# Proposed Transnet loop upgrades at Sishen and Vlermuislaagte, Northern Cape

## PALAEONTOLOGICAL DESKTOP ASSESSMENT

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for:

Transnet SOC Limited
Transnet Freight Rail Division

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# 1. Executive Summary

The Sishen study site is underlain by the calcrete duricrust constituting the Kalahari Formation of the Kalahari Group, that is considered to have a High Palaeontological Sensitivity. The Vermuislaagte study site is mainly underlain by the sands of the Gordonia Formation of the Kalahari Group that is considered to have a Moderate Palaeontological Sensitivity.

An overview of the literature on the palaeontology and associated geology of the area is given. The fossil record of the 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.

Based on the nature of the upgrades, location of the proposed sites (within existing disturbed land, adjacent to the existing railway line), a Desktop Assessment is considered sufficient for the proposed project, with the implementation of the Chance Find Procedure.

The ECO should take responsibility for supervising the development and should follow the Chance Find Procedure (pp.14-15) if in the **unlikely event** a significant fossil discovery is made.

# 2. 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 that was prepared in line with Regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment.

**Sishen Scope:**

- Staging line and loop upgrades are approximately 5km in length
- Relocation of ESKOM pylons
- Bridge alterations to ensure space/clearances underneath
- Lines to be electrified to 50 kV AC
- Relocation of power lines (132kV)
- Relocation of service roads
- Culverts extensions
- Demolish and relocate retaining wall running parallel to the rail track
- Drainage for additional lines
- Relocation of overheard aerial feeder and return conductors

- Relocation of optic fibre cables if on the impacted structures
- Two (2) lines to be added on the eastern side of the yard as per option 4, which will accommodate three rakes of 116 CR13/14 wagon for iron ore trains and three rakes of 125 CR17 wagon for Manganese trains. These rakes will be pulled by a combination of 15E and 43D locomotives.
- One (1) line to be added on the locomotive staging area.
- 4m wide gravel access road.

**Vlermuislaagte Scope:**

- The staging line and loops upgrades are approximately 8km in length
- Two (2) arrival lines/Crossing loops for 125 wagon trains (1500m) to accommodate manganese traffic.
- Two (2) additional loops for Staging trains
- Shunting neck to accommodate 125 Wagons
- Track Slab or inspection slab
- Five (5) Not to go shunting spurs – non electrified (each to accommodate Six (6) Wagons) to be used to uncouple Skew/Overloaded wagons and rectified on site.
- Additional inspection road.
- One (1) covered parking with four (4) bays
- Hot box Detector, Vehicle identification system (signaling)
- One (1) level crossing will be relocated and another level crossing will be upgraded at Vlermuislaagte.
- All level crossings will allow for cattle grids as well.
- The site will have a 6m wide surfaced road along its length on the east of the yard and access is proposed from either Mamathwane Yard or from the R380.
- The servitude will be increased by approximately 80m.
- Lines to be electrified to 3 kV DC
- Relay rooms will be provided for signaling works. Color signals to be integrated the CTC’s CS90 train authorization system.
- The turnouts shall be 1:20 or 1:12

- Catch points must be added to the first loop to protect the mainline
- 1:12 Runaway sets to be installed to protect loop 1 and 2

# 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 sites and the type of assessment:


Figure 1: Google Earth photo indicating the Sishen study site (grey line)

The study site is a railway line situated east of the Sishen iron ore mine. The vegetation is sparce and highly disturbed due to mining and other anthropogenic impacts.

