Proposed Diamond View – Mapoteng MV Line, Kuruman, Northern Cape

PALAEONTOLOGICAL IMPACT ASSESSMENT

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1. Executive Summary

The site that will be impacted by this development is primarily underlain by dolomitic limestone of the Lime Acres Formation of the Ghaap Plato Formation of the Campbell Rand Subgroup of the Transvaal Supergroup that is potentially Very Highly Palaeontologically Sensitive.

The dolomitic limestone is covered by a layer of sandy soil of the Gordonia Formation of the Kalahari Group that has Moderate Palaeontological Sensitivity in the north while the southern portion is partially covered by rubble of the Mokalanen Formation of the Kalahari Group. The geology of the area is obscured by shallow sandy soils and vegetation. The underlaying dolomite is exposed where ditches were dug for sewage and water pipes and these are marked by blocks of dolomite lining the filled in ditches.

An overview of the literature on the palaeontology and associated geology of the area is given. Although no publications exist that mention fossils from the study site, several palaeontological studies have been done elsewhere on the same geological formations that occur at the study site where stromatolites (fossilised bacterial mats) have been discovered.

The ECO should take responsibility for supervising the development and should follow the Chance Find Procedure (pp.17-18) if a significant fossil discovery, especially extensive and well-preserved stromatolite formations, is made in the dolomite or bones and shells are found in the calcrete in the southern part of the study site.

2. Introduction

The Heritage Act of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of this document is to detail the probability of finding fossils in the study area that may be impacted by the proposed development.

The purpose of this document is to detail the probability of finding fossils in the study area and whether, if indeed there are fossils, what the impact of the mining activities will be on the fossils and fossil sites.

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 played a crucial role 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 Impact Assessment which was prepared in line with Regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involved a site visit where the palaeontologist evaluated the nature of the geology and potential palaeontology of the study site and an overview of the literature on the palaeontology and associated geology of the area.

3. 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 form 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.

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

Figure 1: Google Earth photo indicating study site (black line)

The study site is situated northeast of Kuruman in the Northern Cape. The study has been developed as a residential area. The study area is sparsely covered with grass in relatively undisturbed areas.

The relevant literature and geological maps have been studied and the site was visited for a Palaeontological Impact Study.

5. Geological setting

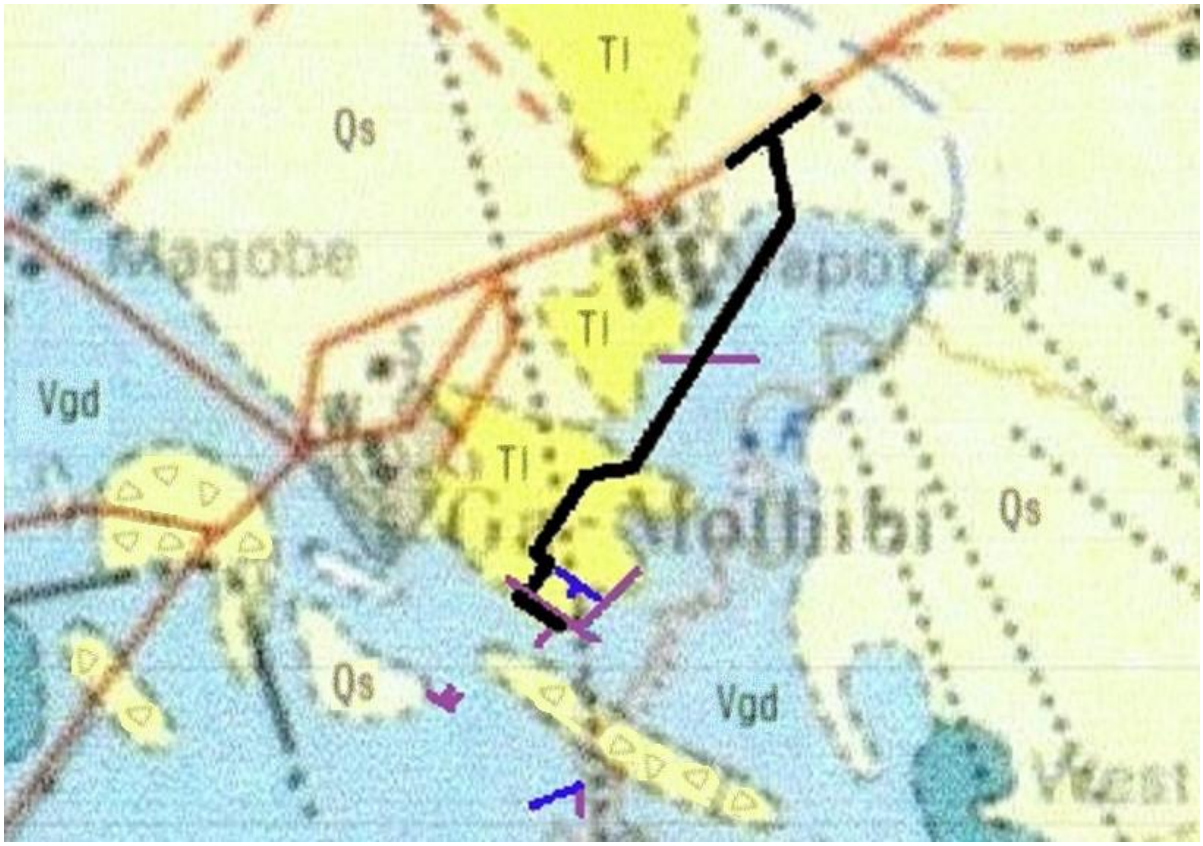

Figure 2: Geology map of the study site (black line) and surroundings. Adapted from the Kuruman 2722 1: 250 000 Geology Map (Geological Survey, 1979) and Beukes & Gutzmer (2008)

