

**FIELD-WORK PALAEOLOGICAL
ASSESSMENT REPORT: MPUNGOZE WATER
SUPPLY SCHEME, EMPANGENI MUNICIPALITY,
KWAZULU-NATAL**

FOR

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EXECUTIVE SUMMARY

A palaeontological field assessment was conducted at the Mpungoze site on 14 October, 2019. The Beaufort Group (Emakwezini Formation) and the Ecca Group (Volksrust Formation and Vryheid Formations) are exposed on this site. No palaeontological material was found during the site visit. Evidence of trace fossils were seen in the Volksrust Formation, but this is very common and NOT significant. Significant palaeontological material is known from the Emakwezini shales and could be encountered during excavation, even though none was evident from the field investigation. If so, this would be palaeobotanical material. Although palaeontological material could be found within the Vryheid Formation, it is very unlikely in this area. The rocks encountered during the field trip were all very weathered. Typically, palaeontological material is not observed in weathered rocks, as the fossils themselves have been weathered and ruined in this natural process. Fossils could be found in deeper (> 2m) excavations where fresher rock is encountered. A “Chance Find” Protocol has been incorporated into this report and MUST be incorporated into the EMP. Due to the specialization of this subject, this should include regular site inspections by a qualified person.

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1. BACKGROUND AND PROPOSED PROJECT

The King Cetshwayo District Municipality proposes to construct a network of bulk and reticulation water supplied through a network of reticulation water pipes and stand pipes. There is some existing pipeline infrastructure in place, however the pipes have fallen into disrepair and are mostly dysfunctional. The new pipelines will run east from Habeni towards the villages of Ngodini, Khabingwe and Mkhuphulan Gwenya (Mid-point: 28°46'14.40"S, 31°39'6.01"E), located approximately 23.7 km west of Empangeni. The Mpungoze Water Supply Scheme is located across Wards 23, 24, 25, 26 and 27, uMlalazi Local Municipality within the King Cetshwayo District Municipality. The pipelines will be located, where possible, within the road servitudes and along footpaths, and will be buried in a trench 800 mm wide and 1.2 m deep. The pipeline route will cross numerous watercourses and wetlands throughout the project footprint. The entire supply area covers approximately 10 000 hectares and includes approximately 350 000 m of pipeline to be installed. The supply scheme will tie into and maintain two existing reservoirs (28°48'3.35"S, 31°32'33.23"E; and 28°47'13.97"S, 31°36'36.94"E), and construct four new reservoirs.

Based on portion of the area falling within the red zone (i.e. a very high sensitivity) of the SAHRIS palaeosensitivity map, a field assessment and protocol for finds is required, thus a fieldwork palaeontological impact assessment (PIA) was requested. The terms of reference were to assess for the possibility of palaeontological material being encountered along the proposed pipeline routes, as supplied by the kml file represented in Figure 1.

