



PALAEONTOLOGICAL DESKTOP
ASSESSMENT FOR THE PROPOSED
PROSPECTING RIGHT APPLICATION
WITHOUT BULK SAMPLING FOR THE
PROSPECTING OF DIAMONDS ALLUVIAL
(DA), DIAMONDS GENERAL (D), DIAMONDS
IN KIMBERLITE (DK) & DIAMONDS (DIA) ON
PORTION 1 OF THE FARM KORRIDOR 21,
REGISTRATION DIVISION: NAMAQUALAND
RD, WITHIN THE NORTHERN CAPE
PROVINCE, DMRE

REF: NC30/5/1/1/2/12960PR.

July 2022

COMPILED FOR:

MILNEX CC

Declaration of Independence

BANZAI ENVIRONMENTAL (PTY) LTD.
Reg No. 2015/332235/07 | VAT No. 4240303828



General declaration:

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



Disclosure of Vested Interest

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

PALAEONTOLOGICAL CONSULTANT:

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SIGNATURE:

A handwritten signature in black ink that reads "Elize Butler".



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

Table 1: NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report
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, inclusive of a site plan identifying site alternative;	Section 1 and 10
(g) An identification of any areas to be avoided, including buffers	Section 5 No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the 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



Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report
(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 11
(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 1 and 10
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and	
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 10
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A
(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 without Bulk Sampling for the Prospecting of Diamonds Alluvial (Da), Diamonds General (D), Diamonds in Kimberlite (Dk) & Diamonds (Dia) on Portion 1 of the Farm Korridor 21, Registration Division: Namaqualand Rd, within the Northern Cape Province, DMRE. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to verify if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The proposed development is underlain by sediments of the Orange River Group, Vioolsdrif and Richtersveld Suite is Zero as it is igneous in origin while that of the Nama Group moderate (Almond and Pether, 2009; Almond *et al.*, 2013). However, many fossil taxa are known from only a single fossil and, thus, any fossil material is potentially highly significant. 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 **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that suitable mitigation (recording and collection) can be carried out

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



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Appendix A:

Curriculum Vitae Elize Butler



1 INTRODUCTION

Milnex CC was commissioned by Morgenson Mining (Pty) Ltd as the independent environmental consultant to undertake the Scoping and EIA process for the proposed Prospecting Right Application without Bulk Sampling for the Prospecting of Diamonds Alluvial (Da), Diamonds General (D), Diamonds in Kimberlite (Dk) & Diamonds (Dia) on Portion 1 of the Farm Korridor 21, Registration Division: Namaqualand Rd, within the Northern Cape Province, DMRE. Banzai Environment was in turn appointed to conduct the Palaeontological Desktop Assessment for this project (Figure 1-2).

It is important to note that the Richtersveld Cultural and Botanical Landscape was proclaimed as a UNESCO World Heritage Site in 2007 (Government Gazette 505 No 30043, 4 July 2007).

The proposed Prospecting Right Application will be 10804.3026 ha in extent and continuous rehabilitation will be implemented during the operational phase of the development, while a full rehabilitation plan for the proposed 10804.3026 ha will be included in the EMPr.

