

**PHASE 1 PALAEOLOGICAL  
ASSESSMENT FOR THE PROPOSED  
CONSTRUCTION OF THE MAHLATINI  
ROAD UPGRADE, OKHAHLAMBA LOCAL  
MUNICIPALITY, UTHUKELA DISTRICT  
MUNICIPALITY, KWAZULU-NATAL  
PROVINCE.**

**FOR**

**HIA CONSULTANTS**

**Active Heritage CC**

**DATE: 06 May 2016**

**By**

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## EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological field survey, assessing the potential Palaeontological Impact of the proposed construction and upgrade of the Mahlatini Road (L1528), Okhahlamba Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province.

The purpose of this Phase 1 Palaeontological Impact Assessment is to identify exposed and potential Palaeontological Heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

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 as well as the KwaZulu-Natal Heritage Act No 4 of 2008. 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.

The development site for the proposed construction and upgrade of the Mahlatini Road (L1528), Okhahlamba Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province is underlain by Permian and Triassic aged sedimentary rocks of the Normandien (Adelaide Subgroup) and Katberg/Verkykerskop Formations (Tarkastad Subgroup), Beaufort Group and Dolerite of the Karoo Supergroup as well as sections underlain by deep clay-rich or sandy alluvium.

No significant fossils were observed during the field investigation. The potential for finding significant fossils in any excavation into sediments of the Normandien and Katberg/Verkykerskop Formations is high, but due to the deep weathering it is recommended that further professional mitigation is required during excavation of foundations for this road. If fossils are observed during construction, the HIA consultant must be notified and the fossils collected by a suitably qualified palaeontologist according to AMAFA and SAHRA specifications.

It is recommended that:

- The EAP and ECO must be informed of the fact that a Very High Palaeontological sensitivity is allocated to the sections of the development underlain by shale and sandstone of the Beaufort Group and although highly weathered, fossils might very likely be recorded during the next phase of construction.
- If fossils are recorded, a suitably qualified palaeontologist must be appointed to inspect all areas where excavation of deeper than 1,5m is made into sediments of the Beaufort Group and a protocol for the chance find of fossils must then be developed and discussed with the contractor on site.
  - These recommendations must be included in the EMP of this project.

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## INTRODUCTION

Gideon Groenewald was appointed to undertake a Phase 1 Palaeontological field survey, assessing the potential Palaeontological Impact of the proposed construction and upgrade of the Mahlatini Road (L1528), Okhahlamba Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province.

The purpose of this Phase 1 Palaeontological Impact Assessment is to identify exposed and potential Palaeontological Heritage on the site of the proposed development, to assess the impact the development may have on this resource, and to make recommendations as to how this impact might be mitigated.

### 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 as well as the KwaZulu-Natal Heritage Act No 4 of 2008. 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 Phase 1 investigation is often the last 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 identifying exposed and subsurface rock formations that are considered to be palaeontologically significant;

- to assessing 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 the field investigation a preliminary assessment (desktop study) of the topography and geology of the study area was made using appropriate 1:250 000 geological maps (2828 Harrismith) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) were identified within the study area and the known fossil heritage within each rock unit was inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas were identified within the development footprint to focus the field investigator's time and resources. The aim of the fieldwork was 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 was 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 2.1 below.

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 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>
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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, 2009) (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 Gordonia 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) recommended.
<b>BLUE</b>	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

	<p>sedimentary rock units occurring in larger alluvium deposits. Collection of a representative sample of potential fossiliferous material is recommended.</p>
<p><b>GREY</b></p>	<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 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.</p>

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures should be incorporated into the Environmental Management Plan.

### Scope and Limitations of the Phase 1 Investigation

The scope of a phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and

- where feasible, location and examination of any fossil collections from the study area (e.g. museums).
- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/study area rather than formal palaeontological collection. The investigation focussed on the bedrock exposure where excavations would most probably require palaeontological monitoring.

The results of the field investigation are used to predict the potential of buried fossil heritage within the development footprint. In some investigations, this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

### Locality and Proposed Development

The study area is located to the west of Geluksburgek and is an upgrade of the existing path development referred to as the Mahlatini Road (route number L1528) in the Okhahlamba Local Municipal area (Figure 1).

