroup; Dwyka Group (Pd)       |                      | Conglomerates, glacial to fluvioglacial diamictites, sandstones, shales  | Trace fossil assemblage, pre and post glacial, possible plants and shelly invertebrates |
|         | Transvaal Supergroup Pretoria Group      | Daspoort (Vdq)       | Alluvial, fluvial and deltaic mudrocks and sandstones; marine sediments in east  | Stromatolites   |
|         | Transvaal Supergroup Pretoria Group      | Hekpoort (Vha) green | Volcanics (including basalts, pyroclastics) with minor lacustrine shales   | No Fossils  |
|         | Transvaal Supergroup Pretoria Group      | Boshoek (Vb)         | Sandstones, conglomerates, diamictite (alluvial fans, slumps)  | No Fossils  |
|         | Transvaal Supergroup Pretoria Group      | Timeball Hill (Vt)   | Quartzite, siltstone, shale, conglomerate, Fluvio-deltaic and lacustrine mudrocks with diamictite, quartzite, minor lavas. | Stromatolites   |
|         | Transvaal Supergroup; Chuniespoort Group | Malmani (Vmd)        | Minor secondary mudrocks, <b>cherts</b> , containing carbonaceous shale, stromatolitic                                     | Stromatolites Shallow marine to intertidal stromatolites organic-walled microfossils    |

| <b>Complex</b> | <b>Supergroup/Group/Suite</b> | <b>Formation</b> | <b>Lithology</b>                                   | <b>Fossil Heritage</b> |
|----------------|-------------------------------|------------------|--|------------------------|
|                |                               |                  | carbonates<br>(limestones /<br><b>dolomites</b> ), |                        |
|                | Diabase                       |                  |  | None                   |

| FORMATIONS                | LITHOFACIES                                  | INTERPRETATION   |
|---------------------------|--|--|
| Timeball Hill             | upper shales                                 | relatively deep marine basin subject to suspension sedimentation, turbidites, distal fluvial-deltaic deposition and short-lived periglacial reworked tillite deposition. Basal volcanism in the south and widespread fumarolic influence throughout the basin and stratigraphy |
|                           | diamictite/conglomerate lens                 |  |
|                           | Klapperkop quartzite Member                  |  |
|                           | lower shales                                 |  |
| Rooihoogte                | Bushy Bend lava Member                       | basal <i>in situ</i> karst-fill, alluvial fan, lacustrine and fluvial sedimentation  |
|                           | Polo Ground quartzite Member                 |  |
|                           | shales<br>Bevets conglomerate/breccia Member |  |
| <b>Chuniespoort Group</b> |  | (paleo-karst topography)   |

Figure 5: Stratigraphy and depositional settings of the Timeball Hill Formation at the base of the Pretoria succession (Catuneanu and Eriksson 2002).

The Malmani Subgroup platform carbonates of the Transvaal Basin comprise of an assortment of stromatolites (microbial laminites), range from supratidal mats to intertidal columns and large subtidal domes (Eriksson *et al.* 2006). The Malmani Subgroup comprise of an assortment of stromatolites (microbial laminites), ranging from supratidal mats to intertidal columns and large subtidal domes

Stromatolites are layered mounds, columns and sheet-like sedimentary rocks (Figure 6). These structures were originally formed by the growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe. Cyanobacteria are prokaryotic cells (simplest form of modern carbon-based life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils. The oxygen atmosphere that we depend on was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.



Figure 6: Example of a well-preserved stromatolites from the Archaean Era.

