



PALAEONTOLOGICAL DESKTOP ASSESSMENT

DIAMOND PROSPECTING RIGHT
APPLICATION NEAR DOUGLAS ON
FARM KLEIN TORQUAY 249,
NORTHERN CAPE PROVINCE

NC30/5/1/1/2/11457PR

MAY 2022

COMPILED FOR: MILNEX CC



Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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



Disclosure of Vested Interest

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

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SIGNATURE:



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

Table 1: NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report
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 -Methods and TOR
(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 8
(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 4 -Methods and TOR
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 1 and 9
(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



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4.1 – 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 9
(k) Any mitigation measures for inclusion in the EMPr	Section 1 and 9
(l) Any conditions for inclusion in the environmental authorisation	Section 1 and 9
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 9
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 9
(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 9
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A
(p) A summary and copies if any comments that were received during any consultation process	N/A
(q) Any other information requested by the competent authority.	N/A
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to 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) to assess the proposed Prospecting Right application to prospect for Diamonds Alluvial (DA) and Diamonds General (D) near Douglas on the Remaining Extent & the Remaining Extent of Portion 1 of the Farm Klein Torquay 249, Registration Division: Herbert, Northern Cape Province. Under the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA is necessary to confirm if fossil material could potentially be present in the approved development area and to evaluate the potential impact of the proposed changes to the development on the Palaeontological Heritage.

The development is underlain by the Miocene to Recent Cenozoic Gordonia Formation of the Kalahari Group which are in turn underlain by sediments of the Dwyka Group. The PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, indicate that the Palaeontological Sensitivity of the Gordonia Formation (Kalahari Group) as well as that of the Dwyka Group is Moderate (Almond and Pether 2008, SAHRIS website). A Low Palaeontological Significance has been allocated to the proposed development and it is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage.

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

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



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1 INTRODUCTION

Milnex CC was commissioned by Bondeo 140 CC as the independent environmental consultant to undertake the Scoping and EIA process for the proposed Prospecting Right Application to prospect for Diamonds Alluvial (DA) and Diamonds General (D) near Douglas on the Remaining Extent & the Remaining Extent of Portion 1 of the Farm Klein Torquay 249, Registration Division: Herbert, Northern Cape Province. DMRE Ref: NC 30/5/1/1/2/11457 PR. Banzai Environment was in turn appointed to conduct the Palaeontological Desktop Assessment for this project.

