

**DESKTOP PALAEONTOLOGICAL ASSESSMENT**  
**Application letter for exemption from Phase 1 site visit**

**PROPOSED DEVELOPMENT OF A LOW-PRESSURE SYSTEM (LPS) PIPELINE AND 11KV POWERLINE IN ASSOCIATION WITH AN EXISTING AUTHORISED (EA DATED 28 JULY 2015) ASH DISPOSAL FACILITY (ADF) AT THE KENDAL POWER STATION, EMALAHLENI AND DELMAS LOCAL MUNICIPALITIES, NKANGALA DISTRICT MUNICIPALITY, MPUMALANGA PROVINCE.**

**FOR**

**Sazi Environmental Consulting CC**

**DATE: 22 November 2022**

**By**

**Dr Gideon Groenewald**

**Cell: 078 713 6377**

## EXECUTIVE SUMMARY

Gideon Groenewald was appointed by Sazi Environmental Consulting cc to undertake a desktop palaeontological assessment survey for the proposed development of a Low-Pressure System (LPS) Pipeline and 11kV Powerline in association with an existing authorised (EA dated 28 July 2015) Ash Disposal Facility (ADF) at the Kendal Power Station, Emalahleni and Delmas Local Municipalities, Nkangala District Municipality, Mpumalanga Province. The development falls in a rural setting where the natural ecosystem has, to a lesser degree, been modified by agricultural as well as mining activities over the years.

Sazi Environmental Consulting CC was appointed by Eskom Holdings SOC Ltd to undertake an Environmental Impact Assessment process in terms of the National Environmental Management Act (Act No.107 of 1998). As part of the EA process the consultants conducted an HIA for the proposed site and liaised with SAHRA for comment. Eskom Kendal Power Station was granted with an Integrated Environmental Authorisation; dated 28 July 2015 and Water Use License; dated 08 August 2017 for the continuous Ash Disposal Facility (ADF) project. The proposed new infrastructure, LPS pipeline and 11kV powerline, will be constructed within the authorised development footprint, which is already disturbed (in some areas) as construction for the continuous ADF has commenced. SAHRA proposed that Sazi Environmental Consulting CC can motivate for an exemption from a field-based PIA. The purpose of this report is to provide SAHRA with the basic information needed for a decision on an application for exemption from a field-based study.

The geology underlying the proposed development area include Pre-Karoo lithology and sediments of the Vryheid Formation, Ecca Group of the Karoo Supergroup.

It is very important to note that, although a very high sensitivity rating is accolated to areas underlain by Vryheid Formation geology, the actual impact per site of excavation might be limited. Although it is imperative to indicate the very high sensitivity on the initial maps, the *modus operandi* of the project palaeontologist, when appointed, must be to train the ECO and team members to adhere to the "Chance Find Protocol" recommendation. Fossils recorded during construction must be curated and moved to the ESI at the University of the Witwatersrand (Wits) or the preferred institute indicated by SAHRA.

### Recommendations

- The EAP and developer must be informed that significant areas are underlain by rocks with a very high sensitivity for palaeontological heritage. The areas underlain by dolerite and Pre-Karoo lithology will have a very low to insignificant sensitivity for palaeontological heritage.

- All excavations that will expose sedimentary strata of the Vryheid Formation (geotechnical reports) will most probably contain significant fossils. The appointment of a palaeontologist to do a comprehensive Phase 2 PIA assessment (field assessment during construction **if requested by ECO** – see CFP attached) will be a minimum requirement for monitoring of excavations into the Vryheid Formation strata.
- The project will require a formal “Chance Find Protocol” (attached) **that will have to be upgraded during the construction phase of the project.**
- Recommendations for palaeontological monitoring and mitigation will have to be incorporated into the EMPr for approval by the SAHRA.
- **If is recommended that the application for exemption from a Phase 1 site visit for this Palaeontological Impact Assessment be approved.**

## TABLE OF CONTENT

EXECUTIVE SUMMARY .....	2
Recommendations .....	2
TABLE OF CONTENT .....	4
INTRODUCTION .....	6
Legal Requirements .....	6
Aims and Methodology .....	7
Scope and Limitations of the Desktop Study .....	10
Locality and Proposed Development .....	11
GEOLOGY .....	12
Pre-Karoo Lithology .....	13
Rooiberg Group .....	13
Selons River Formation (Vse) .....	13
Diabase (Vdi) .....	13
Lebowa Granite (Mle) .....	13
Karoo Supergroup .....	13
Ecca Group .....	13
Vryheid Formation (Pv) .....	13
Alluvium .....	13
PALAEONTOLOGY .....	14
Rooiberg Group .....	14
Selons River Formation (Vse) .....	14
Diabase (Vdi) .....	14
Lebowa Granite (Mle) .....	14
Karoo Supergroup .....	14
Ecca Group .....	14
Vryheid Formation (Pv) .....	14
Alluvium .....	15
PREVIOUS FIELDWORK OBSERVATIONS IN THE VICINITY OF THE PROJECT AREA .....	16
MITIGATION FOR PALAEONTOLOGICAL HERITAGE .....	22
CONCLUSIONS .....	23
Recommendations .....	23
REFERENCES .....	24
QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR .....	26
DECLARATION OF INDEPENDENCE .....	26
<b>CHANCE FIND PROTOCOL FOR PALAEONTOLOGICAL HERITAGE .....</b>	<b>27</b>
<b>Mitigation Measures Normally Encountered .....</b>	<b>28</b>
<b>Functional responsibilities of the Developer .....</b>	<b>28</b>
<b>Documentary record of palaeontological occurrences .....</b>	<b>29</b>