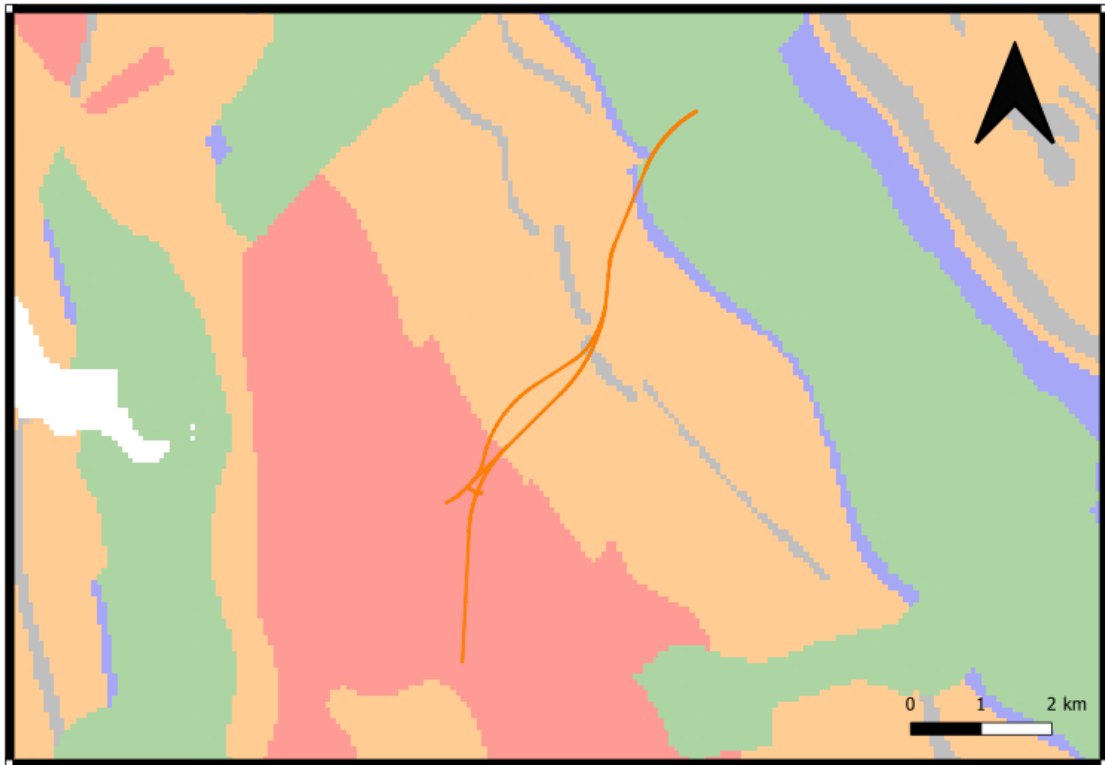


Figure 7: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the location of the proposed development.

| Colour        | Sensitivity        | Required Action   |
|---------------|--------------------|---|
| RED           | VERY HIGH          | Field assessment and protocol for finds is required   |
| ORANGE/YELLOW | HIGH               | desktop study is required and based on the outcome of the desktop study, a field assessment is likely                               |
| GREEN         | MODERATE           | desktop study is required   |
| BLUE          | LOW                | no palaeontological studies are required however a protocol for finds is required   |
| GREY          | INSIGNIFICANT/ZERO | no palaeontological studies are required  |
| WHITE/CLEAR   | UNKNOWN            | these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map. |

According to the SAHRIS palaeo sensitivity map (Figure 7) there is a very High chance of finding fossils in the red area, a high chance in the orange area and a moderate chance in the green area. The grey area is unfossiliferous.

## 6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed road will be constructed in the east of Tshwane in the Mooikloof area via The Hills and Mooikloof Manor linking Atterbury Road to Delmas Road. The road construction will be situated on several Portions of Rietfontein 375 JR and Portion 30 of Rietvallei 377 JR.

## 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 2528 Pretoria Geological map (Council of Geoscience);
- A Google Earth map with polygons of the proposed development was obtained from Bokomaso Landscape Architects & Environmental Consultants CC.

## 9 SITE VISIT

A one-day site specific field survey of the development footprint and three alternative alignments was conducted on foot and by motor vehicle on 26 October 2020. The following photographs were taken during the site visit. No fossiliferous outcrop was identified in the planned development footprint. However, fossil heritage may be unearthed during the construction phase of the development. A Chance find protocol is thus attached if fossils are found during the construction phase.



Figure 8: Lush vegetation present in the development area with high grasses and trees. No fossiliferous outcrops are present.

GPS Coordinates 25°51'4.00"S 28°20'55.01"E





Figure 9: Big trees present in the proposed development. No fossiliferous outcrops are present.  
GPS Coordinates 25°51'8.17"S 28°20'52.96"E