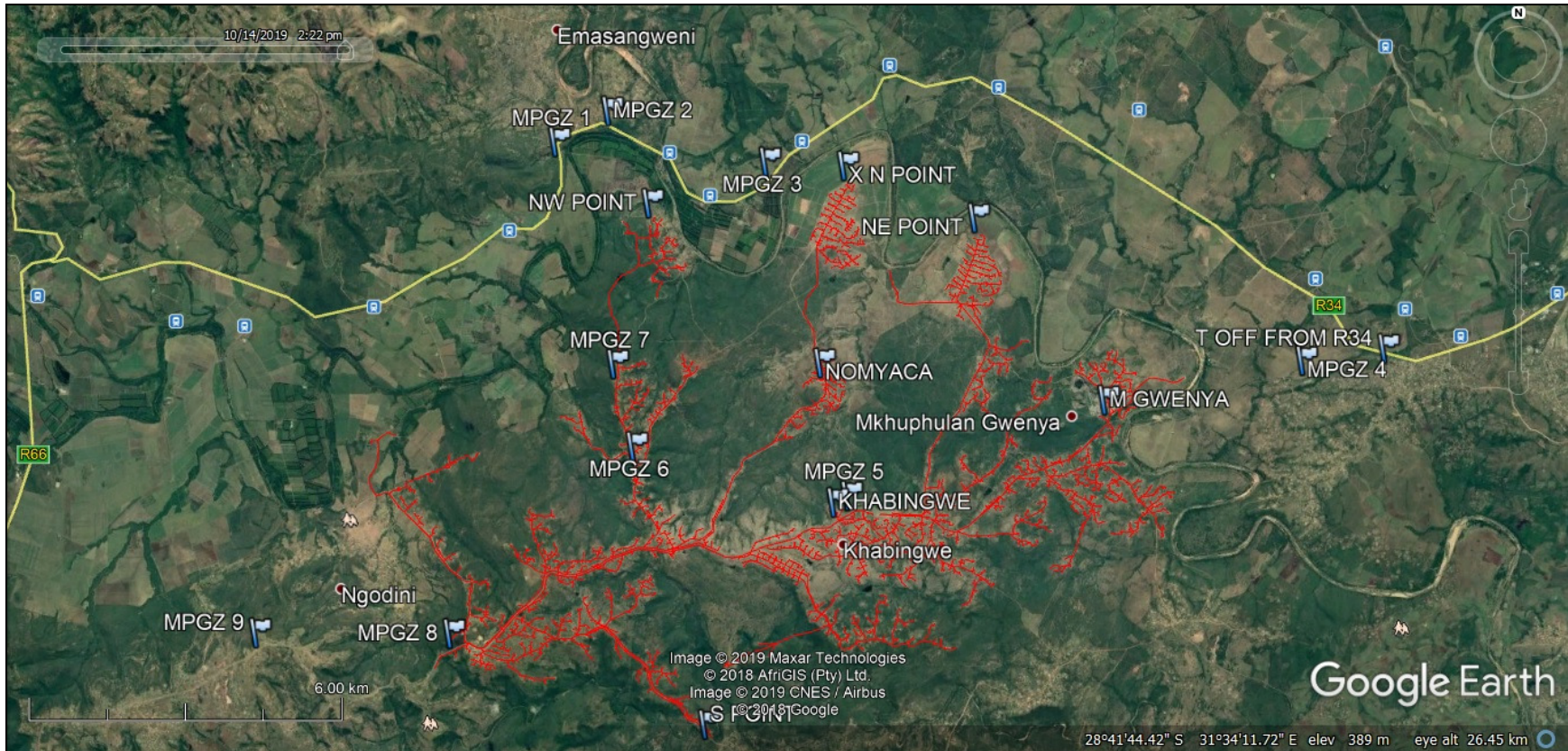


Figure 1: Location Map (Image source GoogleEarth) showing proposed Mpungoze Water Reticulation project. Proposed pipes are indicated in red and waypoints taken during the field survey are indicated by the blue flags with MPGZ prefix. These points are referenced in the figures. Appendix 1 lists the waypoints and co-ordinates, as well as corresponding figures.

2. GEOLOGY

The SAHRIS palaeosensitivity map (Fig. 2) shows much of the northern part of the pipeline area falls within the red zone, i.e. very high sensitivity, requiring a field assessment and protocol for finds; whilst portion falls within the orange zone, i.e. high sensitivity, requiring a minimum of a desktop assessment.