<b>Functional responsibilities of the appointed Palaeontologist</b> .....	29
<b>Exposure of palaeontological material</b> .....	30
<b>CONCLUSION</b> .....	31

## TABLE OF FIGURES

Figure 1 Locality and layout of the proposed routs of the LPS pipeline and 11kV Powerline at the ADF facility of the Kendal Power Station.....	11
Figure 2 Geology of the study area. The larger part of the site is underlain by Vaalian/Mokolian aged rocks (Vdi, Vse, Mle) as well as Permian aged sediments of the Vryheid Formation (Pv) .....	12
Figure 3 Palaeontological sensivity of the study area. Large areas are underlain by geology with low to very low sensitivity for Palaeontological heritage (blue and grey) Areas underlain by the Vryheid Formation (red) will require ECO intervention during construction (see the CFP) .....	22

## LIST OF TABLES

Table 1 Palaeontological sensitivity analysis outcome classification .....	8
Table 2 Field based observations and photographic records in the region of the application (not on the actual site).....	16

## INTRODUCTION

Gideon Groenewald was appointed by Sazi Environmental Consulting cc to undertake a desktop palaeontological assessment survey for the proposed development of a Low-Pressure System (LPS) Pipeline and 11kV Powerline in association with an existing authorised (EA dated 28 July 2015) Ash Disposal Facility (ADF) at the Kendal Power Station, Emalahleni and Delmas Local Municipalities, Nkangala District Municipality, Mpumalanga Province. The development falls in a rural setting where the natural ecosystem has, to a lesser degree, been modified by agricultural as well as mining activities over the years.

Sazi Environmental Consulting CC was appointed by Eskom Holdings SOC Ltd to undertake an Environmental Impact Assessment process in terms of the National Environmental Management Act (Act No.107 of 1998). As part of the EA process the consultants conducted an HIA for the proposed site and liaised with SAHRA for comment. Eskom Kendal Power Station was granted with an Integrated Environmental Authorisation; dated 28 July 2015 and Water Use License; dated 08 August 2017 for the continuous Ash Disposal Facility (ADF) project. The proposed new infrastructure, LPS pipeline and 11kV powerline, will be constructed within the authorised development footprint, which is already disturbed (in some areas) as construction for the continuous ADF has commenced. SAHRA proposed that Sazi Environmental Consulting CC can motivate for an exemption from a field-based PIA. The purpose of this report is to provide SAHRA with the basic information needed for a decision on an application for exemption from a field-based study. Following this desktop survey and referencing existing Environmental Authorizations, as well as previous personal visits to the development site, it is the professional opinion of the author of this report that the requested exemption be granted.

### **Legal Requirements**

This palaeontological assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 (revised 2017). In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

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; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

### ***Aims and Methodology***

A desktop investigation is often the only opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

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.

Prior to a field investigation, a preliminary assessment (desktop study) of the topography and geology of the study area is made, using appropriate 1:250 000 geological information (2628 East Rand) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc.) are identified within the study area and 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.

Priority palaeontological areas are identified within the development footprint to focus the field investigator's time and resources. The aim of the desktop survey is to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

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 minimal extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

<b>PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS</b>	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008) and Groenewald et al., (2014)	
<b>RED</b>	Very High Palaeontological sensitivity/vulnerability. Development will most likely have a very significant impact on the Palaeontological Heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
<b>ORANGE</b>	High Palaeontological sensitivity/vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and phase I Palaeontological Impact Assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.
<b>GREEN</b>	Moderate Palaeontological sensitivity/vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example areas underlain by the Gordonian Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the Palaeontological Heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a



	professional palaeontologist, desktop survey and phase I PIA (ground proofing of desktop survey) compulsory.
<b>BLUE</b>	<p>Low Palaeontological sensitivity/vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. Collection of a representative sample of potential fossiliferous material recommended. At least a Desktop Survey and "Chance Find Protocol" is compulsory. The Chance Find Protocol must be included in the EMPr for the project.</p>
<b>GREY</b>	<p>Very Low Palaeontological sensitivity/vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during emplacement of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are</p>

	<p>allocated a grey colour of significance, and the geological unit is surrounded by very high and highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits. At least a Desktop Survey and "Chance Find Protocol" document is compulsory. The Chance Find Protocol must be included in the EMP of the project.</p>
--	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

When rock units of Moderate to Very High Palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures must be incorporated into the Environmental Management Plan. A suitably qualified Palaeontologist must clear all projects falling on Low to Very Low Palaeontological sensitive geology.