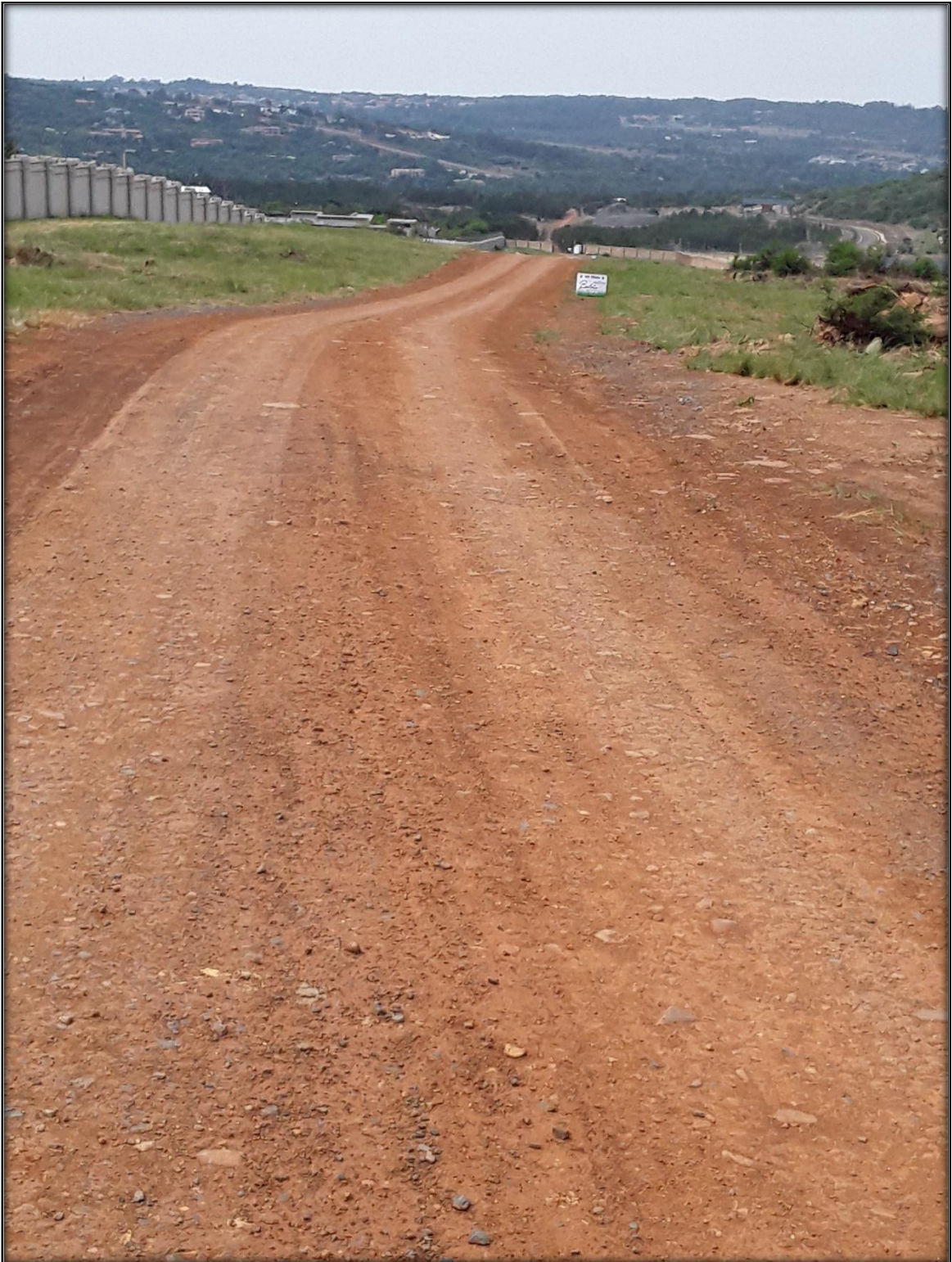


Figure 10: Short grass where site clearance has taken place. No fossiliferous outcrops are present.

GPS Coordinates 25 51 40S 28 20 39E





Figure 11: Wattle plantation with high grass. No fossiliferous outcrops are present.  
GPS Coordinates 25 52 10S 28 20 35E



Figure 12: Low grass present in the planned development footprint. No fossiliferous outcrops are present.

