PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED PROSPECTING RIGHT WITH BULK SAMPLING FOR THE PROSPECTING OF DIAMONDS ALLUVIAL, DIAMONDS GENERAL & DIAMONDS IN KIMBERLITE INCLUDING ASSOCIATED INFRASTRUCTURE, STRUCTURE AND EARTHWORKS ON THE REMAINING EXTENT, REMAINING EXTENT OF PORTION 1 (FIJNDOORNS), PORTION 9 (PORTION OF PORTION 2) OF THE FARM MARAETCHESFONTEIN 54 AND REMAINING EXTENT OF PORTION 4 OF THE FARM RIETPUT 60, REGISTRATION DIVISION: HO, NORTH WEST PROVINCE

(NC30/5/1/1/2/13113PR)

Compiled for:

Milnex CC

Potchefstroom Office

Waterberry Street, Waterberry Square, 1st Floor, Office 5B

P.O. Box 1086, 2780Tel: 018 011 1925 | Fax: 087 231 7021

Email: info@milnex-sa.co.za

www.milnex.sa.co.za

Prepared by

Banzai Environmental

December 2021

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.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE: 

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

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii- iii 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	Section 1, 6 and 10	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;		
(g) An identification of any areas to be avoided, including buffers	Section 1, 5 and 10	
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation	Section 11	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities, or portions	Section 1 and 10	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by Milnex CC to conduct the Palaeontological Desktop Assessment (PDA) assessing the proposed Prospecting Right with Bulk Sampling for the Prospecting of Diamonds Alluvial, Diamonds General & Diamonds in Kimberlite including associated infrastructure, structure and earthworks on the Remaining Extent, Remaining Extent of Portion 1 (Fijndoorns), Portion 9 (Portion of Portion 2) of the Farm Maraetchesfontein 54 and Remaining Extent of Portion 4 of the Farm Rietput 60, Registration Division: HO, North West Province. This PDA is compiled to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), to confirm if fossil material could potentially be present in the planned development area and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed development is mostly underlain by the Allanridge Formation (Platberg Group, Ventersdorp Supergroup), while a small portion of Quaternary alluvium is present along the riverbed. Sediments of the Ecca Group also underlie the south-eastern margin of the development. According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Allanridge Formation is Low, Quaternary alluvium is Low but locally High while that of the Ecca Group is High. In this development diamond Prospecting is limited to the Allanridge Formation (Platberg Group, Ventersdorp Supergroup) and Quaternary alluvium along the riverbed. For this reason, a Low Palaeontological Sensitivity has been allocated to the proposed development. It is therefore considered that the proposed mining will not lead to detrimental impacts on the palaeontological heritage of the area.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

PLEASE NOTE: The ECO of the operations must be aware of the Chance find Protocol when any operations (construction) enter the Ecca Group.

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

TABLE OF CONTENT

List of Figures

List of Tables

Appendix A: CV

1 INTRODUCTION

Milnex 189 CC was commissioned by JH Delwery (Pty) Ltd as the independent environmental consultant to conduct the Scoping and EIA process for a Prospecting Right Application for the prospecting of Diamonds Alluvial (DA), Diamonds General (D) and Diamonds in Kimberlite (DK) including associated infrastructure, structure and earthworks on the Remaining Extent, Remaining Extent of Portion 1 (Fijndoorns), Portion 9 (Portion of Portion 2) of the farm Maraetchesfontein 54 and Remaining Extent of Portion 4 of the farm Rietput 60, Registration Division: HO, North West Province (**Figure1-3**).

Diamonds originates in the earth's mantle (aka the diamond stability zone) about 150 km below the earth's surface at temperatures above 1000 degrees Celsius and at pressures between 45 and 60 kilobars. Magma transports the diamonds from the diamond stability zone to the earth's surface during volcanic eruptions. Close to the earth's surface lighter rock normally disintegrates, and the carrot shaped kimberlite explodes in all directions. Occasionally kimberlites fracture at the surface and forms dikes some distance away from where the original volcanic eruption took place. As time passes surface sediment deposits and vegetation mantles the igneous deposits.

1.1 Background

Studies by the Council of Geosciences in 2015-2016 have indicated that diamondiferous gravels are mainly distributed in the following three areas:

- area underlain by dolomite from the east of Ventersdorp towards Lichtenburg and Bakerville and beyond (VLB) where diamondiferous gravels are clustered along meandering and straight runs as well as sinkholes.
- The Lichtenburg–Delareyville–Bloemhof–Klerksdorp–Lichtenburg area (LDBKL), generally underlain by Dwyka Group tillite and Ventersdorp Supergroup basalt. These diamonds are present in ancient and current river channels, banks, or terraces and as colluvial and elluvial deposits.
- areas linked with the Vaal River terraces and gravels. Diamonds are present along the gravels of the current river and alongside older gravels along ancient terraces.

Information provided by Milnex CC

The Orange-Vaal River system is recognised as the primary secondary resource for alluvial diamond. 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. Studies have shown that majority of the alluvial diamonds in gravel deposits along all the terraces along the Orange River are derived from two distinct gravel horizons. These comprise an upper deflation deposit (Rooikoppie) and an underlying (Primary fluvial-alluvial) gravel unit.

Primary fluvial-alluvial gravel deposits

The primary palaeo-fluvial succession comprises various proportions of gravel, sand, and silt, typically with a basal gravel unit of up to 2m in thickness and an overlying finer-grained unit of up to 6m (the so-called "middlings" gravels). The poorly sorted gravels vary from pebble to cobble gravels, generally with a fair percentage of boulders (rarely +1m diameter). Interbedded sandy or granule beds and lenses occur frequently in sandier, matrix supported gravel successions.