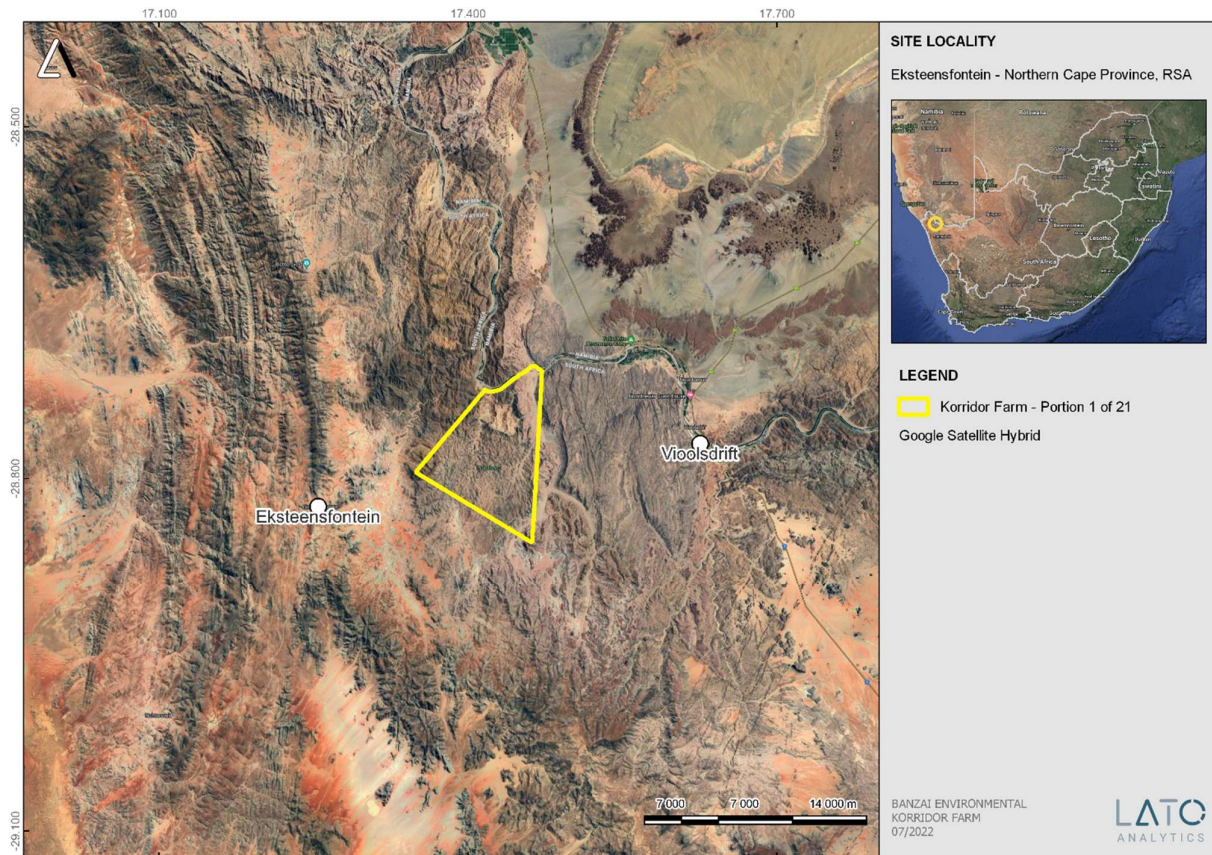


Figure 1: Location of the proposed Prospecting Right Application without Bulk Sampling for the Prospecting of Diamonds Alluvial (Da), Diamonds General (D), Diamonds in Kimberlite (Dk) & Diamonds (Dia) on Portion 1 of the Farm Korridor 21, Registration Division: Namaqualand Rd, within the Northern Cape Province, DMRE.

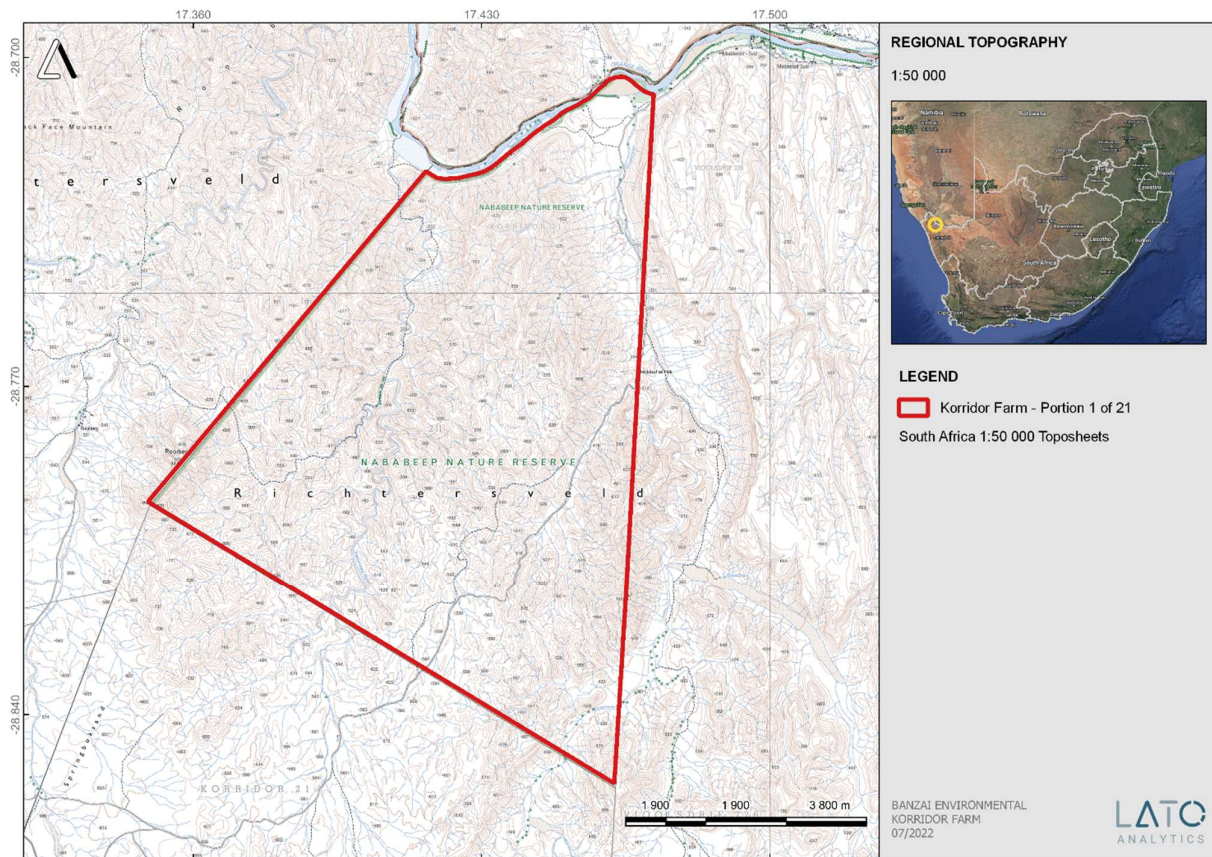


Figure 2: Regional Topography of the proposed prospecting development

The extensive diamondiferous gravels of the Lower Vaal, Harts, and Middle Orange River ("MOR") valleys are associated with remnants of outwash deposits formed during the retreat of the ancient Ghaap (Kaap) Valley glacial system and subsequent reworking and alluvial deposition by major rivers. These rivers included the proto- Vaal, - Orange, - Harts, and -Riet Rivers and their modern antecedents. The glacial system is identified as a prominent ice lobe emanation from the central Dwyka (Carboniferous) ice sheet of central Gondwana which utilized the structurally controlled through flanking the Ghaap Escarpment.

