PALAEONTOLOGICAL DESKTOP ASSESSMENT OF THE PROPOSED DEVELOPMENT OF THE EASTERN PLATEAU AND MAANHAARBERG 132kV POWER LINES AT DE AAR IN THE NORTHERN CAPE

FOR

MULILO

HIA CONSULTANTS

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By

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EXECUTIVE SUMMARY

Metsi-Metseng Geological and Environmental Services CC was appointed by PSG Heritage and Grave Relocation Consultants to undertake a desktop survey, assessing the potential palaeontology impact of the proposed 132kV overhead power line developments by Mulilo to connect Wind Energy Facilities around De Aar with the Eskom National Transmission Grid.

This report forms part of the Environmental Impact Assessment for the power line development 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 upgrade development.

De Aar is situated in the Emthanjeni Municipality in the Pixley ka Seme District of the Northern Cape. Numerous renewable energy projects are proposed for the De Aar area. The proposed 132kV transmission lines with associated substations developments will connect these renewable energy projects with the national transmission grid. The proposed transmission lines consist of the southern Maanhaarberg line of ±43.4km and the northern Eastern Plateau line of ±39km. Both lines will have steel monopole towers with a footprint of between 0.6 - 1.5m². Where possible existing roads will be used or 4x4 tracks will be made for access.

A basic desktop assessment of the topography and geology of the area was made by using 1:250 000 geological maps (3022 Britstown and 3024 Colesberg) in conjunction with Google Earth. The known fossil heritage within each rock unit was determined from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience. The major limitation of this study is that no supporting field assessment was made and the assumption that existing geological maps and datasets used to assess site sensitivity are correct and reliable.

The study area is mainly underlain by Permian sedimentary rocks of the Tierberg Formation of the Ecca Group of the Karoo Supergroup and the Abramskraal Formation of the Adelaide Subgroup of the Beaufort Group of the Karoo Supergroup. Jurassic Dolerite sills dominate the high laying areas while recent Quaternary Alluvium deposits occur in the river valleys.

There is a high and moderate possibility that fossils could be encountered during excavation of the Abramskraal and Tierberg Formations respectively. These fossil founds would be of international significance. The damage and/or loss of these fossils due to inadequate mitigation would be a highly negative palaeontological impact. The exposure and subsequent reporting of fossils (that would otherwise have remained undiscovered) to a qualified palaeontologist for excavation will be a beneficial palaeontological impact.

It is therefore recommended that:

- A Palaeontologist be appointed as part of the Environmental Construction Team for preferable all identified palaeontological sensitive areas but definite for the identified high sensitive areas.
- A palaeontological rescue and/or destruction permit is obtained by the Palaeontologist.
- The Palaeontologist accompany the surveyor and foundation teams during the pylon construction phase to move pylons where possible from potential fossil bearing areas or rescue any fossils from construction footprint.
- Compile a Phase 2 report to the Heritage Authority responsible after palaeontological construction inputs.

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1. INTRODUCTION

1.1. Background

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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 identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assessing the level of palaeontological significance of these formations;
- to commenting on the impact of the development on these exposed and/or potential fossil resources and
- to making 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, previous palaeontological impact studies in the same region and the author's field experience.

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

Sensitivity	Description
Low Sensitivity	Areas where there is likely to be a negligible impact on the fossil heritage. 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.
Moderate Sensitivity	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.
High Sensitivity	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

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field-based assessment by a professional palaeontologist is usually warranted.

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 are also 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 tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium etc).

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

The town of De Aar is situated in the Emthanjeni Municipality of the Pixley ka Seme District in the Northern Cape. Numerous renewable energy projects are proposed for the De Aar area. The proposed 132kV transmission lines with associated substations (Figure 2.1) will connect these renewable energy projects with the national transmission grid. The proposed transmission lines consist of the southern Maanhaarberg line of ±43.4km and the northern Eastern Plateau line of ±39km.

Figure 2.1 Locality of the Proposed Maanhaarberg and Eastern Plateau 132kV Transmission Lines

Both lines will be constructed from steel monopole poles. These poles weigh approximately 1 200 kg each and vary in height from approximately 17.4m to 21m. The size of the footprint depends on the type of pole, i.e. whether it is a self-supporting, guyed suspension or an angle strain pole structure. The size of the footprint ranges from 0.6m² to 1.5m², with the larger footprint associated with the guyed suspension and angle strain pole used as bend/strain structures.