Deflation of 'Rooikoppie' deposits

These deposits represent derived gravel and consist mainly of well-rounded and polished siliceous pebbles and reddish coloured sand. The clastic material is believed to originate the fluvial alluvial gravel units and consists of its most resistant components, in particular chert, agate, jasper, quartzite, and vein quartz. Due to the decomposition and winnowing of the less resistant clastic and matrix material there has been a substantial concentration of the more durable components in the original gravel, including diamonds.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

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

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

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 m^2 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 m^2 in extent.
  or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

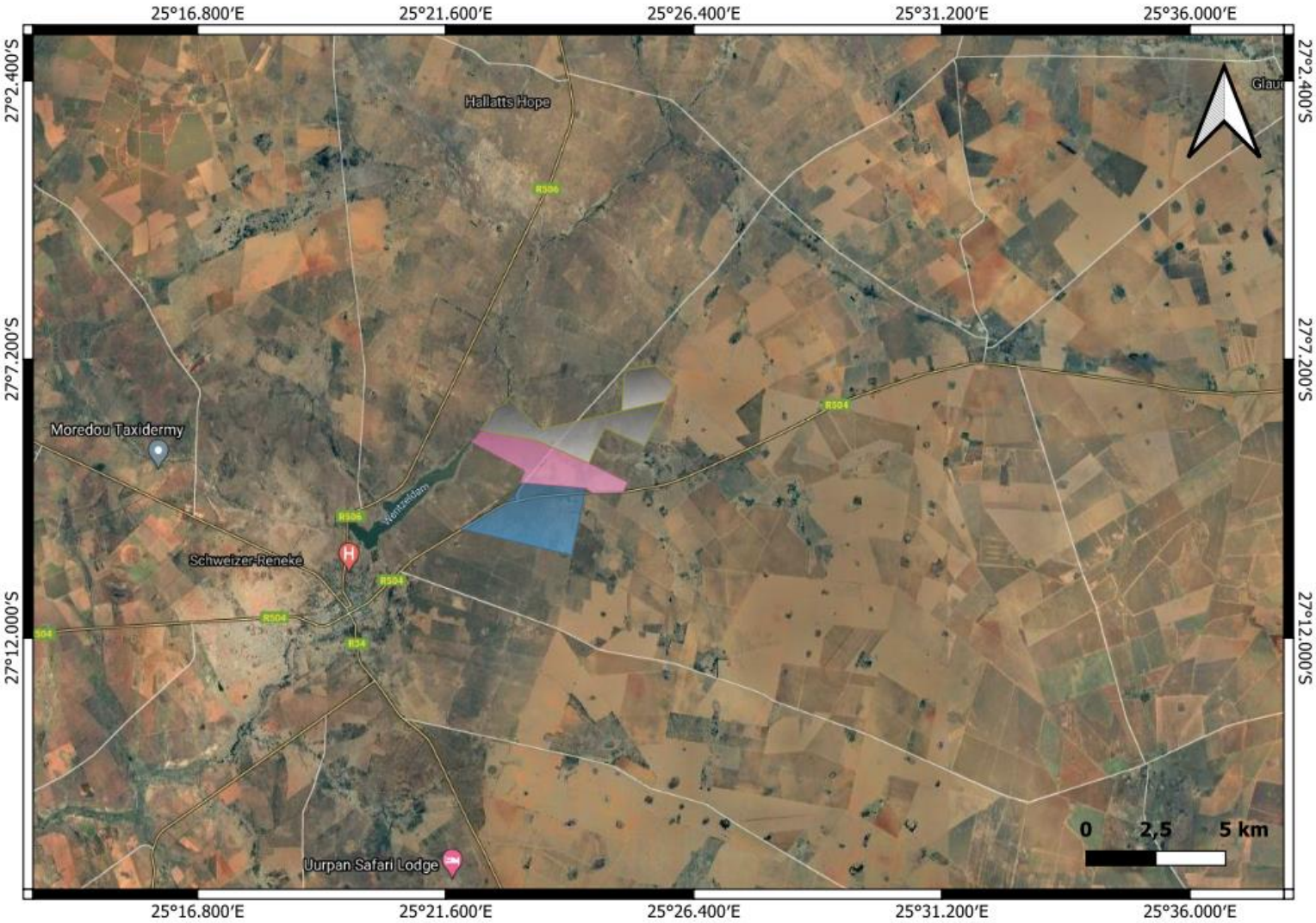


Figure 1: Google Earth Image (2021) indicating the locality of the proposed development near Schweizer-Reneke in the Northern Cape.