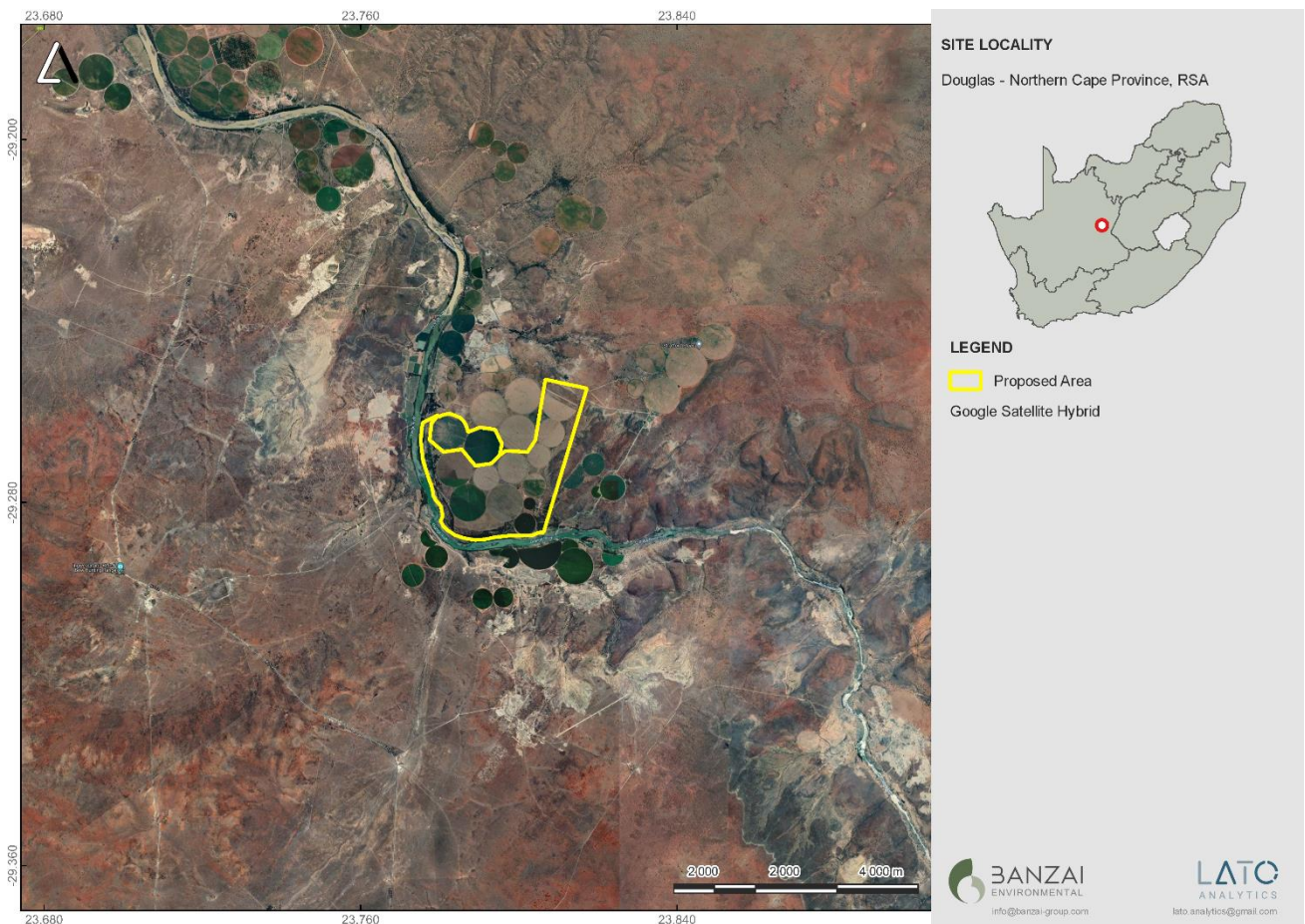


Figure 1: Location of the proposed Diamond Prospecting Right Application near Douglas on the Remaining Extent & the Remaining Extent of Portion 1 of the Farm Klein Torquay 249, Registration Division: Herbert, Northern Cape Province.