### **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).

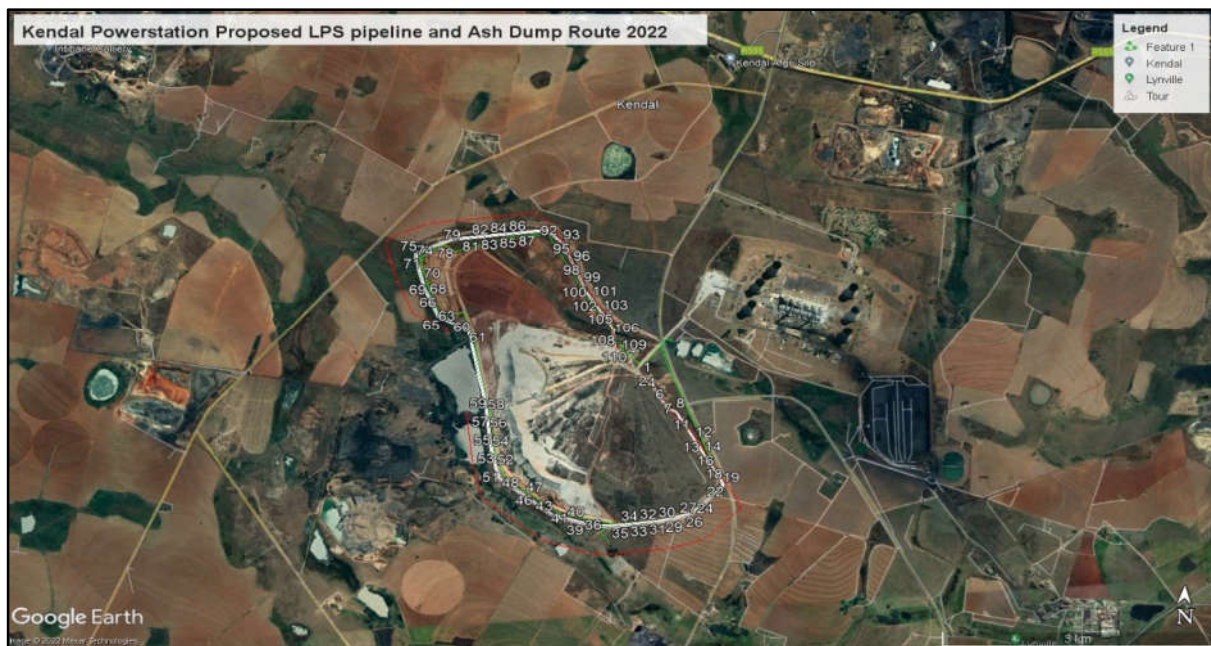
The key assumption for this scoping study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. 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 and the Kingdom of Lesotho. 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.).

### **Locality and Proposed Development**

The proposed development of a Low-Pressure System (LPS) Pipeline and 11kV Powerline falls in an area association with an existing authorised (EA dated 28 July 2015) Ash Disposal Facility (ADF) at the Kendal Power Station, Emalahleni and Delmas Local Municipalities, Nkangala District Municipality, Mpumalanga Province. The development falls in a rural setting where the natural ecosystem has, to a lesser degree, been modified by agricultural as well as mining activities over the years (Figure 1).



**Figure 1 Locality and layout of the proposed routes of the LPS pipeline and 11kV Powerline at the ADF facility of the Kendal Power Station**

This desktop survey aims to provide the decision making authority with a general summary of the geology and palaeontology of the development site.

## GEOLOGY

The development site is underlain by geological formations that varies from very old (Vaalian) aged lithology to Permian and even Quaternary age sedimentary rocks (Figure 2).

Extensive areas are underlain by rocks of the Permian aged Vryheid Formation of the Ecca Group and dolerite of the Karoo Supergroup (Figure 2).