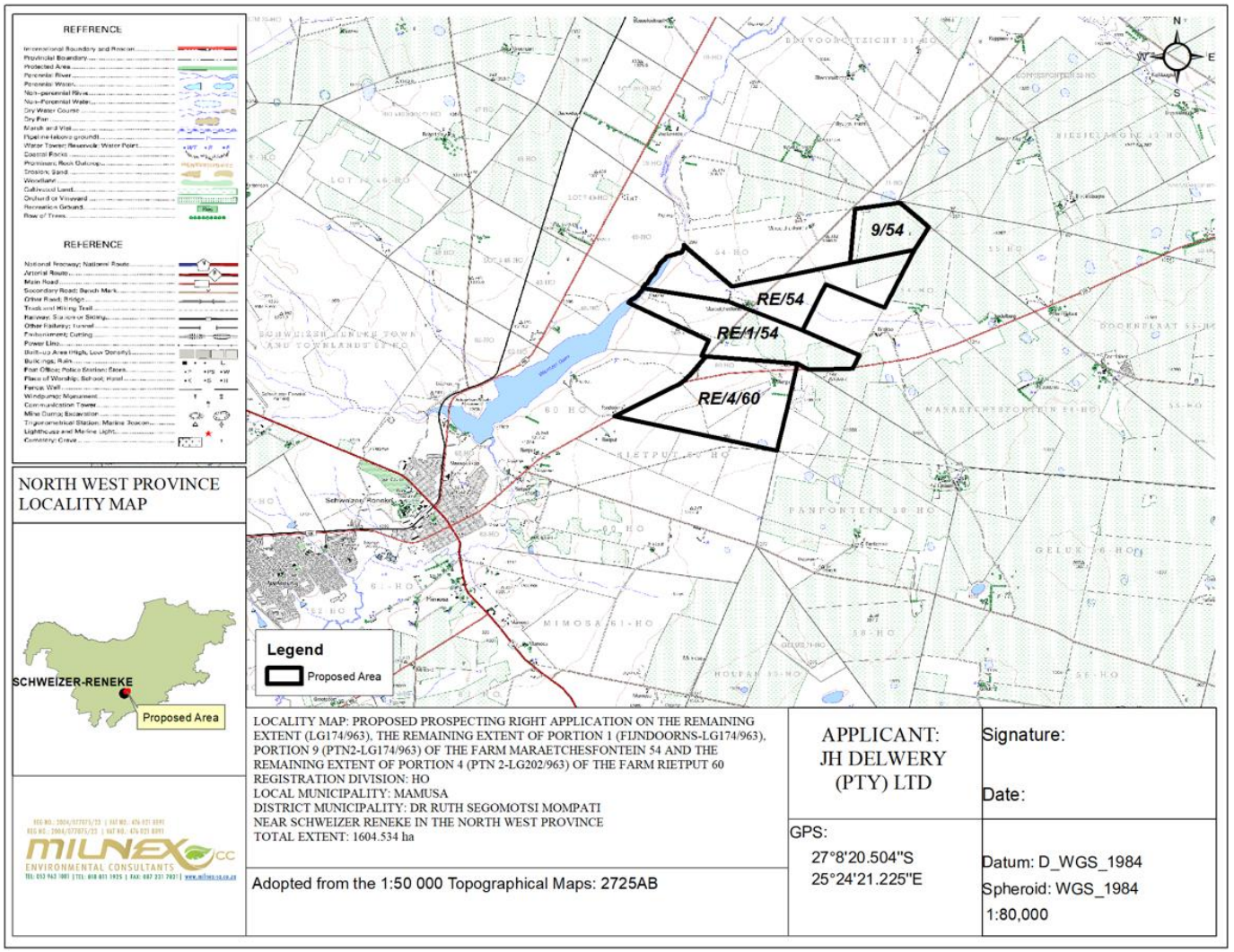


Figure 2: Locality of the proposed prospecting area near Schweizer Reneke in the Northern Cape..

