



PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR

The proposed Prospecting Right combined with a Waste Licence application to prospect for Diamonds Alluvial (DA), Diamonds General (D) and Diamonds in Kimberlite (DK) on the Remaining Extent, Portion 1, Portion 2, and Portion 3 (Boorwater) of the farm Bultfontein 327, Registration Division: Hay, Northern Cape Province.

NC30/5/1/1/2/12990PR

Compiled for:

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Prepared by

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Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

Disclosure of Vested Interest

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

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SIGNATURE:

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

This PIA 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 vitae	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 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment		Desktop Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure,	Section 1 and 10	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
inclusive of a site plan identifying site alternative;		
(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 environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation	Section 11	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 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	Section 1 and 10	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
be included in the EMPr, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	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 Milnex CC to conduct the Palaeontological Desktop Assessment (PDA) assessing the proposed Prospecting Right combined with a Waste Licence application to prospect for Diamonds Alluvial (DA), Diamonds General (D) and Diamonds in Kimberlite (DK) on the Remaining Extent, Portion 1, Portion 2, and Portion 3 (Boorwater) of the farm Bultfontein 327, Registration Division: Hay, Northern Cape Province. This PDA is compiled to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), to confirm if fossil material could potentially be present in the planned development area and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed Diamond Prospecting Right Application near Prieska is underlain by Quaternary deposits, Tertiary calcretes and the Ghaap Group (Transvaal Supergroup, Griqualand West Basin). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary sediments is Low, that of the Tertiary Calcrete is High, while the Palaeontological Sensitivity of the Ghaap Group is Moderate (Almond and Pether 2008, SAHRIS website). A Low Palaeontological Significance has been allocated to the proposed Prospecting Right Application. It is therefore considered that the proposed development is believed to be appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area.

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

Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).

These recommendations should be incorporated into the Environmental Management Plan for the proposed development.

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1 INTRODUCTION

Milnex CC was commissioned by **Morgenson Mining (Pty) Ltd** as the independent environmental consultant to commence with the Scoping and EIA process for the proposed Prospecting Right combined with a Waste Licence application to prospect for Diamonds Alluvial (DA), Diamonds General (D) and Diamonds in Kimberlite (DK) on the Remaining Extent, Portion 1, Portion 2, and Portion 3 (Boorwater) of the farm Bultfontein 327, Registration Division: Hay, Northern Cape Province. (Figure1-2).

1.1 Background

Information provided by Milnex CC

Mining has played a vital role in the economy of South Africa for over 100 years. In 2015 the mining industry contributed R286 billion towards South African Gross Domestic Product (GDP) representing 7.1% of overall GDP. Mining is a significant contributor to employment in the nation, with 457 698 individuals directly employed by the sector in 2015. This represents just over 3% of all employed nationally. Diamond mining has 17 885 direct employees.

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

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

Economic growth - South Africa's total reserves remain some of the world's most valuable, with an estimated worth of R20.3-trillion. Overall, the country is estimated to have the world's fifth-largest mining sector in terms of GDP value. It has the world's largest reserves of manganese and platinum group metals (PGMs), according to the US Geological Survey, and among the largest reserves of gold, diamonds, chromite ore and vanadium.

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

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

Formation of Diamonds

Diamonds are formed in the diamond stability zone deep in the earth's mantle (about 150 km below the earth's surface). Temperatures at this depth is above 1000 degrees Celsius, while pressures vary between 45 to 60 kilobars. During volcanic eruptions, diamonds are transported by magma from the diamond stability zone to the earth's surface. At the surface, the diamonds are deposited across wide areas. The lava rocks/magma transporting the diamonds are known as kimberlite pipes. Over time the igneous deposits are mantled by deposits of surface sediments as well as vegetation. Kimberlites are generally deposited in ancient cratons and diamonds are concentrated in certain areas e.g., Canada, Russia, and South Africa. When kimberlite pipes erode diamonds may be redistributed by ancient rivers and streams.

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 forms dikes away from where the original volcanic eruption took place.

Diamonds are rare and only a small portion of known kimberlites carry diamonds. South Africa has about one thousand individual kimberlite intrusions of which only fifty carries significant diamond quantities.

Alluvial diamond deposits develop on or adjoining cratonic source areas where basin dynamic, climatic, and local geomorphic factors are ideal for deposition e.g., semi-arid conditions alternating with humid tropical palaeo-climatic conditions. During humid periods, rocks weather and resistant minerals are released from the magma while semi-arid phases lead to the transportation of the released diamonds. Fluctuations in the level of a river basin create rotating periods of local sediment deposition (aggradation) and erosion (degradation). Terraces are formed when rivers cut downwards to a lowered base-level and may appear at different heights, higher than present day river levels with the higher terraces being the oldest.

Diamond prospecting comprise of Diamond Drilling and Sampling.

Information obtained by

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

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

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

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

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

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

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

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

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

National Heritage Resources Act (NHRA) Act 25 of 1999

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

MPRDA Regulations of 2014

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

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

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

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

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

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
- (Exceeding 5 000 m² in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.



Figure 1: Google Earth Image (2022) indicating the locality of the proposed Prospecting Right combined with a Waste Licence application to prospect for Diamonds Alluvial (DA), Diamonds General (D) and Diamonds in Kimberlite (DK) on the Remaining Extent, Portion 1, Portion 2, and Portion 3 (Boorwater) of the farm Bultfontein 327, Registration Division: Hay, Northern Cape Province.