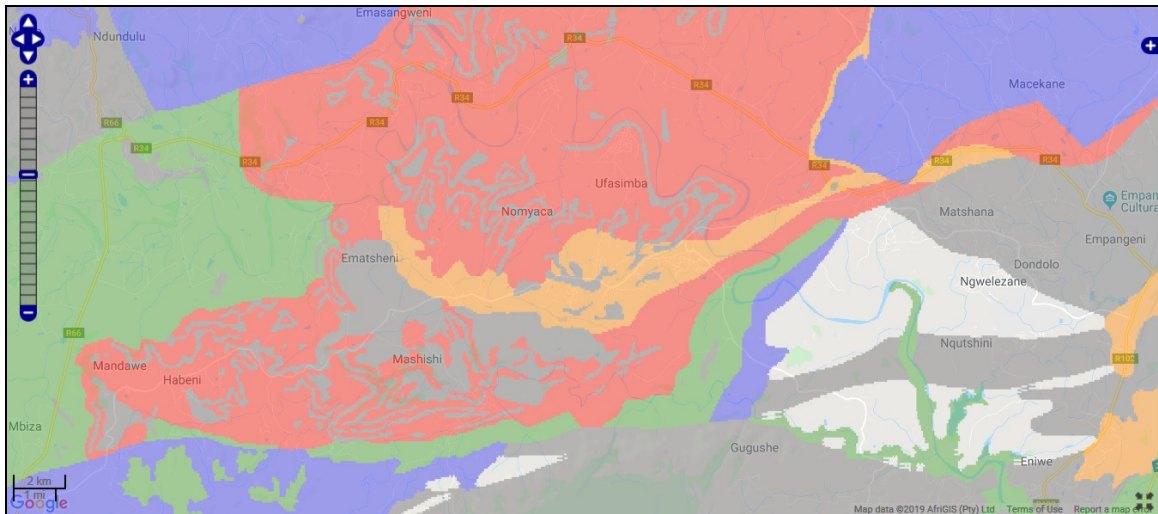


Figure 2: Extract from the SAHRIS PalaeoSensitivityMap. Red = very high sensitivity, Orange = high, green = moderate, blue = low, grey = zero and white = unknown.

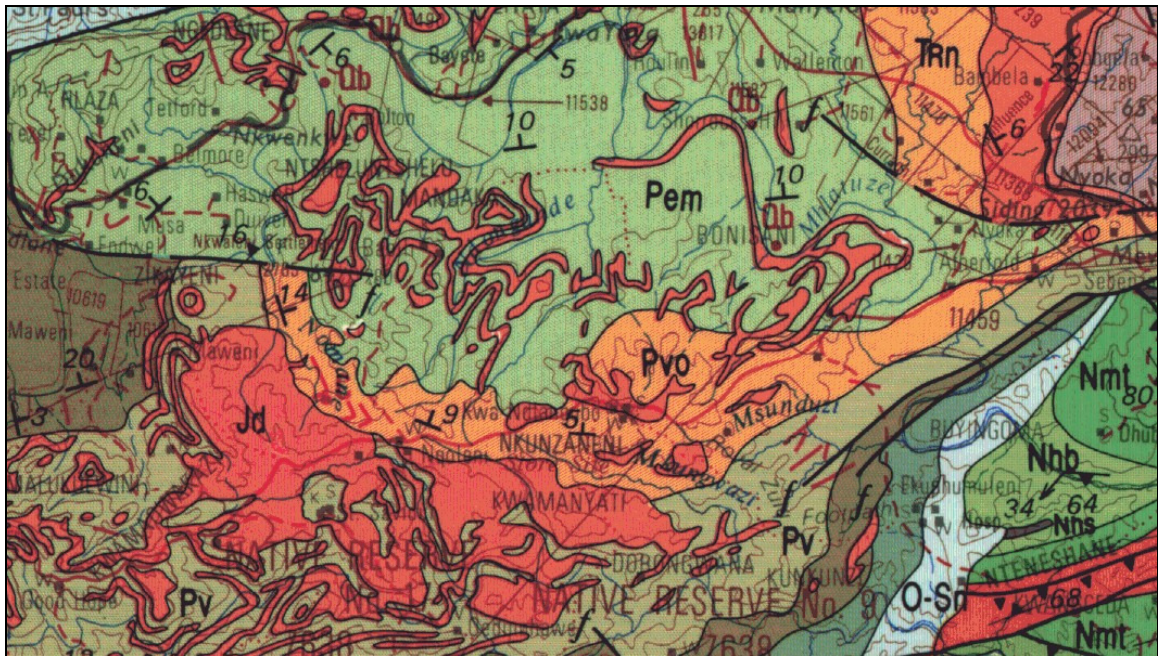


Figure 3: Extract from the Dundee (2830) 1:250 000 Geological Map. Emakwezini (Pem), Volksrust Formation (Pvo), Vryheid Formation (Pv) and Karoo Dolerite (Jd).