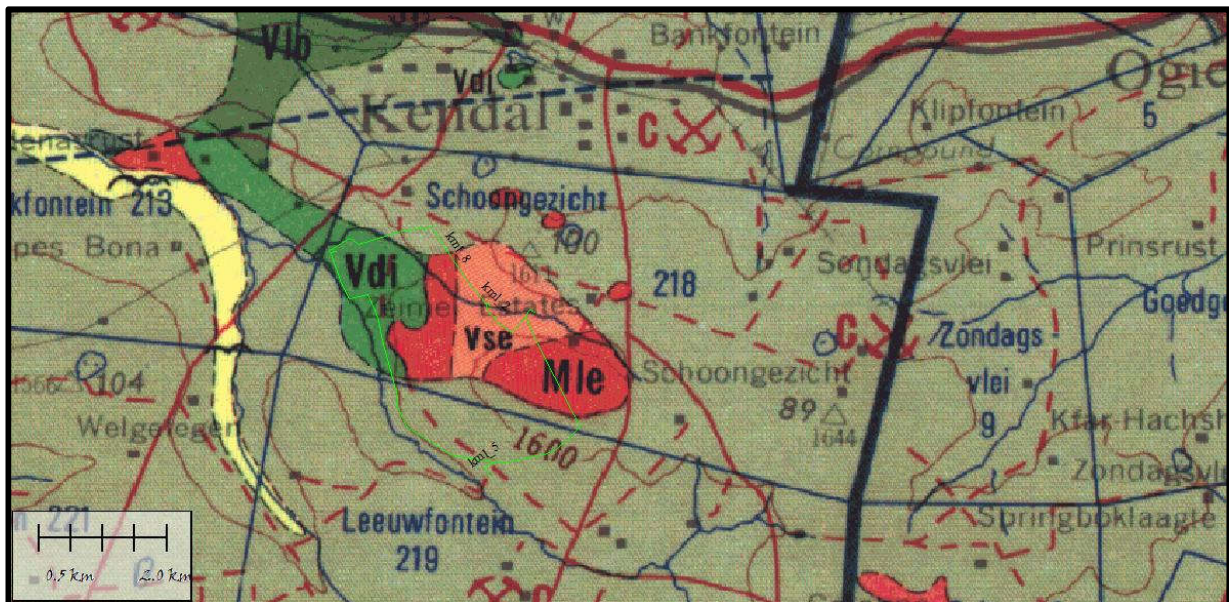


Figure 2 Geology of the study area. The larger part of the site is underlain by Vaalian/Mokolian aged rocks (Vdi, Vse, Mle) as well as Permian aged sediments of the Vryheid Formation (Pv)



## **Pre-Karoo Lithology**

### **Rooiberg Group**

#### ***Selons River Formation (Vse)***

Sequence of Vaalian aged phophyritic rhyolite with interbedded mudstone and sandstone.

#### **Diabase (Vdi)**

Vallian aged diabase intrusive rocks.

#### **Lebowa Granite (Mle)**

Mokolian aged Lebowa granite suite of the Bushveld Complex.

### **Karoo Supergroup**

#### **Ecca Group**

#### ***Vryheid Formation (Pv)***

Overlying the Pre-Karoo basement rocks is a thick sedimentary sequence dominated by light grey sandstones, called the **Vryheid Formation**. These sandstones were deposited along ancient sandy shorelines behind which lay vast swamplands. Burial of vegetation in the swamps eventually formed coal which is mined in the Kendal area.

#### **Alluvium**

Local rivers have alluvium in the valley floors but the local occurrence is limited and insignificant in terms of palaeontological heritage.

## **PALAEONTOLOGY**

The palaeontological heritage of the Pre-Karoo Basement rocks is very limited since granite and diabase are igneous rocks and will not contain any fossils. The Permian aged Karoo Supergroup on the other hand is very rich in palaeontological heritage items and must be investigated during all excavations of deeper than 1,5m.

### **Rooiberg Group**

#### **Selons River Formation (Vse)**

Sequence of Vaalian aged porphyritic rhyolite with interbedded mudstone and sandstone with records of micro-fossils and stromatolites. The chance find of fossils during this development is extremely low and insignificant.

#### **Diabase (Vdi)**

Vallian aged diabase intrusive rocks will not contain fossils.

#### **Lebowa Granite (Mle)**

Mokolian aged Lebowa granite suite of the Bushveld Complex will not contain fossils.

### **Karoo Supergroup**

#### **Ecce Group**

#### **Vryheid Formation (Pv)**

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 hammanskraalensis*, *Annularia sp.*, *Raniganjia sp.*, *Asterotheca spp.*, *Liknopetalon enigmata*, *Glossopteris > 20 species*, *Hirsutum 4 spp.*, *Scutum 4 spp.*, *Ottokaria 3 spp.*, *Estcourtia sp.*, *Arberia 4 spp.*, *Lidgettonia sp.*, *Noeggerathiopsis sp.* and *Podocarpidites sp.*

According to Bamford (2011) "Little data has been published on these potentially fossiliferous deposits. Around the coalmines there is most likely to be good material 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, however, in the interests of heritage and science 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 (1985). 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; Modesto, 2006). 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 (Catuneanu et al 2005).

The late Carboniferous to early Jurassic Karoo Supergroup of South Africa includes economically important coal deposits within the Vryheid Formation of Natal. 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 the study area 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, 1985).

### **Alluvium**



The alluvium deposits are limited to stream beds and no significant fossils are expected in these areas.

## PREVIOUS FIELDWORK OBSERVATIONS IN THE VICINITY OF THE PROJECT AREA





The main motivation for the application for exemption from a Phase 1 Site inspection for this Palaeontological Impact Assessment is the fact that the author of this application is familiar with the geological environment and is of the professional opinion that a site visit at this stage of the planning for this development will not add any further value to the recommendations in the "Chance Find Protocol" that is included in this discussion.