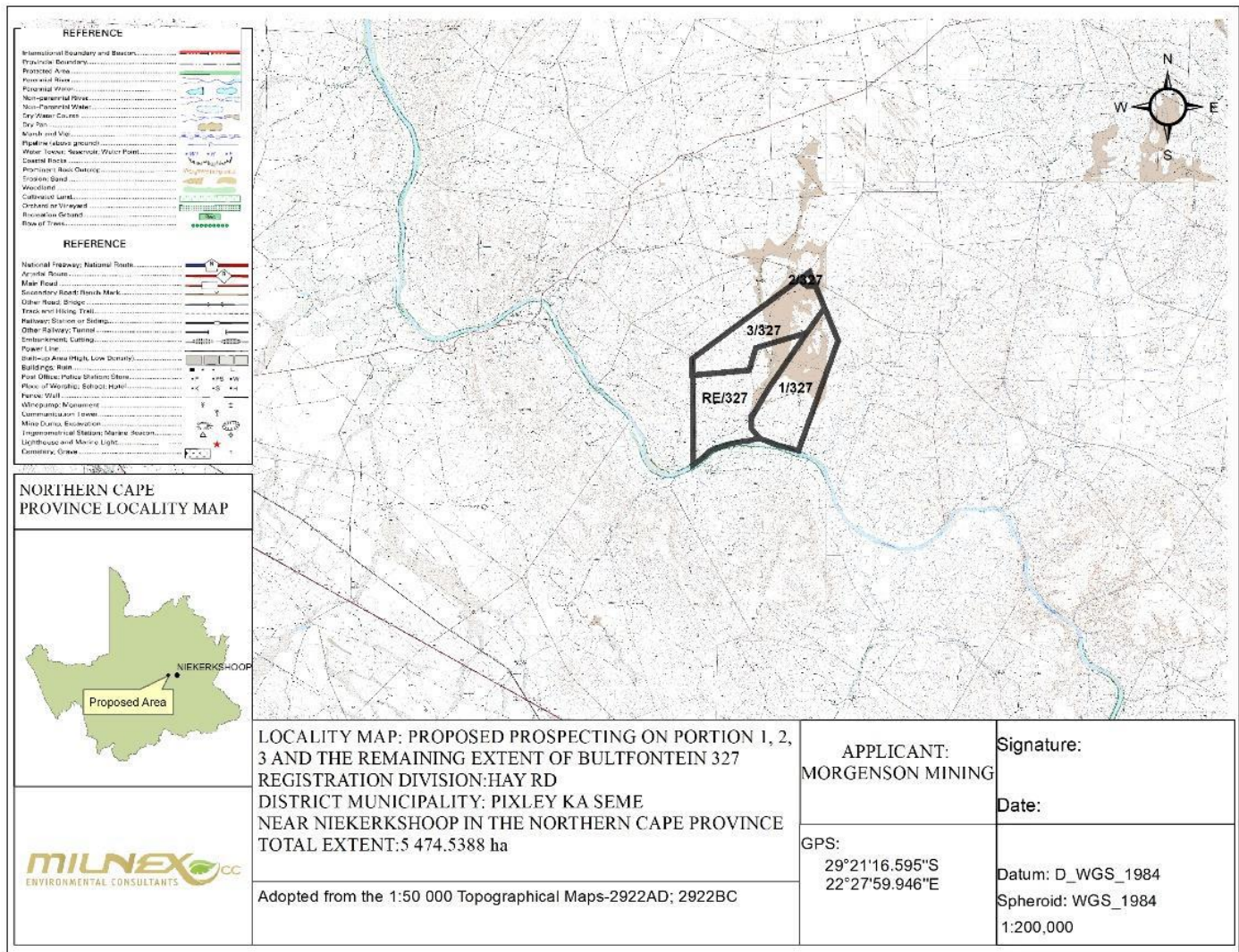


Figure 2: Locality of the proposed Prospecting Right Application.

4 OBJECTIVE

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

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

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

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

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

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.

- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect, and cumulative:
 - a. **Direct impacts** are impacts that are caused directly by the activity and occur at the same time and at the place of the activity.
 - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
 - c. **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present, or reasonably near future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed Prospecting Right Application near Prieska in the Northern Cape is depicted on the 1: 250 000 Prieska 2922 Geological Map (1995) (Council for Geosciences, Pretoria) (**Figure 3**). This map indicates that the proposed development is underlain by Quaternary deposits [alluvium (yellow single bird figure) as well as scree and rubble (yellow with triangles)], Tertiary deposits (T-Qc, calcrete) and the Ghaap Group (Transvaal Supergroup, Griqualand West Basin). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary scree/rubble is Low, that of the Tertiary Calcrete is High, while the Palaeontological Sensitivity of the Ghaap Group is Moderate (Almond and Pether 2008, SAHRIS website).

The Shape files (Council of Geosciences, Pretoria; **Figure 4**) refines the surface geology of the 1995 Geological Map and indicates that the proposed development is mainly underlain by Ongeluk Formation (Postmasburg Group, Transvaal Supergroup), with a small portion in the south-west underlain by the Danielskuil Formation (Transvaal Supergroup). Sediments of the Kalahari Group is present to the north of the proposed development.