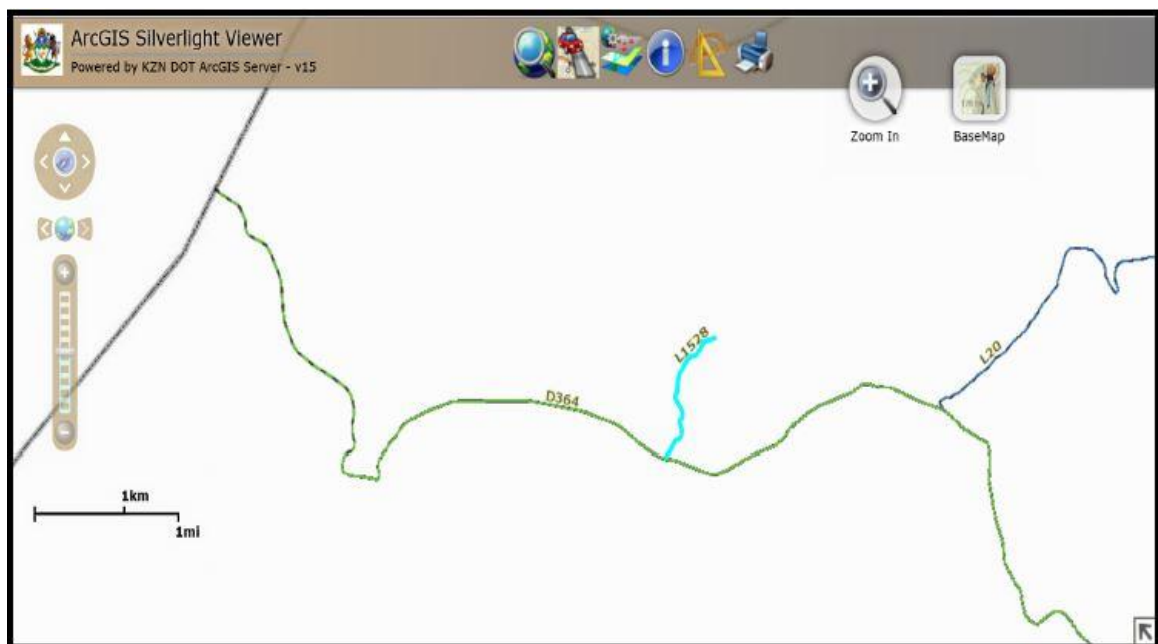


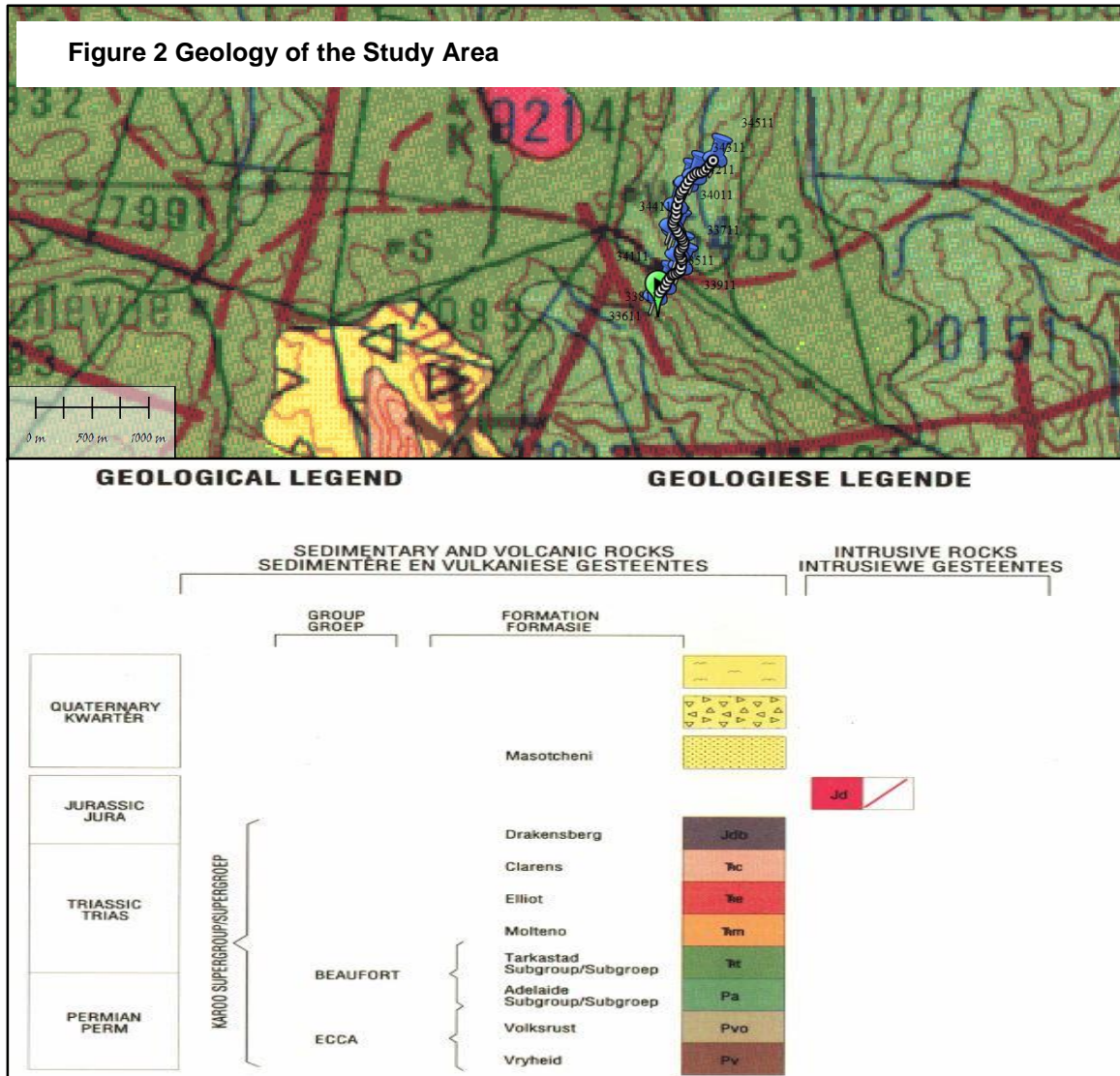
Figure 1 Locality of the Mahlatini Road (L1528) west of Geluksburg