GPS Coordinates 25°52'20.72"S 28°20'30.28"E





Figure 13: Disturbed agricultural land. No fossiliferous outcrops are present.  
GPS Coordinates 25°52'32.22"S 28°20'12.03"E



Figure 14: End of proposed road construction. No fossiliferous outcrops are present.  
GPS Coordinates 25°54'30.57"S 28°19'29.39"E

## 10 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

*Palaeontological Field Assessment for the K147 Provincial Road Construction, Gauteng Province*



- 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:

**NOTE: it is important to note the three alternatives proposed for this project has the same Geology and there is therefore NO Preference between the three alternatives. The rating for the alternatives will consequently be the same.**

*Table 3: 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).   |
| <b>DURATION</b>   |                            |  |
| This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity. |                            |  |
| 1   | Short term                 | The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction |

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



|  |                               |   |
|--|-------------------------------|---|
| 2  | Partly reversible             | The impact is partly reversible but more intense mitigation measures are required.                        |
| 3  | Barely reversible             | The impact is unlikely to be reversed even with intense mitigation measures.                              |
| 4  | Irreversible                  | The impact is irreversible and no mitigation measures exist.  |
| <b>IRREPLACEABLE LOSS OF RESOURCES</b>   |                               |   |
| This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.  |                               |   |
| 1  | No loss of resource           | The impact will not result in the loss of any resources.  |
| 2  | Marginal loss of resource     | The impact will result in marginal loss of resources.   |
| 3  | Significant loss of resources | The impact will result in significant loss of resources.  |
| 4  | Complete loss of resources    | The impact is result in a complete loss of all resources.   |
| <b>CUMULATIVE EFFECT</b>   |                               |   |
| This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.  |                               |   |
| 1  | Negligible cumulative impact  | The impact would result in negligible to no cumulative effects.   |
| 2  | Low cumulative impact         | The impact would result in insignificant cumulative effects.  |
| 3  | Medium cumulative impact      | The impact would result in minor cumulative effects.  |
| 4  | High cumulative impact        | The impact would result in significant cumulative effects   |
| <b>SIGNIFICANCE</b>  |                               |   |
| Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula:<br><b>(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.</b><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   |

**(Extent (1) + probability (3) + reversibility (4) + irreplaceability (4) + duration (4) + cumulative effect) (3) x magnitude/intensity (1) = 19**

### 10.1 Summary of Impact Tables

The development footprint is in the Transvaal Basin and is underlain by the Timeball Hill and Hekpoort Formations (Pretoria Group, Transvaal Supergroup) as well as diabase. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Timeball Hill Formation is High and that of the Hekpoort Formation is Moderate. Diabase is igneous rocks and is considered to have no palaeontological significance.

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 high probability. The magnitude of the impact on the fossil heritage will be low. The significance of the impact occurring will be low.

## 11 FINDINGS AND RECOMMENDATIONS

The development footprint is in the Transvaal Basin and is underlain by the Timeball Hill and Hekpoort Formations (Pretoria Group, Transvaal Supergroup). The most western margin of the development falls in the Malmani Subgroup (Chuniespoort Group; Transvaal Supergroup). The igneous rock, diabase, is also present in the proposed development. The diabase would have had a thermal metamorphic effect on the adjoining Timeball Hill Formation and would decrease the chance of fossil preservation in these areas. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Malmani Subgroup is Very High, the Timeball Hill Formation is High and that of the Hekpoort Formation is Moderate while that *Palaeontological Field Assessment for the K147 Provincial Road Construction, Gauteng Province*

of the Boshhoek Formation is Low. Diabase is igneous rocks and is considered to have no palaeontological significance. **Three Alternatives** are being considered for this project. These alternatives have the same Geology and there is therefore Palaeontologically **NO Preference** between the three alternatives.

A Palaeontological Desktop Assessment was conducted for the project dated 3 October 2020. This study found that there was a Very High chance of finding fossils in the Malmani Subgroup and a High chance of finding fossils in the Timeball Hill Formation, thus triggering a field assessment. A site-specific field survey of the development footprint was thus conducted on foot and by motor vehicle on 26 October 2020. During the site visit no fossiliferous outcrops were identified. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the development footprint will be of a low significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological reserves of the area.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ESO (Environmental Site Officer) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ESO 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 correct mitigation (recording and collection) can be carry out by a paleontologist.

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

## 12 CHANCE FINDS PROTOCOL

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

### 12.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 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, *Palaeontological Field Assessment for the K147 Provincial Road Construction, Gauteng Province*

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.

## 12.2 Background

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

## 12.3 Introduction

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

The Environmental Site Officer (ESO) [an internal appointment who is on site permanently during construction, to ensure legal compliance] is responsible to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. The ESO reports to the ECO (Environmental Compliance Officer) which is an external appointment to ensure legal compliance and is only on site occasionally. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

## 12.4 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.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO or site manager. 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 Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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## Appendix A – Elize Butler CV

### 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

#### 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 National Museum, Bloemfontein  
and Collection Manager 1998–currently

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**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 Noupoot 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 Noupoot, Northern Cape. Bloemfontein.