The geological settings of the diamondiferous gravel deposits vary from thick remnant palaeo- river terraces and channels of late- Cretaceous age through to young surface deflation or Rooikoppie deposits of 1-2 meters thick. The river deposits, which in part reworked glacial outwash deposits, all appear to have a common or similar origin as seasonal ephemeral flood deposits. Large elongated channels containing gravel sequences were probably created initially by glacial scoring (as for example on Holpan and Klipdam). Locally, bedrock features including large boulders (glacial erratics) protruding from and released by the Dwyka diamictites of the floor rocks, and fractures and potholes found on Ventersdorp bedrock played an important role in diamond concentration of the older alluvial deposits. Well-developed splays (e.g., Windsorton and Waldecks Plant on the Vaal River), dykes, faults and contrasting rock competencies also lead to grade enhancement



in younger deposits. Locally plunge and scour pools lead to high concentration of diamonds (The Southern African Institute of Mining and Metallurgy, 2007).

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils. 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 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 is 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 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** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed diamond prospecting Right Application without Bulk Sampling for Diamonds Alluvial (Da), Diamonds General (D), Diamonds in Kimberlite (Dk) & Diamonds (Dia) on Portion 1 of the Farm Korridor 21, Registration Division: Namaqualand Rd, within the Northern Cape Province, DMRE is depicted on the 1: 250 000 Upington 2816 Alexander Bay Geological Map (2011) (Council of Geosciences, Pretoria) (**Figure 3; Table 2**). According to this map the proposed development is underlain by the following sediments: Quaternary alluvium (Q-S1; yellow with single bird figure); Urusis Fm (Nu, light green), Nadaus Formation (Nnd-green) of the Schwartzrand Subgroup, (Nama Group); Zaris (Nz, blue-green) and Dabis (Nng, brown) of the Kuibis Subgroup and Nama Group; Rooiberg Pluton (Nro, orange) and Mt Steward Pluton, (Nms Brown) of the Richtersveld Suite, Goodhouse Subsuite (Kgd-dull orange); Vioolsdrif Suite and the Windvlakte (Kwi-blue), De Hoop Subgroup of the Orange River Group. According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the

Orange River Group, Vioolsdrif and Richtersveld Suite is Zero as it is igneous in origin while that of the Nama Group moderate (Almond and Pether, 2009; Almond *et al.*, 2013). However, many fossil taxa are known from only a single fossil and, thus, any fossil material is potentially highly significant.

The oldest rocks in the Richtersveld are about 1996 million years old (myo) and are represented by the volcanic Orange River Group (Windvlakte Formation). The Vioolsdrif Suite intruded the Orange River Group about 1900 to 1731 Mya (Million years ago). These extrusive igneous rocks comprise of the Goodhouse Subsuite and consist of granite porphyry, granite, and syenite rocks. Overlying the Vioolsdrif Suite is the Richtersveld Suite (920 mya) that comprises of sharp dome-shaped masses of granite and ring complexes of the Mount Stewart



and Rooiberg Plutons. The above-mentioned rocks are all volcanic rocks and not discussed in this report as they are unfossiliferous.

Overlying the Richtersveld Suite is the 570 My old Nama Group. The Nama Group has been dated as between 570 to 510 Ma (million years ago) (Meert et al, 1997). This Group has developed as a foreland basin between the northern Damara and western Gariep orogenic belts and the eastern Kalahari Craton. The Nama foreland basin is subdivided in the Zaris, Witputs, and Vanrhynsdorp subbasins. These basins are separated by east-west ridges (Germs and Gresse, 1991). The Nama Group comprise over 3000 m of fluvial to shallow marine sedimentary rocks. These sediments were deposited in a foreland basin during the end stages of Gondwana assembly (Germs 1995; Saylor *et al.* 1995). The foreland basin extends for more than 1000 km from south to north alongside the western edge of the Kalahari Craton. The base of the Nama Group comprises of the Kuibis Subgroup that consists mainly of a series of shallow marine deposits overlain by an arrangement of transitional shallow-marine to continental deposits of the fluvial Schwarzrand Subgroup. In turn these sediments are overlain by the fluvial Fish River Subgroup.

The stratigraphy of the Nama Group (**Figure 3**) has been described by Martin (1965) and Germs (1974, 1972b, 1983) (**Figure 4**). The Nama Group (both Kuibis and Schwarzrand Subgroups) comprise of several marine shelf siliciclastic and carbonate sequences. These sediments are overlain by alluvial to shallow marine molasse of the Fish River Subgroup. The basal unit of the Nama Group is the Kuibis Subgroup. This Subgroup is regionally extensive, and comprises of a thin basal, transgressive sandstone that grading upwards into a major carbonate platform. The thickness of this Subgroup varies between 150 to 500 meters (Grotzinger, 2000). The proximal facies consist mainly of limestone, while deep-water facies are varied with shales as well as fine sandstones. In the Zaris subbasin a well-developed carbonate ramp developed thickening northwards from the Osis arch to the Naukluft Mountains (Smith, 1998). This transformation in thickness is associated with a grading from shallow-water (in the south) to basinal facies in deeper water, near the Naukluft Mountains (Grotzinger, 2000).

The oldest documented assemblage composed of reef-forming microbialites and metazoans has been uncovered in the Nama Group (Grotzinger 2000). Thrombolite (clotted internal texture) and stromatolite (laminated internal texture) reefs form an integral part of in the Nama Group. These reefs are best developed in the Kuibis Subgroup (Zaris subbasin), and in the Huns platform (Schwarzrand Subgroup) of the Witputs subbasin (Grotzinger, 2000).

Ediacaran shelly invertebrates, calcified algae, agglutinates tubes, metazoans, organic walled microfossils as well as trace fossils. Several trace and body fossils have been described from the Nama Group (**Figure 5-6**). Some of these include Brooksells sp, Bergaueria sp, Nereites sp Diplocraterion sp, and Skolithos sp. (Crimes et al, 1982; Germs, 1972a, b, c, and 1973 a, b; and Seilacher 1995, 1960 see bibliography).