Photographic observations and field based records in the general area of the application are presented for the sake of clarity and to assist the SAHRA in the decision regarding granting of exemption from a field based assessment at this stage of the EIA application (Table 2)




**Table 2 Field based observations and photographic records in the region of the application (not on the actual site)**





P hoto no	GPS Coordinates	Description	Photograph
1	S25° 58' 34.1" E29° 13' 16.2"	Deep soils – no outcrop	
2	S25° 58' 06.6" E29° 13' 38.2"	Deep soils, No outcrop	







3	S25° 58' 06.6" E29° 13' 38.2"	Deep soils, no outcrop, no fossils observed	
4	S25° 58' 05.5" E29° 13' 40.0"	Deep soils with no outcrop	
5	S25° 58' 04.4" E29° 13' 42.3"	Deep soils with no outcrop	
6	S25° 57' 59.9" E29° 13' 53.1"	Deep soils with no outcrop	


7	S25° 57' 59.9" E29° 13' 53.1"	Deep soils with no outcrop	
8	S25° 57' 48.2" E29° 14' 21.6"	Deep soils with no outcrop	
9	S25° 57' 47.5" E29° 14' 19.5"	Deep soils with no outcrop	
10	S25° 57' 46.7" E29° 14' 21.1"	Outcrop of Vryheid Sandstone – no fossils observed	

11	S25° 57' 46.7" E29° 14' 21.1"	Iron oxide cast of fossils wood in Vryheid Sandstone	
12	S25° 57' 46.7" E29° 14' 21.1"	Casts of plants in sandstone	
13	S25° 57' 46.7" E29° 14' 21.1"	Casts of plants in sandstone	

14	S25° 57' 46.7" E29° 14' 21.1"	Small scale trace fossils ( <i>Scolithos</i> like) in siltstone of the Vryheid Formation	
15	S25° 57' 46.8" E29° 14' 17.8"	Typical sandbar deposit in Vryheid Formation. No fossils observed	
16	S25° 57' 45.7" E29° 14' 27.5"	Trench excavation. Deep soils, little outcrop and no fossils observed	
17	S25° 57' 45.7" E29° 14' 27.5"	Trench excavation. Deep soils, little outcrop and no fossils observed	



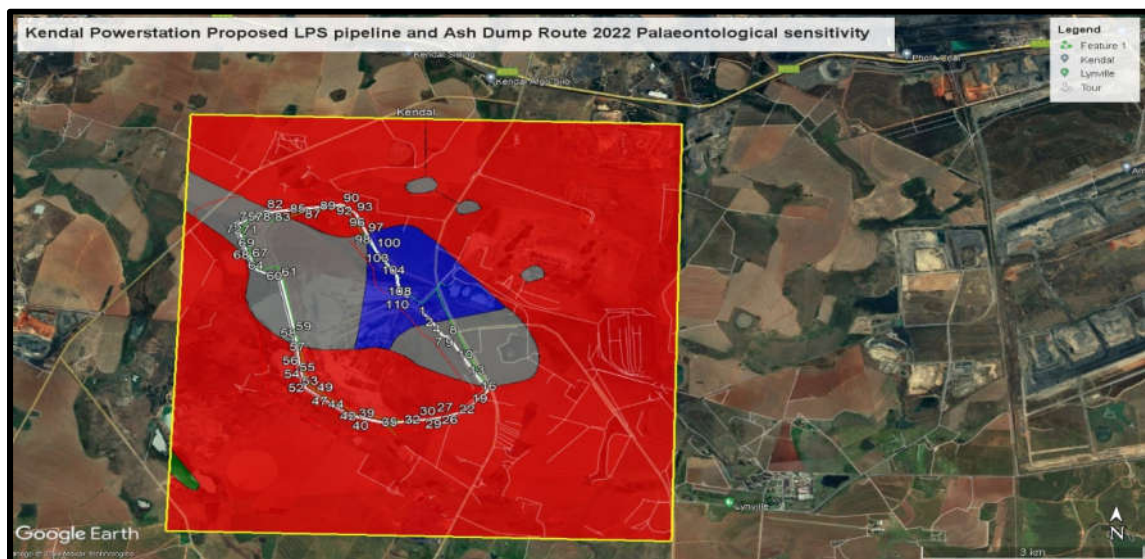
18	S25° 57' 42.0" E29° 14' 36.4"	Trench excavation. Deep soils, little outcrop and no fossils observed	
19	S25° 57' 42.0" E29° 14' 36.4"	Trench excavation. Deep soils, little outcrop and no fossils observed	
20	S25° 57' 42.8" E29° 14' 34.3"	Excavation into deep sandy soils and some sandstone outcrops. No fossils observed	
21	S25° 57' 35.9" E29° 14' 50.2"	Deep soils on Loskop Formation. No outcrops and no fossils expected or observed	

22	S25° 57' 35.9" E29° 14' 50.2"	Deep soils on Loskop Formation. No outcrops and no fossils expected or observed	
----	----------------------------------	---------------------------------------------------------------------------------	------------------------------------------------------------------------------------

### MITIGATION FOR PALAEOONTOLOGICAL HERITAGE

The palaeontological sensitivity of the study area is very high in areas underlain by the Vryheid Formation (Table 3 and Figure 3). Mitigation for palaeontological heritage must follow the existing EMPr instructions as was recommended for the development of the Ash Disposal Facility (see existing documentation and Environmental Authorization for reference as well as the Chance Find Protocol in this report).

The rest of the study area is underlain by rocks with a very low to low significance for palaeontological heritage and no further mitigation for palaeontology is recommended.



