

# **PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF THE GROOTVLEI POWERSTATION PHOTOVOLTAIC FACILITY SOUTH OF HEIDELBERG, GAUTENG PROVINCE.**

**For:**

**HIA CONSULTANTS**



**DATE: 26 March 2014**

**By**

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## EXECUTIVE SUMMARY

Gideon Groenewald was appointed by PGS Heritage to undertake a desktop survey, assessing the potential palaeontological impact of the proposed development of a photovoltaic facility at the Grootvlei power station near Heidelberg, Gauteng Province.

This report forms part of the Environmental Impact Assessment and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the project.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged.

The proposed PV facility is located at the Grootvlei Power Station near Heidelberg, Gauteng Province. The footprint for the development is approximately 17Ha.

The Vryheid Formation of the Ecca Group, Karoo Supergroup consists of a sequence of coarse-grained sandstone and mudstone, with economically important coal seams. The formation is interpreted as a deltaic deposit of rivers that entered the Karoo Basin from the north, with extensive coal swamps that developed in a foreshore environment.

According to Bamford (2011), little data has been published on these potentially fossiliferous deposits. Good fossil material is likely around the coal mines and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites. In the interests of heritage and science, however, such sites should be well recorded, sampled and the fossils kept in a suitable institution.

The study area is underlain by sediments of the Permian aged Vryheid Formation. Due to the deep weathering of the Vryheid Formation sediments and relatively thick soil layers, fossils will only be present in areas where the surface deposits have been disturbed to expose sediments of the Vryheid Formation. For this reason, a Moderate Palaeontological Sensitivity rating is allocated to the sites.

### Recommendations:

1. The EAP and ECO must be informed of the fact that fossils might be present in all disturbed areas and where the topsoil will be removed to expose shale and mudstone of the Vryheid Formation.
2. A professional palaeontologist must be appointed to investigate the exposed outcrops of Vryheid Formation sediments and to record any fossil finds in the development sites according to SAHRA specification.

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## 1. INTRODUCTION

### 1.1. Background

Gideon Groenewald was appointed by PGS Heritage to undertake a desktop survey, assessing the potential palaeontological impact of the proposed development of a photovoltaic facility at the Grootvlei power station near Heidelberg, Gauteng Province.

This report forms part of the Environmental Impact Assessment and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the project.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

### 1.2. Aims and Methodology

Following the *“SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports”* the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

In preparing a palaeontological desktop study the potential fossiliferous rock units (groups, formations etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature and previous palaeontological impact studies in the same region.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1.1 below.

**Table 1.1** Palaeontological Sensitivity Analysis Outcome Classification

| <b>Sensitivity</b>          | <b>Description</b>   |
|-----------------------------|--|
| <b>Low Sensitivity</b>      | Areas where a negligible impact on the fossil heritage is likely. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.  |
| <b>Moderate Sensitivity</b> | Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate. A field-based assessment by a professional palaeontologist is usually warranted.   |
| <b>High Sensitivity</b>     | Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops and the chances of finding fossils during a field-based assessment by a professional palaeontologist are very high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan |

### 1.3. Scope and Limitations of the Desktop Study

The study will include: i) an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units; ii) a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports; iii) data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and iv) where feasible, location and examination of any fossil collections from the study area (e.g. museums).

The key assumption for this scoping study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. There is also an inadequate database for fossil heritage for much of the RSA, due to the small number of professional palaeontologists carrying out fieldwork in RSA. Most development study areas have never been surveyed by a palaeontologist.

These factors may have a major influence on the assessment of the fossil heritage significance of a given development and without supporting field assessments may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium etc.).

## 2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

The proposed PV facility is located at the Grootvlei Power Station near Heidelberg, Gauteng Province. The footprint for the development is approximately 14Ha.