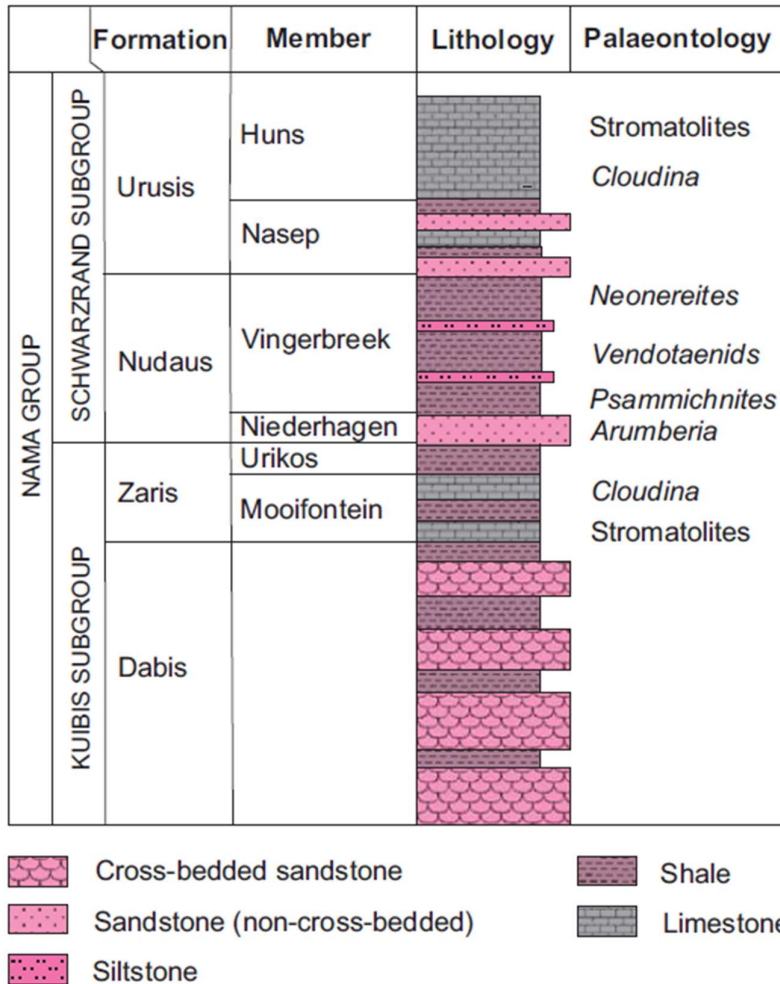


Figure 3: Schematic stratigraphic profile of the Nama (Image taken from Gresse Et al, 2006)

The Cenozoic Kalahari Group is the most widespread body of terrestrial sediments in southern Africa. The Cenozoic sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge et al., 2006). The youngest formation of the Kalahari group is the Gordonia Formation (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 corns as well as mammalian teeth. Tortoise remains have also been uncovered



as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile remains have been uncovered where the depositional settings in the past were wetter.

