



**PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED DRILLING
PROJECTS IN THE NORTHERN CAPE BY DE BEERS CONSOLIDATED MINES**

Compiled for:

De Beers Consolidated Mines - Kimberley Mines
36 Stockdale street
Kimberley
8300

Prepared by
Banzai Environmental
5 December 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'.

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

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
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 Appendix A	-
(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	Desktop Assessment	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 10	
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the	Section 5 – Geological and	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
environmental sensitivities of the site including areas to be avoided, including buffers;	Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation	N/A	None required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	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.	N/A	Not applicable.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by the De Beers Consolidated Mines (Kimberley) to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed diamond drilling in the Northern Cape. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Assessment (PA) is necessary to determine if fossil heritage is present in the planned development. This study is thus necessary to evaluate the effect of the drilling on the palaeontological resources.

The planned development is underlain by Quaternary aeolian sand and calcrete; Jurassic Dolerite and the Prince Albert and Whitehill Formations (Ecca Group; Karoo Supergroup), Allanridge Formation of the Ventersdorp Supergroup; Schmidtsdrift Subgroup and Campbell Rand Subgroup of the Ghaap Group, Transvaal Supergroup Vryburg Formation of the Transvaal Supergroup. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) database (Table 2), the Palaeontological Sensitivity of the Jurassic dolerite is zero as it is igneous in origin, while that of the Whitehill Formation is Very High, the Prince Albert has a Moderate Palaeontological Sensitivity as well as the Campbell Rand, Schmidtsdrift Vryburg and Allanridge Formations. The Quaternary sediments have a low Palaeontological sensitivity overall, but locally high. (Almond and Pether, 2009; Almond *et al.*, 2013).

Diamonds are present in kimberlites pipes which is intrusive igneous rocks and thus unfossiliferous. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological heritage of the area. Hence, the construction of the development may be authorised in its whole extent, as 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 **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO 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) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

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1 INTRODUCTION

The De Beers Consolidated Mines (Kimberley Mines) commissioned Banzai Environmental to conduct the Palaeontological Desktop Assessment (PDA) to assess proposed drilling developments in the Northern Cape (Figure1-3). The following projects was commissioned by SAHRA as no Palaeontological Studies was conducted previously:

- SAHRA **Case 6634**- NC 30/5/1/1/2/11437 PR Roscommon: Roscommon 206 portion 1 and remaining extent
- SAHRA **Case 6642**- NC 30/5/1/1/2/11436 PR Biessie Laagte: Remaining Extent of Biessie Laagte 96, portion 2 and 6 of Aasvogel Pan 141
- SAHRA **Case 6644** - NC 30/5/1/1/2/11448 PR Klipjes Pan: Farm Klipjes Pan 145
- SAHRA **Case 6645**- NC 30/5/1/1/2/11445 PR Arnotsdale: Ptn 6 of Scholtzfonte South 165 and farm Arnotsdale 175

PR Name	District	PR Number
Biessie Laagte	HOPETOWN	NC 30/5/1/1/2/11436PR
Roscommon	HERBERT	NC 30/5/1/1/2/11437PR
The Grange	HERBERT	NC 30/5/1/1/2/11438PR
Farm 236_7_8 & 274	BARKLY WEST	NC 30/5/1/1/2/11449 PR
Enslin West Consolidated	HOPETOWN	NC 30/5/1/1/2/11447PR
Klipjes Pan	HOPETOWN	NC 30/5/1/1/2/11448 PR
Scholtzfontein	HERBERT	NC 30/5/1/1/2/11446 PR
Arnotsdale	HERBERT	NC 30/5/1/1/2/11445PR
FARM 277, 293 & 294	BARKLY WEST	NC 30/5/1/1/2/11477PR
FERNY HOEK FLAT	BARKLY WEST	NC 30/5/1/1/2/11482PR
Spitskop	BARKLY WEST	NC 30/5/1/1/2/11484PR
B3 Greeffputs	BARKLY WEST	NC 30/5/1/1/2/11481PR
Ramah 211/2. Farm 210 /2&6	Herbert	NC 30/5/1/1/2/11501 PR
B6 Greeffputs 169	Barkly West	NC 30/5/1/1/2/11530 PR
Middeldam	Kimberley	NC 30/5/1/1/2/11508 PR
Likatlong	BARKLY WEST	NC 30/5/1/1/2/11453 PR
Graspan - New Kingston	Kimberley	NC 30/5/1/1/2/11502 PR
Chalk Farm	Herbert	NC 30/5/1/1/2/11505 PR
Khosopskraal	Barkly West	NC 30/5/1/1/2/11570PR
Hartebees (Prev Doornbult)	Hopetown	NC 30/5/1/1/2/11510 PR
Wolwedam) Resubmission	KIMBERLEY	NC 30/5/1/1/2/11452PR
Welgevonden	KIMBERLEY	NC 30/5/1/1/2/11455 PR
Fermanagh	Herbert	NC 30/5/1/1/2/11506 PR
Likatlong - Fairfield - prev Karolusdrift 219	Barkly West	NC 30/5/1/1/2/11539 PR
Plot 1 VaalHarts	Barkly West	NC 30/5/1/1/2/11569PR
Holding 576 VaalHarts	Barkly West	NC 30/5/1/1/2/11572PR
Philmar	Barkly West	NC 30/5/1/1/2/11573PR
Groenwater	Z.F MGCAWU	NC30/5/1/1/2/11759PR
FARM 529 & 553	Z.F MGCAWU	NC30/5/1/1/2/11758PR
Strathmore	Z.F MGCAWU	NC30/5/1/1/2/11757PR

1.1 Background

Diamonds are formed in the earth's mantle (aka the diamond stability zone) approximately 150 km below the earth's surface at temperatures above 1000 degrees Celsius. Diamonds form at very high pressures of between 45 to 60 kilobars. During volcanic eruptions, the magma transports the diamonds from the diamond stability zone to the earth's surface. At the surface, the diamonds are deposited across a wide area. The lava rocks/magma transporting the diamonds are known as kimberlite pipes. Over time the igneous deposits are mantled by surface sediment deposits and vegetation. Kimberlites are generally deposited in ancient cratons and thus diamonds are concentrated in certain areas e.g., Canada, Russia, and South Africa.

Near to the earth's surface the lighter rock usually disintegrates during the eruption process, and the carrot shaped kimberlite explodes at the surface in all directions. This is the reason why diamond is usually first mined with open pit mining and later by underground mining. Sometimes kimberlites fissure at the surface and form dikes away from where the original volcanic eruption took place.

Diamonds are exceedingly rare and only a small proportion of known kimberlites carry diamonds. South Africa has approximately only one thousand individual kimberlite intrusions of which only fifty carry significant diamond quantities. Diamond prospecting comprises of Diamond Drilling and Sampling.