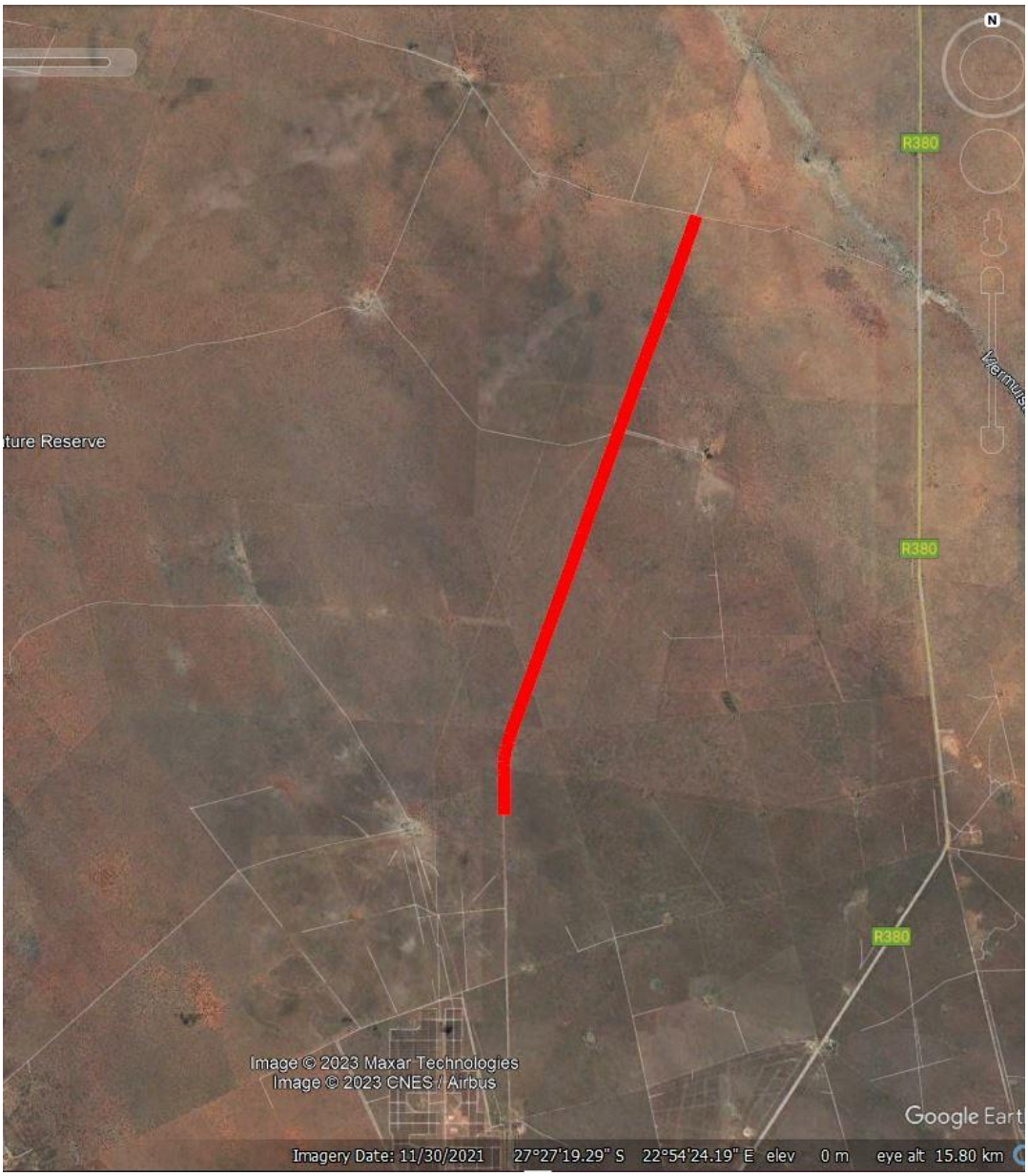



Figure 2: Google Earth photo indicating the Vlermuislaagte study site (red line)

The Vlermuislaagte study site is a railway line in a rural area between the Sishen Photovoltaic Plant and the Tshipi Borwa Mine and west of the R380.

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

Based on the nature of the upgrades, location of the proposed sites (within existing disturbed land, adjacent to the existing railway line), a Desktop Assessment is considered sufficient for the proposed project, with the implementation of a Chance Find Procedure.