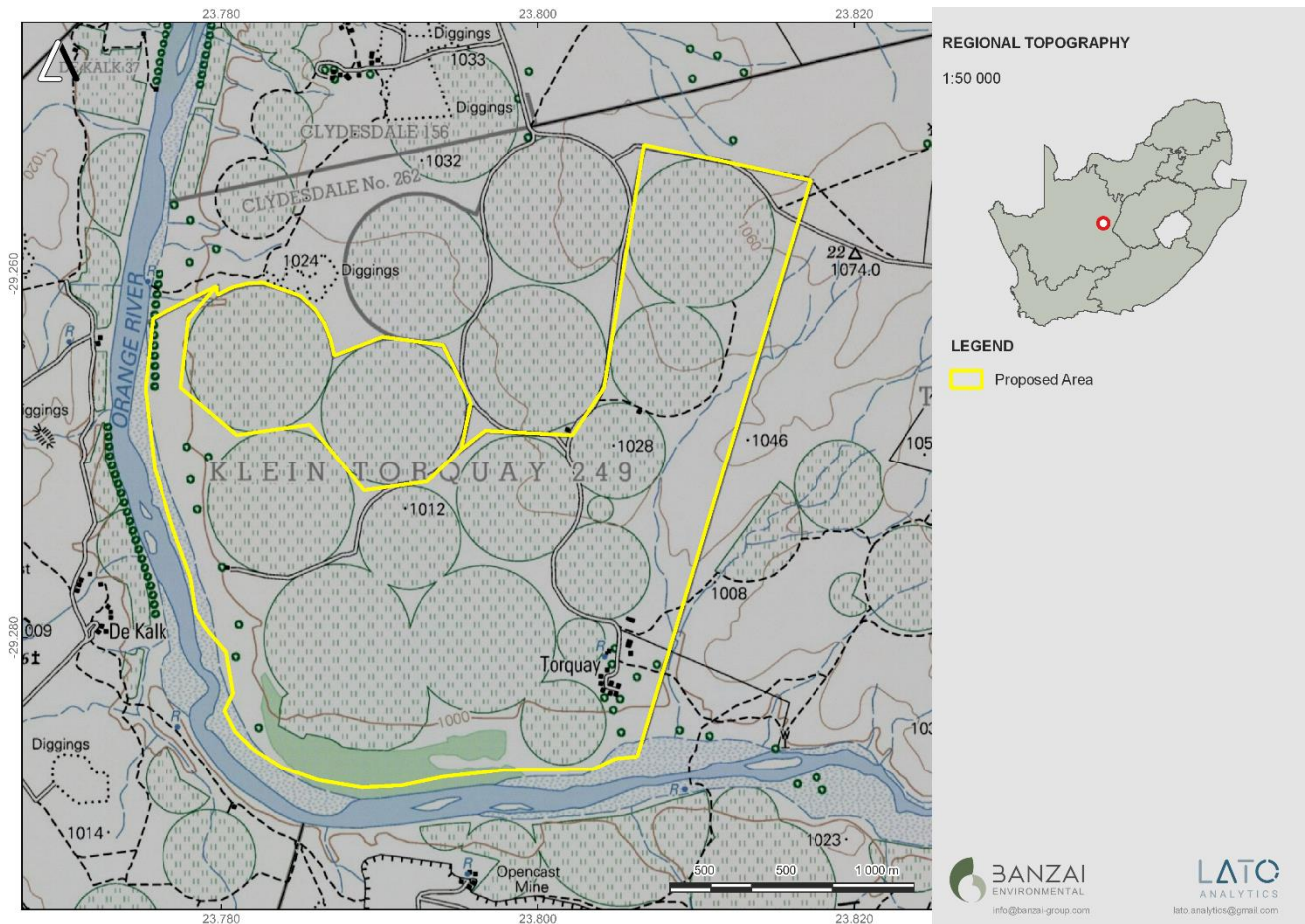


Figure 2: Regional Topography of the proposed development.

The extensive diamondiferous gravels of the Lower Vaal, Harts, and Middle Orange River valleys are associated with remnants of outwash deposits formed during the retreat of the ancient Ghaap (Kaap) Valley glacial system and subsequent reworking and alluvial deposition by major rivers. These rivers included the proto- Vaal, - Orange, - Harts, and -Riet Rivers and their modern antecedents.

Past and present work has shown that the majority of the alluvial diamonds found in gravel deposits along all of the middle Orange River terraces are, typically, found in two distinct gravel horizons. These comprise an upper, deflation deposit (locally known as Rooikoppie gravels) overlying fluvial-alluvial units, often known as Primary gravels.

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



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

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 500 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 laudè*) 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.

4 METHODS AND TERMS OF REFERENCE

This study forms part of the Heritage Impact Assessment Report. 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.

All possible information is consulted to compile a scoping report, and this includes the following: Provisional DFFE Screening Tool, SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical and geological maps as well as scientific articles of specimens from the development area and Assemblage Zones.

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.

During a site investigation the palaeontologist does not only survey the development but also tries to determine the density and diversity of fossils in the development area. This is confirmed by examining representative exposures of fossiliferous rocks (sedimentary rocks contain fossil heritage whereas igneous and metamorphic rocks are mostly unfossiliferous). Rock exposures that are investigated usually contains a large portion of the stratigraphic unit, can be accessed easily and comprise of unweathered (fresh) exposed rock. These exposures may be natural (rocky outcrops in stream or river banks, cliffs, dongas) but could also be artificial (quarries, open building excavations and even railway and road cuttings). It is common practice for palaeontologist to log well-preserved fossils (GPS, and stratigraphic data) during field assessment studies.

Mitigation usually precedes construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils, a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When



mitigation is applied correctly, a positive impact is possible as 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 of 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).

4.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area and the sheet explanations of the Geological Maps 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 also used to provide information on the existence of fossils in an area which has 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.

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed prospecting right application is depicted on the 1: 250 000 Prieska 2922 Geological Map (1995) (Council of Geosciences, Pretoria) (**Figure 3; Table 2**). The study area is mantled by the Gordonia Formation of the Kalahari Group (Qg/Qs, beige) which are in turn underlain by sediments of the Dwyka Group. Updated Geology (Council of Geosciences, Pretoria) also indicates that the development is also underlain by the Kalahari and Dwyka Groups (**Figure 6**). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) (**Figure 5**) indicates that the Palaeontological Sensitivity of the study area is Moderate (Almond and Pether, 2009; Almond *et al.*, 2013, Groenewald *et al* 2014).

The Orange-Vaal River system is recognised as the primary secondary resource for alluvial diamond deposits along the west coast of Namaqualand and in the Northern Cape. Between Douglas and Prieska the present-day Orange River exhibits a meandering channel morphology, which are best developed in regions underlain by the Dwyka Group. Gresse (2003) states that intensive exploration has revealed remnants of a similar older meandering system, which are covered by calcrete and sand along the middle-Orange River.

Both sides of the Orange River valley between Douglas and Prieska are flanked by a steep calcrete-capped escarpment approximately 60-100 m above the present river level. The valley width varies between 8 and 10 km, while the depth is about 80 m below the calcrete cap. Remnants of older valley floors are preserved as topographic benches which are capped by younger, less indurated calcrete deposits. On the northern bank, where the large Cretaceous calcrete cap of the Ghaap Plateau is exposed, an older calcrete cap is present about 150 m above the riverbed. This escarpment is about 10 km from the Orange River and shows the distance of scarp retreat due to river incision since the Cretaceous. The distance fluctuates according to bedrock hardness—the scarp regressed faster on the soft Dwyka sediments between Ghaap se Berg and Asbesberge, thus exposing a large extended Dwyka Group 'basin' which extends northwards towards Postmasburg and Finsch. Calcrete scarp retreat and calcrete erosion indicates repeated land cycle evolution and frequent lowering of base level and river incision due to local tectonic activity along the course of the Orange River or sea level fluctuations (Gresse, 2003).



