

**DESKTOP PALAEOLOGICAL  
ASSESSMENT AND "CHANCE FIND  
PROTOCOL" FOR THE PROPOSED  
ROAD (L2598) UPGRADING AND  
BRIDGE AT THE WHITE MFOLOZI  
RIVER, ULUNDI LOCAL  
MUNICIPALITY, ZULULAND  
DISTRICT MUNICIPALITY,  
KWAZULU-NATAL PROVINCE.**

**FOR**

**HIA Consultants  
Active Heritage**

**DATE: 23 September 2017**

**By**

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## EXECUTIVE SUMMARY

Gideon Groenewald was appointed by Active Heritage CC to undertake a Desktop Palaeontological Assessment and “Chance Find Protocol” (CFP) for the proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province.

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 2014, 2017) as well as the KwaZulu-Natal Heritage Act No 4 of 2008 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 applicable to the application for the proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province is underlain by Swazian aged granites and metamorphic rocks as well as Carboniferous to Permian aged tillite of the Dwyka Group and Jurassic aged dolerite of the Karoo Supergroup.

Although no significant fossils are expected in the Swazian aged granites and the Jurassic aged dolerite rocks on site.

Very significant fossils or “stromatolites” are expected in the Chobeni Formation and several significant fossils in the Dwyka Group. No fossils will be exposed before deep excavation (>1.5m) are done. As soon as excavation starts, it will be very important that a suitably accredited Palaeontological Specialist be appointed to do a Phase 1 PIA and to upgrade the “Chance Find Protocol” document that forms part of this discussion. The CFP document must be included as part of the EMP of this project, to record all fossils associated with the Highly sensitive Chobeni Formation and Karoo Supergroup rocks that underlie the majority of the L2598 road development site. The entire area where the bridge over the White Mfolozi River is planned is underlain by Swazian aged granite and no mitigation for Palaeontological Heritage is needed unless extensive excavation into alluvium of the river is planned. The

alluvium is not mapped at the scale of the geological map used for this Desktop Study.

It is recommended that:

The EAP and ECO must be informed of the fact that a High Palaeontological Sensitivity is allocated to the study area underlain by the Chobeni Formation and the Dwyka Group. A Phase 1 PIA document and revision of the "Chance Find Protocol" must be prepared in all areas where excavation will exceed 1.5m in the sensitive formations.

Granite, dolerite and metamorphosed lava will not contain fossils.

If fossils are recorded a revised "Chance Find Protocol" must be prepared by a suitably accredited Palaeontologist and recommendations contained in the Phase 1 PIA must be approved by AMAFA for inclusion in the EMPr of the project.

These recommendations must be included in the EMPr of this project.

## **CHANCE FIND PROTOCOL FOR PALAEOLOGICAL HERITAGE**

### **Proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province - 2017**

#### **Mitigation for Excavation Impact on Palaeontological Heritage Resources**

It is essential that the appointed palaeontologist, in consultation with the Project Managers and the contractors of the excavation works develop a short-term strategy for the recovery of significant fossils during the excavation operation.

The development site for the Proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province, falls on Highly significant stromatolitic dolomite and sedimentary rocks (Chobeni Formation and Dwyka Group) that contain Highly significant fossils. No fossils are expected in the granite and dolerite on site, but the alluvium of the White Mfolozi River at the bridge site can contain significant Quaternary aged vertebrate fossils (not mapped on the scale of the map used for the Desktop Survey).

Fossils were recorded during the Desktop Survey studies in these rock formations. The potential for finding significant Stromatolites and trace-fossils, in any excavation into sediments of the Chobeni Formation and Dwyka Group, is always High and the cooperation of the entire team of RHDHV and the contractors, is of critical importance. The interest and cooperation of the management team will be highly appreciated and it is essential that the excavation be monitored during the entire period of excavation and that this "Chance Find Protocol" be updated on a monthly bases 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 EAP and ECO must be informed of the fact that a High Palaeontological Sensitivity is allocated to the eastern section of the L2598 road development during the desktop survey. No

fossils are expected in granite at the bridge site, but if alluvium is exposed, the chance find of Quaternary vertebrate fossils is very high. The Palaeontological sensitivity has been revised and all sections underlain by geology with a Moderate to High Palaeontological sensitivity must be inspected by an accredited Palaeontologist on a weekly basis. Due to the highly weathered nature of the material, significant fossils is only expected **after** the start of excavations for foundations that exceed 1.5m.