# 5. Geological setting of the study sites

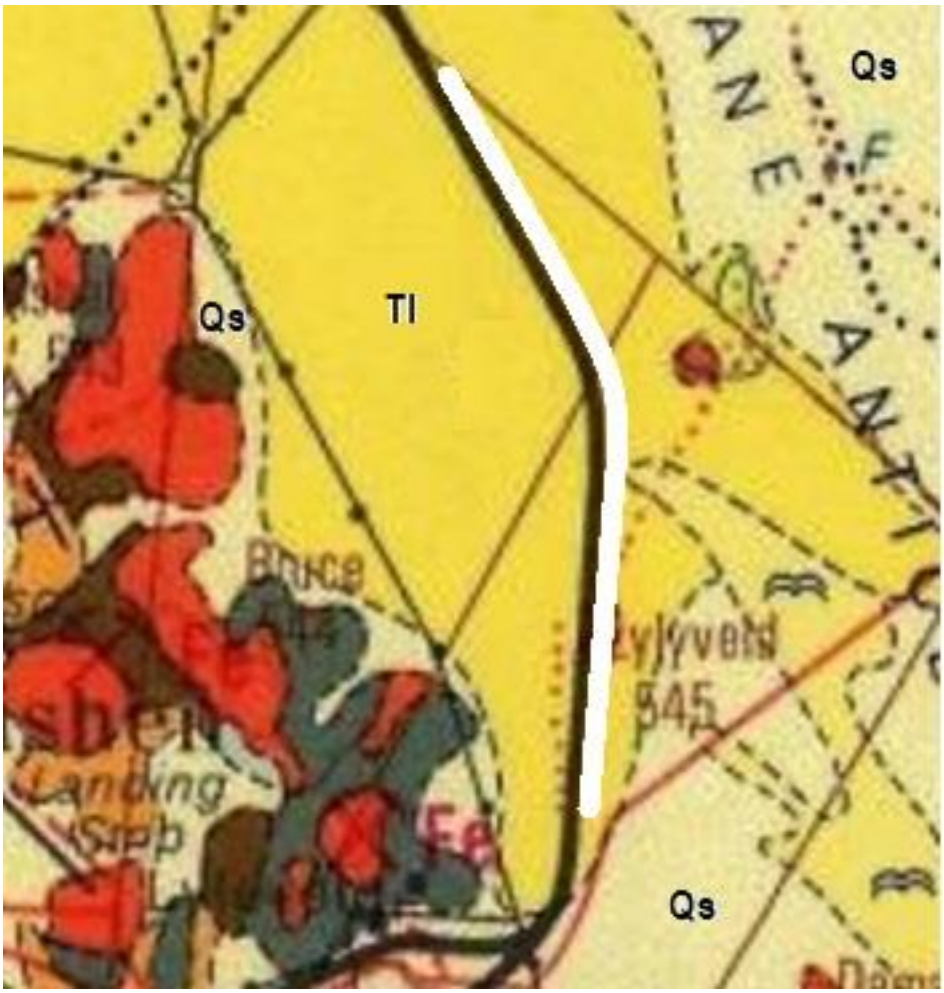



Figure 3: Geology map of the Sishen study site (white line) and surroundings. Adapted from the Kuruman 2722 1: 250 000 Geology Map (Geological Survey, 1979) and Beukes & Gutzmer (2008)

**LEGEND** (based on Beukes & Gutzmer, 2008)**:**

| | Lithology | Geological unit | | Age |
|---|---|---|---|---|
| | River terrace gravel | | | Quaternary |
| Qs | Red to pinkish wind-blown sand | Gordinia Formation | Kalahari Group | |
| Tl | Sand and calcrete | Kalahari Formation | | Tertiary |
| | Conglomerate, shale, flagstone and quartzite | Gamagara Formation | Elim Group of the Keis Supergroup | Mokolian |
| | Chert, hematite | Manganore Iron Formation | Asbestos Hills Subgroup of the Ghaap Group of the Transvaal Supergroup | Vaalian |
| | Siliceous breccia | Wolhaarkop Breccia | | |

The Sishen study site is underlain by sand and calcrete of the Kalahari Formation of the Kalahari Group. The much older rocks of the Vaalian and Mokolian (Proterozoic) are covered at the Sishen study site by a layer of calcrete duricrust or hardpan formed in the Tertiary which is in turn covered with Quaternary age sand (Partridge *et al*., 2009).

The large iron ore deposits of Sishen were formed when the iron formations of the Asbestos Hills Subgroup slumped into the paleokarst structures in the underlying dolomite of the Transvaal Supergroup {Beukes & Gutzmer, 2008).