**Figure 3 Palaeontological sensitivity of the study area. Large areas are underlain by geology with low to very low sensitivity for Palaeontological heritage (blue and grey) Areas underlain by the Vryheid Formation (red) will require ECO intervention during construction (see the CFP)**

## CONCLUSIONS

The geology underlying the proposed development area for a Low-Pressure System (LPS) Pipeline and 11kV Powerline in association with an existing authorised (EA dated 28 July 2015) Ash Disposal Facility (ADF) at the Kendal Power Station, Emalahleni and Delmas Local Municipalities, Nkangala District Municipality, Mpumalanga Province include Pre-Karoo lithology and sediments of the Vryheid Formation, Eccu Group of the Karoo Supergroup.

It is very important to note that, although a very high sensitivity rating is accorded to areas underlain by Vryheid Formation geology, the actual impact per site of excavation might be limited. Although it is imperative to indicate the very high sensitivity on the initial maps, the *modus operandi* of the project palaeontologist, when appointed, must be to train the ECO and team members to adhere to the “Chance Find Protocol” recommendation. Fossils recorded during construction must be curated and moved to the ESI at the University of the Witwatersrand (Wits) or the preferred institute indicated by SAHRA.

### Recommendations

- The EAP and developer must be informed that significant areas are underlain by rocks with a very high sensitivity for palaeontological heritage. The areas underlain by dolerite and Pre-Karoo lithology will have a very low to insignificant sensitivity for palaeontological heritage.
- All excavations that will expose sedimentary strata of the Vryheid Formation (geotechnical reports) will most probably contain significant fossils. The appointment of a palaeontologist to do a comprehensive Phase 2 PIA assessment (field assessment during construction if requested by ECO – see CFP attached) will be a minimum requirement for monitoring of excavations into the Vryheid Formation strata.
- The project will require a formal “Chance Find Protocol” (attached) **that will have to be upgraded during the construction phase of the project.**
- Recommendations for palaeontological monitoring and mitigation will have to be incorporated into the EMP for approval by the SAHRA.
- **If it is recommended that the application for exemption from a Phase 1 site visit for this Palaeontological Impact Assessment be approved.**

## REFERENCES

- Almond J.E. and Pether J. 2008.** *Palaeontological Heritage of the Western Cape*. Internal Report Heritage Western Cape.
- Almond J.E., De Klerk B. and Gess R., 2009.** *Palaeontological Heritage of the Eastern Cape*. Internal Report, SAHRA.
- Groenewald GH., 1996.** *Stratigraphy and Sedimentology of the Tarkastad Subgroup, Karoo Supergroup, South Africa*. Unpubl PhD Thesis, University of Port Elizabeth.
- Groenewald GH., 2012.** *Palaeontological Technical Report for Kwazulu-Natal*. Internal Report, AMAFA.
- Groenewald G.H., Groenewald D.P. and Groenewald S.M., 2014.** *Palaeontological Heritage of the Free State, Gauteng, Limpopo, Mpumalanga and North West Provinces*. Internal Palaeotechnical Reports, SAHRA.
- Groenewald, D.P., Day, M.O., Penn-Clarke C.R. and Rubidge, B.S., 2022.** Stepping out across the Karoo retro-foreland basin: Improved constraints on the Ecca-Beaufort shoreline along the northern margin. *Jour of African Earth Sciences* 185.
- Johnson MR , Anhaeusser CR and Thomas RJ (Eds). 2009.** *The Geology of South Africa*. GSSA, Council for Geoscience, Pretoria.
- MacRae C. 1999.** *Life Etched in Stone*. Geological Society of South Africa, Linden, South Africa.
- McCarthy T and Rubidge BS. 2005.** *Earth and Life*. 333pp. Struik Publishers, Cape Town.
- SACS, 1980.** *Statigraphy of South Africa, Handbook 8. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the republics of Bophuthatswana, Transkei and Venda*. Geological Survey of South Africa, Pretoria.
- Smith, R.M.H., Rubidge, B.S., Day, M.O. and Botha, J. 2020:** *Introduction to the tetrapod biozonation of the Karoo Supergroup*. *South African Journal of Geology* 123, 131–140.



**Smith, R.M.H. 2020:** *Biostratigraphy of the Cistecephalus Assemblage Zone*. South African Journal of Geology 123, 181–190.

**Viglietti, P.A. 2016:** *Stratigraphy and sedimentary environments of the late Permian Dicynodon Assemblage Zone (Karoo Supergroup, South Africa) and implications for basin development*. Unpublished PhD Thesis, University of the Witwatersrand, Johannesburg, South Africa, 272pp.

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

## **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 palaeo-ecological 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).