The Rooikoppie gravels covers the calcrete caps as well as the fluvial terrane deposits. Multi-cyclic deflation and gravitational deposits are represented by Rooikoppie gravels and sourced from surface scree deposits and/or elevated fluvial deposits. Diamondiferous Rooikoppie gravels frequently overlie, and underly barren fluvial deposits. Diamonds are found where the Rooikoppie gravels recycled older diamondiferous fluvial deposits.

Orange River kimberlites are the primary sources of diamonds imprisoned in the palaeo-gravels. Intermediate secondary sources include colluvial, alluvial and fluvial deposits in the catchment regions of the Orange and Vaal rivers. Diamonds were deposited along the river courses in favourable trap sites in point-bar complexes or in bedrock-traps within-channel bars, mainly in scour pools, areas of divergent flow and meanders.

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 (present in the development) which is generally termed Kalahari sand and comprises of red aeolian sands that covers most of the Kalahari Group sediments. The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands, and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters. Quaternary alluvium, aolian sands, surface limestone, silcrete, and terrace gravels are also included in the Kalahari Group (Kent 1980).

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

Partridge *et al.*, (2006) describes numerous types of superficial deposits of Late Cenozoic (Miocene to Pliocene to Recent) age throughout the Karoo Basin. Sands and gravel in the development footprint has a possible fluvial origin. The fossil assemblages of the Kalahari are generally very low in diversity and occur over a wide range. 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.



Almond & 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.

The Dwyka Group is Late Carboniferous to Early Permian in age (300-290 Million years ago (Ma) (**Figure 3, Table 2**) and overlies glaciated Precambrian bedrock faces along the northern margin of the basin. In the south the Dwyka overlies the Cape Supergroup unconformably/paraconformably and in the east it unconformably overlies the Natal Group and Msikaba Formation. Underlying rocks, especially in the north, form in places well-developed striated glacial pavements. Visser (1986) identified several types of lithofacies which he perceived to be deposited in a marine basin.

The Dwyka Group is divided into northern and southern facies (Visser, 1981) due to the distinctive lithological variations over the basin. The Mbizane Formation consists mainly of the northern inlet facies which is characterised by thickness changes, extremely varying lithology and low massive diamictite (~20 %) and high mudrock (~40%) content. The Elandsvlei Formation is the southern platform and are depicted by a high massive diamictite (~70%) and low mudrock (~8%) content, gradual southerly increase in thickness (100 m to 800 m). Debris eroded, from the highlands was deposited by a ground ice sheet but in the west fluctuations in the ice front caused bedded diamictons and subaqueous and subglacial outwash sediments (Visser *et al*/1987).

The Permian Ecca Group outcrops widely in the Karoo Basin and spans the Late Carboniferous Dwyka Group and Late Permian-Middle Triassic Beaufort Group. The Ecca Group consists essentially of a clastic sequence of mudstone, sandstone, siltstone, minor conglomerates and coal in places (SACS, 1980) (Catuneau *et al*/2005). The Ecca Group is the thickest in the southern part of the Karoo basin where it reaches 3000 m and thins out elsewhere in the basin.

The Dwyka sediments are of low palaeontological sensitivity. The Permo-Carboniferous Dwyka Group is known for its track ways also known as Ichnofacies that was formed by fish and arthropods. Fossilized faeces or coprolites have also been recovered. Body fossils consists of gastropods, invertebrates and marine fish, as well as fossil plants. A rich diversity of conifers, cordaitaleans, glossopterids, ginkgoaleans, pollens and spores have been described from this Group while ferns, horsetails and lycopods, are also found.