- The contractor must, under guidance of a suitably accredited Palaeontologist, remove a representative sample of the Stromatolites (Desktop Survey attached to this report) and deliver the rock (1m<sup>3</sup>) as an entity to the KZN Museum in Pietermaritzburg.
- The allocated team members of the contractor must be introduced to Palaeontological material that is likely to be found on site. A once-off information session with the Palaeontological specialist must be arranged, to present a simple and understandable (preferably audio-visual presentation in an “interpreted voice”) of the majority of the contractual workers on site (isiZulu) during the initial site visit (one day during first month of excavations) that must form part of the EMPr for the project.
- This “Chance Find Protocol” must be included into the EMPr of the project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer/implementing agent, in terms of the proper conservation of and storage of Palaeontological Heritage.
- AMAFA must be informed of the content of this “Chance Find Protocol” and EMPr arrangements by the EAP or the developer, for final approval of the ROD documentation during the EIA process.

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## INTRODUCTION

Gideon Groenewald was appointed by Active Heritage CC to undertake a Desktop Palaeontological Assessment and “Chance Find Protocol” (CFP) for the proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province (Figure 1).



Figure 1 Locality of the Road L2598 and bridge at the White Mfolozi River

### 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 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 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 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 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 maps (2830 Dundee) 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>	<p>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) compulsory.</p>
<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 EMP 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 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>
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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 L2598 Road and Mfolozi Bridge Development is situated close to KwaMphothi and at the crossing of the White Mfolozi River in the Ulundi Local Municipality in KwaZulu-Natal Province (Figure 1),

### **GEOLOGY**

The site of the development falls partly on very old, Swazian aged granites, quartzite and dolomite, Randian aged Diabase of the White Mfolozi area as well as Permian aged tillites and Jurassic aged dolerite of the Karoo Supergroup (Figure 2).

