

PROPOSED MINING RIGHT AND WASTE MANAGEMENT
LICENCE FOR THE PROPOSED MINING OF GRANITE ON A
PORTION OF ZWART MODDER MOUNTAIN NO. 446 (445) IN THE
KAI! GARIB LOCAL MUNICIPALITY, NORTHERN CAPE
PROVINCE

**DESKTOP STUDY
PALAEOLOGY**

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1. Executive Summary

The study site is underlain mainly by igneous and metamorphic rocks of the Namaqua-Natal Province that formed or metamorphosed during the Namaqua Orogeny approximately 1200-1000 Mya. These igneous and metamorphic rocks are non-fossiliferous and are of no palaeontological concern.

Quaternary aged red sand, scree, gravelly and sandy soil cover parts of the South-Eastern corner of the study site however, there is a moderate likelihood that these sediments may contain fossils. Elsewhere rare fossils of ostrich eggshells, mollusc shells, isolated bones, root casts, burrows and termitaria were found in Quaternary sedimentary deposits and the possibility of finding similar fossils in the area cannot be excluded. The ECO should follow the guidelines as stipulated under the Chance Find Procedure on p. 13-14 in such an event.

2. Declaration of Independence:

I, Jacobus Francois Durand declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



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3. Introduction

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in inter alia the origin of dinosaurs, mammals and humans.

Fossils are also used to identify rock strata and determine the geological context of the subregion with other continents and to study evolutionary relationships, sedimentary processes and palaeoenvironments. South African fossils were central in the discovery of Gondwanaland and the formulation of the theory of plate tectonics. Fossils are also used to study evolutionary relationships, sedimentary processes and palaeoenvironments.

South Africa has the longest record of palaeontological endeavour in Africa. South Africa was even one of the first countries in the world in which museums displayed fossils and palaeontologists studied earth history. South African palaeontological institutions and their vast fossil collections are world-renowned and befittingly the South African Heritage Act is one of the most sophisticated and best considered in the world.

Fossils and palaeontological sites are protected by law in South Africa. Construction and mining in fossiliferous areas may be mitigated in exceptional cases but there is a protocol to be followed.

This is a Palaeontological Desktop Study which was prepared in line with Regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment.

4. Terms of reference for the report

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(4)** No person may, without a permit issued by the responsible heritage resources authority-
 - (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
 - (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
 - (c) trade in, sell for private gain, export or attempt to export from the republic any category of archaeological or palaeontological material or object, or any meteorite; or
 - (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist with the detection or recovery of metals or archaeological material or objects or use such equipment for the recovery of meteorites.
- **Subsection 35(5)** When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedures in terms of section 38 has been followed, it may-
 - (a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
 - (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
 - (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
 - (d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports.

The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them.

The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A **Palaeontological Desktop Study** – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial photos, etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

A **Phase 1 Palaeontological Impact Assessment** is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large-scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A **Phase 2 Palaeontological Mitigation** involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before

and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before Phase 2 may be implemented.

A **'Phase 3' Palaeontological Site Conservation and Management Plan** may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

5. Details of study area and the type of assessment:



Figure 1: Google Earth photo indicating the study site (white polygon)

The study site is situated approximately 42 km northeast of Pofadder.

The study site covers part of the northwestern slope of the Zwartmodder Mountain (see Fig. 1).

The relevant literature and geological maps for the study site, in which the development is proposed to take place, have been studied for a Desktop Report.