Information obtained by

Diamond Geology. www.debeersgroup.com (12-12-2020)

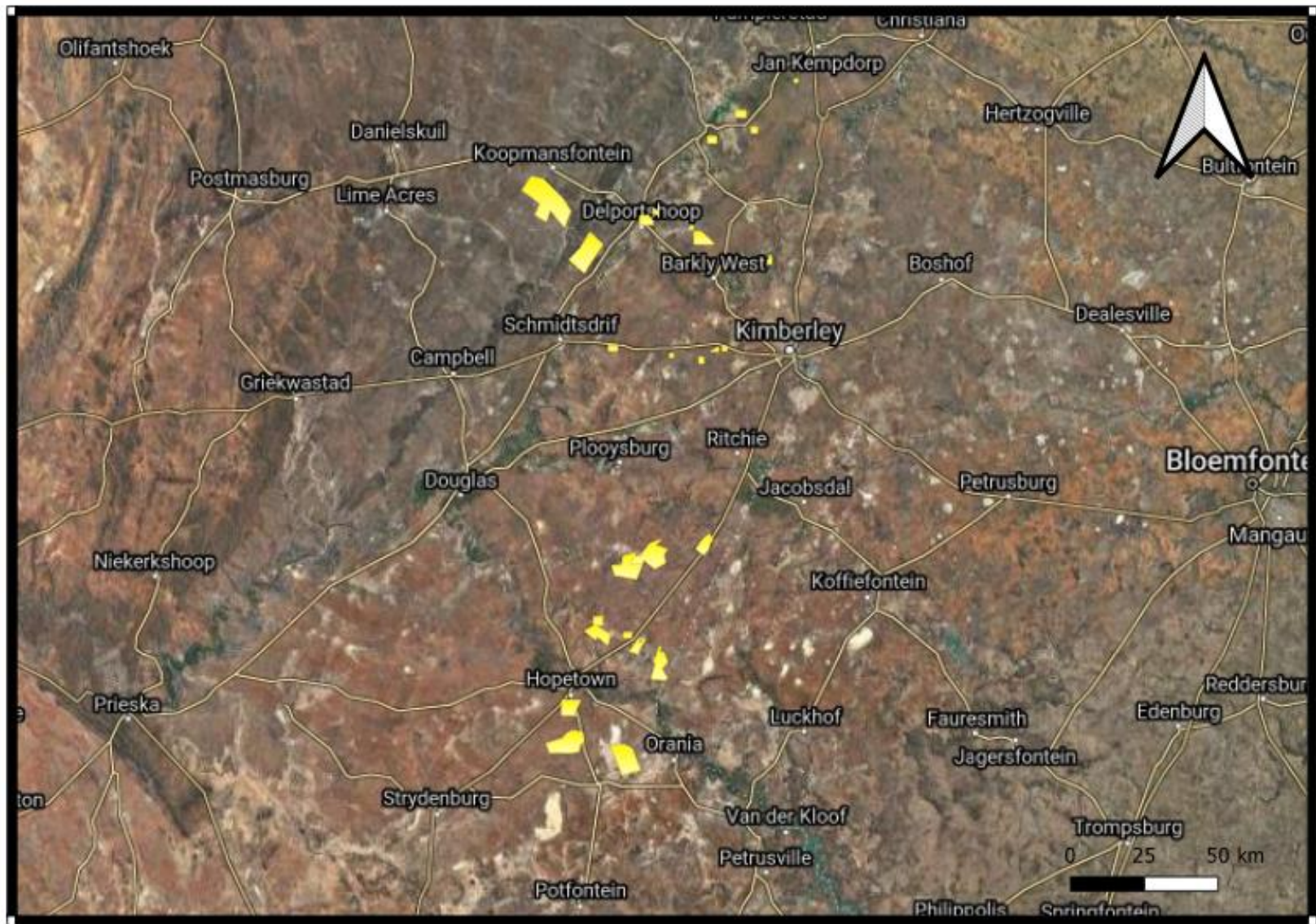


Figure 1: General overview of proposed drilling in the Northern Cape. Proposed drilling sites are indicated in yellow.

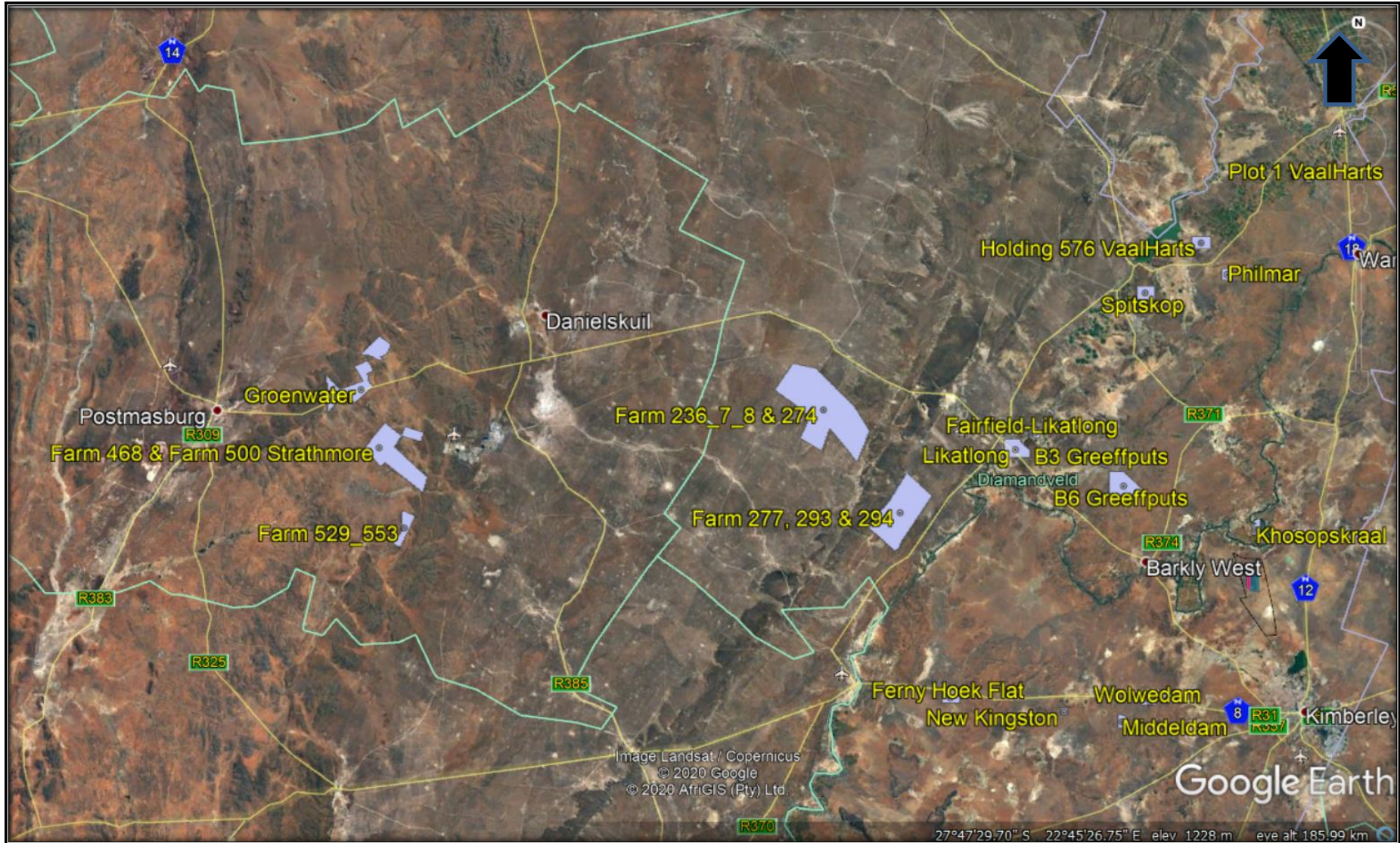


Figure 2: Google Earth (2020) Image of the proposed drilling sites (in purple) located north of Kimberley.