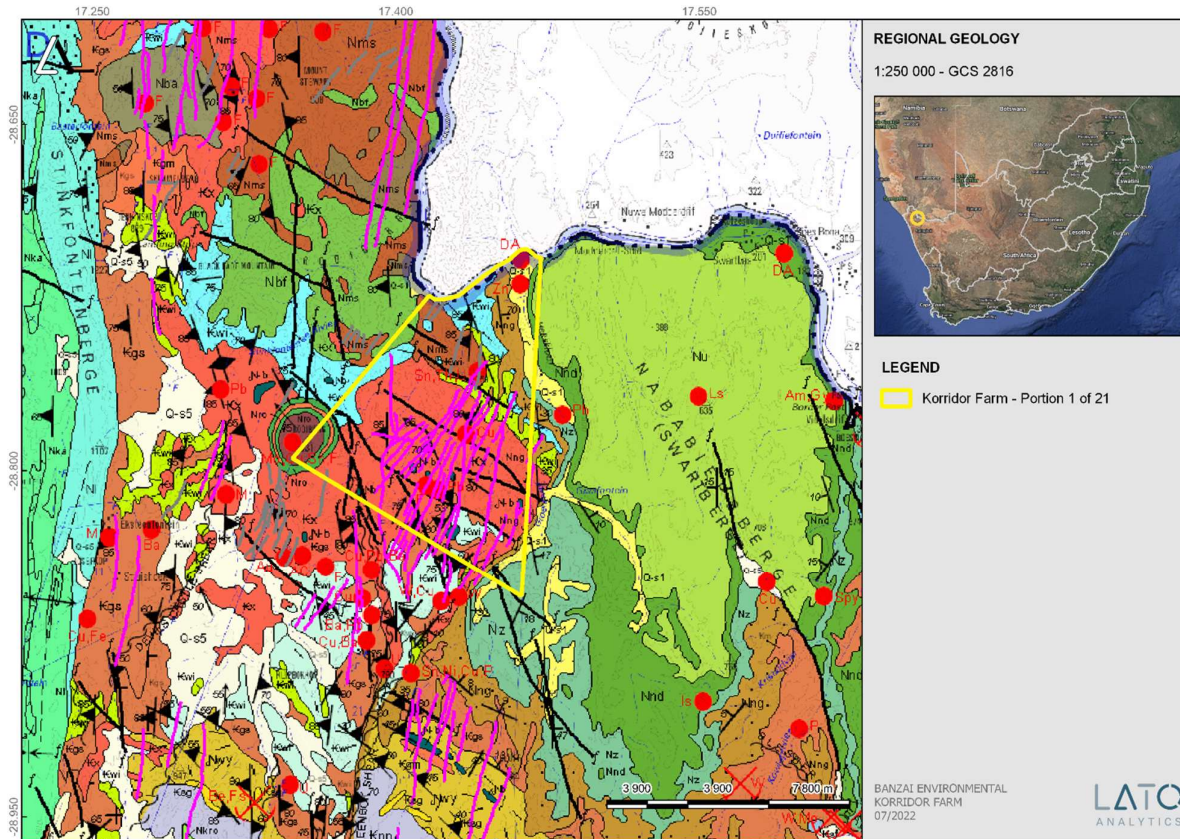


Figure 4: Extract of the 1: 250 000 Alexander Bay 2816 Geological Map (2011) (Council of Geosciences, Pretoria) indicating the geology of the proposed prospecting application in the Northern Cape Province.

This map indicates that the development is underlain by Quaternary alluvium (Q-S1; yellow with single bird figure); Nadaus Formation (Nnd-green) (Schwartzrand Subgroup, Nama Group; Zaris (Nz, green) and Dabis (Nng, brown) of the Kuibis Subgroup and Nama Group; Mt Steward Pluton, (Nms Brown) and Rooiberg Pluton (Nro, orange) and Mt Steward Pluton, (Nms Brown) of the Richtersveld Suite, Goodhouse Subsuite (Kgd-dull orange of the Violsdrif Suite and the Windvlakte (Kwi-blue), De Hoop Subgroup of the Orange River Group.



Table 2: Legend of the 1: 250 000 Upington 2820 Geological Map (1988) (Council of Geosciences, Pretoria)

Symbol	Period	Group(G); Subgroup (SG); Formation (F)	Lithology
Q-s1	Quaternary		Q-s1 Alluvium
Nu	Namibian	Urusis Fm, Schwardtzrand SG, Nama Group	Nu Black massive limestone, fine-grained white quartzite with interlayered shale
Nnd		Nudaus Fm, Nama Group, Schwardtzrand SG, Nama Group	Nnd Blue and green shale with interlayered siltstone, red and blue massive quartzite at base
Nz		Zaris Fm, Kuibis SG Nama Group	Nz Grey shale, limestone with interlayered shale, yellow and orange limestone at base
Nng		Dabis Fm, Kuibis SG Nama Group	Nng Green, blue and red shale; arkose and feldspathic quartzite; impersistent conglomerate at base



<p>Rooiberg Pluton</p>		<p>Rooiberg Pluton Richtersveld Suite</p>	<p>Nro Coarse-grained syenite (◀), melanocratic syenite (◀) and fine-grained porphyritic granite (◀)</p>
<p>Mount Stewart Pluton</p>		<p>Mount Stewart Pluton, Richtersveld Suite</p>	<p>Nms Porphyritic alkali granite (◀) and coarse-grained alkali granite (◀)</p>
<p>Gaarseep Granodiorite* Khoromus Tonalite*</p>		<p>Goodhouse Subsuite, Violsdrift Suite</p>	<p>Kgd Undifferentiated brown-weathering, homogeneous granitoids (granite, granodiorite, tonalite)</p>
<p>Xaminxaip River Granodiorite</p>	<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Kheisian</p>	<p>Xaminxaip River Granodiorite</p>	<p>Kx Brown-weathering medium- and even-grained granitoids; migmatised in places</p>
<p>Kwi</p>		<p>Windvlakte Fm, De Hoop SG, Orange River Group</p>	<p>Kwi Undifferentiated volcanics, leucocratic (◀), mesocratic (◀) and dark mesocratic (◀); metasediments in places recrystallised to varying degrees, granitised in places</p>

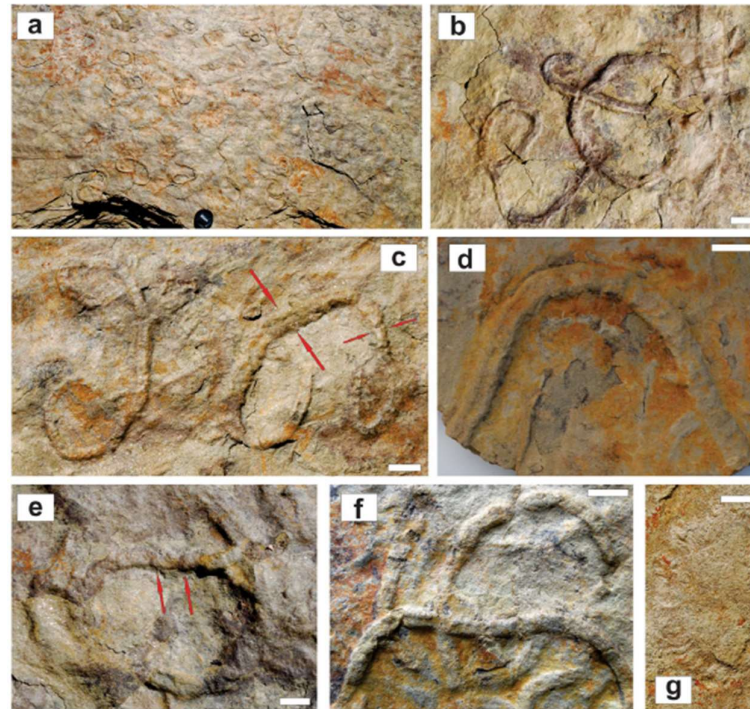


Figure 5: Morphological variability of *Parapsammichnites pretzeliformis* n. igen. and n. isp. from the Urusis Formation.