6 Geological setting of the study area

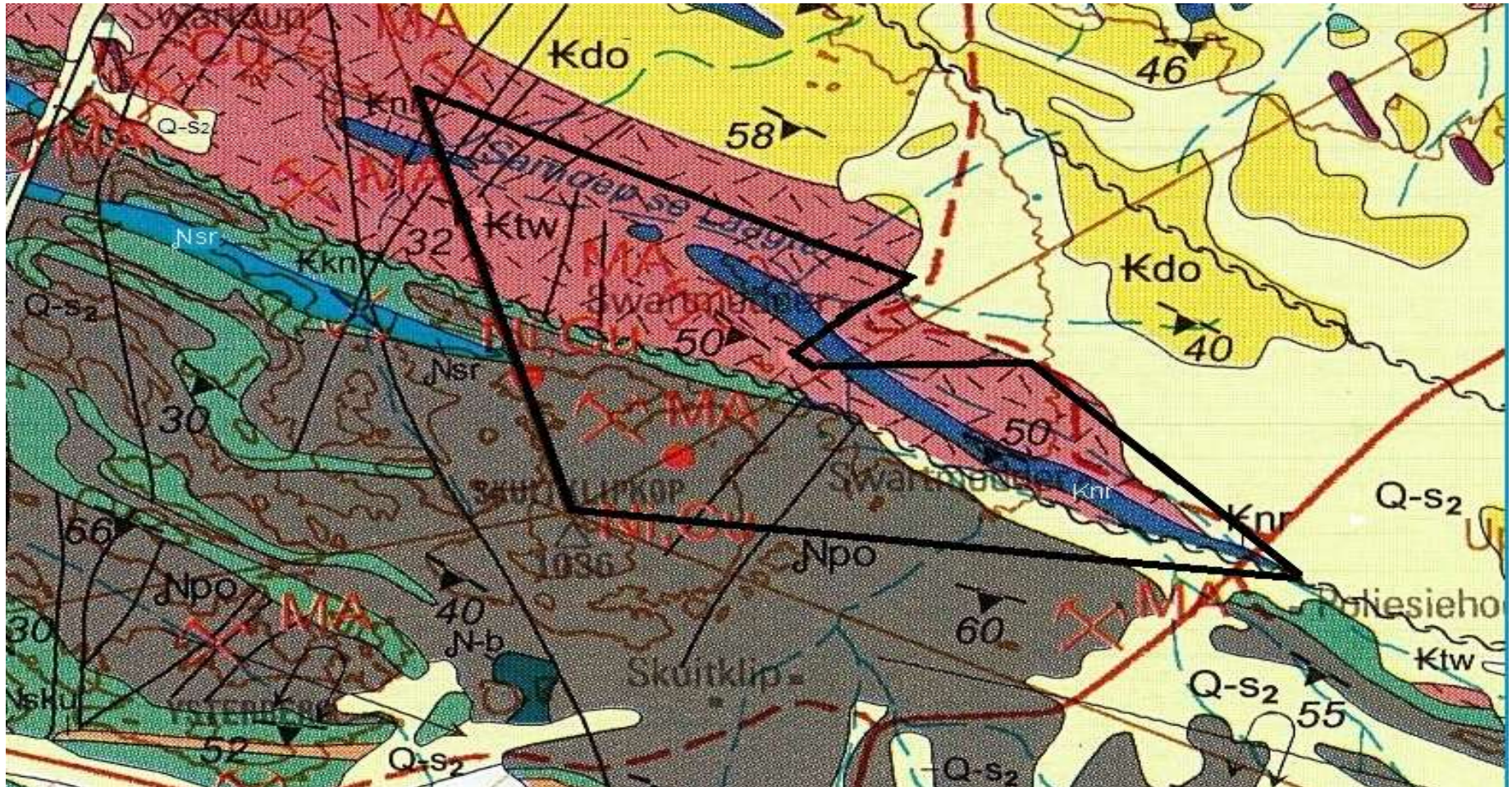


Figure 2: Geological Map of the study site and surroundings. Adapted from 2828 ONSEPKANS 1: 250 000 Geology Map (Council for Geoscience, 2007) The study site is represented by the black polygon

Table 1: Geological Map legend:

	Lithology	Stratigraphy		Age	
Q-s ₂	Red sand, scree, gravelly and sandy soil			Quarter-nary	
Nsk	Course to megacrystic biotite granite dark-grey granodiorite	Skuitklip Granite	Namaquan	Mokolian	
Nsr	Course-grained, biotite-bearing enderbite and charno-enderbite	Swartoup Enderbite			
Nb	Amphibolite, metagabbro				
Npo	Red-brown-weathering biotite-poor augen gneiss	Polieshoek Granite			
Kdo	Fine- to medium-grained garnet-bearing leucogneiss	De Bome Gneiss	Kheisian		
Ktw	Megacrystic garnetiferous biotite gneiss	Twakputs Gneiss			Koelmanskop Metamorphic Suite
Knr	Kinzigite, migmatitic biotite-garnet metapelite	Narries Subsuite			
Kkn	Kinzigite, garnet-bearing metapelitic rocks	Koenap Formation of the Arribees Group			

The northern to eastern half of the study site is underlain by the megacrystic garnetiferous biotite gneiss of the Twakputs Gneiss Formation that has been intruded by the kinzigite and migmatitic biotite-garnet metapelite of the Narries Subsuite. The kinzigite and garnet-bearing metapelitic rocks of the Koenap Formation of the Arribees Group occur in the middle of the study site and the red-brown-weathering biotite-poor augen gneiss of the Polieshoek Granite occurs in the southern part of the study site. These rocks form part of the igneous and metamorphic rocks of the Namaqua-Natal Province that formed or metamorphosed during the Namaqua Orogeny approximately 1200-1000 Mya (Moen & Toogood, 2007; Cornell *et al.*, 2009)

Quaternary aged red sand, scree, gravelly and sandy soil cover parts of the southeastern corner of the study site (see Fig. 2)