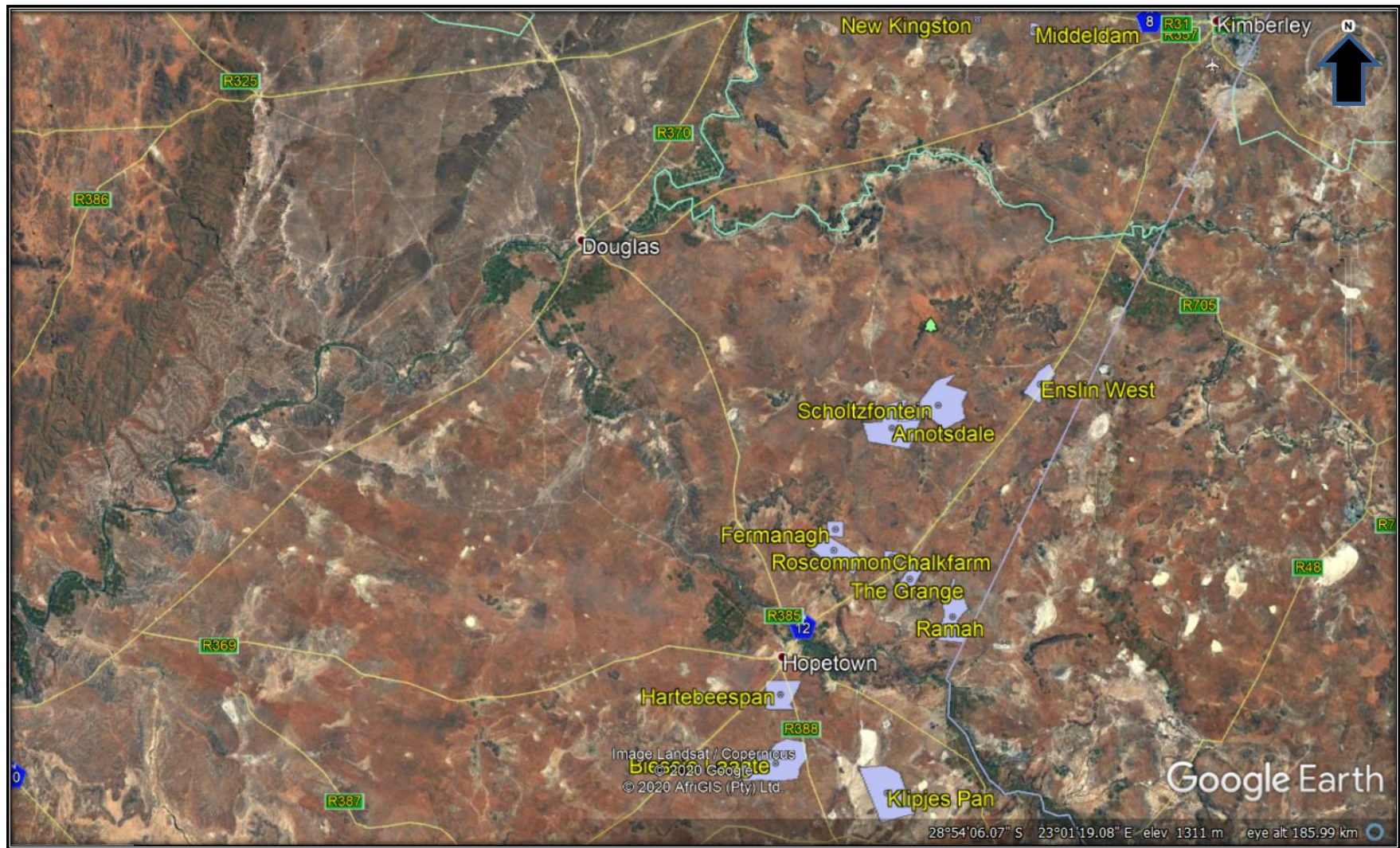


Figure 3: Google Earth (2020) Image of the proposed drilling sites (in purple) located south of Kimberly.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

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 m² 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 000m² 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 surface geology of the proposed De Beers drilling projects is depicted on the 1:250 000 2924 Koffiefontein (1992) and 2922 Prieska (1995); 2824 Kimberley (1993) and 2822 Postmasburg (1977) and Geological Maps (Council of Geosciences, Pretoria) (Figure 4-5). The planned development is underlain by Quaternary aeolian sand (Qs) and calcrete (Qc); Jurassic Dolerite (Jd) and the Prince Albert and Whitehill Formations (Ecca Group; Karoo Supergroup), Allanridge Formation (Ra) of the Ventersdorp Supergroup; Schmidtsdrif Subgroup (Vs) and Campbell Rand (Vgu) Subgroup of the Ghaap Group, Transvaal Supergroup Vryburg Formation (Vv) of the Transvaal Supergroup.

Table 2: Explanation of the symbols on the Geological Map (Johnson et al, 2006). SG-Supergroup; Fm-Formation

Symbol	Group/Formation	Lithology	Palaeontological Sensitivity
Q	Quaternary	Alluvium, sand, calcrete	Low
Qc	Quaternary Calcrete	Calcrete	Low
Jd	Jurassic dykes	Intrusive Dolerite dykes	Zero
Ppr	Prince Albert Fm, and Whitehill Fm early Ecca, Karoo Supergroup	Shales, mudstones	Moderate Very High
Vgu	Campbell Rand Formation Ghaap Group, Transvaal SG	Dolomite and limestone, interbedded chert	Moderate
Vsc	Schmidtsdrif subgroup, Ghaap Group, Transvaal SG	Dolomite, shale	Moderate
Vv	Vryburg Fm, Transvaal SG	Shale, sandstone, andesite	Moderate

Ra	Allanridge Fm, Ventersdorp SG	Andesite, Mafic lava, tuff, amygdaloidal	Moderate
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According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) database (Table 2), the Palaeontological Sensitivity of the Jurassic dolerite is zero as it is igneous in origin, while that of the Whitehill Formation is Very High, the Prince Albert has a Moderate Palaeontological Sensitivity as well as the Campbell Rand, Schmiddrift Vryburg and Allanridge Formations. The Quaternary sediments have a low Palaeontological sensitivity overall, but locally high. (Almond and Pether, 2009; Almond *et al.*, 2013).

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, aeolian 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 Cenozoic (Miocene to Pliocene to Recent) age throughout the Karoo Basin. Radiometric dating could thus far not establish a precise boundary between the Quaternary and Tertiary (Kent(1980). Some of these Tertiary (T) sediments are also present in the development footprint.

The fossil assemblages of the Kalahari are generally very low in diversity and occur over a wide range). These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn cores as well as mammalian teeth. 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.

The **Jurassic dolerite** (Jd) present in the development belongs to the Karoo Igneous Province that is a classic continental flood basalt province formed during the Early Jurassic. This province occurs over a large area in southern Africa and comprises a widespread system well developed igneous bodies (dykes, sills) that invaded the sediments of the Main Karoo Basin. Flood basalts do not typically form any visible volcanic structures, but with a series of outbursts form a suite of fissures of sub-horizontal lava flows that may vary in thickness. The Karoo is an old flood basalt province and is preserved today as erosional remnants of a more extensive lava cap that covered much of

southern Africa in the geological past. As this Suite consist of igneous rocks it is unfossiliferous. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Karoo Dolerite is zero.