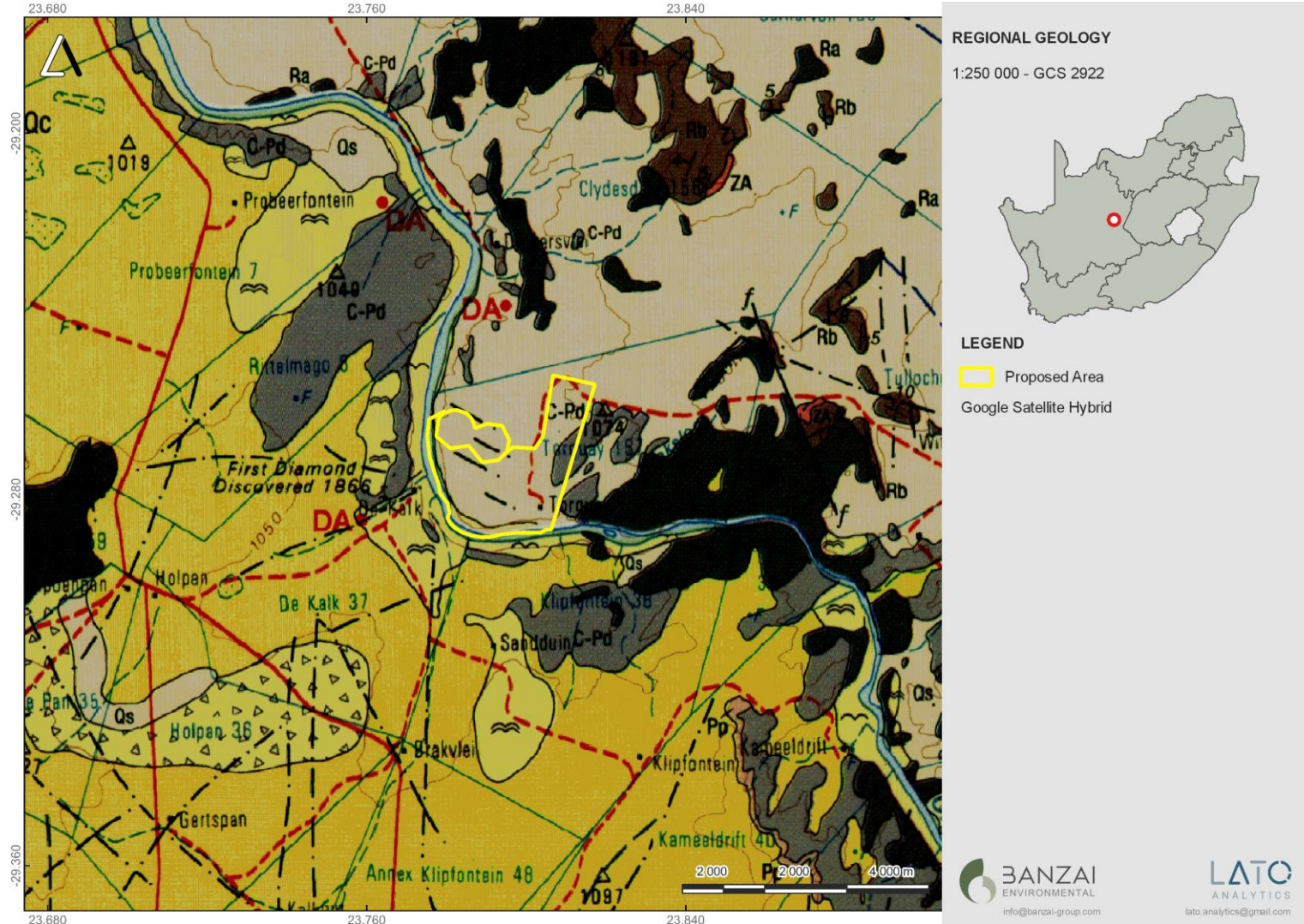


Figure 3: Extract of the 1: 250 000 Prieska 2922 Geological Map (1995) (Council of Geosciences, Pretoria) indicating the geology of the study area near Douglas in the Northern Cape Province.



This map indicates that the development is underlain by the Gordonia Formation of the Kalahari Group (beige, Qg) of the Kalahari Group, as well as the Dwyka Group (C-Pd, khaki).

Table 2: Legend of the 1: 250 000 Prieska 2922 Geological Map (1995) (Council of Geosciences, Pretoria).

		SEDIMENTARY ROCKS SEDIMENTÊRE GESTEENTES				
		GROUP GROEP	FORMATION FORMASIE	Outcrop Dagsoom	Suboutcrop Subdagsoom	
QUATERNARY KWARTÊR	KALAHARI	Gordonia		~ ~ ~	~ ~ ~	Alluvium Alluvium
				Qs	Qs	Sand and sandy soil Sand en sanderige grond
				Qg	Qg	Red wind-blown sand and dunes Rooi windgewaaide sand en duine
				△ △ △	△ △ △	Scree, surface rubble Glooiingspuin, oppervlakpuin
				~ ~ ~	~ ~ ~	Terrace gravel Terrasgruis
T-Qc	T-Qc	Calcrete Kalkreet				
TERTIARY TERSIER						
JURASSIC JURA						
PERMIAN PERM	KAROO SUPERGROUP/ SUPERGROEP	ECCA	Tierberg	Pt		Jd Dolerite Doleriet
			Whitehill	Pw		Pp Shale, mudstone Skalie, moddersteen
			Prince Albert Prins Albert	Pp		Pt Shale, siltstone, sandstone Skalie, sliiksteen, sandsteen
				C-Pd		Pw White-weathering carbonaceous shale Witverwerende koolstofhoudende skalie
CARBONIFEROUS KARBOON		DWYKA		C-Pd		C-Pd Tillite, sandstone, mudstone, shale Tilliet, sandsteen, moddersteen, skalie