**Butler, E. 2016.** Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from the 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. 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, Mbhashe 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 opencast 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 sports 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 opencast 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, Middelberg, 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.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.

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

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.

**Butler, E. 2017** Palaeontological Desktop Assessment of the proposed development of a railway siding on a portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a stormwater drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed of the Lephale Coal and Power Project, Lephale, Limpopo Province, Republic of South Africa. Bloemfontein.

**Butler, E. 2017.** Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.

**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed development of the H2 Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.



**Butler, E. 2017.** Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.

**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.

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

**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.

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

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

**Butler, E. 2018.** Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.

**Butler, E. 2018.** Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

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

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

**Butler, E. 2018.** Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.

**Butler, E. 2018.** Palaeontological Phase 1 Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

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

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

**Butler, E. 2018.** Palaeontological Field Assessment for the proposed re-alignment and de-commissioning of the Firham-Platrand 88kv Powerline, near Standerton, Lekwa Local Municipality, Mpumalanga province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.

**Butler, E. 2018.** Palaeontological field Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.

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

**Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed Thornhill Housing Project, Ndlambe Municipality, Port Alfred, Eastern Cape Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological desktop assessment of the proposed housing development on portion 237 of farm Hartebeestpoort 328. Bloemfontein.

**Butler, E. 2018.** Palaeontological desktop assessment of the proposed New Age Chicken layer facility located on holding 75 Endicott near Springs in Gauteng. Bloemfontein.

**Butler, E. 2018** Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological field assessment of the proposed development of the Wildealskloof mixed-use development near Bloemfontein, Free State Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein.

**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.

**Butler, E. 2018.** Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delportshoop in the Northern Cape. Bloemfontein.

**Butler, E. 2018.** Palaeontological Field Assessment of the proposed construction of a new 22 kV single wood pole structure power line to the proposed MTN tower, near Britstown, Northern Cape Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Exemption Letter for the proposed reclamation and reprocessing of the City Deep Dumps in Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Exemption letter for the proposed reclamation and reprocessing of the City Deep Dumps and Rooikraal Tailings Facility in Johannesburg, Gauteng Province. Bloemfontein.

**Butler, E. 2018.** Proposed Kalabasfontein Mine Extension project, near Bethal, Govan Mbeki District Municipality, Mpumalanga. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment for the development of the proposed Leslie 1 Mining Project near Leandra, Mpumalanga Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop assessment of the Proposed New Age Chicken Layer Facility located on Holding 75 Endicott near Springs in Gauteng. Bloemfontein.

**Butler, E. 2018.** Palaeontological Desktop Assessment of the proposed Mookodi – Mahikeng 400kV Line, North West Province. Bloemfontein.

**Butler, E. 2018.** Environmental Impact Assessment (EIA) for the Proposed 325 MW Rondekop Wind Energy Facility between Matjiesfontein and Sutherland in the Northern Cape Province.

**Butler, E. 2018.** Palaeontological Impact Assessment of the proposed construction of the Tooverberg Wind Energy Facility, and associated grid connection near Touws River in the Western Cape Province. Bloemfontein.

**Butler, E. 2018.** Palaeontological impact assessment of the proposed Kalabasfontein Mining Right Application, near Bethal, Mpumalanga.

**E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed Westrand Strengthening Project Phase II.

**E. Butler.** 2019. Palaeontological Field Assessment for the proposed Sirius 3 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province

**E. Butler.** 2019. Palaeontological Field Assessment for the proposed Sirius 4 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province

**E. Butler.** 2019. Palaeontological Field Assessment for Heuningspruit PV 1 Solar Energy Facility near Koppies, Ngwathe Local Municipality, Free State Province.

**E. Butler.** 2019. Palaeontological Field Assessment for the Moeding Solar Grid Connection, North West Province.

**E. Butler.** 2019. Recommended Exemption from further Palaeontological studies for the Proposed Agricultural Development on Farms 1763, 2372 And 2363, Kakamas South Settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.

**E. Butler. 2019.** Recommended Exemption from further Palaeontological studies: of Proposed Agricultural Development, Plot 1178, Kakamas South Settlement, Kai! Garib Municipality

**E. Butler. 2019.** Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:

**E. Butler. 2019.** Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province

**E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo

**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

**E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province

**E. Butler.** 2019. Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.

**E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed construction of an iron/steel smelter at the Botshabelo Industrial area within the Mangaung Metropolitan Municipality, Free State Province.