The **Whitehill Formation** of the Ecca Group (Karoo Supergroup) is a comparatively thin succession of well-laminated carbon-rich mudrocks. The mudstone weathers to a characteristic pale grey to creamy white colour (Johnson et al, 2006). The Permian aged Whitehill Formation (high Palaeontological Sensitivity) is renowned for an abundance of body fossils as well as trace fossils. Almond (2011) described the main groups of Early Permian fossils found within the Whitehill Formation include as follows:

- A low diversity of trace fossils (possible shark coprolites / faeces and king crab trackways)
- Aquatic mesosaurid reptiles (the earliest known sea-going reptiles)
- Insects (preserved as isolated wings, although some intact specimens has also been recovered)
- Occasional cephalochordates (ancient relatives of the living lancets)
- Other rare vascular plant remains (*Glossopteris* leaves, lycopods etc)".
- Palynomorphs (organic-walled spores and pollens)
- Petrified wood (mostly of primitive gymnosperms, silicified or calcified)
- Several palaeoniscoid fish species (primitive bony fish)
- Small eocarid crustaceans are very common (bottom-living shrimp-like forms)

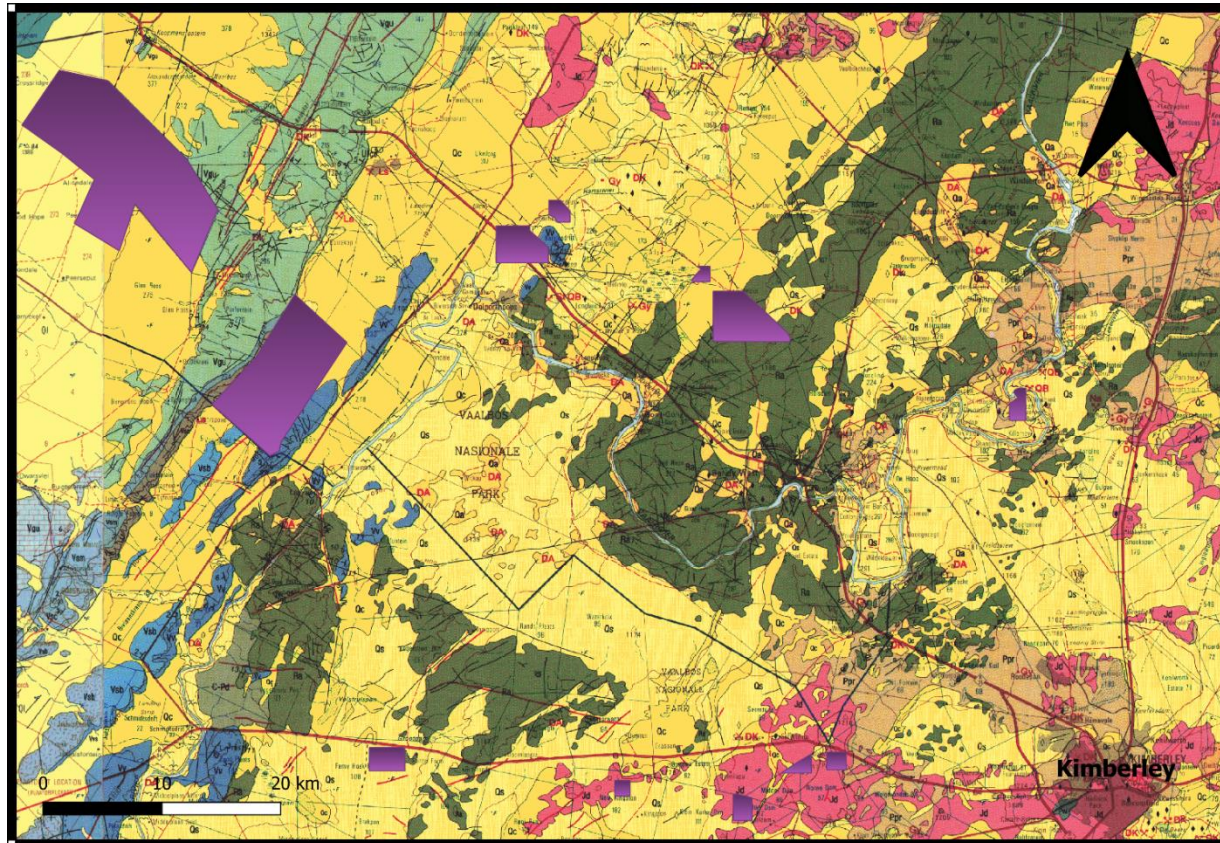


Figure 4: Extract of the 1:250 000 2824 Kimberley (1993) and 2822 Postmasburg (1977) Geological map (Council of Geoscience, Pretoria) indicating the proposed drilling projects to the north of Kimberley in the Northern Cape.

The proposed development is underlain by the Quaternary aeolian sand (Qs); Quaternary Calcrete (Qc), Jurassic Dolerite (Jd) as well as the Prince Albert and Whitehill Formations (Ppr) (Ecca Group; Karoo Supergroup) and Dwyka Group of the Karoo Supergroup, Allanridge Formation of the Ventersdorp Supergroup; Schmidtsdrift Subgroup and Campbell Rand Subgroup of the Ghaap Group Transvaal Supergroup. The proposed development footprint is indicated in purple.

Map drawn by QGIS 2.18.28.

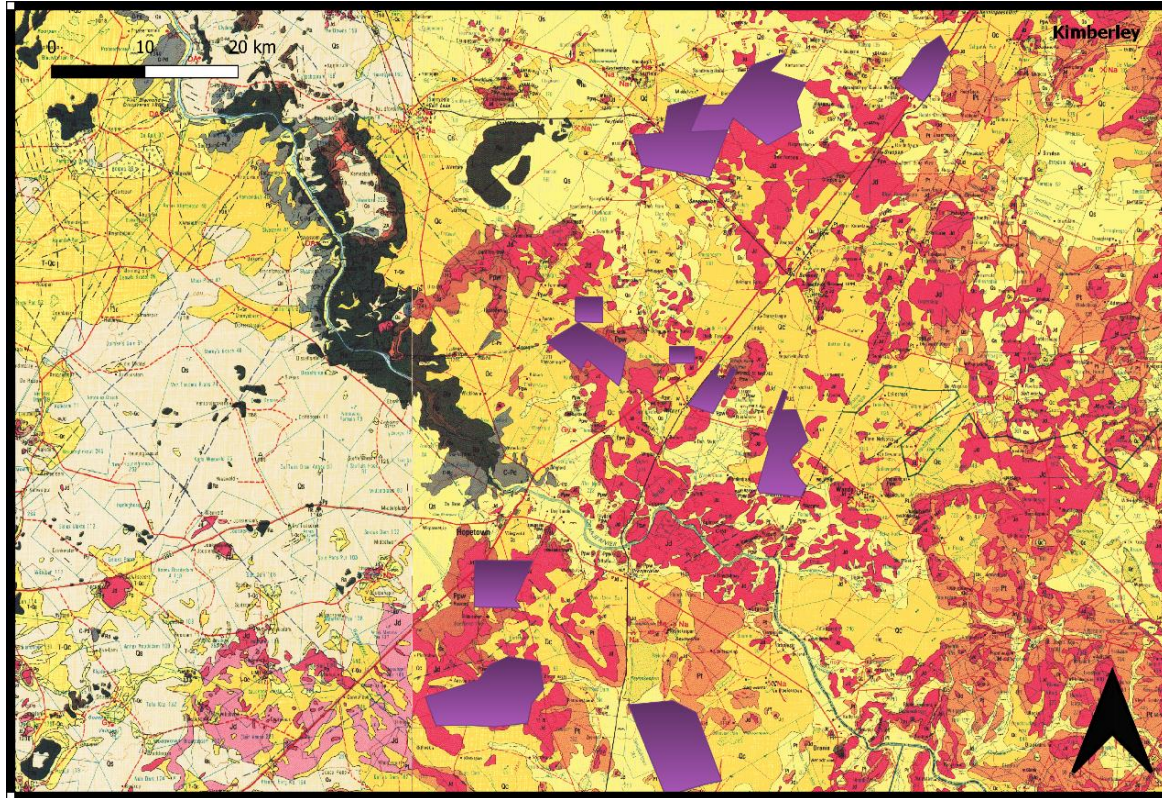


Figure 5: Extract of the 1:250 000 2924 Koffiefontein (1992) and 2922 Prieska (1995) Geological map (Council of Geoscience, Pretoria) of the proposed drilling projects to the south of Kimberley in the Northern Cape (development footprint indicated in purple)., Northern Cape.