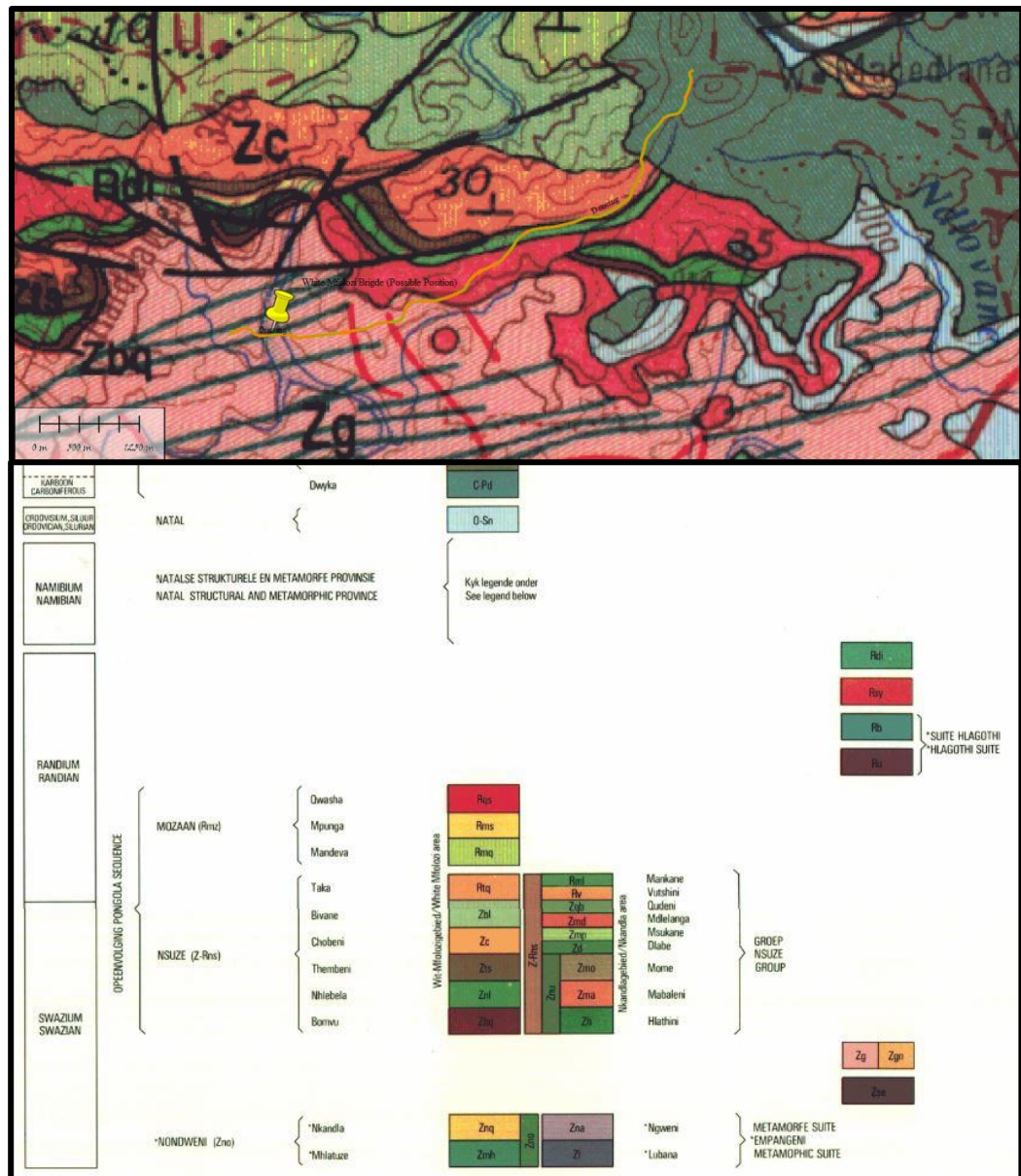


Figure 2 Geology of the Study Area

### Swazian aged Granites (Zg)

Swazian aged granites underlies the south-western section of the road footprint as well as the entire region where the new bridge across the White Mfolozi River is planned. These deeply weathered rocks result in clay-rich soils that rarely forms good outcrops in the study area.

## **Pongola Supergroup**

### **Nsuze Group**

#### **Ndlebela Formation (Znl)**

The Swazian aged Ndlebela Formation consist primarily of dark green amygdaloidal lava, representing ancient volcanic eruptions in this part of South Africa.

#### **Thembeni Formation (Zts)**

The Swazian aged Thembeni Formation consists of a sequence of metamorphic siltstone, sandstone and grit beds.

#### **Chobeni Formation (Zc)**

The Swazian aged Chobeni Formation metamorphic rocks are primarily quartzite and dolomite with carbonate cemented sandstone that were metamorphosed during the structural events associated with the formation of the Natal Metamorphic Province.

## **Karoo Supergroup**

### **Dwyka Group (C-Pd)**

The rocks overlying the Nsuze Group is a thick unit of tillite that was deposited in a glacial environment by retreating ice sheets about 300 million years ago.

At this time South Africa was part of the supercontinent Gondwana, which was situated near the South Pole and covered with ice. Rocks imbedded in the slowly moving ice sheets scoured and polished the underlying older rocks giving rise to glacial pavements. Striation directions indicate that ice flow was from north to south - valuable information when it comes to reconstructing Gondwana.

The **Dwyka Group** forms the lowermost and oldest deposit in the Karoo Supergroup basin. The Karoo Basin extended across much of southern Gondwana and records 120 million years of geological history.

The tillite in KZN often weathers to a characteristic yellowish colour.

## **Dolerite (Jd)**

Jurassic aged dolerite represent the intrusion of magma into the Karoo Supergroup sediments during the breakup of Gondwanaland about 183 million years ago.

## **PALAEONTOLOGY**

### **Swazian aged Granites (Zng)**

Swazian aged granites will not contain any fossils.