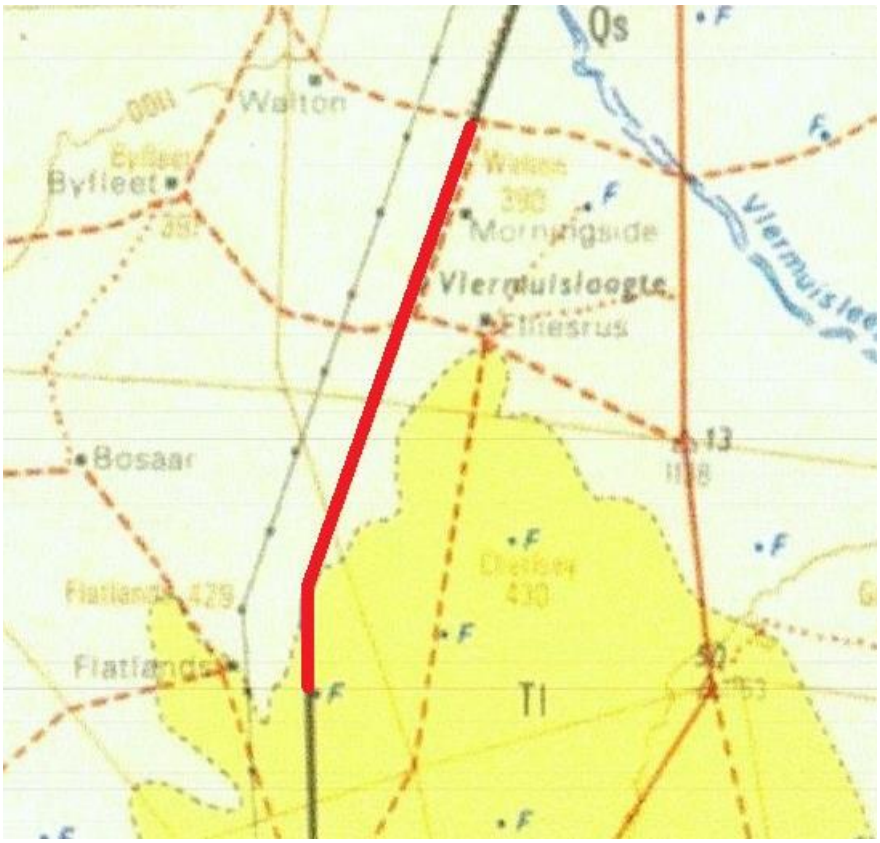



Figure 4: Geology map of the Vlermuislaagte study site (red line) and surroundings. Adapted from the Kuruman 2722 1: 250 000 Geology Map (Geological Survey, 1979)

| | Lithology | Geological unit | | Age |
|---|---|---|---|---|
| **Qs** | Red to pinkish wind-blown sand | Gordinia Formation | Kalahari Group | Quaternary |
| **Tl** | Sand and calcrete | Kalahari Formation | | Tertiary |

The largest (northern part) of the Vlermuislaagte study site is underlain by the red to pinkish, wind-blown sand of the Quaternary-aged Gordinia Formation while the southernmost end of the study site is underlain by the Tertiary-aged sand and calcrete of the Kalahari Formation of the Kalahari Group.

# 6. PALAEONTOLOGICAL ASSESSMENT


Figure 5: Palaeontological sensitivity map of the Sishen study area (black line) and surroundings (SAHRA, 2023)


Key:

| 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. |

Figure 6: Palaeontological sensitivity map of the Vlermuislaagte study area (black line) and surroundings (SAHRA, 2023)

The calcrete duricrust constituting the Kalahari Formation of the Kalahari Group, that is considered to have a High Palaeontological Sensitivity, underlies the Sishen study site and the southern end of the Vlermuislaagte study site (see Figs. 5 & 6).

The largest part of the Vlermuislaagte study site is underlain by the red to pinkish sand of the Gordonia Formation of the Kalahari Group that is considered to have a Moderate Palaeontological Sensitivity (see Fig. 6).

The fossil record of the 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).

Based on the nature of the upgrades, location of the proposed sites (within existing disturbed land, adjacent to the existing railway line), a Desktop Assessment is considered sufficient for the proposed project, with the implementation of the Chance Find Procedure.

# 7. Conclusion and recommendations:

The Sishen study site is underlain by the calcrete duricrust constituting the Kalahari Formation of the Kalahari Group, that is considered to have a High Palaeontological Sensitivity. The Vermuislaagte study site is mainly underlain by the sands of the Gordonia Formation of the Kalahari Group that is considered to have a Moderate Palaeontological Sensitivity. However, fossils are rare in the Kalahari Formation and the chances of making significant fossil discoveries during construction are low.

Based on the nature of the upgrades, location of the proposed sites (within existing disturbed land, adjacent to the existing railway line), a Desktop Assessment is considered sufficient for the proposed project, with the implementation of the Chance Find Procedure.

In the **unlikely event** of finding fossils during construction, the ECO must follow the Procedure for Chance Palaeontological Finds as stipulated below and contact a palaeontologist for further advice.

**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:

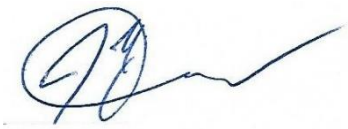
b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

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.

# 8. 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.



Palaeontological specialist:
**Dr JF Durand (Sci. Nat.)**
BSc Botany & Zoology (RAU), BSc Zoology (WITS), Museology Dipl. (UP), Higher Education Diploma (RAU), PhD Palaeontology (WITS)

References:

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