Mining activity –(DA)

Diamonds

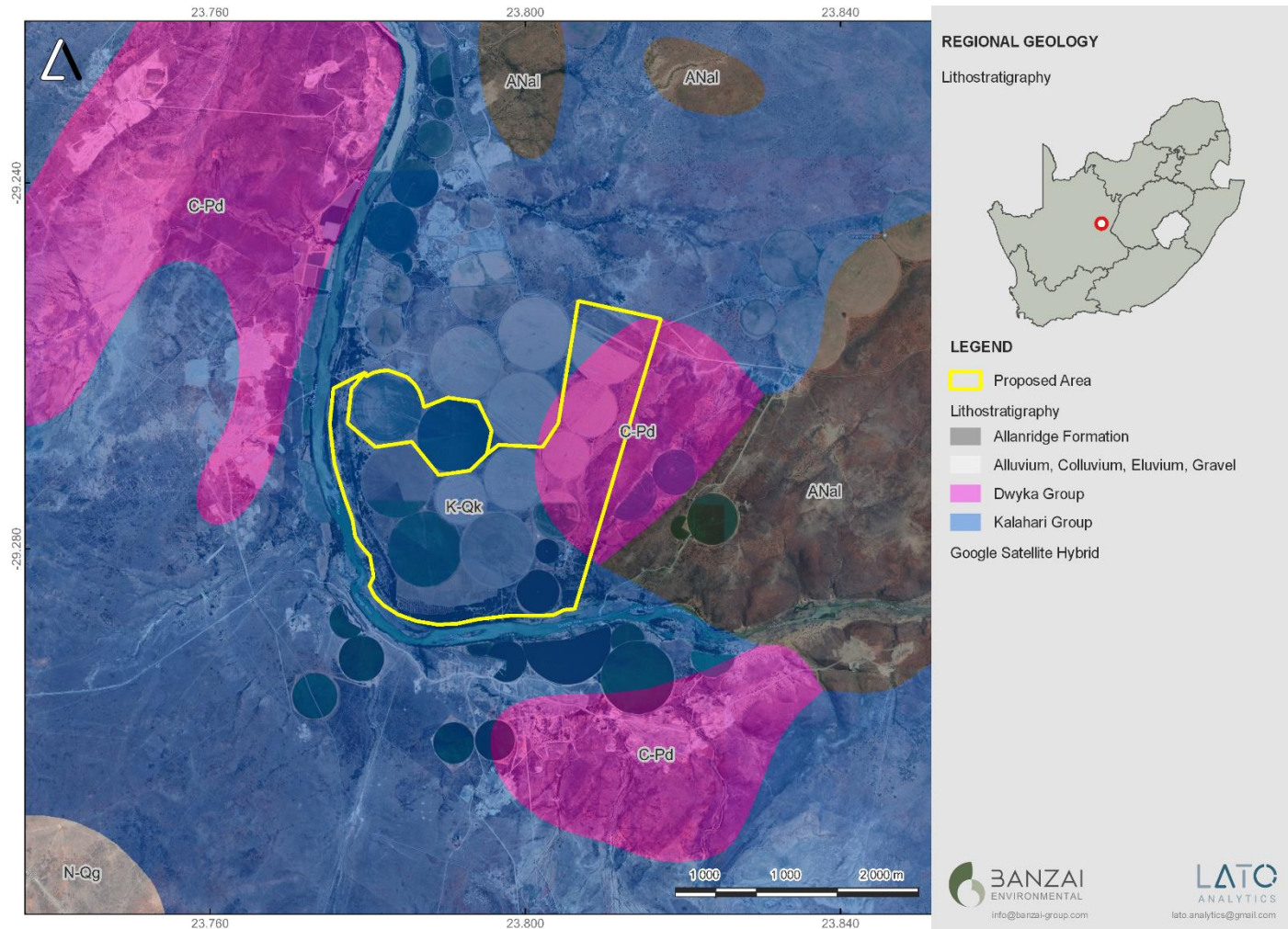


Figure 4: Updated Geology (Council of Geosciences, Pretoria) of the proposed study area indicates that the development is underlain by the Kalahari and Dwyka Groups.