(a) General view of sandstone base showing moderate density of horizontal trace fossils depicting scribbles, circles and spirals. Lens cover is 5.5 cm wide. **(b)** Close-up of scribbles, showing bilobate nature of the structures. **(c)** Trace fossil displaying self-overcrossing and pretzel shape. Long trace fossil displaying several self-overcrossings and significant width changes along the course (large and short arrows). Large arrows show expansion “envelope” of reworked sediment. **(d)** Unilobate trace fossil showing sediment pads and grading into a bilobate segment (left). **(e)** Specimens displaying inclined arcuate ridges (sediment pads), resulting locally in constricted aspect. Arrows mark arcuate sediment pads slightly offset from the axis. **(f)** Several specimens showing transitions between unilobate to bilobate segments. **(g)** Weathered specimen displaying meniscate laminae, hinting towards packing in sediment pads. All views are from sandstone bed soles. All scale bars are 2 cm long. Image taken Buatois et al 2018

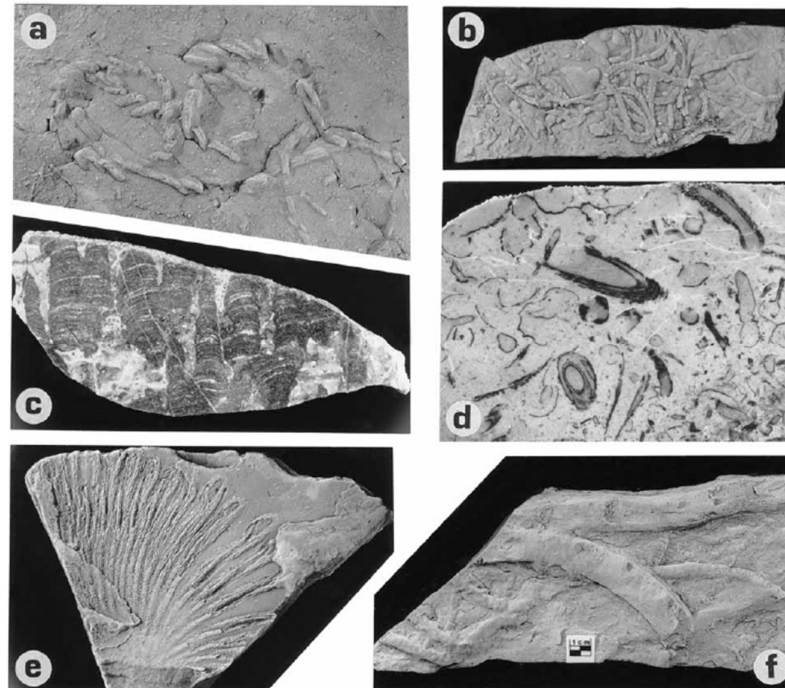


Figure 6: Trace fossils and stromatolites of the Nama and Vanrhynsdorp Groups.

(a) Phycodes/Trichophycus pedum, *Kalk Gat Formation (Vanrhynsdorp Group), north of Vanrhynsdorp (x 0.5)*;
(b) Neonereites, *Kuibis Subgroup (Nama Group), near Nababeep (x 0.5)*; (c) *Micro-columnar substructure of large domal stromatolite, Huns Member (Nama Group), near Vioolsdrif (x 0.8)*; (d) *Cloudina and other unnamed shelly fossils, Mooifontein Member (Nama Group), near Vioolsdrif (x 1.5)*; (e) *Oldhamia, Besonderheid Formation (Vanrhynsdorp Group), near Vanrhynsdorp (x 1.25)*; (f) *Planolites, Gannabos Formation (Vanrhynsdorp Group), near Bitterfontein (x 0.5)*. (Photographs supplied by J.E. Almond.) (Image taken from Gresse et.al., 2006)