The proposal for development includes the upgrading of the Mahlatini Road (Road L1528) west of Geluksburg.



## GEOLOGY

The study area is underlain predominantly by Permian to Triassic aged rocks of the Normandien Formation (Adelaide Subgroup) and Triassic aged rocks of the Verkykerskop Formation of the Tarkastad Subgroup, Beaufort Group and Jurassic aged Dolerite of the Karoo Supergroup. Scree is restricted to high mountain sides (Figure 2).



### Beaufort Group

#### Adelaide Subgroup, Normandien Formation (Pa)

The Permian to Triassic aged Normandien Formation is a thick sequence of sedimentary rocks dominated by light grey sandstones with interbedded grey-

green shale with a prominent brightly coloured mudstone known as the Harrismith Member in the study area (Groenewald, 1989, 1996). Thin, uneconomic coal seams are abundantly present in the sedimentary sequence

The lower sandstones and mudstone were deposited in ancient muddy meandering rivers whilst the upper brightly coloured mudstone unit was deposited in lacustrine conditions in a predominantly dry climate (Groenewald, 1990). Burial of vegetation in the swamps eventually formed thin coal seams which are not economically viable deposits (Johnson et al, 2009; Groenewald 2012).

### **Tarkastad Subgroup, Katberg/Verkykerskop Formation (Trt)**

The Triassic aged Katberg/Verkykerskop Formation is an assemblage of fine- to very coarse-grained sediments, consisting mainly of dark grey and yellow sandstone. The deposits represent Triassic aged braided river deposits in this part of Gondwanaland (Groenewald, 1989, 2012; Johnson et al, 2009).

The Katberg Formation is defined as the lower sandstone-rich unit of the Tarkastad Subgroup and consists of fine-grained sandstone with a main provenance to the southeast. The Verkykerskop Formation is a time equivalent of the Katberg Formation, but consists predominantly of coarse-grained sandstone with a provenance to the northeast (Groenewald, 1996; Johnson et al, 2009).

### **Dolerite (Jd)**

Jurassic aged Dolerite is associated with the breakup of Gondwanaland and outcrops in parts of the study area not underlying the road development.

## **PALAEONTOLOGY**

### **Beaufort Group**

#### **Adelaide Subgroup, Normandien Formation (Pa)**

The Beaufort Group is well-known for its richness in fossils of vertebrates and also includes several recordings of unique vertebrate burrows. (Groenewald 1989; Johnson and Verster , 1994; Rubidge, 1995; Groenewald 1996, 2012; Groenewald et al, 2001 and Johnson et al, 2009).