The Prospecting Right Application near Prieska is located in the **Griqualand West Basin** in the Northern Cape and consists of clastic sediments as well as volcanic rocks, diamictites and banded iron formations (BIF) (**Table 2**). Manganese deposits are present in the Hotazel Formation, upper Postmasburg Group (approximately 2222 Ma). The Vryburg Formation is the basal unit and overlies unconformably the granite and rocks of the Ventersdorp Supergroup. The Campbell Group overlies the Vryburg Formation and consists of the Schmidtsdrif Formation and the upper Ghaap Plateau Formation. The Griquatown Group is divided into two formations namely the Asbestos Hills and Koegas Formations. The Gamagara Formation follows and is positioned on the Maremane Anticline and is overlain by the Makganyene Formation. The Cox Group comprises of the lower Ongeluk (Vo, **Figure 3**) Formation and the upper Voëlwater Formation. The Ongeluk Formation was deposited under water and reaches a thickness of between 400 and 900 m. This Formation is basal and is mainly volcanic (Visser 1989). Manganese is present in the upper Voëlwater Formation (Snyman 1996). According to Kent (1980) and Snyman (1996) Griqualand West Basin attains a maximum thickness of 4500 m.

Algal growth structures, also known as Stromatolites, are fossil structures described from the dolomites of the Ghaap Group (Transvaal Supergroup). 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-based life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils. The oxygen atmosphere that we depend on was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era. Organic-walled micro fossils may also be present.

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

Recently, revisions to the stratigraphic subdivision and alignments of the Precambrian rocks present in the Postmasburg and Kathu area has been completed. Eriksson *et al.* (2006) conducted stratigraphic studies on the Transvaal Supergroup while Moen (2006) conducted the study for the Olifantshoek Supergroup.

In the past the shallow marine carbonates of the Campbell Rand Subgroup (Ghaap Group) were included in the Ghaapplatoo Formation. It is about 2.6 to 2.5 Ga (billion years old) and was deposited on the shallow submerged shelf of the Kaapvaal Craton. This carbonate platform is very thick

(approximately 1.6 -2.5 km) and comprise of cherts with minor tuffs and siliciclastic rocks as well as dolostones and dolomitic limestones.

Frequent changes in sea level were caused by changing depositional cycles in shallow water facies. Stromatolitic limestones and dolostones, oolites, laminated calcilutites, cherts, with subordinate siliclastics (shales, siltstones) and minor tuffs are present in this area (Beukes 1980, Beukes 1986, Sumner 2002, Eriksson *et al.* 2006, Sumner & Beukes 2006).

On the western side of the Maremane Dome (Campbell Rand carbonates, Asbesheuwels Banded Iron Formation and Koegas quartzites and iron formation) a major unconformity exists at the base of the Palaeoproterozoic Elim Group (basal Keis Supergroup), This unconformity (about 2.2-2.0 Ga) cuts the folded Ghaap Group succession and is associated with the development of manganese and iron ores. In the past the Elim Group was included in the Olifantshoek Group (Schalkwyk 2005, Van Niekerk 2006, Da Silva 2011, Cairncross & Beukes 2013, Smith & Beukes 2016). The Postmasburg Group comprise of basaltic to andesitic lavas/magma of the Ongeluk Formation (dated to 2.2 Ga).

Older Precambrian rocks are mantled by the late Cretaceous to Late Caenozoic aeolian sands, clays, calcretes, and gravels of the Kalahari Group [approximately Ca 65 – 2.5 million years old (Ma)]. Studies north west of the proposed development site has shown that the Kalahari Group sediments that overlies the Precambrian rocks are about 80 m thick (Haddon, 2005). The earliest Kalahari beds are assigned to the Wessels Formation (basal gravels) and Budin Formation (calcareous clays) and is probably Late Cretaceous in age (Partridge *et al.* 2006).

The top 15 m of the Kalahari sediments consist of clays, calcretised siltstones, and pebbly horizons with the occurrence of solution hollows along joint surfaces (10 m from the surface) (**Figure 7**). Calcretised silcretes with *in situ* brecciation are present close to the surface . Thick pedogenic calcretes (Plio-Pleistocene Mokalanen Formation) are mapped along the Ga-Mogara drainage line and underlies the Kalahari sands in this region. These deposits indicate the seasonally arid climates over the last five million years (Truter *et al.* 1938; Boardman and Visser 1958). Surface limestones may be up to 20 m thick and are locally conglomeratic with clasts of reworked calcrete and foreign pebbles.

Pleistocene Kalahari sands (Gordonia Formation) has been described to mantle thick calcretes and downwasted surface gravels (Almond 2013). He described a range of calcrete types namely gravelly, brecciated, silicified, honeycomb and karstified facies, the latter with an associated sand- or gravel-infilled solution hollows

Older terrace gravels are described from the banks of the Orange River drainage line. Unconsolidated, reddish-brown aeolian sands of the Quaternary Gordonia Formation are present *Palaeontological Desktop Assessment for a proposed Diamond Prospecting Right Application on the farm Bultfontein 327 in the Northern Cape Province.*

(Qs). These sands are Late Pliocene / Early Pleistocene to Recent in age due to the Middle to Later Stone Age stone tools found in them (Dingle *et al.*, 1983, p. 291). Recent studies have dated the Pliocene - Pleistocene boundary from 1.8Ma back to 2.588 Ma and placed the Gordonia Formation almost completely within the Pleistocene Epoch.

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn cores, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens, and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

Quaternary alluvial gravels also known as high level gravels is mapped along both the Vaal and Orange River. These gravels have been associated with diamond mining (De Wit *et al.*, 2000). Windsorton is located north of the development and is known to have heavily calcretized "Older Gravels". These gravels are proposed to be Miocene-Pliocene in age (Partridge & Brink 1967, De Wit *et al.*, 2000, Partridge *et al.* 2006). The "Younger gravels" of the Vaal River System comprise of the Rietputs Formation.