The average span between two towers is 200m, but can vary between 250m and 375m depending on the ground profile (topography) and the terrain to be spanned. The self-supporting structure (suspension pole) is typically used along the straight sections of the power line, while the guyed intermediate or guyed suspension and angle strain structures are used where there is a bend in the power line alignment. The servitude width for a 132 kV Sub-transmission line is 31m and for 2 lines it will be 52m. Existing roads will be used and 4x4 jeep tracks will only be developed for access to the transmission route where no roads currently exist.

The final tower sizes and positions will only be determined once the project has received Environmental Authorisation and after negotiations with landowners.

3. GEOLOGY OF THE AREA

The study area is mainly underlain by Permian sedimentary rocks of the Karoo Supergroup (Figure 4.1). These Permian sedimentary rocks are classified as the Tierberg Formation (Pt) of the Ecca Group of the Karoo Supergroup and the Abramskraal Formation (Pa) of the Adelaide Subgroup of the Beaufort Group of the Karoo Supergroup. Jurassic Dolerite (Jd) sills dominate the hilltops while the low laying areas consist of recent Quaternary (^^) Alluvium deposits.

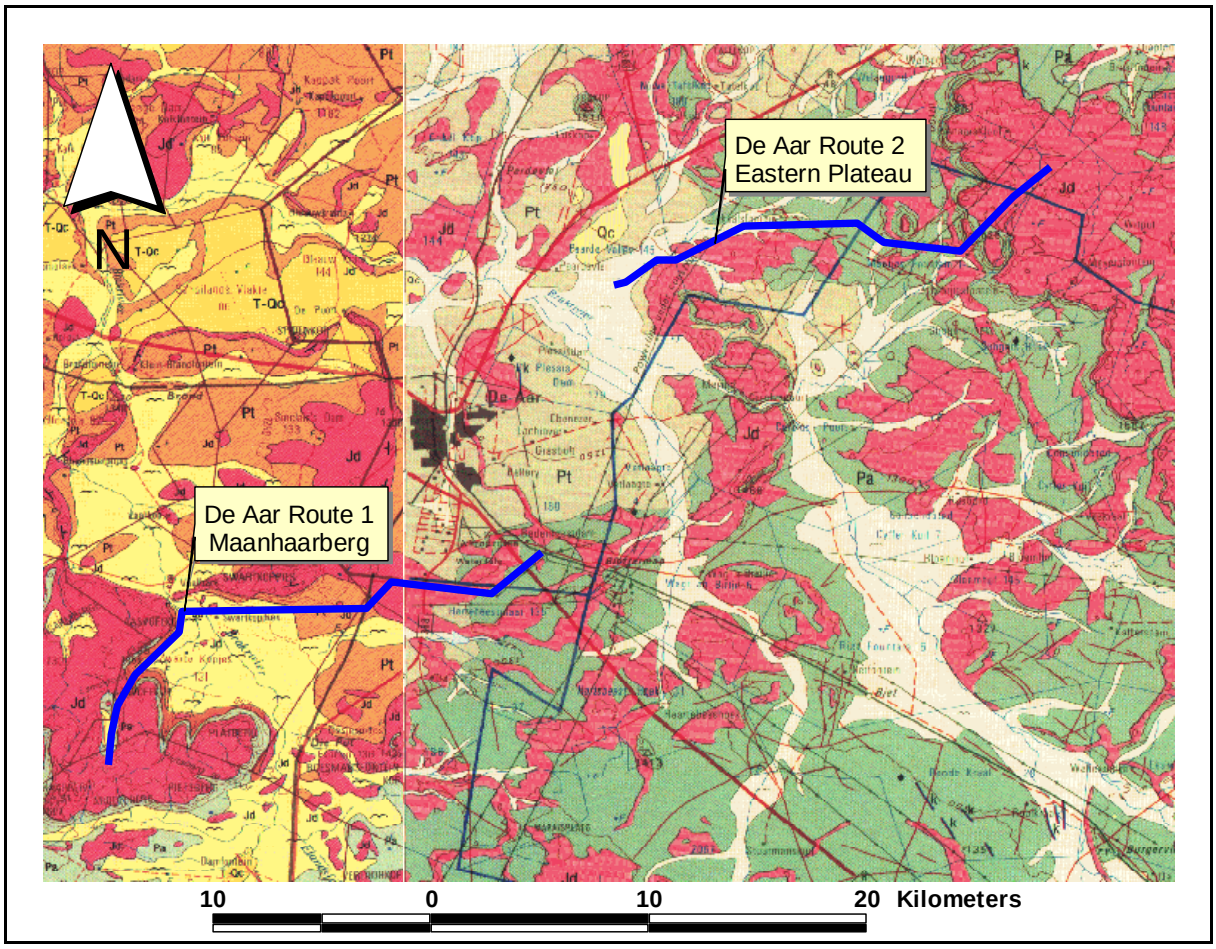

Figure 3.1 **Geology of the study area at De Aar (Geo Maps 3022 Britstown and 3024 Colesberg)**