## **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

## CHANCE FIND PROTOCOL FOR PALAEONTOLOGICAL HERITAGE

**Proposed development area for a Low-Pressure System (LPS) Pipeline and 11kV Powerline in association with an existing authorised (EA dated 28 July 2015) Ash Disposal Facility (ADF) at the Kendal Power Station, Emalahleni and Delmas Local Municipalities, Nkangala District Municipality, Mpumalanga Province**

### **Mitigation for excavation Impact on Palaeontological Heritage Resources - LPS Pipeline and 11kV Powerline in existing ADF development site**

It is essential that the appointed palaeontologist, in consultation with the Project Environmental Manager and the contractors and ECO's of the excavation works develop a short-term strategy for the recovery of significant fossils during the excavation operation. As part of such a strategy, the discussions with the palaeontologist must include:

- Initially, and at least for the *duration of excavation*, visit the site **on request of the ECO** of the specific construction site, to ensure recording of all potentially significant fossil strata. Due to the longevity of this contractual involvement it is not possible to have pre-determined timing on potential visits and it is a conclusion from present observations, that more frequent visits by the Palaeontologist during excavations into the Karoo Subgroup sediments will **probably** be required.
- Determine a short-term strategy and budget for the recording of significant fossils (only if very deep (>2m) excavations into bedrock is planned). This Strategy is simply an oral agreement on when the site is to be inspected and what the finds are that might be recorded. The site visit must include an introduction session with all the managers of the Project Team, including training of the ECO and site managers by the appointed palaeontologist, to basically train people to know what to look out for in terms of fossil heritage on site. This action will be required at the start of each individual construction activity for the duration of construction in the "greenfield sections" of the site.
- **Following the Desktop Survey, site visits (Phase 2 PIA) are recommended for areas (only indicated with red colour on sensitivity map) where excavation into bedrock might expose highly significant fossils. The palaeontologist must only visit the site if specifically requested by the ECO if/when significant fossil finds are recorded during the construction phase.**
- In the case of reporting of any unusual sedimentary structures, the Palaeontologist must be notified, and a site visit must be arranged at the earliest possible time with the Palaeontologist. In the case of the site ECO or the Site Manager becoming aware of suspicious looking material that might be a "Significant Find", the construction must be halted in that specific area and the PEM must be informed

who will inform the Project Engineer. The Palaeontologist must be given enough time to reach the site and the PEM will request a Site Instruction from the Engineer to allow for removal of the material before excavation continues. In the case of this specific project and based on the experience of the author of this CFP, this chance find is **unlikely**.

### **Mitigation Measures Normally Encountered**

1. Mitigation of palaeontological material must begin as soon as possible and preferably when “trial excavation” takes place. The appointed specialists must acquaint themselves with the operation and determine feasible mitigation strategies.
2. A plan for systematic sampling, recording, preliminary sorting and storage of palaeontological and sedimentological samples will be developed during the early stages of the project, in collaboration with the Evolutionary Studies Institute (ESI) at WITS University, which is the closest Institute to the site.
3. Mitigation will involve an attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labelled, boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers. The developer will not be responsible for any funding of continued research on site – **the only funding obligation is the appointment of the specialist, assistance with collecting of the samples, safe-keeping and delivery to the preferred institute.**

### **Functional responsibilities of the Developer**

1. Ensuring, at their cost, that a representative archive of palaeontological samples and other records is assembled to characterise the palaeontological occurrences affected by the excavation operation.
2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas. In the case of this project it is foreseen that invertebrate and trace fossils will be present. *(If more fossils of Permian age are exposed, it will be Very Highly significant and the Palaeontologist will obviously be in close communication with the site ECO and the PEM to act as required by HWC/SAHRA without causing undue standing time for the contractors).*
3. “Facilitate” systematic recording of the stratigraphic and palaeo-environmental features of exposures in the fossil-bearing excavations, by allowing time to describe and measure

geological sections, and by providing aid in the surveying of positions where significant fossils are found. *(In the case of this specific development, the likelihood of such finds is only **very high** in areas indicated with a **red colour** on the sensitivity map).*

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.

5. Provide covered, dry storage for samples and facilities that is defined as a work area for sorting, labelling and boxing/bagging of samples.

6. Costs of basic curation and storage in the sample archive at the ESI, WITS University (labels, boxes, shelving and, if necessary, specifically-tasked temporary employees). In the case of this specific project this scenario is deemed to be of **limited probability**.

### **Documentary record of palaeontological occurrences**

1. The contractors will, after consultation with the PEM and in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which the following information are indicated on the plan in the site office at the excavation site. This must be done in conjunction with the appointed specialist and form part of the on-going revision of this “Chance Find Protocol” (CFP) during the excavation stage of the project:

1.1. Initially, all known specific palaeontological information will be indicated on the plan **(Red colour areas indicated on the sensitivity map)**. This will be updated throughout the excavation period.

1.2 Locations of samples and measured sections are to be pegged, and routinely accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any significant fossils are recorded during the time of excavation. This information must be recorded during the first site visit and a clearance from the Palaeontologist (e-mail message will suffice) must be followed up with subsequent e-mail communications with the Site Specific ECO, Site Manager and the PEM.

### **Functional responsibilities of the appointed Palaeontologist**

***In the case of this specific project the following responsibilities will only be applicable if the ECO observes significant fossils in the areas indicated with a red color on the sensitivity maps.***

1. If fossils are recorded during the first week of excavation (ECO action), apply for a permit to collect fossils during the lifetime of the Project and establishment of a representative collection of fossils. Contextual archive of appropriately documented and

sampled palaeo-environmental and sedimentological geodata in collaboration with the ESI at WITS University.