The proposed development is underlain by the Quaternary aeolian sand (Qs); Quaternary Calcrete (Qc), Jurassic Dolerite (Jd) as well as the Prince Albert and Whitehill Formations (Ecca Group; Karoo Supergroup) (Ppr) and Allanridge Formation of the Ventersdorp Supergroup; Dwyka Group of the Karoo Supergroup, Schmidtsdrift Subgroup and Campbell Rand Subgroup of the Ghaap Group Transvaal Supergroup. The proposed development footprint is indicated in purple.

Map drawn by QGIS 2.18.28.

The **Prince Albert Formation** consists of marine to hyposaline basin plain mudrocks that occur with minor volcanic ashes, iron stones and phosphates. Post-glacial mudrocks is present at the base of the Prince Albert Formation. The fossil assemblage of the Prince Albert Formation is known for its rich assemblages of plant fossils known as the *Glossopteris* flora. This includes petrified wood, roots and palynomorphs which include spores and acritarchs. Body fossils of insects have been recovered, but is rare. Moderately diverse trace fossil assemblages can be present of which many can be assigned to fish or non-marine arthropod groups like crustaceans, king crabs and predatory water scorpions which could have reached lengths of two meters or more.

This trace fossil assemblage of the non-marine *Mermia* Ichnofacies, is dominated by the ichnogenera *Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails). Fish coprolites have also been described from this formation. A low diversity of marine invertebrates (bivalves brachiopods, nautiloids), palaeoniscoid fish, sharks and protozoans have been uncovered. There is also a possibility that stromatolites and oolites are preserved. Well-preserved skeletons of the well-known aquatic mesosaurids have been uncovered while amphibians are also recorded from the uppermost Ecca beds (Almond, 2011).

The Kaapvaal Craton stabilized 3000 to 2100 Million years ago. Four basins developed on the Kaapvaal Craton. The Ventersdorp Supergroup was the third Basin to develop and presents a unique volcano-sedimentary supracrustal record. The Ventersdorp Supergroup comprise of the biggest and most wide-spread system of volcanic rocks in the Kaapvaal Craton.

The best exposures of the **Ventersdorp Supergroup** are in the Northern Cape and North West Province as well as Gauteng and southern Botswana. This Supergroup consists of (from oldest to youngest) the Kliprivierberg Group, which is overlain by the Platberg Group, followed by the sedimentary Bothaville Formation and the volcanic Allanridge Formation (uppermost Ventersdorp unit and youngest Formation).

The Platberg Group is subdivided in four formations namely the Kameeldoorns-, Goedgenoeg-, Makwassie-, and Rietgat Formations. These formations consist of heterogeneous rock varying from chemical and classic sediments, to felsic and mafic volcanics (Visser et al, 1975-1976, Buck, 1980).

The **Allanridge Formation** comprise mostly of light-greenish grey porphyritic lava, dark-green amygdaloidal lava, and pyroclastic rocks (Keyser, 1992). The lavas are approximately 2700 million years old and comprise of basaltic andesites. The Vryburg Formation overlies the Ventersdorp Supergroup and is interpreted as a fluvial to marginal marine deposit that comprise of basal transgressive conglomerate and quartzites, subordinate stromatolitic carbonates and shales (Eriksson et al., 2006).

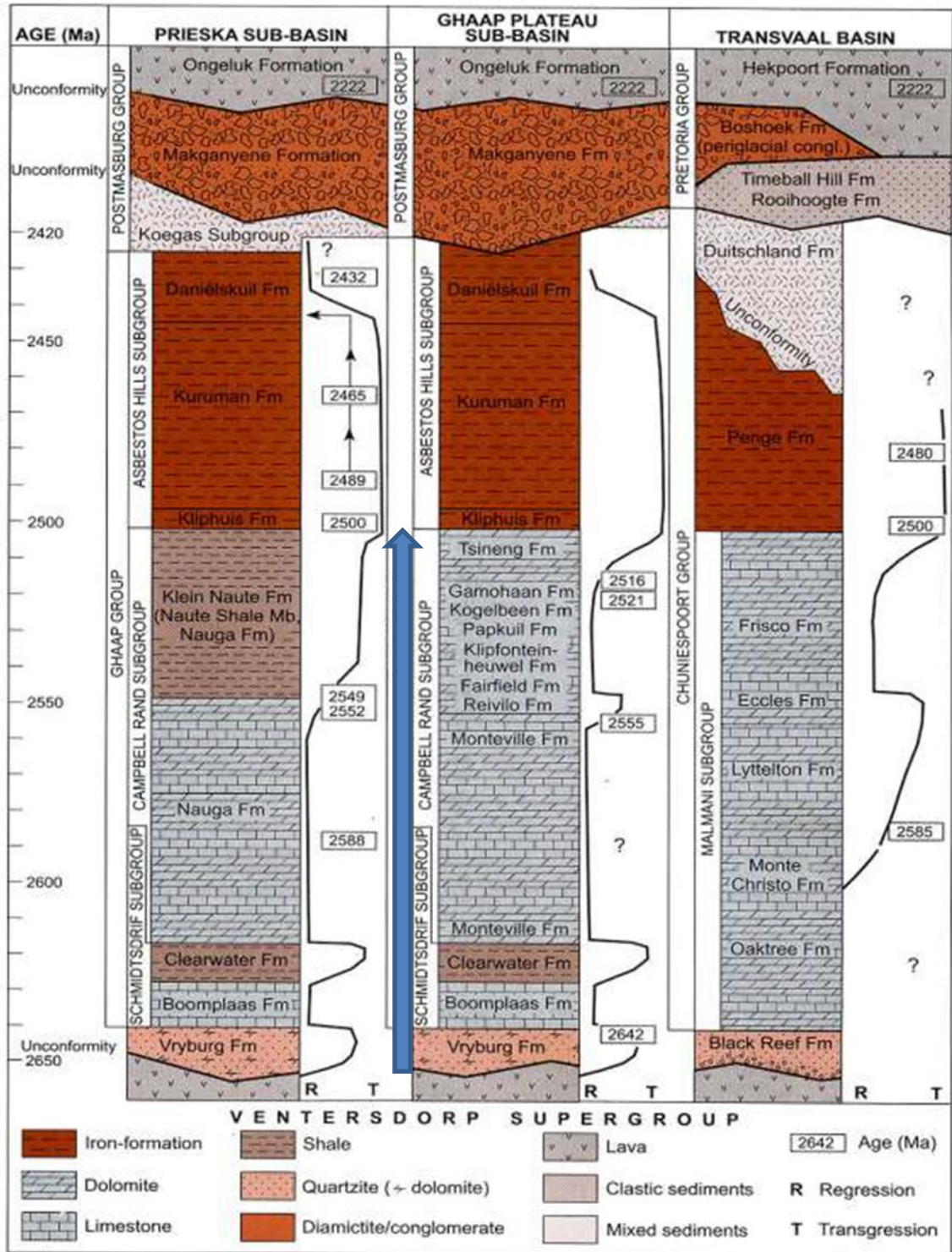


Figure 6: Stratigraphy of the Transvaal Supergroup of the Ghaap Plateau Basin. The middle column shows the rock units represented in the proposed study area (blue arrow) (Eriksson, et al. 2006). The Vryburg Formation is incorporated within the base of the Schmidtsdrif Subgroup by some recent authors and is no longer correlated with the Black Reef Formation of the Transvaal Basin as shown here (e.g. Altermann and Wotherspoon, 1995, Sumner and Beukes, 2006).