Table 2: Generalised Stratigraphic Column and Associated Geology of the proposed development site

Stratigraphy			Lithology	
Kalahari Formation (Qs and Q)			Clay, limestone and sand	
Transvaal Supergroup	Postmasburg Group	Voëlwater Subgroup	Hotazel Formation	Iron Formation
				Upper Mn ore body
				Middle Mn ore body
				Iron Formation
				Lower Mn ore body
				Mn-rich iron formation
			Iron Formation	
			Ongeluk Formation	Basaltic lava

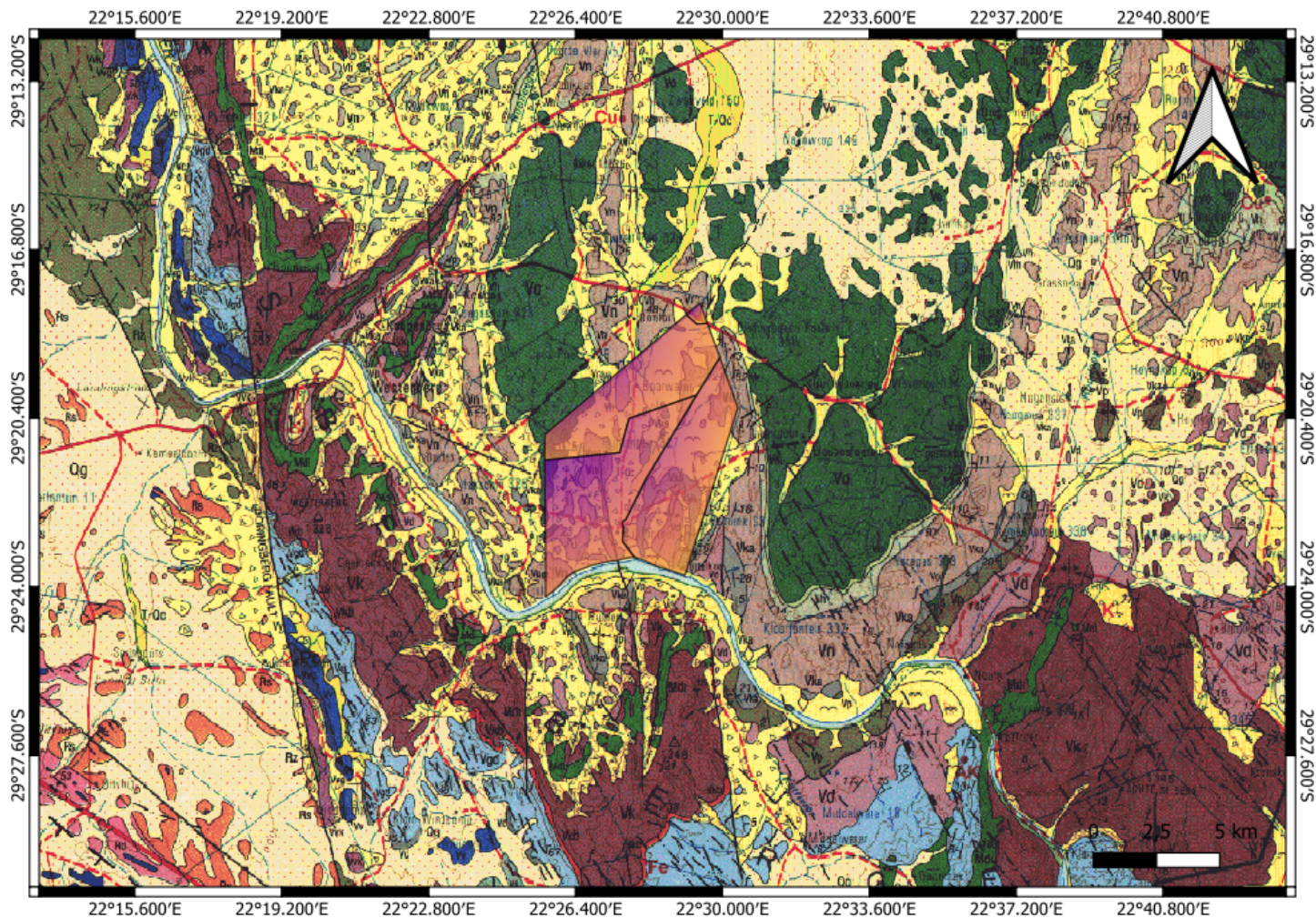
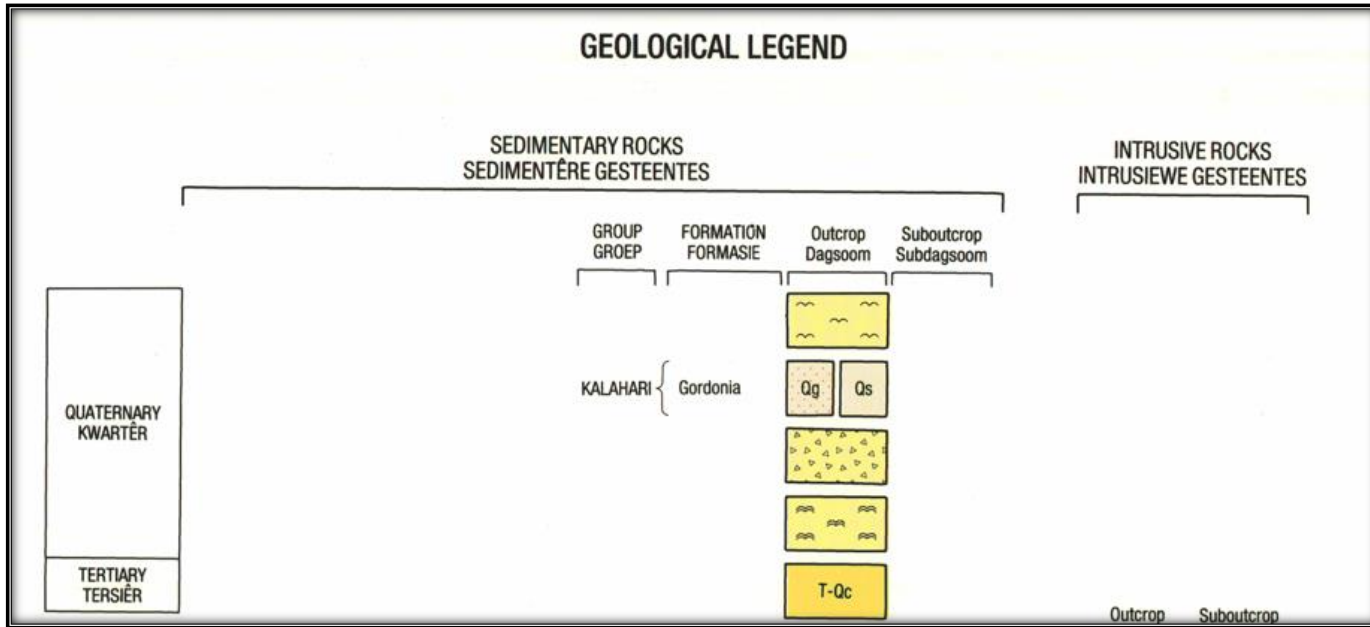
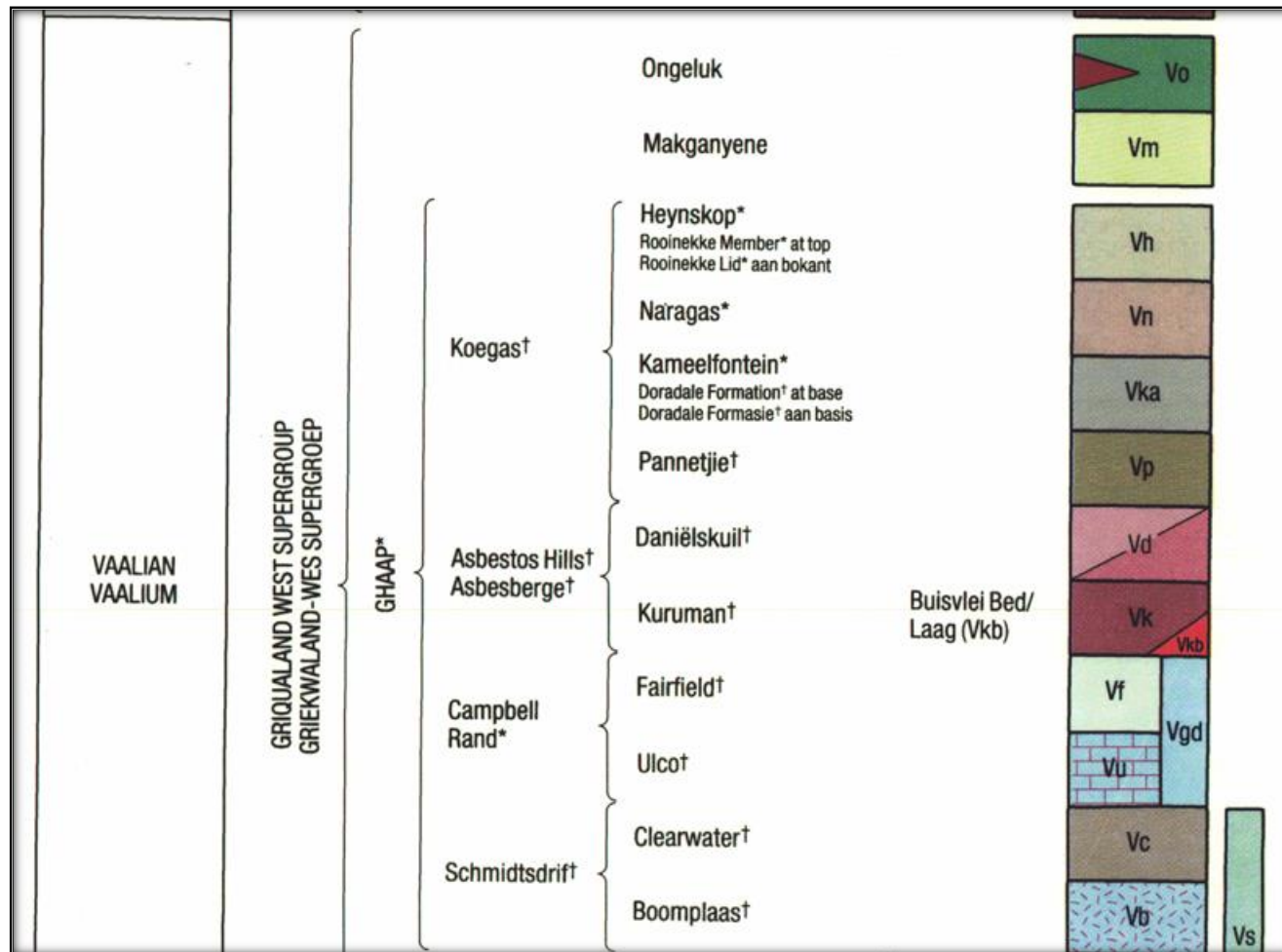


Figure 3: Extract of the 1:250 000 Prieska 2922 Geological map(1995) (Council of Geoscience, Pretoria) indicating the proposed development underlain by Quaternary deposits as well as the Ghaap Group of the Griqualand West Supergroup.