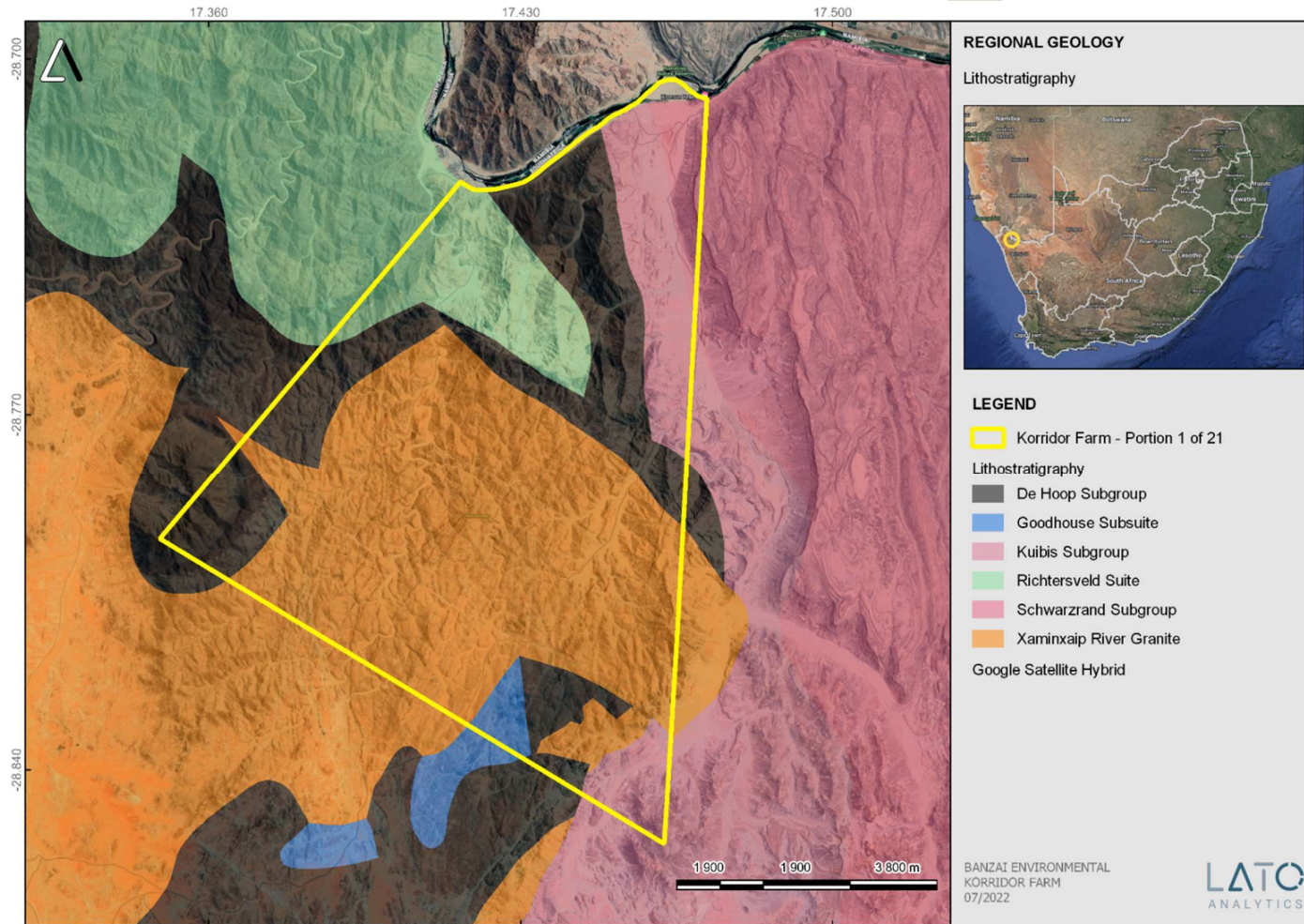


Figure 7: Geology indicated by Shape Files (Council for Geosciences, Pretoria). According to this map the development is underlain by the De Hoop Subgroup, Goodhouse Subsuite, Kuibis Subgroup, Richtersveld Suite, Schwartrand Subgroup ad well as the Xaminxiap River Granite.