The north western margin of the study area is underlain by ancient sedimentary rocks of the Schmidtsdrif Subgroup. In the Griekwaland West Basin, the Schmidtsdrif Subgroup is the basal subdivision of the Late Archaean to Early Proterozoic Ghaap Group (Transvaal Supergroup) (Figure 7). The Schmidtsdrif Subgroup can be divided into the geological older Boomplaas Formation and younger Clearwater Formation. The Ghaap Group represents 200 Ma of chemical sedimentation of which iron and manganese ores, cherts and carbonates with subordinate silicastic rocks are prominent. The Boomplaas Formation is known to contain well-preserved stromatolite assemblages (Figure 7; microbial dome). Stromatolites are layered mounds, columns and sheet-like sedimentary rocks. 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-bases 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.

The Boomplaas beds are characterized by grey dolomites which weathers reddish-brown with subordinate interbeds of limestone (weathering blue-grey), quartzite, flaggy sandstone and shale. Oolitic and stromatolitic dolomite alternating with intervals of carbonaceous possible lagoonal mudrocks containing interbeds of calcareous sandstone and mudclast breccias is present. The Boomplaas beds are overlain by the grey- to khaki-hued mudrocks and interbedded dolomites, flagstones, tuffites and BIF-like cherts of the Clearwater Formation (= Lokamonna Formation), the topmost unit of the Schmidtsdrif Subgroup. Stromatolites and oolites from the Transvaal Supergroup have been described by various authors (Keyser and Du Plessis, 1993; Truswell and Eriksson, 1973; Eriksson and Altermann, 1998).



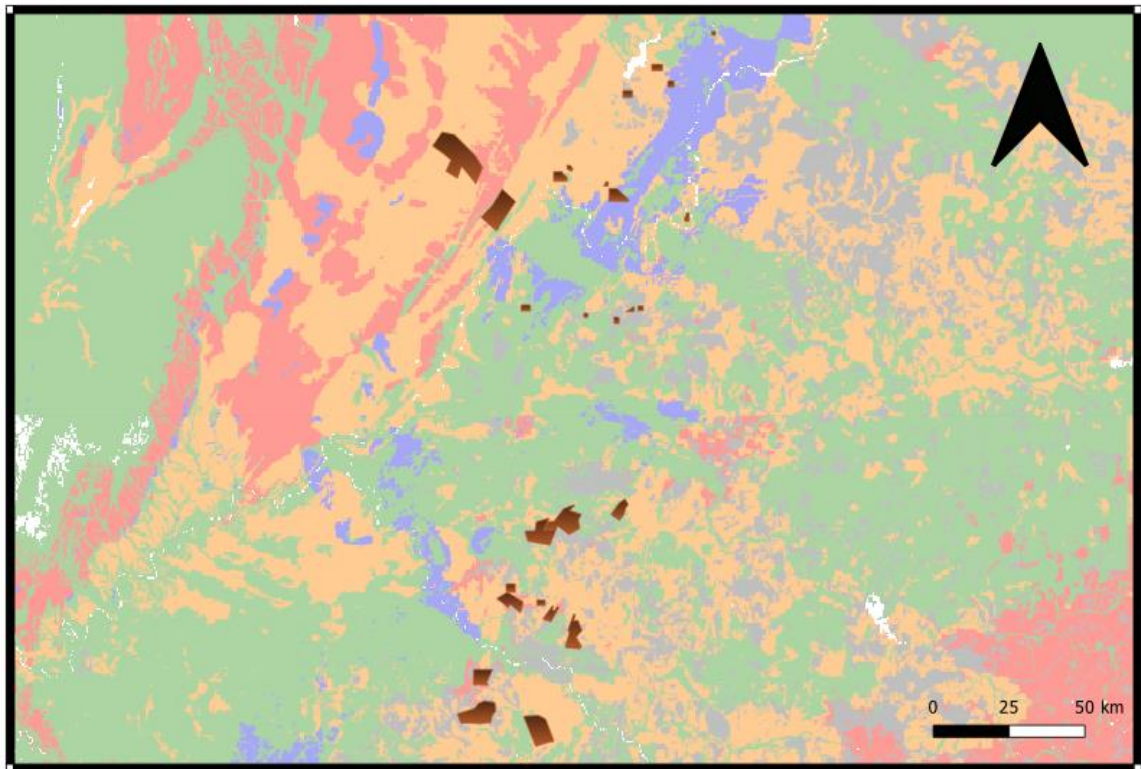
Figure 7: Example of a well-preserved stromatolites from the Archaean Era.

Microbial stromatolites in the upper Vryburg Formation were described by Smith (1991). The stromatolitic carbonates are interpreted to be intertidal (Altermann and Wotherspoon, 1995). South African Archaean stromatolites have been discussed in detail (Altermann, 2001; Buick, 2001; and Schopf, 2006). Columnar stromatolites from the Schmidtsdrif Subgroup of the Northern Cape have been described by Bertrand-Sarfarti and Eriksson (1977).

Table 3: Fossil heritage of rocks represented in the proposed Diamond drilling Project Development (Almond and Pether, 2008)

Fossil Heritage of the Development Area in the Northern Cape			
Geological Unit	Rock Types & Age	Fossil Heritage	
FLUVIAL, LACUSTRINE & TERRESTRIAL DEPOSITS (most too small to be indicated on small scale geological maps) including eg Kwaggaskop Fm	Fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes, Late Cretaceous to Holocene c. 65 Ma to 0 Ma	Bones and teeth of mammals (eg proboscideans, rhinos, bovids, horses, micromammals), reptiles, fish, freshwater molluscs, petrified wood, trace fossils (eg termitaria), rhizoliths, diatom floras	
KALAHARI GROUP (K-Q)	Fluvial gravels, sands, lacustrine and pan mudrocks, evaporites, aeolian sands, pedocretes (especially calcrete) Late Cretaceous to <90 Ma → 0 Ma	Palynomorphs, root casts (rhizomorphs) and burrows (eg termitaria), rare vertebrate remains (mammals, fish, ostrich egg shell etc), diatom-rich limestones, freshwater stromatolites, freshwater and terrestrial shells (gastropods, bivalves), ostracods, charophytes	
KIMBERLITES AND OTHER POST-KAROO IGNEOUS ROCKS, CRATER LAKE SEDIMENTS	Kimberlite pipes and other alkaline intrusions, sometimes associated	Bryophytes, vascular plants (leaves, wood), fish, frogs, reptiles, rare dinosaurs, insects, ostracods,	

eg Sutherland Suite (Ksu), Koegel Fontein Complex		with lacustrine sediments (deep to shallow crater lakes) Jurassic, Cretaceous to Palaeocene c. 200-60 Ma	palynomorphs in crater lake sediments	
KAROO DOLERITE SUITE (Jd)		Intrusive dolerites (dykes, sills), associated diatremes Early Jurassic (c. 183 Ma)	NO fossils recorded	
KAROO SUPERGROUP	ECCA GROUP	Offshore basin plain (predominantly non-marine) to coastal deltaic sediments, minor volcanic ashes (tuffs) Early – Mid Permian 290 – 266 Ma	Ecca Group: non-marine trace fossils, vascular plants (including petrified wood) and palynomorphs of <i>Glossopteris</i> flora, mesosaurid reptiles, fish (including microvertebrate remains, coprolites), crustaceans, sparse marine shelly invertebrates (molluscs, brachiopods), microfossils (radiolarians etc), insects	
TRANSVAAL SUPERGROUP 2c. Postmasburg Group (Vmk, Vo) 2b. Ghaap Group (Vsc, Vvs, Vca, Va, Vk)		Metasediments (fluvial & lacustrine siliciclastics, chert, dolomite), lavas Neoproterozoic (Randian) c. 2.7 Ga	Lacustrine stromatolites in carbonates, Possible organic-walled microfossils	