**E. Butler. 2019.** Recommended Exemption from further Palaeontological studies for the proposed agricultural development on farms 1763, 2372 and 2363, Kakamas South settlement, Kai! Garib Municipality, Mgcawu District Municipality, Northern Cape Province.

**E. Butler. 2019.** Recommended Exemption from further Palaeontological Studies for Proposed formalisation of Gamakor and Noodkamp low cost Housing Development, Keimoes, Gordonia Rd, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

**E. Butler. 2019.** Recommended Exemption from further Palaeontological Studies for proposed formalisation of Blaauwskop Low Cost Housing Development, Kenhardt Road, Kai !Garib Local Municipality, ZF Mgcawu District Municipality, Northern Cape Province.

**E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed mining permit application for the removal of diamonds alluvial and diamonds kimberlite near Windsorton on a certain portion of Farm Zoelen's Laagte 158, Registration Division: Barkly Wes, Northern Cape Province.

**E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Vedanta Housing Development, Pella Mission 39, Khâi-Ma Local Municipality, Namakwa District Municipality, Northern Cape.

**E. Butler. 2019.** Palaeontological Desktop Assessment for The Proposed 920 Kwp Groenheuwel Solar Plant Near Augrabies, Northern Cape Province

**E. Butler. 2019.** Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province

**E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province

**E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London

**E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km Of the Merensky-Kameni 132KV Powerline

**E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape

**E. Butler. 2019.** Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.

**E. Butler. 2019.** Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaining Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng



**E. Butler. 2019.** Palaeontological Desktop Assessment Of The Proposed Upgrade Of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction

**E. Butler. 2019.** Palaeontological Desktop Assessment Of The Expansion Of The Jan Kempdorp Cemetry On Portion 43 Of Farm Guldenskat 36-Hn, Northern Cape Province

**E. Butler. 2019.** Palaeontological Desktop Assessment of the Proposed Residential Development On Portion 42 Of Farm Geldunskat No 36 In Jan Kempdorp, Phokwane Local Municipality, Northern Cape Province

**E. Butler. 2019.** Palaeontological Impact Assessment of the proposed new Township Development, Lethabo Park, on Remainder of Farm Roodepan No 70, Erf 17725 And Erf 15089, Roodepan Kimberley, Sol Plaatjies Local Municipality, Frances Baard District Municipality, Northern Cape

**E. Butler. 2019.** Palaeontological Protocol for Finds for the proposed 16m WH Battery Storage System in Steinkopf, Northern Cape Province

**E. Butler. 2019.** Palaeontological Exemption Letter of the proposed 4.5WH Battery Storage System near Midway-Pofadder, Northern Cape Province

**E. Butler. 2019.** Palaeontological Exemption Letter of the proposed 2.5ml Process Water Reservoir at Gloria Mine, Black Rock, Hotazel, Northern Cape

**E. Butler. 2019.** Palaeontological Desktop Assessment for the Establishment of a Super Fines Storage Facility at Gloria Mine, Black Rock Mine Operations, Hotazel, Northern Cape:

**E. Butler. 2019.** Palaeontological Desktop Assessment for the Proposed New Railway Bridge, and Rail Line Between Hotazel and the Gloria Mine, Northern Cape Province

**E. Butler. 2019.** Palaeontological Exemption Letter of the Proposed Mixed Use Commercial Development On Portion 17 Of Farm Boegoeberg Settlement Number 48, !Kheis Local Municipality In The Northern Cape Province

**E. Butler. 2019.** Palaeontological Desktop Assessment of the Proposed Diamond Mining Permit Application Near Kimberley, Sol Plaatjies Municipality, Northern Cape Province

**E. Butler. 2019.** Palaeontological Desktop Assessment of the Proposed Diamonds (Alluvial, General & In Kimberlite) Prospecting Right Application near Postmasburg, Registration Division; Hay, Northern Cape Province

## **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<sup>th</sup> Biennial conference of the PSSA 2014. Wits, Johannesburg, South Africa.

### **INTERNATIONAL**

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

## **CONFERENCES: POSTER PRESENTATION**

### **NATIONAL**

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

Butler, E., and J. Botha-Brink. Postcranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle. 14<sup>th</sup> Conference of the PSSA, Matjesfontein, South Africa. September 2008:

Butler, E., and J. Botha-Brink. The biology of the South African non-mammaliaform cynodont *Galesaurus planiceps*. 15<sup>th</sup> 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