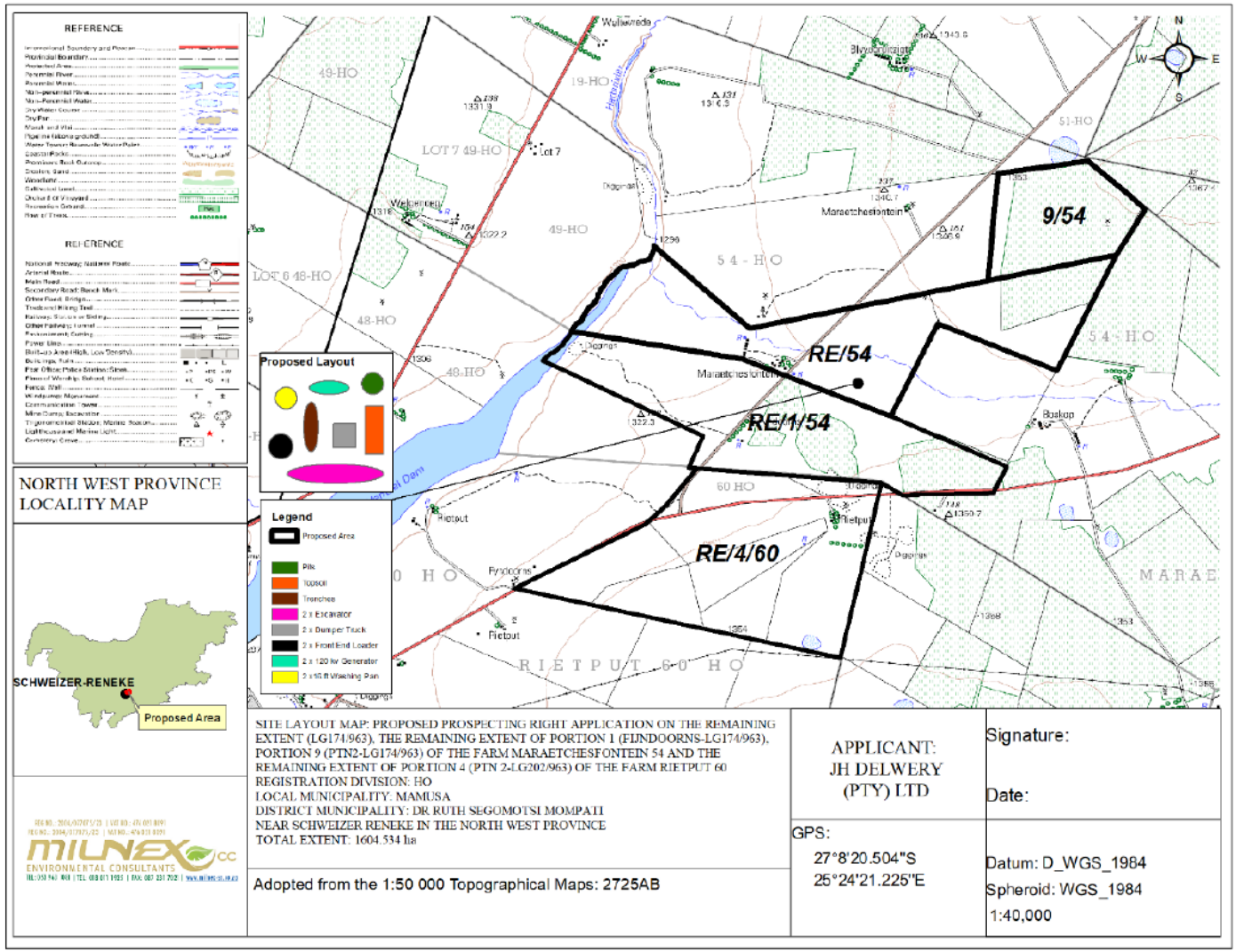


Figure 3:Site Plan

4 OBJECTIVE

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

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

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

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

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

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation, and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.

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

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Prospecting Right Application is depicted on the 2724 Christiana Geological map (1993) (Council of Geoscience, Pretoria) (**Figure 4**). According to this map the proposed development is mostly underlain by the Allanridge Formation (**Ra-dark green**) (Platberg Group, Ventersdorp Supergroup), a small portion of Quaternary alluvium (**single bird figure, yellow**) among the riverbed while sediments of the Ecca Group (**Pe, light green**) underlie the south eastern margin of the development.

Four basins developed on the Kaapvaal Craton about 3000 to 2100 million years ago. The Ventersdorp Supergroup was the third Basin to develop and provides an exceptional volcano-sedimentary supracrustal record. The Ventersdorp Supergroup comprise of the biggest and most wide-spread system of volcanic rocks in the Kaapvaal Craton.

The best exposures of the Ventersdorp Supergroup are in the North West Province, Northern Cape Province as well as Gauteng and southern Botswana. This Supergroup consists of the Klipriviersberg Group (oldest) which is overlain by the Platberg Group, followed by the sedimentary Bothaville Formation (**Rb**) and the **volcanic Allanridge Formation** (**Ra**) (uppermost Ventersdorp unit, youngest Formation). The Allanridge Formation comprise mostly of light-greenish grey porphyritic lava, dark-green amygdaloidal lava, and pyroclastic rocks. The lavas are approximately 2700 million years old and comprise of basaltic andesites. The Allanridge Formation is not known to be fossiliferous.

The Platberg Group is subdivided in four formations i.e., the Kameeldoorns-, Goedgenoeg-, Makwassie-, and Rietgat Formations. These formations consist of heterogenous rock varying from chemical and classic sediments, to felsic and mafic volcanics. These rocks were deposited in linear vault troughs during grabed development (Visser et al, 1975-1976, Buck, 1980). These deep intermontane grabens formed in older underlying andesitic terranes and formed areas of debris and scree flows as well as alluvial fan deposits. In these fine-grained chemical and terrigenous sediments, ooids and stromatolites accumulated under lacustrine conditions (Buck, 1980). In time fluvial processes prevailed causing widespread prograding of alluvial fans across basins. The Rietgat Formation consist of alternating sedimentary and volcanic rocks which varies in thickness across the basin.

The Vryburg Formation overlies the Ventersdorp Supergroup and is interpreted as a fluvial to marginal marine deposit that comprise of basal transgressive conglomerate and quartzites, subordinate stromatolitic carbonates and shales (Eriksson et al., 2006).

Quaternary alluvial gravels also known as high level gravels is mapped along both the Vaal and Orange River. These gravels have been associated with diamond mining (De Wit *et al*., 2000). The fossil assemblages of the Quaternary Formations are generally low in diversity and occur over a wide range but has a high Paleontologically Sensitivity. 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 skeletons have been uncovered where the depositional settings in the past were wetter.

The Ecca Group (**Pe**) present in the south eastern portion of the development comprise of the Volksrust and Vryheid Formations. The Volksrust formation is generally an argillaceous section which interfingers with the overlying Beaufort Group and underlying Vryheid Formation. The

Volksrust Formation comprise of black to grey silty shale. Bioturbated silt and sandstone lenses and beds towards the lower and upper boundaries are typically thin. Carbonate, concretions as well as phosphate beds is fairly common. The thickness, large lateral extent as well as fine-grained lithology implies that this formation represents a transgressive open shelf series which largely consists of mud deposited from suspension. The upper and lower margins of this formation most probably have been deposited in lucastrine to lagoonal and shallow coastal environments.

Fossils, usually present in the shale beds of the Volksrust Formation, comprise of trace fossils while the bivalve *Megadesmus* has been described . These fossils are rarely recorded as they are difficult to find in areas of deep weathering.

The Vryheid Formation comprises of carbonaceous shales and a series of coarse-grained sandstones, interpreted as deltaic sedimentary deposits in localised Graben-induced basins in this part of Kwa-Zulu Natal (Johnson et al, 2006). Recent palaeobotanical studies in the Vryheid Formation include that of Bordy and Prevec (2008) and Prevec *et al.* (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum* sp., *Scutum* sp., *Ottokaria* sp., *Estcourtia* sp., *Arberia* sp., *Lidgetonnia* sp., *Noeggerathiopsis* sp., *Podocarpidites* sp as well as more than 20 Glossopteris species.