Rocks belonging to the Beaufort and Ecca Groups are present (Fig. 3). The Beaufort Group comprises the Emakwezini Formation, and the Ecca Group the Volksrust Formation and Vryheid Formations. Both are part of the Karoo Supergroup. The Emakwezini and Vryheid Formations are both assigned by SAHRIS (Fig. 2) as very highly sensitive (red), whilst the Volksrust Formation is highly sensitive (orange).

2.1 Emakwezini Formation (Pem)

This is the lower part of the Beaufort Group (Lower Beaufort), a sequence of fluvio-lacustrine sedimentary rocks that accumulated in a landlocked, intra-cratonic foreland basin in SW Gondwana during the Middle Permian to Middle Triassic (Neveling et al., 2005). Minimal research has been conducted on the Emakwezini Formation (Fm). The Emakwezini Fm is a part of the Karoo super Group and forms the basal formation of the Beaufort Group. It is probably Middle to Upper Permian in age (Brody & Prevec, 2015).

The Emakwezini Fm consists of fine-to-coarse-grained feldspathic sandstone, which is probably fluvial in origin. Sandstone (Fig. 4) alternates with shale (Fig. 5) which may be rich in plant fossils. Coal and very rare, discontinuous limestone lenses are present. The sandstones are 4 to 10 m thick (Brody & Prevec, 2015). Coal seams varying from less than 1 m to 15 m in thickness occur in four distinct coal zones (Grant and Snelling, 2005).



Figure 4: Emakwezini Formation showing the base of a fluvial (river) channel. MPGZ1.



Figure 5: Here an Emakwezini Formation channel base overlies a shale. This shale was weathered and no fossils were encountered. MPGZ2.

2.2 Volksrust Formation (Pvo)

This lithology comprises a blue-black shale. It contains trace fossils (Fig. 6), but is not known for invertebrate body fossils. This unit was deposited in non-marine conditions (Cataneneau et al., 1998).

2.3 Vryheid Formation (Pv)

This is a fluvio-deltaic sequence (Smith and Tavener Smith, 1988). This unit contains a broad ichnofossil (trace fossil) variation, but invertebrate fossils are extremely rare (Fig. 7).

2.4 Karoo Dolerite (Jd)

Karoo dolerite intrusions (these are 184 million years [Ma] old) represent the onset of the break-up of the Gondwana Supercontinent (Hastie et al., 2014). According to Watkeys (2006), Gondwana rifting commenced between 155 and 135 Ma.



Figure 6: Volksrust Formation. This lithology is typically a blue shale and very weathered. MPGZ4



Figure 7: Vryheid Formation fluvial (river) sandstone. MPGZ8.

3. PALAEOONTOLOGY

3.1 Emakwezini Formation

The Emakwezini Fm is highly significant both palaeobotanically and economically. The palaeobotanic significance is that it contains Late Permian plant fossils which are useful to identify and date the Emakwezini Fm. Economically, the Emakwezini Fm is mined for coal at Somkhele (Bordy & Prevec, 2015).

According to Bordy & Prevec (2015) the following plant fossils are present in the Emakwezini Fm mudstones:

- *Schizoneura gondwanensis*,
- *Phyllothea australis*,
- *Dictyopteridium flabellatum*,
- *Rigbya arberioides*,
- *Lidgettonia* spp.,
- *Trizygia speciosa*

These fossils are useful for dating the Emakwezini Fm, but are not rare as they are found throughout the Emakwezini Fm shales (Fig. 5).