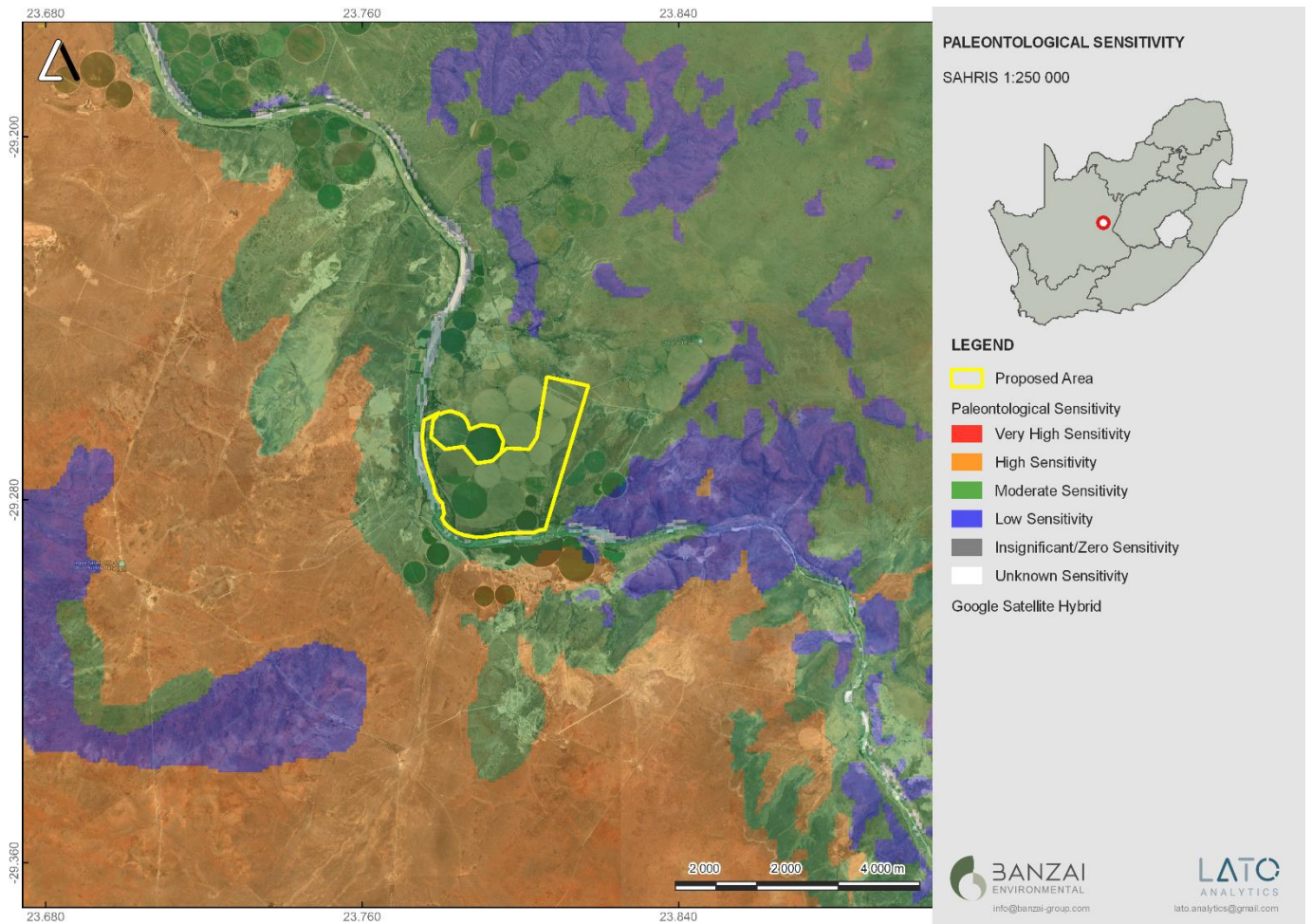


Figure 5: Extract of the SAHRIS PalaeoMap (Council of Geosciences) indicates that the Palaeontological Sensitivity of the study area is Moderate (green).

According to the SAHRIS Palaeosensitivity map (Figure 5) the proposed development is underlain by sediments with a Moderate (green) Palaeontological Sensitivity.

**Table 3: SAHRIS Palaeosensitivity ratings table. The relevant sensitivities are highlighted**

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 National Environmental Web-based Screening Tool indicates that the Palaeontological Sensitivity of the development is Moderate (orange).