In the past, palynological studies have focused on the coal-bearing successions of the Vryheid Formation and include articles by Aitken (1994, 1998), and Millsteed (1994, 1999), while recent studies focussed on the Witbank Coalfield were conducted by Götz and Ruckwied (2014).

Bamford (2011) is of the opinion that only a small amount of data has been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines. When plant fossils do occur, they are usually abundant. According to Bamford, it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Fish scales and non-marine bivalves have been reported. Trace fossils are found abundantly but the diversity is low. The mesosaurid reptile, *Mesosaurus* has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare and irregular occurrence of fossils in this biozone, a single fossil may be of scientific value as many fossil taxa are known from a single fossil.

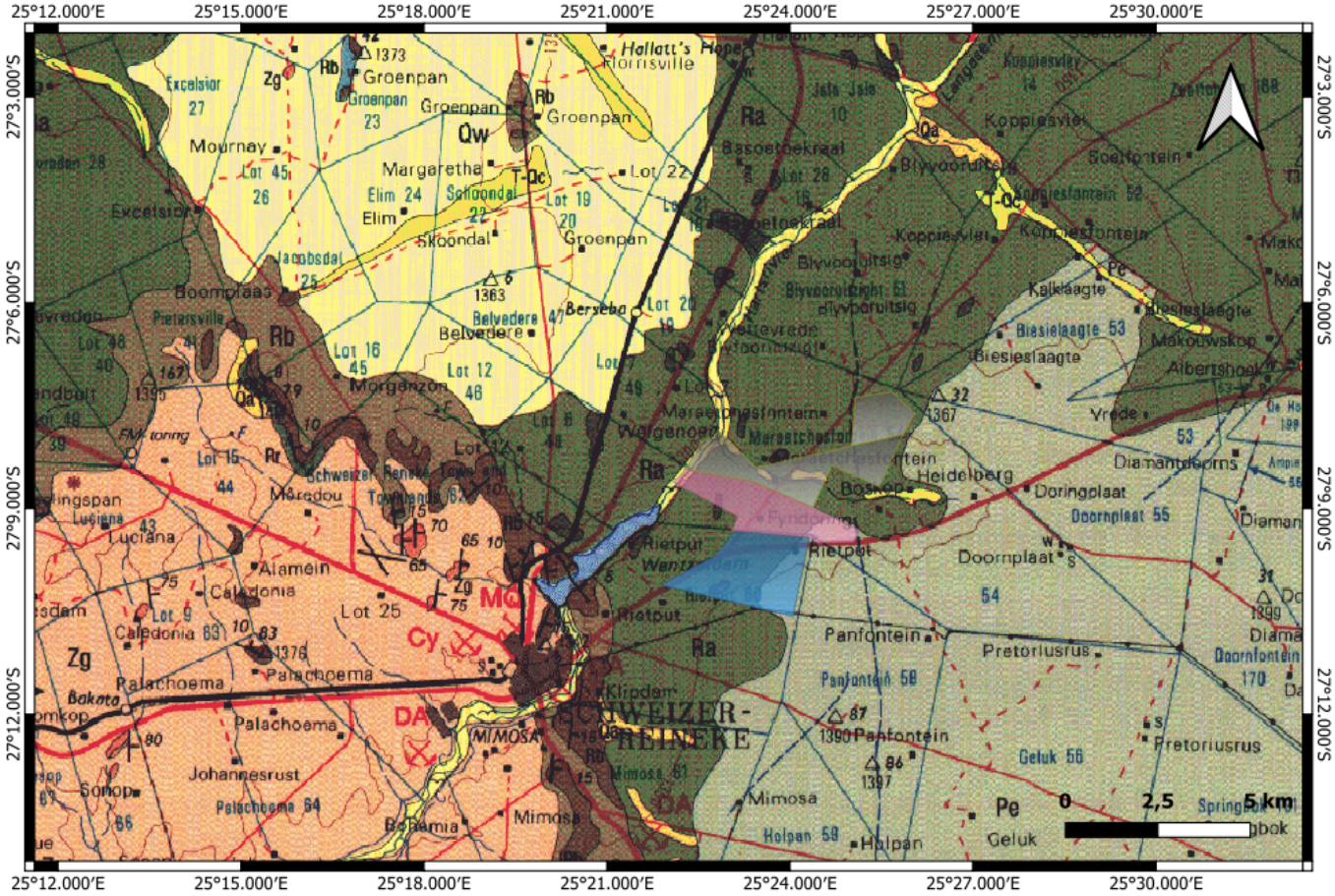
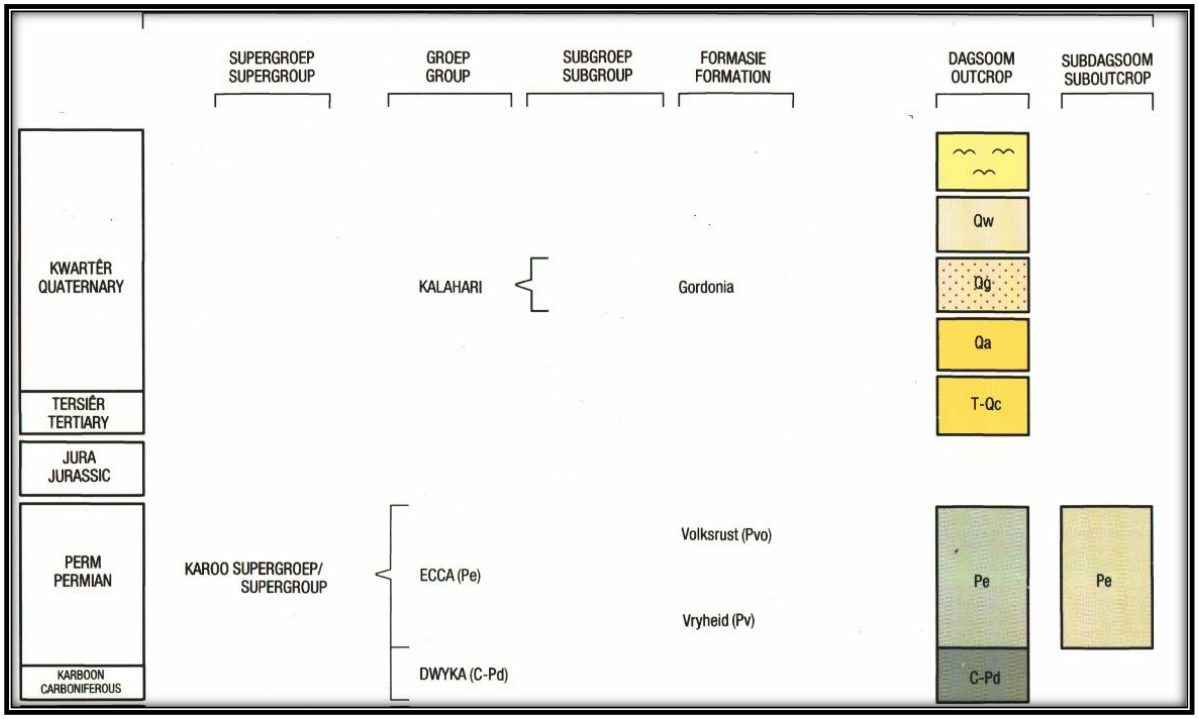