3.1. The Tierberg Formation

The Tierberg Formation (Pt) is interpreted as offshore non-marine mudrocks with distal turbidite beds, prodeltaic sediments and represented by greenish weathering shale with subordinated siltstone and sandstone (Johnson *et al*, 2006).

3.2. The Abramskraal Formation

The Abramskraal Formation (Pa) is interpreted as fluvial sediments with channel sandstones (meandering rivers), thin mudflake conglomerates interbedded with floodplain mudrocks (grey-green, purplish), pedogenic calcretes, playa lake and pond deposits and occasional reworked volcanic ashes (Johnson *et al*, 2006 and Almond & Pether, 2008). The Abramskraal Formation is represented by blue-grey mudstone, sandstone and siltstone.

3.3. Karoo Dolerite

Dolerite (Jd) is a very hard igneous rock that intruded the sedimentary layers and can occur either as sills or dykes. Sills can be from a few meters to tens of meters thick.

3.4. Quaternary Deposits

The Quaternary Deposits consist of alluvial deposits, deposited by rivers in the valley floors.

4. PALAEONTOLOGY OF THE AREA

4.1. The Tierberg Formation

Trace fossils occur throughout the Tierberg Formation, reflecting specific water depths and energy conditions. Plant impressions, mud and vertebrate fragments in the upper sandstone layers are indications of a sallow water environment. These fossils have a low diversity but are locally abundant when found (Almond & Pether, 2008).

4.2. The Abramskraal Formation

The Abramskraal Formation have a diverse continental fossil biota dominated by a variety of *Therapsids* (eg *dinocephalians, dicynodonts, gorgonopsians, therocephalians, cynodonts*) and primitive reptiles (eg *pareiasaurs*), sparse *Glossopteris* Flora (petrified wood, rarer leaves, horsetail stems), tetrapod trackways, burrows and coprolites. Freshwater assemblages include temnospondyl amphibians, palaeoniscoid fish, non-marine bivalves, phyllopod crustaceans and trace fossils (esp. Arthropod trackways and burrows, “worm” burrows, fish fin trails plant rootlet horizons) (Almond & Pether, 2008).

4.3. Karoo Dolirite

Due to the ingenious character of Karoo Dolerite it will contain no fossils.

4.4. Quaternary Deposits

No fossils are expected in the alluvial deposits of recent rivers.

5. PALAEONTOLOGICAL SENSITIVITY

The palaeontological sensitivity is predicted after identifying potentially fossiliferous rock units; ascertain the fossil heritage from the literature and evaluating the nature and scale of the development itself. The palaeontological sensitivity is summarised in Table 4.1 and illustrated in Figure 4.1 below.

Table 5.1 Palaeontological Sensitivity of Geological Units on Site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Tierberg Formation ECCA GROUP	Greenish weathered shale, subordinated siltstone and sandstone PERMIAN	Disarticulated microvertebrate remains (eg fish teeth, scales), sponge spicules, spare vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages such as locally abundant ichnofaunas (horizontal "worm" burrows, arthropod trackways).	*None*	Moderate sensitivity
Abramskraal Formation Adelaide Subgroup BEAUFORT GROUP	Blue-grey mudstone, sandstone and siltstone LATE PERMIAN	Vertebrate fossils of the *Therapsids* group e.g. *Gorgonopsian* and *Dicynodonts* and Plant fossils e.g. *Glossopteris* trees and leaves.	*Dicynodon* Assemblage Zone	High sensitivity