### **Pongola Supergroup**

#### **Nsuze Group**

#### **Ndlebela Formation (Znl)**

The Swazian aged Ndlebela Formation is a lava deposit and will not contain fossils.

#### **Thembeni Formation (Zts)**

The Swazian aged Thembeni Formation can contain trace fossils, but no fossils have to date been recorded in these very old sediments. A moderate sensitivity is allocated to this formation.

#### **Chobeni Formation (Zc)**

The Swazian aged dolomite of the Chobeni Formation contain significant fossils known as “stromatolites”. These very highly significant fossilized structures of algal growths in ancient shallow marine environments are very useful for the explanation of the Palaeontological Heritage of KwaZulu-Natal (MacRae, 1999). Recording and collecting of representative samples of this rock formation will be essential during the initial sites visits or when construction of the road commences. The collecting of these samples must form part of the EMPr of this Project.

### **Karoo Supergroup**

#### **Dwyka Group**

Trace fossils have been recorded from the fine-grained shales of the Dwyka Group in KwaZulu-Natal (Linstrom, 1987; MacRae, 1999). All of the following could potentially be found in KwaZulu-Natal. Trackways, produced mostly by fish and arthropods (invertebrates), have been recovered in shales from the uppermost Dwyka Group.



Other trace fossils include coprolites (fossilized faeces) of chondrichthyans (sharks, skates and rays).

Body fossils include araneaceous foraminifera and radiolarians (single-celled organisms), bryozoans, sponge spicules (internal support elements of sponges), primitive starfish, orthoceroid nautiloids (marine invertebrates similar to the living *Nautilus*), goniatite cephalopods (*Eoasinites* sp.), gastropods (marine snails such as *Peruvispira viperdorfensis*), bivalves (*Nuculopsis* sp., *Phestia* sp., *Aphanaia haibensis*, *Eurydesma mytiloides*), brachiopods (*Attenuatella* sp.) and palaeoniscoid fish such as *Namaichthys schroederi* and *Watsonichthys lotzi*.

Fossil plants have also been found, including lycopods (*Leptophloem australe*), moss, leaves and stems (possibly belonging to a proto-glossopterid flora). Fossil spores and pollens (such as moss, fern and horsetail spores and primitive gymnosperm pollens) as well as fossilized wood probably belonging to primitive gymnosperms have also been recorded from Dwyka deposits (MacRae, 1999; McCarthy and Rubidge, 2005).

### **Dolerite (Jd)**

Jurassic aged dolerite will not contain fossils.

## **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 during the desktop investigation. The desktop investigation confirms that the study area is underlain by relatively deep (>2m) clay soil associated with the ancient granites and metamorphic rocks of the Natal Metamorphic Belt and the Karoo Supergroup.



**Figure 3 Palaeontological sensitivity of the geology underlying the site.**

The areas underlain by the metamorphic rocks and granites will not yield any fossils.

The excavations for the construction of the infrastructure cutting into the Swazian aged Stromatolitic dolomite of the Chobeni Formation will undoubtedly expose significant ancient stromatolites that are very important indicators of palaeo-environments. Swazian aged sediments of the Thembeni and Carboniferous to Permian aged rocks of the Dwyka Group will have a Moderate likelihood of exposing significant fossils. The Jurassic aged dolerite represents volcanic intrusions and will not contain fossils.

Due to the deep weathering it is highly unlikely that any trace and other fossils will be exposed before deep (>1.5m) excavations into the Chobeni and Thembeni Formations and the Dwyka Group.

Recording of fossils will contribute significantly to our understanding of previous eco-systems. A Phase 1 PIA, by a suitably accredited Palaeontologist, and the upgrading of a “Chance Find Protocol” (CFP, included in this study) by the Palaeontologist must form part of the EMP of this project.

## CONCLUSION

The development site applicable to the application for the proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province is underlain by Swazian aged granites and metamorphic rocks as well as Carboniferous to Permian aged tillite of the Dwyka Group and Jurassic aged dolerite of the Karoo Supergroup.

Although no significant fossils are expected in the Swazian aged granites and the Jurassic aged dolerite rocks on site.