*Figure 8: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences).
Location of the proposed development is indicated in brown.*

According to the SAHRIS palaeosensitivity map (Figure 8) there is a very high chance (red), a high chance (orange) and a moderate chance (green) to find fossils in this area.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is divided into two clusters two clusters north and south of Kimberley (Figure1-3).

7 METHODS

The aim of a Palaeontological Impact Assessment is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a PIA 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:

- The Palaeosensitivity Map from the SAHRIS website.
- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- Geological Map 1: 250 000 2924 Koffiefontein (1992)
- Geological Map 1: 250 000 2922 Prieska (1995)
- Geological Map 1: 250 000 2824 Kimberley (1993)
- Geological Map 1: 250 000 2822 Postmasburg (1977)
- A Google Earth map with polygons of the proposed development was obtained from De Beers.

9 IMPACT ASSESSMENT METHODOLOGY

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 4: The Rating System-

NATURE		
The Nature of the Impact is the possible destruction of fossil heritage		
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).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur

		in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.

CUMULATIVE EFFECT

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

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

SIGNIFICANCE

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

(Extent (1) + probability (3) + reversibility (4) + irreplaceability (4) + duration (4) + cumulative effect) (3) x magnitude/intensity (2) = 40.

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects

9.1 Summary of Impact Tables

Construction will have a negative impact on fossil heritage. The expected duration of the impact is assessed as potentially permanent to long term. Only the site will be affected. 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 medium probability. The cumulative impacts are high as the area surrounding the development has a high palaeontological sensitivity. The significance of the impact occurring will be negative medium.

10 FINDINGS AND RECOMMENDATIONS

The planned development is underlain by Quaternary aeolian sand and calcrete; Jurassic Dolerite and the Prince Albert and Whitehill Formations (Ecca Group; Karoo Supergroup), Allanridge Formation of the Ventersdorp Supergroup; Schmidtsdrift Subgroup and Campbell Rand Subgroup of the Ghaap Group, Transvaal Supergroup Vryburg Formation of the Transvaal Supergroup. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) database (Table 2), the Palaeontological Sensitivity of the Jurassic dolerite is zero as it is igneous in origin, while that of the Whitehill Formation is Very High, the Prince Albert has a Moderate Palaeontological Sensitivity as well as the Campbell Rand, Schmidtsdrift Vryburg and Allanridge Formations. The Quaternary sediments have a low Palaeontological sensitivity overall, but locally high. (Almond and Pether, 2009; Almond *et al.*, 2013).

Diamonds are present in kimberlites pipes which is intrusive igneous rocks and thus unfossiliferous. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological heritage of the area. Hence, the construction of the development may be authorised in its whole extent, as 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 **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO 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) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

11 CHANCE FINDS PROTOCOL

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

11.1 Legislation

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

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

11.2 Background

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

11.3 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.

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

11.4 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). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- If the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO. Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

12 REFERENCES

- ALMOND, J.E. & PETHER, J. 2009. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.
- ALMOND, J., PETHER, J, and GROENEWALD, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences.
- COLE, D.I. 2005. Catalogue of South African Lithostratigraphic Units 8: 33-36.
- DE WIT, M.C.J., MARSHALL, T.R. & PARTRIDGE, T.C. 2000. Fluvial deposits and drainage evolution. In: Partridge, T.C. & Maud, R.R. (Eds.) *The Cenozoic of southern Africa*, pp.55-72. Oxford University Press, Oxford.
- DINGLE, R.V., SIESSER, W.G. & NEWTON, A.R. 1983. *Mesozoic and Tertiary geology of southern Africa*. viii + 375 pp. Balkema, Rotterdam.
- DU TOIT, A. 1954. *The geology of South Africa*. xii + 611pp, 41 pls. Oliver & Boyd, Edinburgh.
- GROENEWALD, G.D., 2014. Palaeontological Desktop Assessment for the construction of the Dwarsrug Wind Energy Farm on the farms Brakpan 212 and Stinkputs North 229, near Loeriesfontein, Namaqua District Municipality, Northern Cape Province
- HADDON, I.G. 2000. Kalahari Group sediments. In: Partridge, T.C. & Maud, R.R. (Eds.) *The Cenozoic of southern Africa*, pp. 173-181. Oxford University Press, Oxford.
- JOHNSON, M.R., Visser, J.N.J., et al.2006. Sedimentary rocks of the Karoo Supergroup In JOHNSON, M.R., ANHAEUSSER, C.R. & THOMAS, R.J. (eds). *The geology of South Africa*. 691 pp. Geological Society of South Africa, Johannesburg and Council for Geoscience, Pretoria.
- KENT, L.E. 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. SACS, Council for Geosciences, pp. 535-574.
- KLEIN, R.G. 1984. The large mammals of southern Africa: Late Pliocene to Recent. In: Klein, R.G. (Ed.) *Southern African prehistory and paleoenvironments*, pp 107-146. Balkema, Rotterdam.
- MACRAE , C. 1999. *Life etched in stone. Fossils of South Africa*. 305 pp. The Geological Society of South Africa, Johannesburg.
- MCCARTHY, T. & RUBIDGE, B. 2005. *The story of Earth and life: a southern African perspective on a 4.6-billion-year journey*. 334pp. Struik, Cape Town
- PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) *The geology of South Africa*, pp. 585-604. Geological Society of South Africa, Marshalltown.
- PARTRIDGE, T.C. & SCOTT, L. 2000. Lakes and pans. In: Partridge, T.C. & Maud, R.R. (Eds.) *The Cenozoic of southern Africa*, pp.145 - 161. Oxford University Press, Oxford.
- SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.
- THOMAS, M.J. 1981. *The geology of the Kalahari in the Northern Cape Province (Areas 2620*
- VISSER, D.J.L. (ed) 1984. *Geological Map of South Africa 1:100 000*. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.

VISSER, D.J.L. (ed) 1989. *Toeligting: Geologiese kaart (1:100 000). Die Geologie van die Republieke van Suid Afrika, Transkei, Bophuthatswana, Venda, Ciskei en die Koningkryke van Lesotho en Swaziland*. South African Committee for Stratigraphy. Council for Geoscience, Pretoria, Pp 494.

Tavener-Smith, R., Mason, T.R., Christie, AD.M., Roberts, D.L., Smith A.M. and Van der Spuy, A. 1988a. Sedimentary models for coal formation in the Vryheid Formation, northern Natal. Bull. Geol. Survey. S. Africa., 94,46 pp.