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





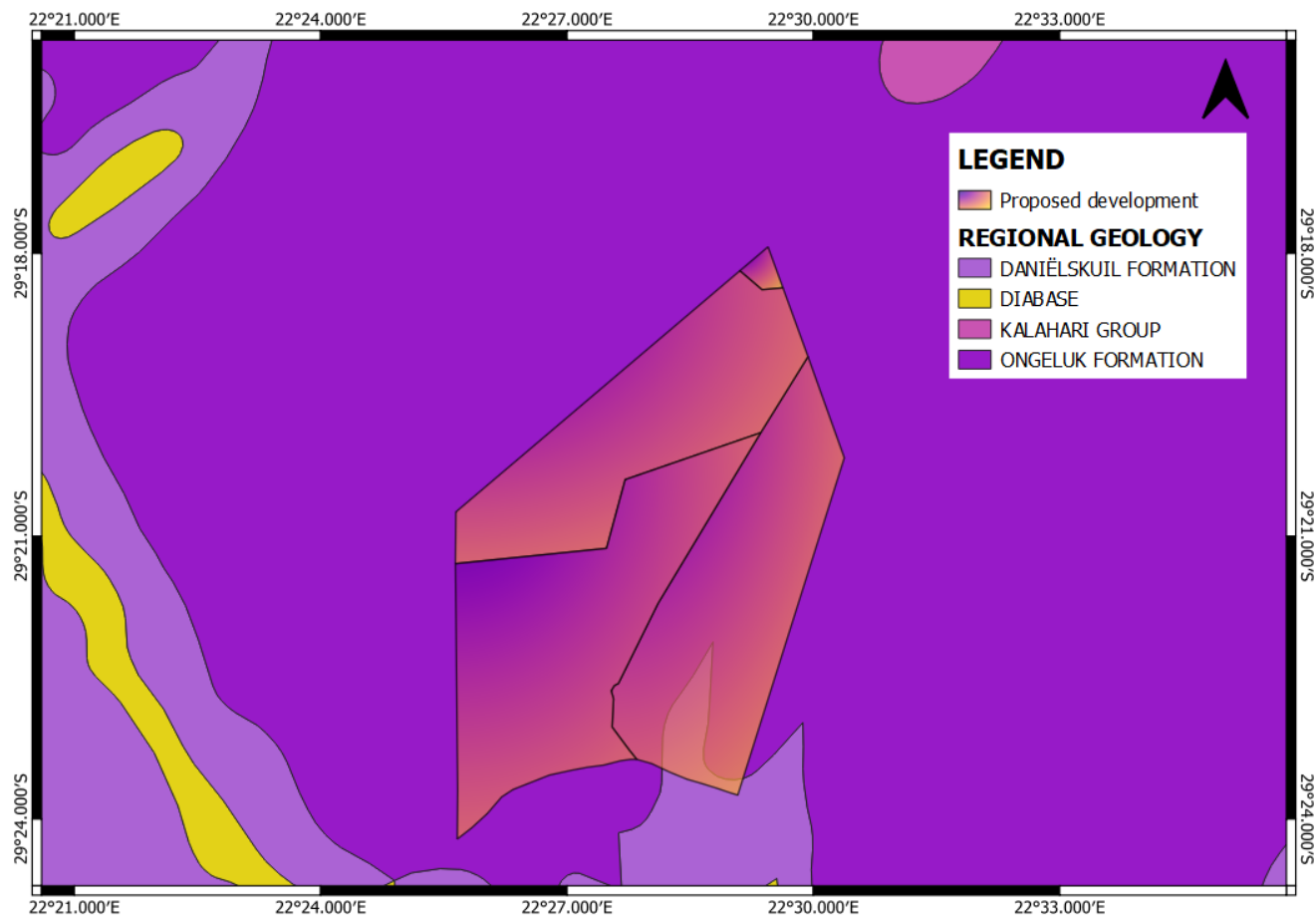


Figure 4: Surface Geology indicated by Shape files (Council of Geoscience, Pretoria) of the proposed Prospecting Right Application .

The map in Figure 4 was drawn by Shape files supplied by the Council of Geoscience, Pretoria. This map indicates that the proposed mining application is largely underlain by the Ongeluks Formation with the south- western portion underlain by the Daniëlskuil Formation (Transvaal Supergroup).