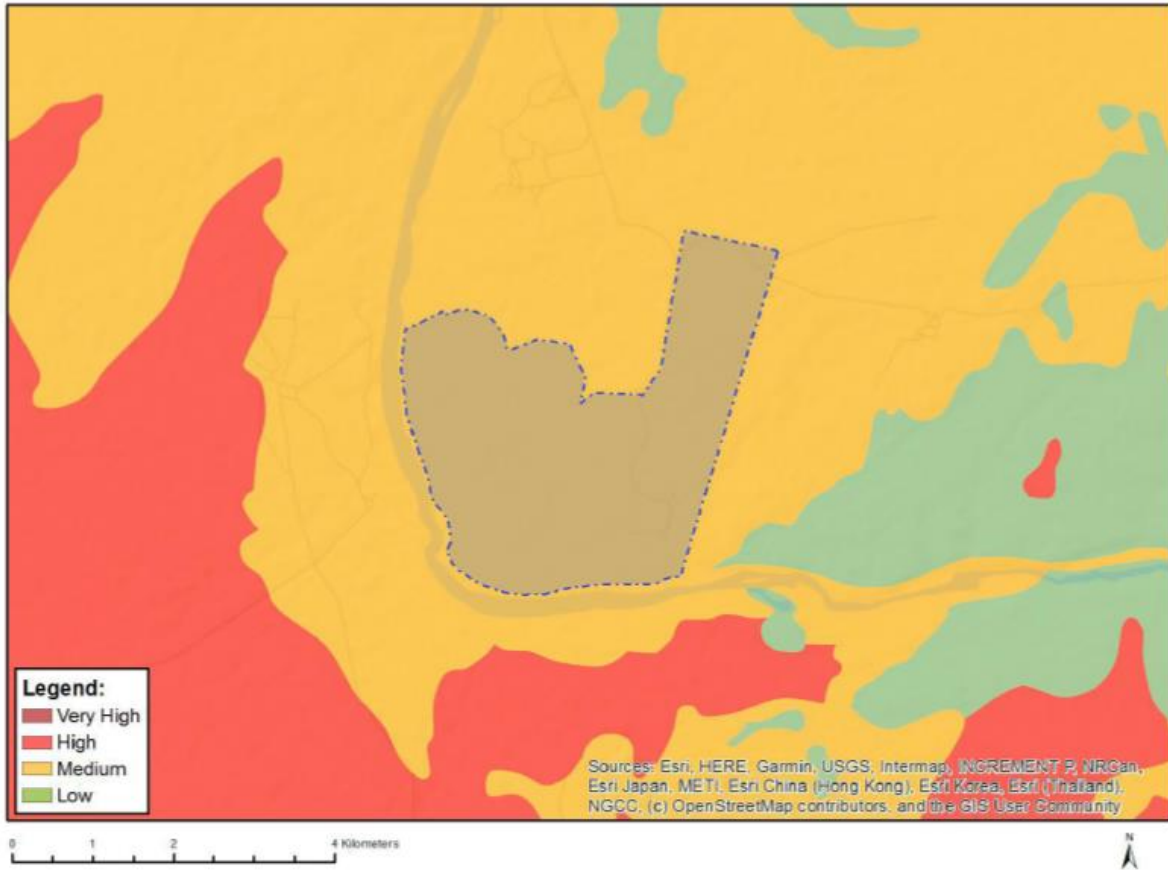


Figure 6: Palaeontological Sensitivity of the study area by the National Environmental Web-based Screening Tool.



6 GEOGRAPHICAL LOCATION OF THE SITE

Table 4: Locality of the proposed development

Farm Name	1) Remaining extent of the farm klein Torquay 249; Title Deed: T1533/2010 Province: Northern Cape 2) Remaining extent of portion 1 of the farm Klein Torquay 249 Title Deed: T1533/2010 Province: Northern Cape
Application area (Ha)	909.1985 hectares
Magisterial district:	Local Municipality: Siyancuma District Municipality: Pixley Ka Seme
Registration division:	Herbert RD
Distance and direction from nearest town	The property is located within the Northern Cape Province, approximately 13.59 km South of Douglas and approximately 68.80 km South-west of Kimberley.
21 digit Surveyor General Code for each farm portion	1) C03200000000024900000 2) C03200000000024900001
Minerals applied for	Diamonds Alluvial (DA) Diamonds General (D)

7 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984).
- A Google Earth map with polygons of the proposed development was obtained from Milnex cc.
- 1: 250 000 Prieska 2922 (1995) Geological Map (Council of Geosciences, Pretoria)
- 1:50 000 Topographical map 2923BD
- Updated Geology produced by the Council of Geosciences (Pretoria).



8 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 5: 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 + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity = X.

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

Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.



51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

8.1 Summary of Impact Tables

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

Table 6: Summary of Impact Tables

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

9 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by the Miocene to Recent Cenozoic Gordonia Formation of the Kalahari Group which are in turn underlain by sediments of the Dwyka Group. The PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, indicate that the Palaeontological Sensitivity of the Gordonia Formation (Kalahari Group) as well as that of the Dwyka Group is Moderate (Almond and Pether 2008, SAHRIS website). A Low Palaeontological Significance has been allocated to the proposed development and it is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. The construction and operation of the project may be authorised, as the whole extent of the development footprint is not considered sensitive in terms of palaeontological heritage.



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

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

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APPENDIX A

CURRICULUM VITAE

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 30 years in Palaeontology

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

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

Management Course, 1991
University of the Orange Free State

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

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

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

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

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



Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–2022

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