LEGEND

	Lithology	Geological unit		Age
Qs	Red to pinkish wind-blown sand	Gordonia Formation	Kalahari Group	Quaternary
	Rubble			
Tl	Sand, calcrete, surface limestone	Mokalanen Formation		Tertiary
Vgd	Dolomitic limestone (puckered limestone)	Ghaap Plato Formation	Campbell Rand Subgroup, Transvaal Supergroup	Vaalian

The central and southern parts of the study site are underlain by Vaalian aged dolomitic limestone and chert and fragmented chert of the Lime Acres Formation of the Ghaap Plato Formation of the Campbell Rand Subgroup of the Transvaal Supergroup. The Campbell Rand Subgroup comprises the oldest geological unit in the study area (Erikkson *et al*., 2009).

The Quaternary aged rubble and aeolian sand of the Gordonia Formation of the Kalahari Group cover the dolomitic rocks in the southern and northern part of the study site respectively. The Kalahari sands which occur in large palaeo-valley systems that run in a north-south direction are part of the most extensive body of terrestrial sediments of Cenozoic age in southern Africa (Partridge *et al*., 2009).

6. Site visit

The study site was visited on 17 October 2021. No palaeontologically significant sites were discovered. None of the exposed rocks contained identifiable macroscopic palaeontological features.

Figure 3: Facing south from 27°22'49.12"S 23°31'06.34"E

Figure 4: Facing east from 27°23'03.76"S 23°31'03.99"E

Figure 5: Facing southeast from 27°23'43.05"S 23°30'40.79"E

Figure 6: *Ex situ* block of dolomite at 27°23'45.97"S 23°30'39.85"E

Figure 7: Facing south from 27°23'53.42"S 23°30'34.24"E

Figure 8: Facing northeast from 27°24'04.10"S 23°30'17.11"E

Figure 9: Facing northeast from 27°24'41.53"S 23°30'07.01"E

Figure 10: *Ex situ* block of rubble and limestone at 27°24'34.32"S 23°29'59.80"E

7. Palaeontological assessment

(Study site marked with the black line)

Figure 11: Palaeontological sensitivity of the region (SAHRA, 2021)

Colour	Palaeontological Significance	Action
RED	VERY HIGH	Field assessment and protocol for finds are required.
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.
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required.

The study area is covered in natural vegetation with grass and shrubs and was originally used for farming but now is mainly used for residential purposes especially in the southern part of the study site.

The soil cover in the study area is relatively thin and the underlying eroded bedrock is exposed in places where ditches were dug. Ex situ blocks of dolomite and chert are found in the study site lining the filled-in ditches. No fossils were found during the field assessment. This however does not imply that stromatolites would not be discovered once the grass and soil are cleared and it is highly probable that they will be discovered in the study site when development commences.

The northern part of the study area is covered with the red to pinkish aeolian sand and sandy soil of the Quaternary-aged Gordonia Formation, while the southern part of the study site is covered with Quaternary-aged rubble. The Quaternary-aged sedimentary deposits overlay the dolomitic limestone of the Lime Acres Member of the Ghaap Plato Formation which is exposed in the central part of the study site and to the south of the study site.

The aeolian and calcrete deposits of the study site have a low to moderate potential to yield fossils and the possibility of finding fossil material cannot be ignored. The fossil record of the overlying Kalahari Group is sparse, occurs sporadically and is low in diversity. Although no fossils have been reported for the study area, fossils such as root casts, burrows, termitaria, ostrich egg shells, mollusc shells and isolated bones have been discovered in the Kalahari Group elsewhere (Almond & Pether 2008).

The underlying dolomitic limestone of the Ghaap Plato Formation of the Campbell Rand Subgroup of the Transvaal Supergroup is exposed in places along the central part of the study site where ditches were dug. The Transvaal Supergroup contain shallow marine carbonate metasediments, deeper water banded iron formations (ironstones and chert), siliclastic sediments, volcanic rocks and tillites. The carbonate rocks of this succession have yielded shallow marine and lacustrine stromatolites and microfossils of bacteria and bacterial filaments.

References:

Almond, J.E. & Pether, J. (2008) Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

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Partridge, T.C., Botha, G.A. & Haddon, I.G. 2009. Cenozoic Deposits of the Interior. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. 585-604.

8. Conclusion and recommendations:

There is a low likelihood that the Quaternary aeolian sand at the study site may contain fossils. Elsewhere rare fossils of root casts, burrows, ostrich egg shells, mollusc shells, isolated bones, root casts, burrows and termitaria have been found and the possibility of finding similar fossils at the study area cannot be excluded.

The overall palaeontological sensitivity of the study areas is considered to be very high based on the probability of finding stromatolites.

Although stromatolites are considered to be fossils, there are hundreds of square kilometres of stromatolites in South Africa and it is not considered to be so scarce that every stromatolite formation has to be preserved. In the event of the discovery of an exceptional stromatolite formation it is advised that it should on principle not be destroyed if it could be preserved *in situ*.

In the event of fossils being discovered in the sands, soils or dolomitic limestone in the study area, the ECO should follow the Chance Find Procedure.

PROCEDURE FOR CHANCE PALAEONTOLOGICAL 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. 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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