Very significant fossils or “stromatolites” are expected in the Chobeni Formation and several significant fossils in the Dwyka Group. No fossils will be exposed before deep excavation (>1.5m) are done. As soon as excavation starts, it will be very important that a suitably accredited Palaeontological Specialist be appointed to do a Phase 1 PIA and to upgrade the “Chance Find Protocol” document that forms part of this discussion. The CFP document must be included as part of the EMPr of this project, to record all fossils associated with the Highly sensitive Chobeni Formation and Karoo Supergroup rocks that underlie the majority of the L2598 road development site. The entire area where the bridge over the White Mfolozi River is planned is underlain by Swazian aged granite and no mitigation for Palaeontological Heritage is needed unless extensive excavation into alluvium of the river is planned. The alluvium is not mapped at the scale of the geological map used for this Desktop Study.

It is recommended that:

The EAP and ECO must be informed of the fact that a High Palaeontological Sensitivity is allocated to the study area underlain by the Chobeni Formation and the Dwyka Group. A Phase 1 PIA document and revision of the “Chance Find Protocol” must be prepared in all areas where excavation will exceed 1.5m in the sensitive formations.

Granite, dolerite and metamorphosed lava will not contain fossils.

If fossils are recorded, a revised “Chance Find Protocol” must be prepared by a suitably accredited Palaeontologist and recommendations contained in the Phase 1 PIA must be approved by AMAFA for inclusion in the EMPr of the project.

These recommendations must be included in the EMPr of this project.

## CHANCE FIND PROTOCOL FOR PALAEOLOGICAL HERITAGE

### Proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province - 2017

#### Mitigation for Excavation Impact on Palaeontological Heritage Resources

It is essential that the appointed palaeontologist, in consultation with the Project Managers and the contractors 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 at least once a month, to ensure recording of all potentially significant fossil strata.
- Determine a short-term strategy and budget for the recording of significant fossils. 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.
- In the case of any unusual 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 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 Palaeontologist must be given enough time to reach the site and remove the material before excavation continues.

#### 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. In the case of this study site it is essential that representative samples of stromatolites be collected from the Chobeni Formation confirmed during this study (Desktop Survey) and safely deposited at the dedicated AMAFA permitted

Institute. The collection activity must be at cost to the Project and the EMPr must reflect this budget item before AMAFA can approve the EIA documentation.

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 KZN Museum in Pietermaritzburg, which is the closest Institute to the site as well as the Evolutionary Studies Institute (ESI) at WITS University. If appropriate, the University of KZN will also be involved in this project.

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.

### **Functional responsibilities of the Developer and the Project Managers**

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 operations.

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 stromatolites will be present. *(If fossils of Swazian, Carboniferous, Permian and/or Quaternary age are exposed, it will be Highly significant and the Palaeontologist will obviously be in close communication with the ECO to act as required by AMAFA 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 High).*

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 KZN Museum and the ESI, WITS University (labels, boxes, shelving and, if necessary, specifically-tasked temporary employees).

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

1. The contractor will 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 the EMPr during the excavation stages of the Project:

1.1. Initially, all known specific palaeontological information will be indicated on the plan. 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.

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

1. Apply for a permit to collect fossils during the lifetime of the Project and establishment of a representative collection of fossils and a contextual archive of appropriately documented and sampled palaeoenvironmental and sedimentological geodata in collaboration with the KZN Museum and the ESI at WITS University.

2. Undertake an initial evaluation of potentially affected areas and of available exposures in excavations. A short training session of the ECO or a representative must be included in 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 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 ECO and environmental staff by the appointed specialist. This step is needed, due to the recording of significant fossils at the time of the Desktop Survey.

5. Respond to significant finds and undertake appropriate mitigation.

6. Initially, for the first three months of operation, and if the ECO indicates significant “strange looking rocks” that might be similar to the fossils indicated to the staff during the initial information sessions, visit at least once a week to “touch base” with the monitoring progress. Document interim “normal” finds and undertake an inspection and documentation of new excavation faces. A strategy for further visits during the life of the excavation must be discussed.