2. **If requested by the ECO** at the induction phase of the project, undertake an initial evaluation of potentially affected areas and of available exposures in excavations. A short training session, inclusive of the PEM, Project Managers and the ECO's or their representatives, was presented during the first site visit to this project.

3. On the basis of the above, and evaluation during the early stages of excavation development, in collaboration with the PEM and the contractor management team, more detailed practical strategies to deal with the fossils encountered routinely during excavation, as well as the strategies for major finds must briefly be agreed on.

4. Informal on-site training in responses applicable to "normal" fossil finds must be provided for the PEM, ECO and environmental staff by the appointed specialist. **This step is will only be arranged following the discovery of significant fossils at the time of the Phase 2 site visits.**

5. Respond to significant finds and undertake appropriate mitigation.

6. Initially, for the first year of operation, and if the PEM or the appropriate ECO indicates significant "strange looking rocks" that might be similar to the fossils indicated to the staff during the information sessions, visit at least **once in twelve weeks** to "touch base" with the monitoring progress. Document interim "normal" finds and undertake an inspection and documentation of new excavation phases. A strategy for further visits during the life of the excavation must be discussed.

7. Transport of material from the site to the ESI, WITS University or the allocated Institute where an expert on the specific fossils discovered, is presently employed.

8. Reporting on the significance of discoveries, as far as can be preliminarily ascertained. This report is in the public domain and copies of the report must be deposited at ESI, and the South African Heritage Resources Authority (SAHRA). It must fulfil the reporting standards and data requirements of these bodies.

9. Reasonable participation in publicity and public involvement associated with palaeontological discoveries.

### **Exposure of palaeontological material**

1. In the event of construction exposing new palaeontological material, not regarded as normative/routine as outlined in the initial investigation, such as a **major fossil find**, (body fossils or vertebrate fossil remains) the following procedure must be adhered to:

1.1 The appointed specialist or alternates ( SAHRA; ESI WITS University; Rhodes University) must be notified by the responsible officer (e.g. the PEM, Chief Engineer, ECO or Contractor Manager), of major or unusual discoveries during excavation, found by the Contractor Staff.

1.2 Should a major *in situ* occurrence be exposed, excavation will immediately cease in that area so that the discovery is not disturbed or altered in any way until the appointed

specialist or scientists from the ESI at WITS University, or its designated representatives, have had reasonable opportunity to investigate the find. Such work will be at the expense of the Developer.

Significant fossil finds (mainly plant fossils) are known from this area and the appointed palaeontologist must clear continued excavation on the proviso that any suspicious material will be indicated by the ECO to the Palaeontologist via **e-mailed or per whatsapp (+27 78 713 6377)- photographic information.**

## CONCLUSION

The development site for the proposed Low-Pressure System (LPS) Pipeline and 11kV Powerline in association with an existing authorised (EA dated 28 July 2015) Ash Disposal Facility (ADF) at the Kendal Power Station, Emalahleni and Delmas Local Municipalities, Nkangala District Municipality, Mpumalanga Province, falls on very low to very highly significant sedimentary rocks (Ecca Group) that contain significant fossils. Fossils are known from the area and arrangements must be made to obtain necessary permits for collecting of the fossils that might be exposed.

Following the desktop survey the conclusion is that the potential for finding significant invertebrate and trace-fossils, in any excavation into sediments of the Vryheid Formation, Ecca Group of the Karoo Supergroup is **very high, albeit only applicable to the limited extent of areas allocated a red colour on the Palaeontological sensitivity map.**

The cooperation of the entire team of engineers and contractors, is of critical importance. The interest and cooperation of the management team will be highly appreciated and it is essential that the excavations be monitored during the entire period of excavation and that this "Chance Find Protocol" be updated on a regular basis during the life-time of the excavation period for the Project. It is essential that the Palaeontologist be notified of the final sign-off of the project date, for final posting of the "Chance Find Protocol" on the SAHRIS Website for record purposes.

It is recommended that:

- The PEM and ECO's must be informed of the fact that a very high Palaeontological Sensitivity was allocated to a limited part of the development and due to the covered nature of the material, significant fossils are only expected during excavations on site if excavations are deeper than 2m into un-weathered bedrock of the Vryheid Formation shale and sandstone.
- This "Chance Find Protocol" must be included in the EMP of the Project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer in terms of the proper conservation of and storage of Palaeontological Heritage.

- The SAHRA must be informed of the content of this “Chance Find Protocol” and EMP arrangements by the PEM and the Developer, for final conclusion of the Project.
- Following the desktop survey it is the professional opinion of Dr Gideon Groenewald, accredited palaeontologist, that further mitigation for Palaeontological Heritage is required during excavation, specifically where very deep (>2m) excavations into un-weathered sedimentary rocks of the Vryheid Formation are planned (see geotechnical reports).
- **It is also the professional opinion of Dr Gideon Groenewald that further site visits by a palaeontologist at this stage of the EIA process, are deemed superfluous and adherence to the Chance Find Protocol will suffice for recording of significant Palaeontological Heritage at this site.**