Figure 4: Extract of the 1:250 000 2724 Christiana Geological map (1993) (Council of Geoscience, Pretoria) indicating the proposed development in grey, pink, and blue.

Table 2:Legend of the 1:250 000 2724 Christiana Geological map (1993) (Council of Geoscience, Pretoria)



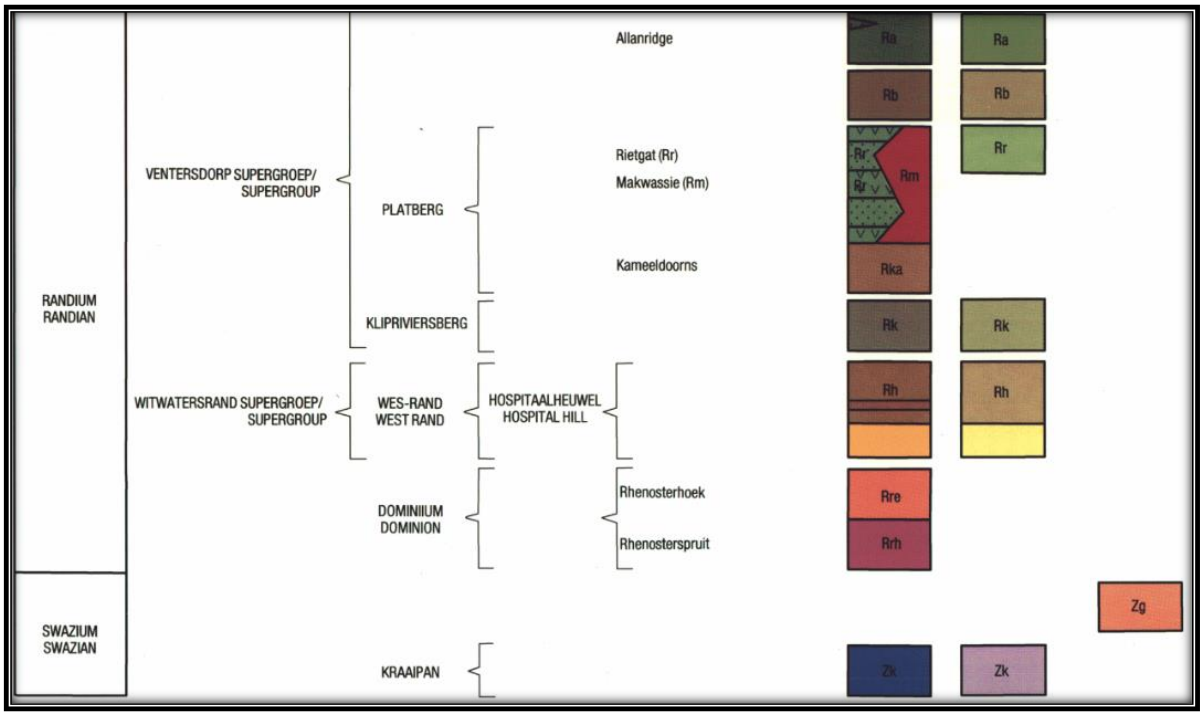


Table 3:Geology and Lithology of the proposed development and surrounding sediments

Symbol	Group/Formation	Lithology	Age
		Alluvial	Quaternary
Pe	Ecca Group, Karoo Supergroup, Volksrust and Vryheid Formation	Sandsrone and shale	Permian
Ra	Allanridge Formation, Platberg Group, Ventersdorp Supergroup	Andesite in places amygdaloidal and/or porphyritic; quartzite and conglomerate lens near button 	Radian
Rb	Bothaville Formation, Platberg Group, Ventersdorp Supergroup	Quartzite, frit conglomerate, pyroclastic breccia, tuffaceous sediments, cherty or calcareous in places	Radian
Zg		Porphyritic granite	Swazian