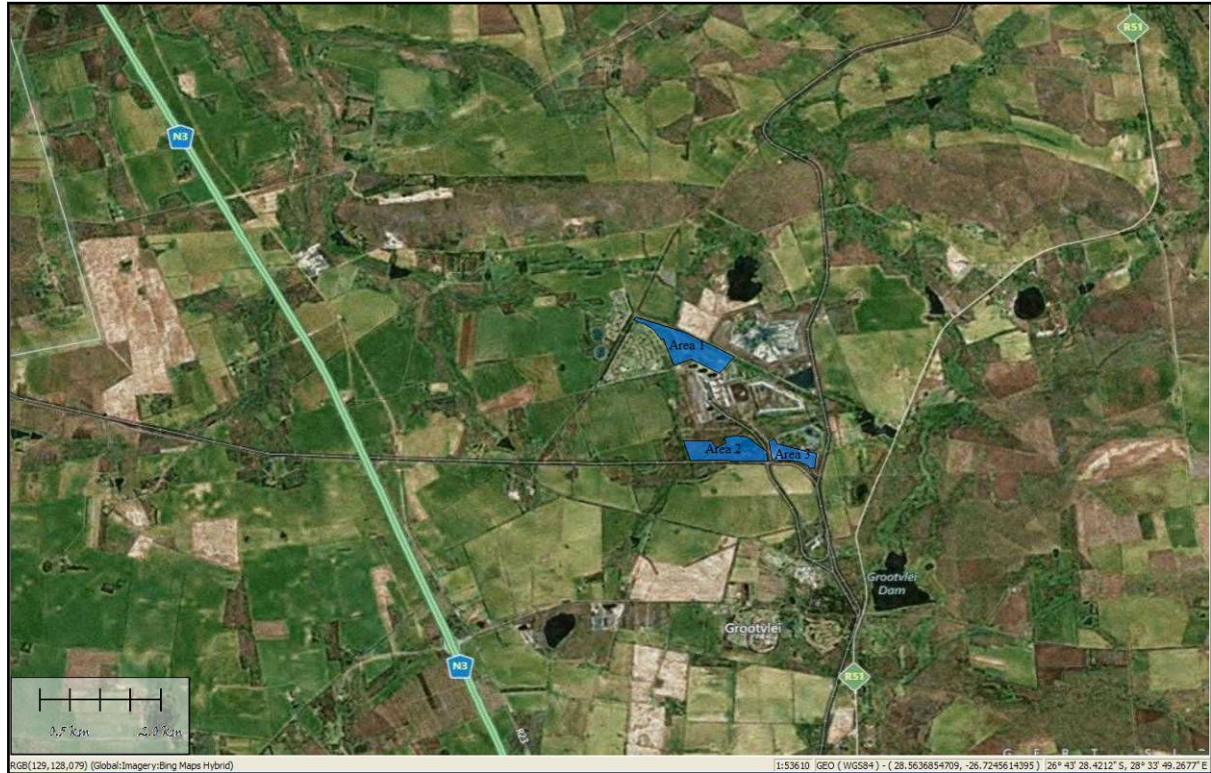


Figure 2.1 Locality of the Grootfontein PV facility

## 3. GEOLOGY

The study area is underlain by Permian aged rocks of the Vryheid Formation, Ecca Group, Karoo Supergroup.

### 3.1. Vryheid Formation (Pv)

The Vryheid Formation of the Eccca Group, Karoo Supergroup consists of a sequence of coarse-grained sandstone and mudstone, with economically important coal seams. The formation is interpreted as deltaic deposit of rivers that entered the Karoo Basin from the north, with extensive coal swamps that developed in a foreshore environment (Johnson et al, 2006).