7. Paleontological Assessment

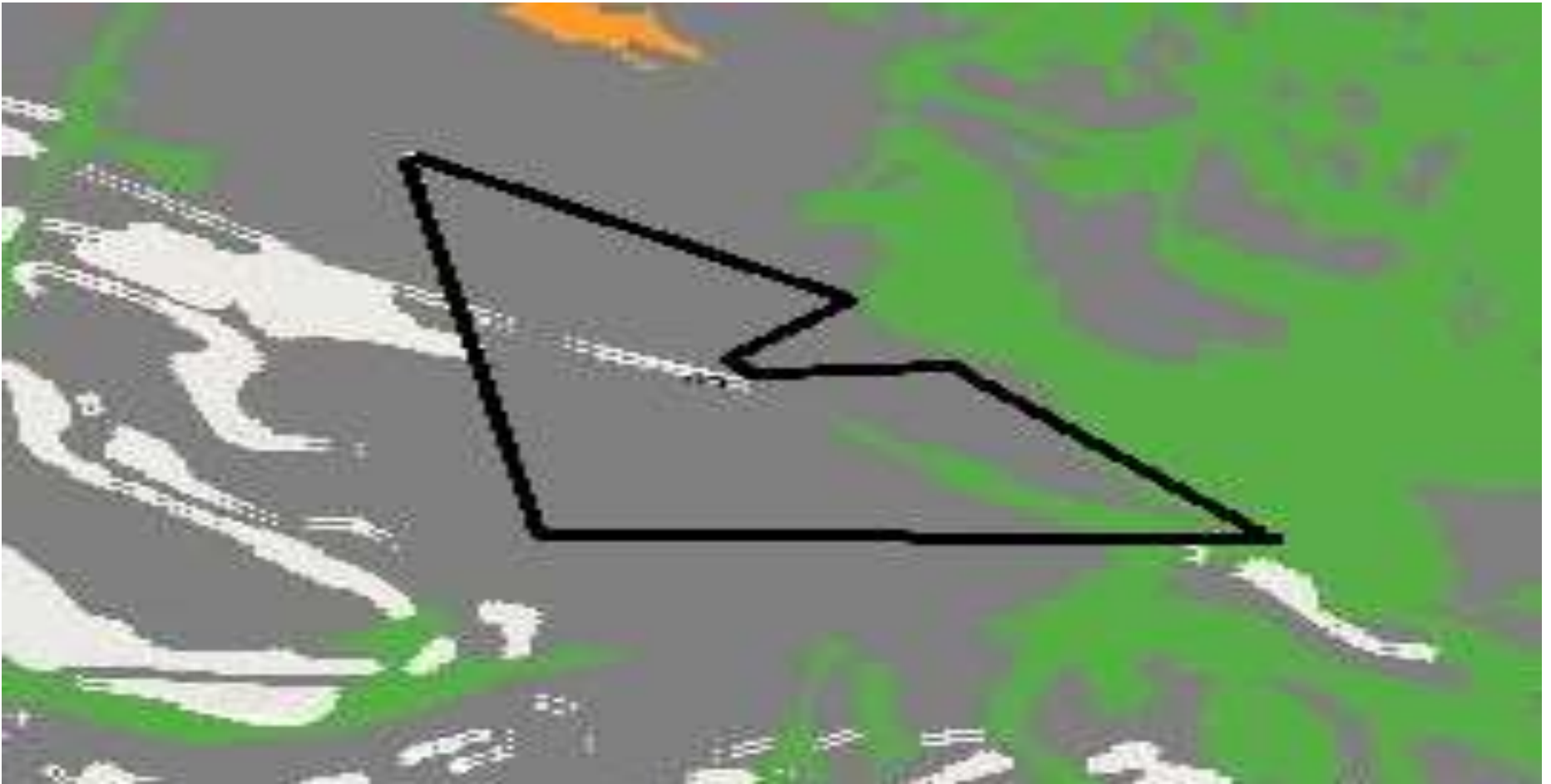


Figure 3: Palaeontological sensitivity map of the study site (black polygon) and surroundings (SAHRA, 2021)

Table 2: Palaeontological Map legend

Colour	Palaeontological Significance	Action
ORANGE	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.
GREY	INSIGNIFICANT / ZERO	No palaeontological studies are required.

The study site is mainly underlain by the igneous and metamorphic rocks of the Namaqua-Natal Province that are non-fossiliferous. There is however an area in the southeast of the study site where Quaternary-aged sediments cover the Mokolian-aged rocks of the Namaqua-Natal Province. These sediments are considered to be of Moderate Palaeontological Significance (see Fig. 3).

There is a moderate chance of finding fossils of isolated teeth and bones, ostrich shell fragments, termitaria, burrows, root casts and mollusc shells in the Quaternary-aged red sand, scree, gravelly and sandy soil in this part of the study area (Almond & Pether, 2009).

8. Conclusion and recommendations:

There is a moderate likelihood that the Quaternary-aged sand, scree and gravelly and sandy soil in the south-eastern corner of the study site may contain fossils. Elsewhere rare fossils of ostrich eggshells, mollusc shells, isolated bones, root casts, burrows and termitaria were found in Quaternary deposits (Almond & Pether 2009) and the possibility of finding similar fossils in the area cannot be excluded.

In the event of fossils being discovered in the sands, soils, calcrete or limestone in the study area, the ECO should follow the instructions below. Although disturbed fossils should be collected and stored safely until it can be inspected by a palaeontologist, no attempt should be made to remove such accidentally discovered fossils from the rock by an unqualified person.

PROCEDURE FOR CHANCE PALAEOLOGICAL FINDS

(Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548)

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and any fossil material be unearthed the excavation must be halted.
2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.
3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.
4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.

5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

a. The material is of no value so development can proceed, or:

b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

9. References:

Almond, J. & Pether, J. (2009). Palaeontological Heritage of the Northern Cape. SAHRA Palaeotechnical Report, Cape Town.

Cornell, D.H.; Thomas, R.J.; Moen, H.F.G.; Reid, D.L.; Moore, J.M. & Gibson, R.L. (2009). Namaqua-Natal Province. The Geology of South Africa, Geological Society of South Africa, Johannesburg & Council for Geoscience, Pretoria, pp. 325-379.

Council for Geoscience (2007). 2828 Onseepkand 1: 250 000 Geology Map.

Moen, H.F.G. & Toogood, D.J. (2007). The geology of the Onseepkans area. Explanation to 1: 250 000 geology Sheet 2818, 101 pp. Council for Geoscience, Pretoria.

SAHRA (2021). Palaeosensitivity Map <https://sahris.sahra.org.za/map/palaeo>