7. Transport of material from the site to the KZN Museum and ESI, WITS University.

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 the KZN Museum, ESI, and the South African Heritage Resources Authority (SAHRA). It must fulfil the reporting standards and data requirements of these bodies (revised 2017).

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, the following procedure must be adhered to:

1.1 The appointed specialist or alternates (AMAFA; KZN Museum, ESI WITS University, University of KZN) must be notified by the responsible officer (e.g. the 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 KZN Museum or 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/Implementing Agent.

Significant fossils were recorded in the Desktop Survey and the Palaeontologist **did not clear** the excavation unconditionally. Any excavation will only proceed on the proviso that the existing significant fossils are removed under a legal permit and that any suspicious material must be indicated to the Palaeontologist via emailed photographic information.

The Appointed Palaeontologist and HIA specialist will not withhold permission to proceed with construction without a scientific explanation of the need for a “Site Instruction” to the Contractor. Provision for significant time needed to sample the stromatolites (at most **one week** or **5 man days**) of total extension time to the normal contractual time for construction) must be written into the EMP with an associated budget for this project, to allow for all Paleontological Impact Mitigation.

## CONCLUSION

The development site for the Proposed Road (L2598) Upgrading and bridge at the White Mfolozi River, Ulundi Local Municipality, Zululand District Municipality, Kwazulu-Natal Province, falls on Highly significant stromatolitic dolomite and sedimentary rocks (Chobeni Formation and Dwyka Group) that contain Highly significant fossils. No fossils are expected in the granite and dolerite on site, but the alluvium of the White Mfolozi River at the bridge site can contain significant Quaternary aged vertebrate fossils (not mapped on the scale of the map used for the Desktop Survey).

Fossils were recorded during the Desktop Survey studies in these rock formations. The potential for finding significant Stromatolites and trace-fossils, in any excavation into sediments of the Chobeni Formation and Dwyka Group, is always High and the cooperation of the entire team of RHDHV and the contractors, is of critical importance. The interest and cooperation of the management team will be highly appreciated and it is essential that the excavation be monitored during the entire period of excavation and that this “Chance Find Protocol” be updated on a monthly 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 EAP and ECO must be informed of the fact that a High Palaeontological Sensitivity is allocated to the eastern section of the L2598 road development during the desktop survey. No fossils are expected in granite at the bridge site, but if alluvium is exposed, the chance find of Quaternary vertebrate fossils is very high. The Palaeontological sensitivity has been revised and all sections underlain by geology with a Moderate to High Palaeontological sensitivity must be inspected by an accredited Palaeontologist on a weekly basis. Due to the highly weathered nature of the material, significant fossils is only expected **after** the start of excavations for foundations that exceed 1.5m.
- The contractor must, under guidance of a suitably accredited Palaeontologist, remove a representative sample of the Stromatolites (Desktop Survey attached to this report) and deliver the rock (1m<sup>3</sup>) as an entity to the KZN Museum in Pietermaritzburg.
- The allocated team members of the contractor must be introduced to Palaeontological material that is likely to be found on site. A once-off information session with the Palaeontological specialist must be arranged, to present a simple and understandable (preferably audio-visual presentation in an “interpreted voice”) of the majority of the contractual workers on site (isiZulu) during the initial site visit (one day during first month of excavations) that must form part of the EMPr for the project.
- This “Chance Find Protocol” must be included into the EMPr of the project and a reasonable budget must be allocated to ensure compliance with the legal responsibility of the developer/implementing agent, in terms of the proper conservation of and storage of Palaeontological Heritage.
- AMAFA must be informed of the content of this “Chance Find Protocol” and EMPr arrangements by the EAP or the developer, for final approval of the ROD documentation during the EIA process.

## 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 G.H., 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.
- Johnson MR , Anhaeusser CR and Thomas RJ (Eds). 2009.** The Geology of South Africa. GSSA, Council for Geoscience, Pretoria.
- Linstrom W. 1987** Die Geologie van die gebied Durban.. Explanation Sheet 2930 (1:250 000). Geological Survey of South Africa.
- 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.

## **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.



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