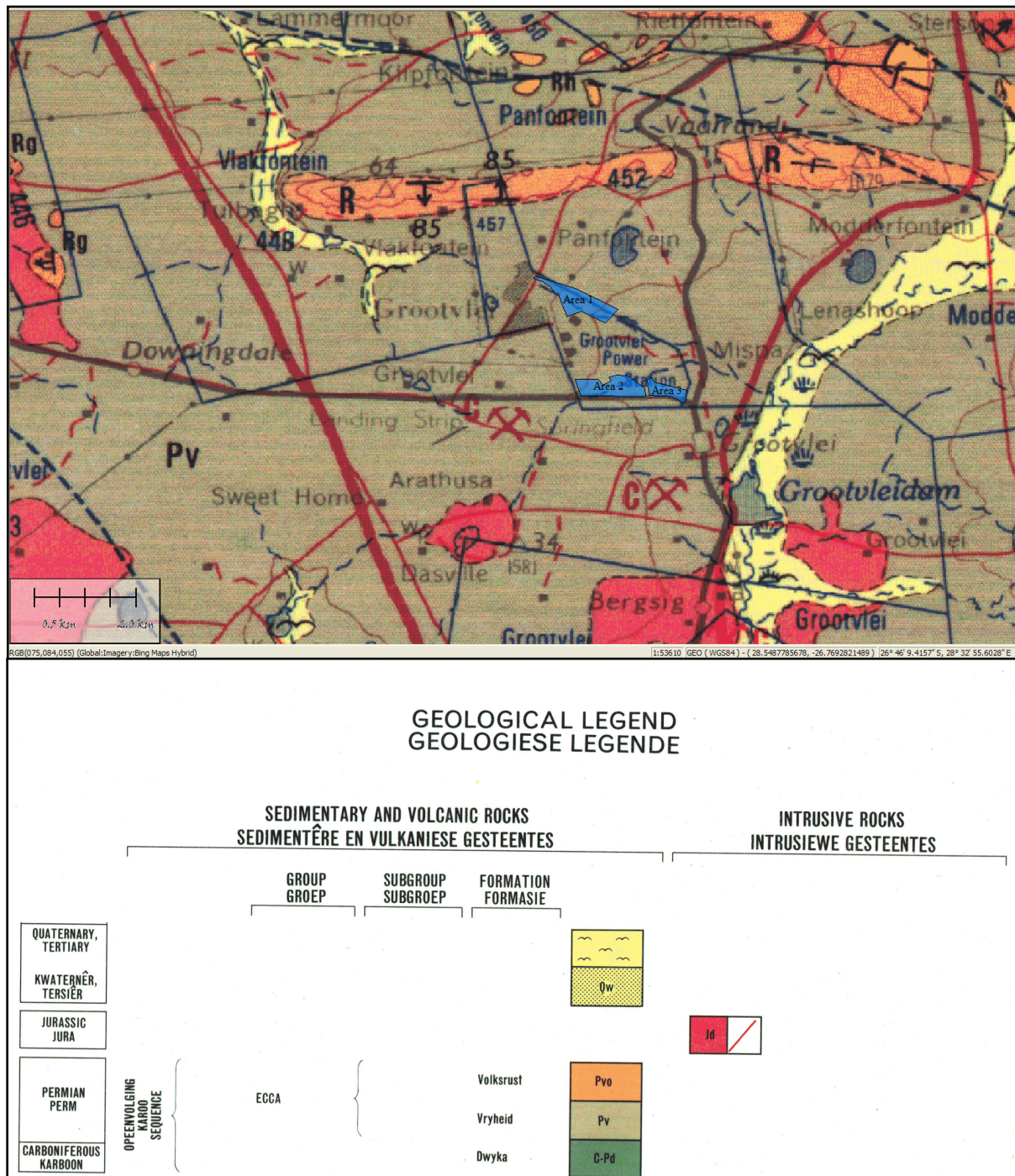


Figure 3.1 Geology of the Grootvlei PV Facility

#### 4. PALAEOLOGY AND PALAEOLOGICAL SENSITIVITY OF THE STUDY AREA

##### 4.1. Palaeontology

The Vryheid Formation is well-known for the occurrence of coal beds that resulted from the accumulation of plant material over long periods of time. Plant fossils described by Bamford (2011) from the Vryheid Formation are; *Azaniodendron fertile*, *Cyclodendron leslii*, *Sphenophyllum hammanskraalsensis*, *Annularia* sp., *Raniganja* sp., *Asterotheca* spp., *Liknopetalon enigmata*, *Glossopteris* > 20 species, *Hirsutum* 4 spp., *Scutum* 4 spp., *Ottokaria* 3 spp., *Estcourtia* sp., *Arberia* 4 spp., *Lidgetonnia* sp., *Noeggerathiopsis* sp. and *Podocarpidites* sp.