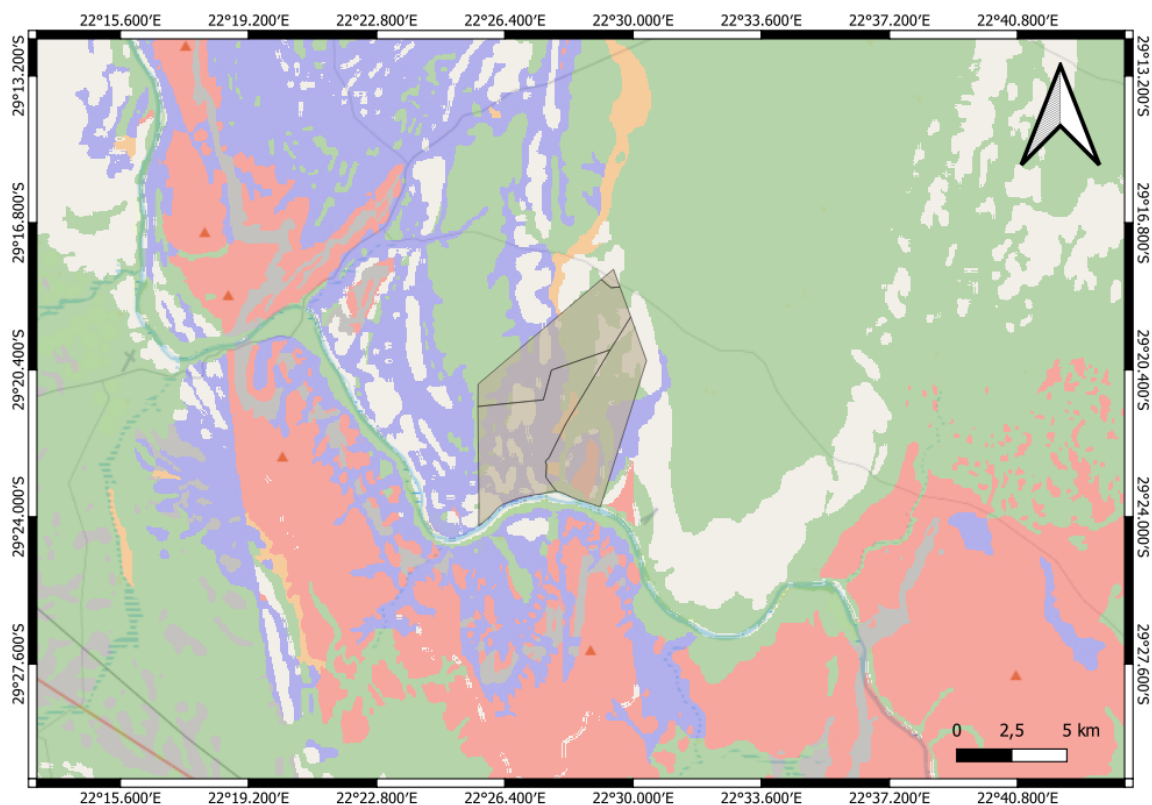


Figure 5: Extract of the 1:250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development.

According to the SAHRIS Palaeosensitivity map (**Figure 5**) the proposed development is underlain by sediments of High (orange), Moderate (green), Low (blue) and unknown (white) Palaeontological Sensitivity.

Table 4: Palaeontological Significance

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

The colours on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

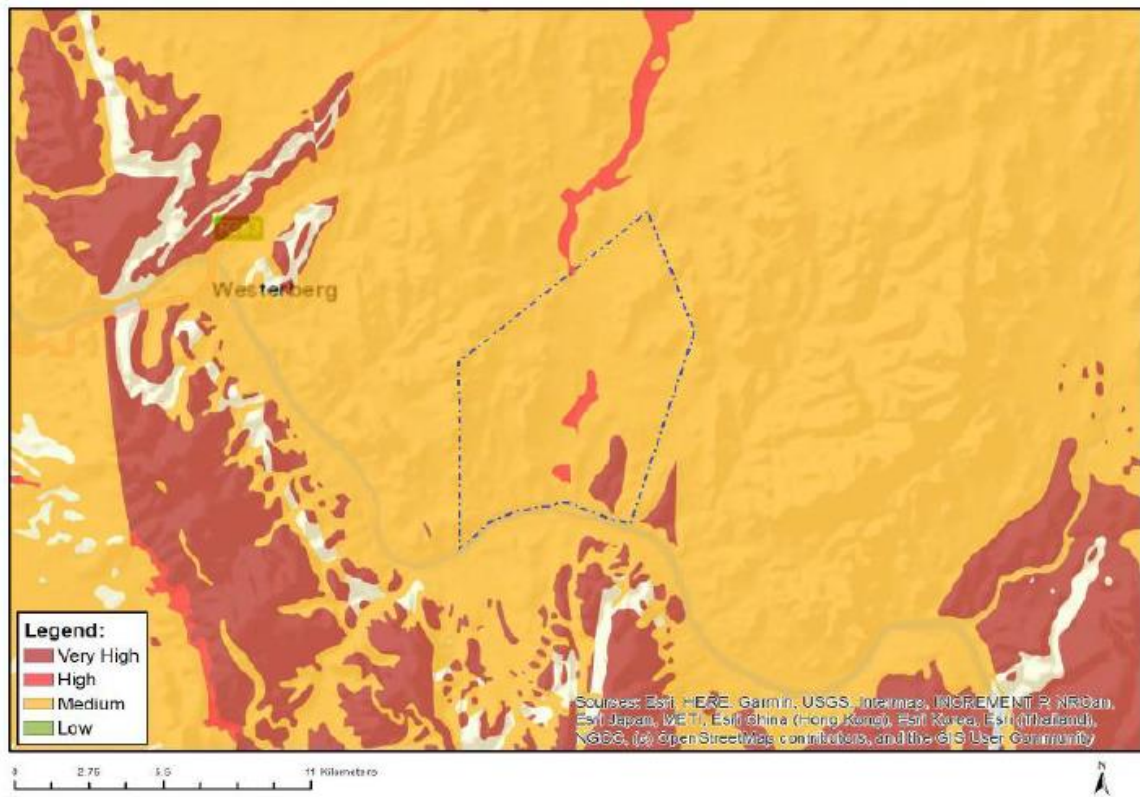


Figure 6: Environmental Screening tool

According to the National Environmental Screening tool (<https://screening.environment.gov.za/screeningtool>) the sensitivity of the proposed mining development in the Northern Cape is Medium to High (**Figure 6**).