The Adelaide Subgroup overlies the Volksrust Formation of the Ecca Group and the transition from deep water deposits of the Volksrust Formation to pro-deltaic and deltaic deposits of the Beaufort Group present fieldworkers with problems in mapping these units (Groenewald, 1984; Munitingh, 1989; Johnson and Verster, 1994; Johnson et al, 2009). The Adelaide Subgroup comprises the

*Daptocephalus* Assemblage Zone (previously the *Dicynodon* Assemblage Zone) (Viglietti et al., 2015) and possibly the underlying *Cistecephalus* Assemblage Zone as well as the *Lystrosaurus* Assemblage Zone that is correlated with the Harrismith Member in the north and the Palingkloof Member in the south of the Karoo Basin (Groenewald, 1996). The Adelaide Subgroup or Normandien Formation is a treasure house of plant fossils of mainly the *Glossopteris* Assemblage as well as remains of insects (Groenewald, 2012).

#### *Normandien Formation*

The Normandien Formation comprises all the sediments of the Adelaide Subgroup and includes the Estcourt Formation (Johnson and Verster, 1989). The Karoo Basin in South Africa is well known for the fact that it represents the most complete sequence of sedimentary history in Gondwana and contains the remains of most of the therapsids (ancient ancestors of mammals) that roamed the Earth during the Permian Period (Rubidge, 1995; MacRae, 1999; McCarthy and Rubidge, 2005). The most significant geological event recorded in this sequence is the end-Permian mass extinction event (EPME) that occurred 252.4 million years ago when much of all life on Earth was terminated. This event can most probably be correlated in time with the deposition of the Schoondraai Member of the Normandien Formation, but much more work is needed to establish the final correlation of this event in KwaZulu-Natal. The 2010 excavations for the Bedford Dam of the Ingula Pumped Storage Scheme (Groenewald, 2011) provided a unique opportunity to collect vertebrate fossils, trace fossils of invertebrates (i.e. trackways, burrows) as well as plants from the rocks that were deposited during the Late Permian.

### **Tarkastad Subgroup, Katberg/Verkykerskop Formation**

The Katberg and Verkykerskop formations are well-defined sandstone rich units along the Drakensberg Escarpment and the lower boundary of the Tarkastad Subgroup is mapped out over the entire escarpment. The Katberg and Verkykerskop Formations are associated with the middle and upper portion of the *Lystrosaurus* Assemblage Zone (Groenewald 1996, 2012).

#### **Dolerite**

Due to its igneous character dolerite will not contain fossils.

### **PRELIMINARY ASSESSMENT RESULTS**

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and

evaluating the nature and scale of the development itself. The palaeontological sensitivity was predicted as highly significant, due to the potential abundance of Permian and Triassic aged trace, vertebrate and plant fossils in the Normandien and Katberg/Verkykerskop Formations of the Beaufort Group. Karoo Supergroup.

### **FIELD INVESTIGATION**

Dr Gideon Groenewald, experienced fieldworker, visited the site of the proposed construction of the Mahlatini Road Upgrade, Okhahlamba Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province on Wednesday 4<sup>th</sup> May 2016. The topography of the area varies from undulating hills and plains to very rugged mountains with well-developed crests, vertical cliffs, very steep middle slopes and extended footslopes ending in a well-defined valley floor of the river valleys. The study area is on very rugged land is mostly grassland with exotic trees.

The site of the proposed development is on the middle slope and valley floor of the landscape and is highly altered by human development, including the creation of local informal housing clusters with typical Zulu Kraal structures that blends in with the environment.


Excavations for the new development will expose mostly brightly coloured siltstone and sandstone of the upper Normandien Formation as well as sandstone of the Katberg/Verkykerskop Formation and possibly local small outcrops of dolerite.

Observations were recorded at different GPS stations (Figure 3 and Table 2).









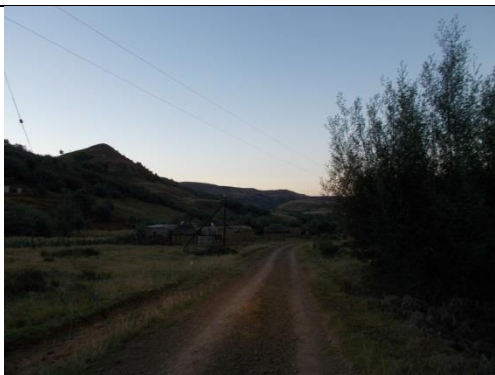

Figure 3 Observations for Palaeontological Heritage. (See Table 2)


Table 2 Record of Photographic Observations

Photo	(GPS station) Coordinates	Comments	Photographic Record
1	(33511) -28° 28' 32.0" 29° 17' 07.1"	Start of the Mahlatini Road towards the north off D364 route. Soil cover on Katberg/Verkykerskop Formation. No fossils observed.	