According to Bamford (2011), little data has been published on these potentially fossiliferous deposits. Good fossil material is likely around the coal mines and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites. In the interests of heritage and science, however, such sites should be well recorded, sampled and the fossils kept in a suitable institution.

Although no vertebrate fossils have been recorded from the Vryheid Formation, invertebrate trace fossils have been described in some detail by Mason and Christie (1986). It should be noted, however, that the aquatic reptile, *Mesosaurus*, which is the earliest known reptile from the Karoo Basin, as well as fish (*Palaeoniscus capensis*), have been recorded in equivalent-aged strata in the Whitehill Formation in the southern part of the basin (MacRae, 1999). Indications are that the Whitehill Formation in the main basin might be correlated with the mid-Vryheid Formation. If this assumption proves correct, there is a possibility that *Mesosaurus* could be found in the Vryheid Formation.

The late Carboniferous to early Jurassic Karoo Supergroup of South Africa includes economically important coal deposits within the Vryheid Formation. The Karoo sediments are almost entirely lacking in body fossils but ichnofossils (trace fossils) are locally abundant. Modern sedimentological and ichnofaunal studies suggest that the north-eastern part of the Karoo basin was marine. In KwaZulu-Natal a shallow basin margin accommodated a prograding fluviodeltaic complex forming a broad sandy platform on which coal-bearing sediments were deposited. Ichnofossils include U-burrows (formerly *Corophioides*) which are assigned to ichnogenus *Diplocraterion* (Mason and Christie, 1986).

#### **4.2. Palaeontological Sensitivity**

The Permian aged Vryheid Formation contains significant fossils of plants belonging to the *Glossopteris* assemblage. It is therefore likely that fossils will be present in all outcrops on the sites of the development. Plant fossils will most likely also be present in mudstone and shale layers exposed during excavation of foundations for the development. Due to the fact that the areas of the development have been disturbed, fossils might be exposed on the site. Due to the deep weathering and relatively thick soil layers present in the study area, a Moderate Palaeontological Sensitivity rating is allocated to the development sites, which might be changed to a High Palaeontological Sensitivity, following a Phase 1 Palaeontological Impact Assessment.