Tavener-Smith, R, Cooper, J.A.J., and Rayner, R.J., 1988b . Depositional environments in the Volksrust Formation (Permian) in the Mhlatuze River, Zuzuland. S. Afr. J. Geol., 9, 198-206.
BUCK, S.G., 1980. Stromatolite and ooid deposits within fluvial and lacustrine sediments of the Precambrium Ventersdorp Supergroup of South Africa. Precambrium Res., 12:311-330.
VISSER, J.N.J., GROBLER, N.J., JOUBERT, C.W., POTGIETER, C.D., POTGIETER G.J.A. McLAREN, C.H., and LIEBENBERG, J. (1975-1976). The Ventersdorp Group between Taung and Britstown, Northern Cape Province. Ann Geol. Surv. S. Afri. 11: 15-28.

JOHNSON, M.R., ANHAEUSSER, C.R. & THOMAS, R.J. 2006. The geology of South Africa. 691 pp. Geological Society of South Africa, Johannesburg and Council for Geoscience, Pretoria.

JOHNSON, M.R., Visser, J.N.J., et al.2006. Sedimentary rocks of the Karoo Supergroup In JOHNSON, M.R., ANHAEUSSER, C.R. & THOMAS, R.J.. (eds). The geology of South Africa. 691 pp. Geological Society of South Africa, Johannesburg and Council for Geoscience, Pretoria.

VISSER, J.N.J., 1989. The Permo-Carboniferous Dwyka Formation of southern Africa: deposition by predominantly subpolar marine ice sheet. Palaeogeogr., Palaeoclimatol, Palaeoecol., 70:377-391.

Visser, D.J.L., LOOCK, J.C., and COLLISTON., W.P. 1987. Subaqueous outwash fan and esker sandstones in the Permo-Carboniferous Dwyka Formation of South Africa. J.Sed.Petrol., 57:467-478

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. <i>Cum laude</i> (Zoology), 2009 University of the Free State

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

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

TECHNICAL REPORTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW 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. Prepared for Savannah Environmental. Bloemfontein.

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

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

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

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

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

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

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

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

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

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

Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW 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. Savannah South Africa. 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. PGS Heritage. Bloemfontein.

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

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

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

Butler, E. 2016. Palaeontological Impact Assessment for the proposed development of four Leeuwberg 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, Mbashe Local Municipality. Bloemfontein.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 Gariiep 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 storm water 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 Lephalale Coal and Power Project, Lephalale, 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 authorisation 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, Ngquba 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 decommissioning 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 Wilealskloof 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 Mookodi – Mahikeng 400kV Line, North West Province. Bloemfontein.

Butler, E. 2018. Environmental Impact Assessment (EIA) for the Proposed 325mw 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 Assesement 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 Emalaheni, 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
- E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed diamonds (alluvial, general & in kimberlite) prospecting right application near Kimberley, Northern Cape Province.
- E. Butler.** 2019. Palaeontological Phase 1 Impact 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 proposed seepage interception drains at Duvha Power Station, Emalahleni Municipality, Mpumalanga Province
- E. Butler.** 2019. Palaeontological Desktop Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.
- E. Butler.** 2019. Palaeontological Phase 1 Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.
- E. Butler.** 2019. Palaeontological field Assessment for the Proposed Upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipality, Northern Cape Province, Northern Cape
- 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, Kail Garib Municipality, Zf Mgcau District Municipality, Northern Cape
- E. Butler.** 2019. Palaeontological Phase 1 Field Assessment of the proposed Summerpride Residential Development and Associated Infrastructure on Erf 107, Buffalo City Municipality, East London.
- E. Butler.** 2019. Palaeontological Desktop Impact Assessment for the proposed re-commission of the Old Balgray Colliery near Dundee, Kwazulu Natal.

- E. Butler.** 2019. Palaeontological Phase 1 Impact Assessment for the Proposed Re-Commission of the Old Balgray Colliery near Dundee, Kwazulu Nata.l
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery.
- E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a Proposed New Quarry on Portion 9 (of 6) of the farm Mimosa Glen 885, Bloemfontein, Free State Province
- E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a proposed development on Portion 9 and 10 of the Farm Mimosa Glen 885, Bloemfontein, Free State Province
- E. Butler.** 2019. Palaeontological Exemption Letter for the proposed residential development on the Remainder of Portion 1 of the Farm Strathearn 2154 in the Magisterial District of Bloemfontein, Free State
- E. Butler.** 2019. Palaeontological Field Assessment for the Proposed Nigel Gas Transmission Pipeline Project in the Nigel Area of the Ekurhuleni Metropolitan Municipality, Gauteng Province
- E. Butler.** 2019. Palaeontological Desktop Assessment for five Proposed Black Mountain Mining Prospecting Right Applications, Without Bulk Sampling, in the Northern Cape.
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and an Integrated Water Use Licence Application for the Reclamation of the Marievale Tailings Storage Facilities, Ekurhuleni Metropolitan Municipality - Gauteng 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 Golfview Colliery near Ermelo, Msukaligwa Local Municipality, Mpumalanga Province
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Kangra Maquasa Block C Mining development near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Amendment of the Kusipongo Underground and Opencast Coal Mine in Support of an Environmental Authorization and Waste Management License Application.
- E. Butler.** 2019. Palaeontological Exemption Letter of the Proposed Mamatwan Mine Section 24g Rectification Application, near Hotazel, Northern Cape Province

E. Butler. 2020. Palaeontological Field Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery

E. Butler. 2020. Palaeontological Desktop Assessment for the Proposed Extension of the South African Nuclear Energy Corporation (Necsa) Pipe Storage Facility, Madibeng Local Municipality, North West Province

E. Butler. 2020. Palaeontological Field Assessment for the Proposed Piggery on Portion 46 of the Farm Brakkefontien 416, Within the Nelson Mandela Bay Municipality, Eastern Cape

E. Butler. 2020. Palaeontological field Assessment for the proposed Rietfontein Housing Project as part of the Rapid Land Release Programme, Gauteng Province Department of Human Settlements, City of Johannesburg Metropolitan Municipality

E. Butler. 2020. Palaeontological Desktop Assessment for the Proposed Choje Wind Farm between Grahamstown and Somerset East, Eastern Cape

E. Butler. 2020. 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

E. Butler. 2020. Palaeontological Impact Assessment for the Proposed Clayville Truck Yard, Ablution Blocks and Wash Bay to be Situated on Portion 55 And 56 Of Erf 1015, Clayville X11, Ekurhuleni Metropolitan Municipality, Gauteng Province

E. Butler. 2020. Palaeontological Desktop Assessment for the Proposed Hartebeesthoek Residential Development

E. Butler. 2020. Palaeontological Desktop Assessment for the Proposed Mooiplaats Educational Facility, Gauteng Province

E. Butler. 2020. Palaeontological Impact Assessment for the Proposed Monument Park Student Housing Establishment

E. Butler. 2020. Palaeontological Field Assessment for the Proposed Standerton X10 Residential and Mixed-Use Developments, Lekwa Local Municipality Standerton, Mpumalanga Province

E. Butler. 2020. Palaeontological Field Assessment for the Rezoning and Subdivision of Portion 6 Of Farm 743, East London

E. Butler. 2020. Palaeontological Field Assessment for the Proposed Matla Power Station Reverse Osmosis Plant, Mpumalanga 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. 18th 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.

Butler, E., and J. Botha-Brink. Postcranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle. 14th 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*. 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