Mining activity –(DA) Diamonds

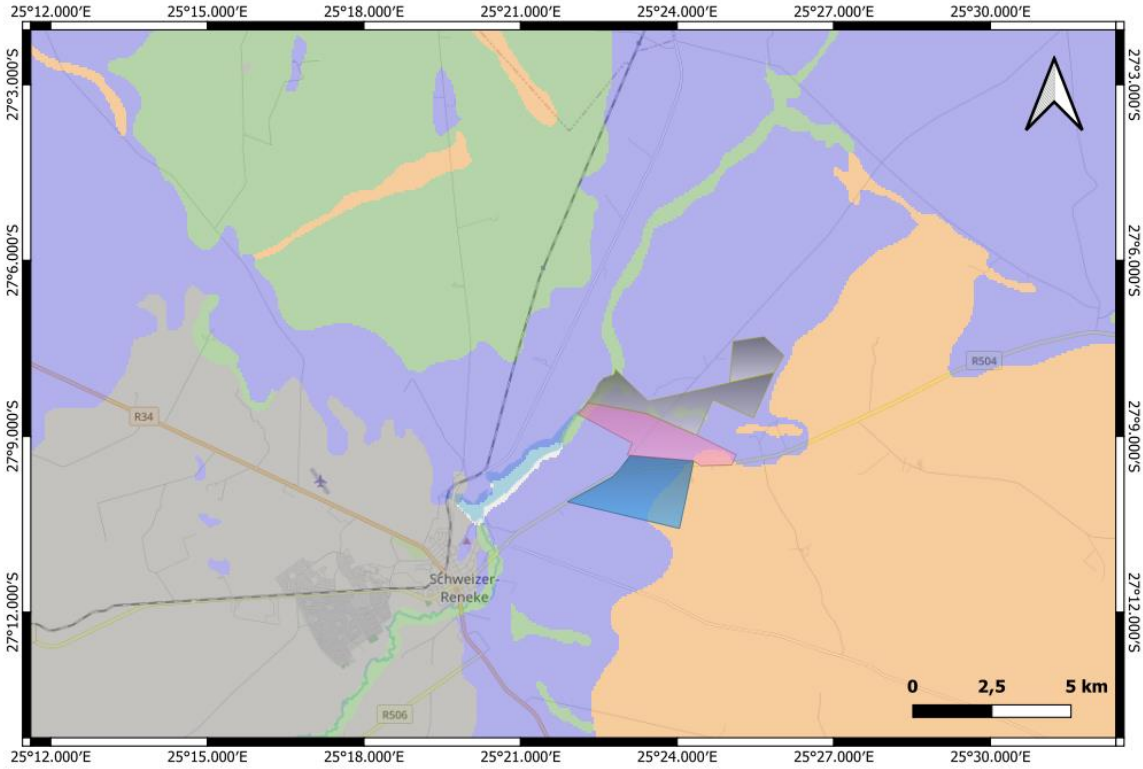


***Figure 5**: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in red.*

Proposed development is indicated in orange. According to the SAHRIS Palaeosensitivity map (**Figure 5)** the proposed development is underlain by sediments with a High (orange) and Low (blue) Palaeontological Significance.

Colour	**Sensitivity**	**Required Action**
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	**HIGH**	**desktop study is required and based on the outcome of the desktop study; a field assessment is likely**
GREEN	MODERATE	desktop study is required
BLUE	**LOW**	**no palaeontological studies are required however a protocol for finds is required**
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required

WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

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

However, according to the National Environmental Screening tool https://screening.environment.gov.za/screeningtool) the sensitivity of the proposed development varies from High to Very High (**Figure 6**). This is in contrast with the findings of the SAHRIS PalaeoMap (Figure 5).

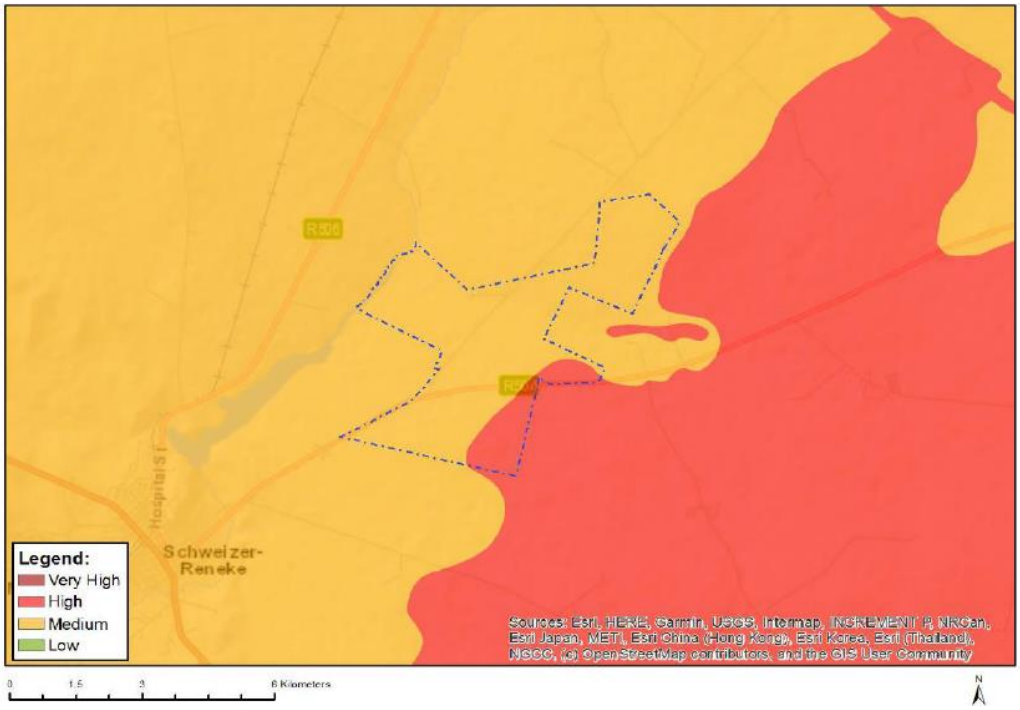


Figure 6: *Environmental Screening tool indicates that the Palaeontological Sensitivity of the proposed development varies from High to Very High.*