2	(33611) -28° 28' 29.0" 29° 17' 09.8"	Outcrop of fine-grained sandstone of the Katberg Formation. No fossils were observed during the field surveys. The sandstone is deeply weathered and fossils will most probably be present during excavation for this development	
3	(33711) -28° 28' 23.3" 29° 17' 14.4"	Typical red coloured siltstone outcrop of the Harrismith Member at the top of the Normandien Formation. This unit is associated with the Lystrosaurus Assemblage Zone and fossils will most probably be present in excavations for the new development. No fossils were observed during the field investigation but outcrops were very small.	
4	(33911) -28° 28' 20.1" 29° 17' 13.6"	No outcrops were present in the valley floor regions and it is not possible to predict if fossils will be excavated during construction. The route must however be seen as highly sensitive for Palaeontological Heritage.	
5	(34011) -28° 28' 13.3" 29° 17' 12.5"	Deep soil in valley floor regions. No outcrop but it can be expected that mudstone of the Normandien Formation might be exposed during construction	

<p>6</p>	<p>(34111) -28° 28' 11.9" 29° 17' 11.7"</p>	<p>Dolerite boulders in road side excavation. Dolerite dyke association will result in local exposure of dolerite gravel at this locality and no fossils are expected</p>	
<p>7</p>	<p>(34211) -28° 28' 06.0" 29° 17' 13.0"</p>	<p>Relatively deep sandy soil on deeply weathered mudstone of the Normandien Formation. No fossils observed</p>	
<p>8</p>	<p>(34311) -28° 27' 59.7" 29° 17' 16.1"</p>	<p>Deep soil in valley floor – alluvial material. No fossils observed.</p>	
<p>9</p>	<p>(34411) -28° 27' 57.7" 29° 17' 18.4"</p>	<p>Deep alluvial fill in valley floor. No fossils observed.</p>	

10	(34511) -28° 27' 52.9" 29° 17' 24.2"	Rugged terrain with steep middle slopes underlain by mudstone of the Normandien Formation. The chances of finding significant fossils in the mudstone of the Harrismith Member is very high. Mitigation for Palaeontological Heritage needs to be planned for this project	
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## PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered

**Figure 4 Palaeontological Sensitivity of the entire route is rated as Very High. For colour code see Table 1**



during the field investigation.

The field investigation confirms that the study area is underlain by green-grey mudstone (*Daptocephalus* Assemblage Zone) and brightly coloured red and grey-green mudstone of the Harrismith Member (*Lystrosaurus* Assemblage Zone) of the Normandien Formation (Adelaide Subgroup) and fine-grained sandstone of the Katberg Formation (Tarkastad Subgroup) of the Beaufort Group, Karoo Supergroup. The rock outcrops are mostly covered in deep soil, except in the streambeds where no rock outcrops are present.



The excavations for the construction of the infrastructure for this development will expose some sediments of the Normandien and Katberg/Verkykerskop Formations. Due to weathering, no well-preserved fossils were observed during the field investigation. Exposure of bedrock during excavation might however result in the exposure of significant plant and/or trace fossils and the Very High Palaeontological sensitivity of the site is retained in areas underlain by sediments of the Normandien and Katberg/Verkykerskop Formations (Figure 4).

## CONCLUSION

The development site for the proposed construction and upgrade of the Mahlatini Road (L1528), Okhahlamba Local Municipality, Uthukela District Municipality, Kwazulu-Natal Province is underlain by Permian and Triassic aged sedimentary rocks of the Normandien (Adelaide Subgroup) and Katberg/Verkykerskop Formations (Tarkastad Subgroup), Beaufort Group and Dolerite of the Karoo Supergroup as well as sections underlain by deep clay-rich or sandy alluvium.

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It is recommended that:

- The EAP and ECO must be informed of the fact that a Very High Palaeontological sensitivity is allocated to the sections of the development underlain by shale and sandstone of the Beaufort Group and although highly weathered, fossils might very likely be recorded during the next phase of construction.
- If fossils are recorded, a suitably qualified palaeontologist must be appointed to inspect all areas where excavation of deeper than 1,5m is made into sediments of the Beaufort Group and a protocol for the chance find of fossils must then be developed and discussed with the contractor on site.
- These recommendations must be included in the EMP of this project.

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## **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