6 GEOGRAPHICAL LOCATION OF THE SITE

Farm Name	The Remaining extent of the farm Bultfontein 327
	Portion 1 of the farm Bultfontein 327
	Portion 2 of the farm Bultfontein 327
	Portion 3 (Boorwater) of the farm Bultfontein 327
Application area (Ha)	5474.2388 ha
Magisterial district:	Pixley Ka Seme District Municipality
Local Municipality	Siyathemba Local Municipality
Registration Division	Hay
Minerals Applied for	Diamonds (Alluvial, General & in Kimberlite)

Farm Coordinates

Farm	Longitude	Latitude
Remaining Extent, Portion 1, Portion 2, and Portion 3 (Boorwater) of the farm Bultfontein 327, Registration Division: Hay, Northern Cape Province	22° 25' 37.804" E	29° 20' 42.585" S
	22° 25' 39.035" E	29° 24' 11.890" S
	22° 29' 4.646" E	29° 23' 49.728" S
	22° 30' 24.674" E	29° 20' 9.343" S
	22° 29' 29.270" E	29° 17' 55.142"

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes PIA reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

When conducting a PIA, several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many, inaccessible regions of South Africa have not been reviewed by palaeontologists and data is based on aerial photographs. Locality and geological

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

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area that was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is assumed that exposed fossil heritage is present within the footprint.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984).
- 1: 250 000 000 Prieska 2922 (1995) Geological map (Council of Geoscience, Pretoria).
- 1: 50000 Topographical Maps 2922AD and 2922 BC.
- A Google Earth map with polygons of the proposed development was obtained from Milnex CC.

9 IMPACT ASSESSMENT METHODOLOGY

9.1 Impact Rating System

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

- Construction
- Operation
- Decommissioning

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

Table 5: *The rating system*

NATURE
Loss 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		
<p>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:</p> <p>(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.</p> <p>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.</p>		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

9.1.1 Summary of Impacts

Only the site will be affected (1). It is that the impact will occur (1). The expected duration of the impact is assessed as potentially permanent to long term (4). The impact on fossil heritage will

be irreversible(4) and a complete loss of fossil heritage will take place (4). The cumulative effect of the impact will be low (2). The magnitude of the impact happening will be low (1)

The Impact significance will therefore be a negative low Impact.

10 FINDINGS AND RECOMMENDATIONS

The proposed Diamond Prospecting Right Application near Prieska is underlain by Quaternary deposits, Tertiary calcretes and the Ghaap Group (Transvaal Supergroup, Griqualand West Basin). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Quaternary sediments is Low, that of the Tertiary Calcrete is High, while the Palaeontological Sensitivity of the Ghaap Group is Moderate (Almond and Pether 2008, SAHRIS website). A Low Palaeontological Significance has been allocated to the proposed Prospecting Right Application. It is therefore considered that the proposed development is believed to be appropriate and will not lead to detrimental impacts on the palaeontological reserves of the area.

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

Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).

These recommendations should be incorporated into the Environmental Management Plan for the proposed development.

11 CHANCE FINDS PROTOCOL

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

11.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA)**. According to Section 3 of the Act, all *Palaeontological Desktop Assessment for a proposed Diamond Prospecting Right Application on the farm Bultfontein 327 in the Northern Cape Province.*

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

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 coordinates.

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

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

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

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ELIZE BUTLER

PROFESSION: Palaeontologist
YEARS' EXPERIENCE: 26 years in Palaeontology

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

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

Management Course, 1991
University of the Orange Free State

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

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

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

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part-time Laboratory assistant Department of Zoology & Entomology
University of the Free State Zoology 1989-1992

Part-time laboratory assistant Department of Virology
University of the Free State Zoology 1992

Research Assistant National Museum, Bloemfontein 1993 – 1997

Palaeontological Desktop Assessment for a proposed Diamond Prospecting Right Application on the farm Bultfontein 327 in the Northern Cape Province.

Principal Research Assistant
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National Museum, Bloemfontein
1998–currently

TECHNICAL REPORTS

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- 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, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.

- Butler, E. 2018.** Palaeontological Phase 1 Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
- Butler, E. 2018.** Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.
- Butler, E. 2018.** Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.
- Butler, E. 2018.** Palaeontological Field Assessment for the proposed re-alignment and 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 Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.
- Butler, E. 2018.** Palaeontological Field Assessment of the proposed Megamor Extension, East London. Bloemfontein
- Butler, E. 2018.** Palaeontological Impact Assessment of the proposed diamonds Alluvial & Diamonds General Prospecting Right Application near Christiana on the Remaining Extent of Portion 1 of the Farm Kaffraria 314, Registration Division HO, North West Province. Bloemfontein.
- Butler, E. 2018.** Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delpoortshoop 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.
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- 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.
- Butler, E.,** 2019. Palaeontological Desktop Assessment of the proposed Westrand Strengthening Project Phase II.
- Butler, E.,** 2019. Palaeontological Field Assessment for the proposed Sirius 3 Photovoltaic Solar Energy Facility near Upington, Northern Cape Province
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- Butler, E.,** 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.
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- Butler, E., 2019.** Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:
- Butler, E., 2019.** Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province
- Butler, E., 2019.** Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo
- Butler, E., **2019.** Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape
- Butler, E., 2019.** Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province
- Butler, E., 2019.** Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.
- Butler, E., 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.
- Butler, E., 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.
- Butler, E., 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.
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Butler, E., 2019. Palaeontological Desktop Assessment of The Proposed Upgrade of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction

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Butler, E., 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

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