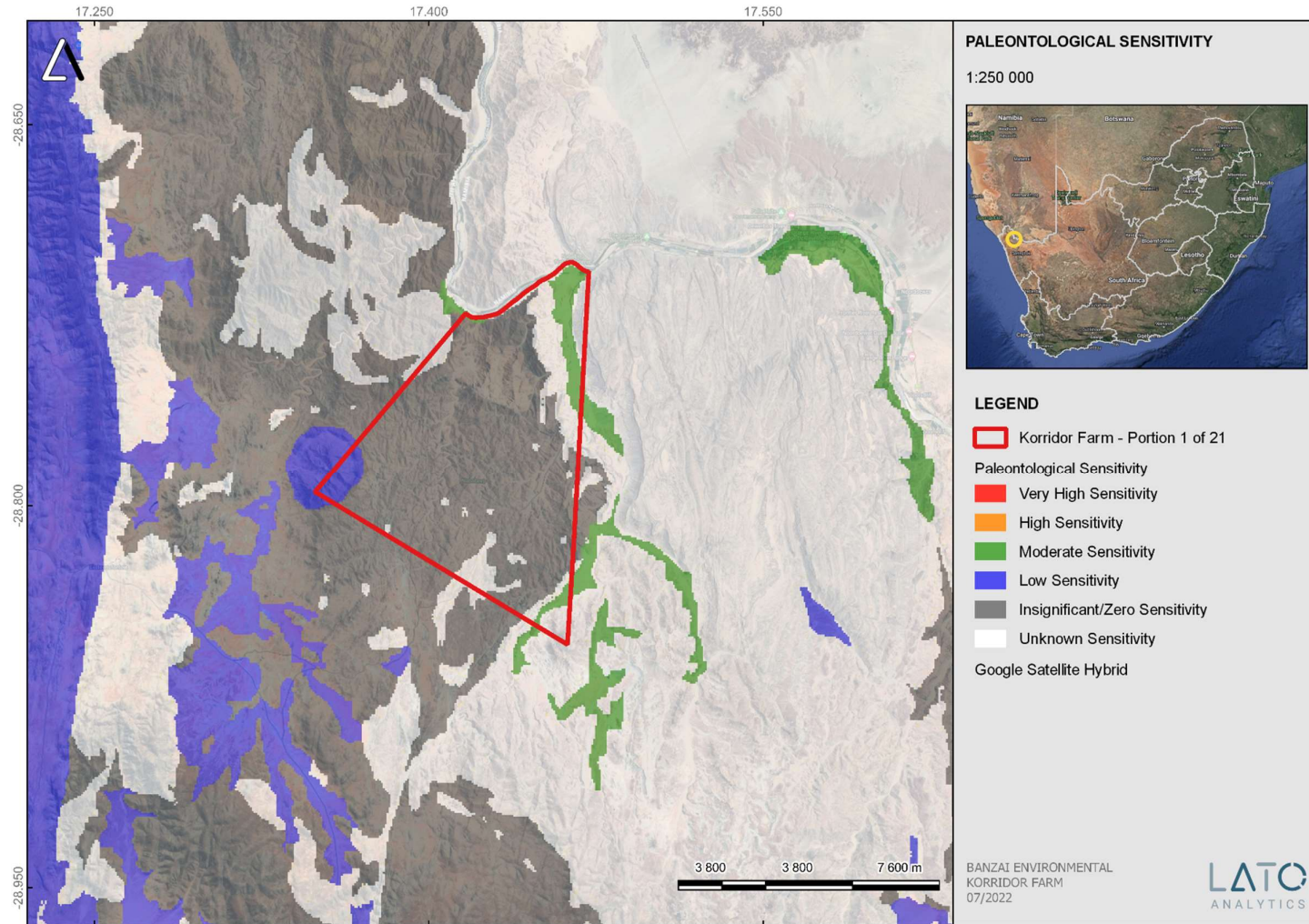


Figure 8: Extract of the 1 in 250 000 SAHRIS PalaeoMap (Council of Geosciences) indicating the location of the proposed development.



According to the SAHRIS Palaeosensitivity map (**Figure 4**) the proposed development is underlain by sediments with a Moderate (green), Low (blue), Zero (grey) and unknown (white) Palaeontological Significance.

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.

6 GEOGRAPHICAL LOCATION OF THE SITE

The property is located approximately 137 km northeast of Port Nolloth in the Northern Cape Province.

The following information was obtained from Milnex CC (**Table 4**).

**Table 4: Locality of the proposed development**

Farm Name:	1) Portion 1 of the farm Korridor 21 Registration division: Namaqualand RD Extent: 10804.3026 hectares Title Deed: T97400/1994CTN Province: Northern Cape
Application area (Ha)	10804.3026 Ha
Magisterial district:	Namakwa District Municipality Nama Khoi Local Municipality
Registration Division	Namaqualand
Distance and direction from nearest town	The property is located approximately 53km North of East of Port in the Northern Cape Province.
21 digit Surveyor General Code for each farm portion	1) C05300000000002100001
Minerals applied for	Diamonds Alluvial (DA) Diamonds General (D) Diamonds in Kimberlite (DK) Diamonds (DIA)
Locality map	Attach a locality map at a scale not smaller than 1:250000 and attach as Appendix 2
Description of the overall activity. (Indicate Mining Right, Mining Permit, Prospecting right, Bulk Sampling, Production Right, Exploration Right, Reconnaissance permit, Technical co-operation permit, Additional listed activity)	<p>1) Listing Notice 1 (GNR 327), Activity 19: "The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from: i) a watercourse;"</p> <p>2) Listing Notice 1 (GNR 327), Activity 20: "Any activity including the operation of that activity which requires a prospecting right in terms of section 16 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including— (a) associated infrastructure, structures and earthworks, directly related to prospecting of a mineral resource[.]; or [including activities for which an exemption has been issued in terms of section 106 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)] (b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing;</p> <p>3) Listing Notice 1 (GNR 327), Activity 27: "The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation."</p> <p>4) Listing Notice 3 (GNR 324), Activity 12: "The clearance of an area of 300 square metres or more of indigenous vegetation. (g) Northern Cape: (i) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (ii) Within critical biodiversity areas identified in bioregional plans; (iv) On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.</p> <p>Prospecting right without bulk sampling for the prospecting of Diamonds Alluvial (DA), Diamonds General (D), Diamonds in Kimberlite (DK) and Diamonds (DIA) including associated infrastructure, structure and earthworks. Application of Prospecting right without bulk sampling.</p>

**Table 5: Farm coordinates**

Farm	Latitude	Longitude
Portion 1 of the Farm Korridor 21	28°43'27.03"S	17°24'59.15"E
	28°47'40.86"S	17°20'56.62"E
	28°51'16.59"S	17°27'44.27"E
	28°42'34.23"S	17°28'17.45"E
	28°42'15.72"S	17°27'49.18"E

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 Palaeontological impact assessment reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps. Scientific research articles of research conducted in the area is also sourced and included in the Impact Assessment.

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 generally 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 which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **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).
- A Google Earth map with polygons of the proposed development was obtained from Milnex cc.
- 1: 250 000 Upington 2816 Alexander Bay Geological Map (2011) (Council of Geosciences, Pretoria)
- Shape files produced by the Council of Geosciences (Pretoria).

9 IMPACT ASSESSMENT METHODOLOGY

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



- Construction.
- Operation; and
- Decommissioning.

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

Table 6: 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		
<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 = X.</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 Summary of Impact Tables

Loss of fossil heritage will be a negative impact. Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures, the damage or destruction of any palaeontological materials will be permanent. Impacts



on palaeontological heritage during the construction phase could potentially occur and are regarded as having a high probability. As fossil heritage will be destroyed the impact is irreversible. The significance of the impact occurring will be high pre-mitigation and low post-mitigation.

Table 7: Summary of Impact Tables

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

10 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by sediments of the Orange River Group, Vioolsdrif and Richtersveld Suite is Zero as it is igneous in origin while that of the Nama Group moderate (Almond and Pether, 2009; Almond *et al.*, 2013). However, many fossil taxa are known from only a single fossil and, thus, any fossil material is potentially highly significant. 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 **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that suitable mitigation (recording and collection) can be carried out

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

11 CHANCE FIND PROTOCOL

The 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 No 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”.

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

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

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when construction activities accidentally uncover 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.

11.2 CHANCE FIND PROCEDURE

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.



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

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Appendix A

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 26 years in Palaeontology

EDUCATION: B.Sc Botany and Zoology, 1988
University of the Orange Free State
B. Sc (Hons) Zoology, 1991
University of the Orange Free State
Management Course, 1991
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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–currently

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