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is about 12.7km North-East of Schweizer-Reneke on the R504 towards Wolmaransstad in the North West Province

Farms		Longitude	Latitude
1) Remaining Extent of the farm Maraetchesfontein 54 2) Remaining Extent of portion 1 (Fijndoorns) of the farm Maraetchesfontein 54 3) Portion 9 (portion of portion 2) of the farm Maraetchesfontein 54 4) Remaining Extent of Portion 4 of the farm Rietput 60	0	25° 25' 3.959" E	27° 7' 23.233" S
	1	25° 25' 39.605" E	27° 7' 18.398" S
	2	25° 26' 2.224" E	27° 7' 37.458" S
	3	25° 25' 50.774" E	27° 7' 55.427" S
	4	25° 25' 27.356" E	27° 8' 41.148" S
	5	25° 24' 40.665" E	27° 8' 22.657" S
	6	25° 24' 22.116" E	27° 8' 59.040" S
	7	25° 25' 7.540" E	27° 9' 19.082" S
	8	25° 25' 2.764" E	27° 9' 28.210" S
	9	25° 24' 33.436" E	27° 9' 30.131" S
	10	25° 24' 29.598" E	27° 9' 30.236" S
	11	25° 24' 18.527" E	27° 9' 25.308" S
	12	25° 24' 10.612" E	27° 10' 0.096" S
	13	25° 24' 2.284" E	27° 10' 34.472" S
	14	25° 21' 53.603" E	27° 10' 7.169" S

	15	25° 22' 45.020" E	27° 9' 41.892" S
	16	25° 22' 53.048" E	27° 9' 34.563" S
	17	25° 23' 5.746" E	27° 9' 19.784" S
	18	25° 23' 2.457" E	27° 9' 19.520" S
	19	25° 23' 8.125" E	27° 9' 7.030" S
	20	25° 22' 13.796" E	27° 8' 41.408" S
	21	25° 22' 4.709" E	27° 8' 37.122" S
	22	25° 22' 8.603" E	27° 8' 34.007" S
	23	25° 22' 12.298" E	27° 8' 31.084" S
	24	25° 22' 15.056" E	27° 8' 27.482" S
	25	25° 22' 17.425" E	27° 8' 23.428" S
	26	25° 22' 20.344" E	27° 8' 20.650" S
	27	25° 22' 22.759" E	27° 8' 16.555" S
	28	25° 22' 25.928" E	27° 8' 13.241" S
	29	25° 22' 27.749" E	27° 8' 8.941" S
	30	25° 22' 30.802" E	27° 8' 4.825" S
	31	25° 22' 33.721" E	27° 8' 2.375" S
	32	25° 22' 37.919" E	27° 8' 0.109" S
	33	25° 22' 42.346" E	27° 7' 58.480" S
	34	25° 22' 46.294" E	27° 7' 57.469" S
	35	25° 22' 48.480" E	27° 7' 53.498" S
	36	25° 23' 26.421" E	27° 8' 24.397" S
	37	25° 24' 30.236" E	27° 8' 11.788" S
	38	25° 25' 0.133" E	27° 8' 5.503" S

7 METHODS

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

7.1 Assumptions and Limitations

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

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

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

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1:250 000 2724 Christiana Geological map (1993) (Council of Geoscience, Pretoria)
- A Google Earth map with polygons of the proposed development was obtained from Milnex CC.

9 IMPACT ASSESSMENT METHODOLOGY

9.1 Impact Rating System

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

• Construction

• Operation

• Decommissioning

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

Table 4:*The rating system*

NATURE

Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
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.** 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

9.1.1 Summary of Impacts

Only the site will be affected (1). It is unlikely that the impact will occur (1). The expected duration of the impact is assessed as potentially permanent to long term (4). The impact on fossil heritage will be irreversible and a complete loss of fossil heritage will take place (4). The cumulative effect of the impact will be low (2). The magnitude of the impact happening will be low (1)

The Impact significance will therefore be a negative low Impact.

10 FINDINGS AND RECOMMENDATIONS

The proposed development is mostly underlain by the Allanridge Formation (Platberg Group, Ventersdorp Supergroup), while a small portion of Quaternary alluvium is present along the riverbed. Sediments of the Ecca Group also underlie the south-eastern margin of the development. According to the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Allanridge Formation is Low, Quaternary alluvium is Low but locally High while that of the Ecca Group is High. In this development diamond Prospecting is limited to the Allanridge Formation (Platberg Group, Ventersdorp Supergroup) and Quaternary alluvium along the riverbed. For this reason, a Low Palaeontological Sensitivity has been allocated to the proposed development. It is therefore considered that the proposed mining will not lead to detrimental impacts on the palaeontological heritage of the area.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

PLEASE NOTE: The ECO of the operations must be aware of the Chance find Protocol when any operations (construction) enter the Ecca Group.

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

11 CHANCE FINDS PROTOCOL

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

11.1 Legislation

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

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

11.2 Background

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

11.3 Introduction

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

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the

absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

11.4 Chance Find Procedure

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

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

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

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Appendix A – Elize Butler CV

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 26 years in Palaeontology

EDUCATION:

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

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

Management Course, 1991
University of the Orange Free State

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

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