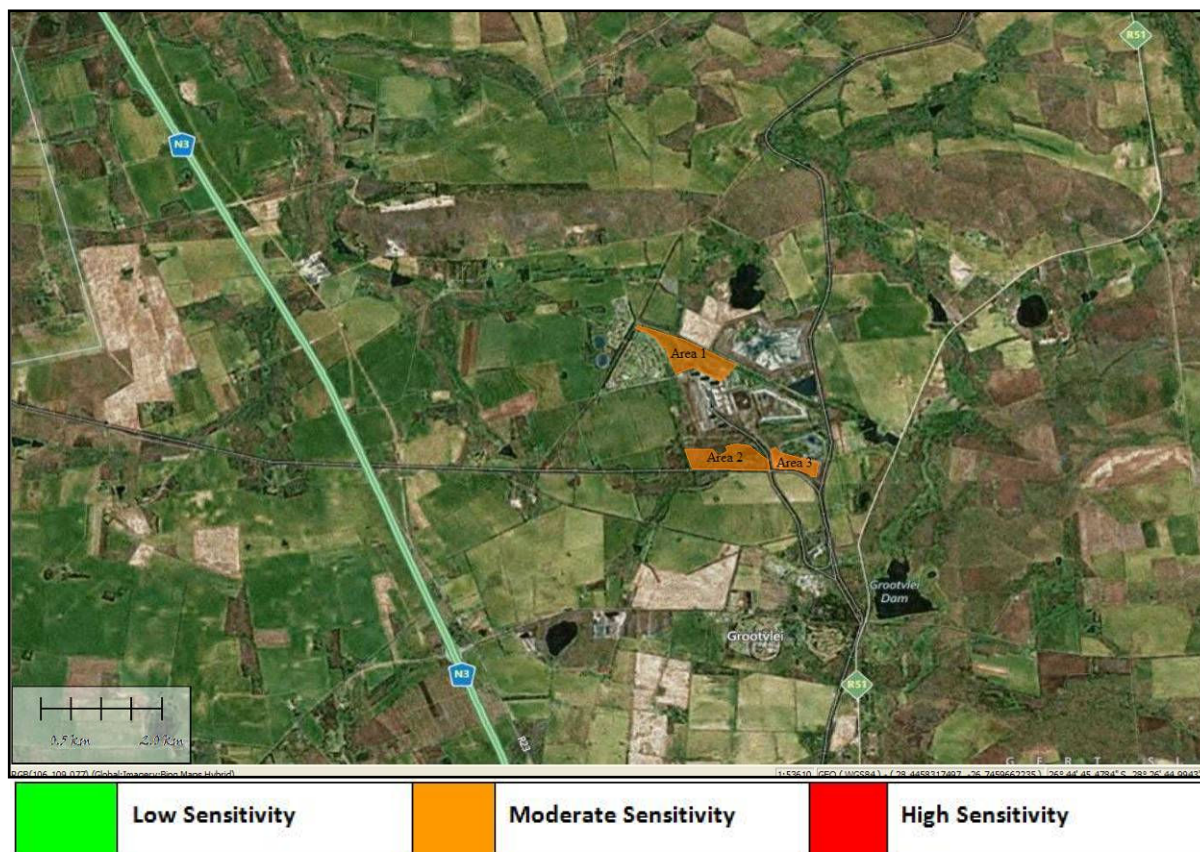


Figure 4.1 Palaeontological sensitivity of the Study area

## 5. CONCLUSION AND RECOMMENDATIONS

The study area is underlain by sediments of the Permian aged Vryheid Formation. Due to the deep weathering of the Vryheid Formation sediments and relatively thick soil layers, fossils will only be present in areas where the surface deposits have been disturbed to expose sediments of the Vryheid Formation. For this reason, a Moderate Palaeontological Sensitivity rating is allocated to the sites.

Recommendations:

1. The EAP and ECO must be informed of the fact that fossils might be present in all disturbed areas and where the topsoil will be removed to expose shale and mudstone of the Vryheid Formation.
2. A professional palaeontologist must be appointed to investigate the exposed outcrops of Vryheid Formation sediments and to record any fossil finds in the development sites according to SAHRA specification.

## 6. REFERENCES

- Bamford M. 2011.** Desktop study Palaeontology Ermelo to Empangeni – Eskom powerline. Internal report Bernard Price Institute for Palaeontological Research, University of the Witwatersrand.
- Johnson MR, Anhausser CR and Thomas RJ. 2009.** The Geology of South Africa. Geological Society of South Africa.
- MacRae C. 1999.** Life Etched in Stone. Geological Society of South Africa.
- Mason TR and Christie ADM 1986.** Palaeoenvironmental significance of ichnogenus *Diplocraterion* torell from the Permian Vryheid Formation of the Karoo Supergroup, South Africa. *Palaeogeography, Palaeoclimatology, Palaeoecology* 53(3-4):249-265.

## **7. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR**

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeoecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

## **8. DECLARATION OF INDEPENDENCE**

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

A handwritten signature in black ink, appearing to read 'G. Groenewald', with a stylized flourish at the end.

**Dr Gideon Groenewald**  
**Geologist**