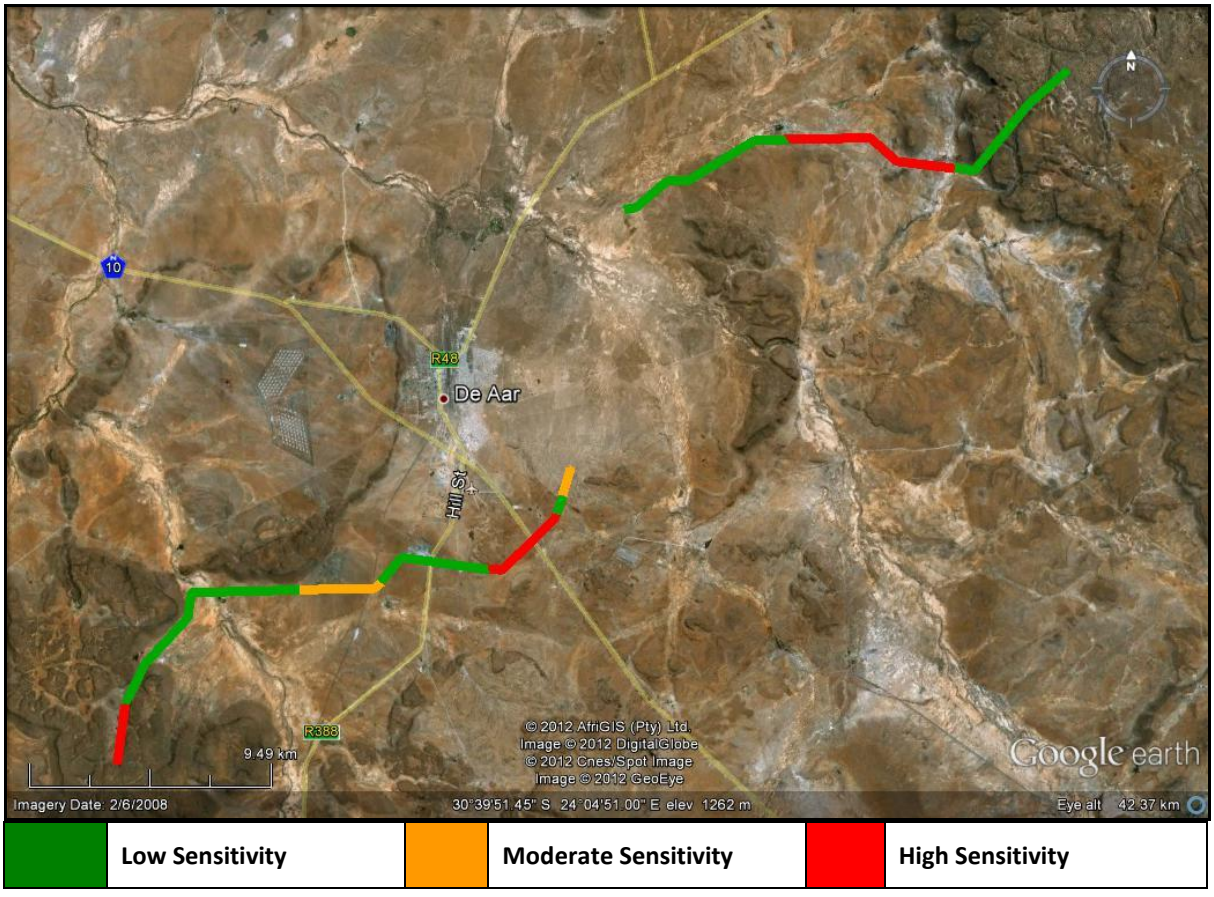

Figure 5.1 Palaeontological Sensitivity Localities

6. CONCLUSION AND RECOMMENDATIONS

The study area is mainly underlain by Permian sedimentary rocks of the Tierberg Formation of the Ecca Group of the Karoo Supergroup and the Abramskraal Formation of the Adelaide Subgroup of the Beaufort Group of the Karoo Supergroup. Jurassic Dolerite sills dominate the high laying areas while recent Quaternary Alluvium deposits occur in the river valleys.

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7. REFERENCES

Almond, J.E. and Pether, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA Technical Report. Natura Viva cc., Cape Town.

Groenewald GH.1996. Stratigraphy and Sedimentology of the Tarkastad Subgroup, Karoo Supergroup, South Africa. Unpubl PhD Thesis, University of Port Elizabeth.

Johnson MR , Anhaeusser CR and Thomas RJ (Eds) (2006). The Geology of South Africa. GSSA, Council for Geoscience, Pretoria.

Rubidge BS (ed) 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup), South Africa. South African Committee for Stratigraphy.

8. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the Nelson Mandela Metropolitan University (1996) and the National Diploma in Nature Conservation from the University of South Africa (1990). 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).

9. 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.

Dr Gideon Groenewald
Geologist