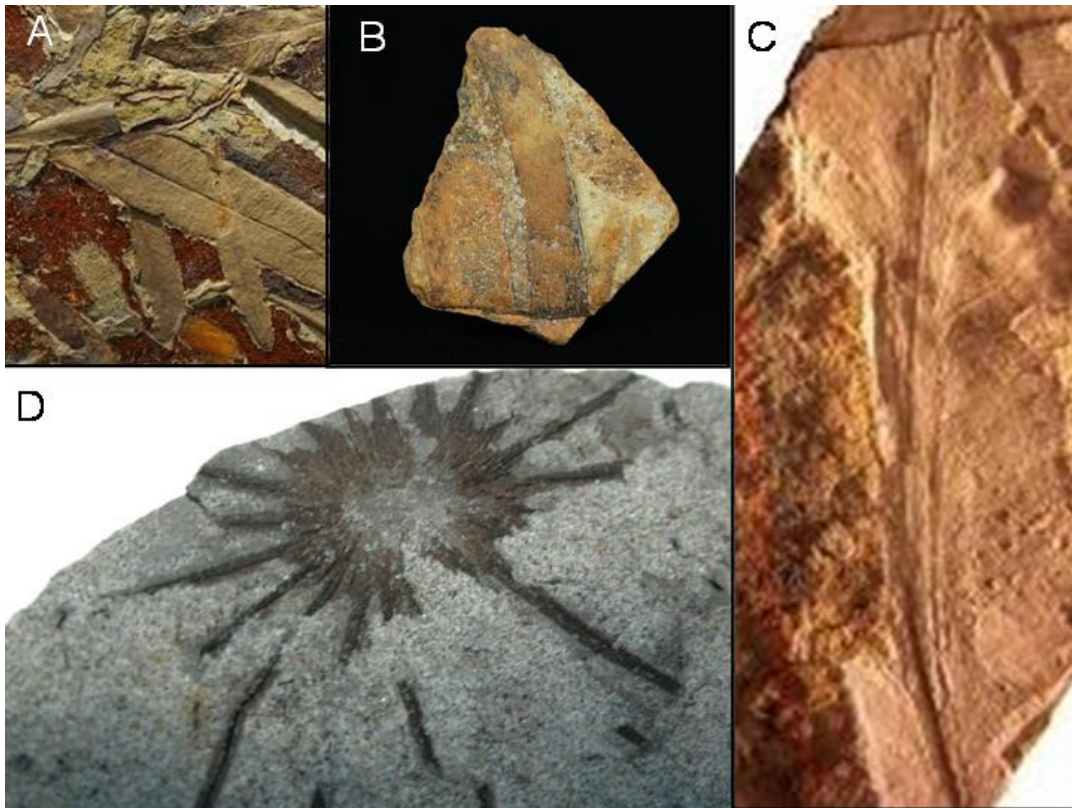


Figure 8: Fossil images. A: *Rigbya arberioides*; B: *Schizoneura gondwanensis*; C: *Trizygia speciosa* and D: *Phyllothea australis*. These images are from the internet and the local aspect may be different.

Fossil leaf fragments and fossil log impressions (centimetre to decimetre in size) are found in the sandstones (Bordy & Prevec, 2015). These are not significant palaeontological material.

There is no record of vertebrate fossils in the Emakwezini Fm.

3.2 Volksrust Formation

The Volksrust Formation is typically very weathered. When fresh exposure was encountered, it was seen to be generally unfossiliferous. On occasion trace fossils of an unknown type or source were encountered (Fig. 9). Trace fossils can be very useful in the interpretation of palaeoenvironments, but have little value with respect to Palaeontology.



Figure 9: Unidentified trace fossils from the Volksrust Formation. MPGZ6.

3.3 Vryheid Formation

Theoretically the Vryheid Formation could contain palaeontological material, however in practice this is exceedingly rare. Trace fossils such as *Diplocraterion* and *Skolithos* are ubiquitous and can be ignored.

3.4 Karoo Dolerite

Dolerite is an intrusive igneous rock and by definition cannot be fossiliferous.

Palaeontological Comment

The rocks encountered during the field survey were all very weathered and outcrop is very poor. Typically palaeontological material is not seen in weathered rocks as the fossils themselves have been weathered and ruined in this natural process. Fossils could however, be found in deeper (> 2 m) excavations where fresher rock is encountered.

4. CHANCE FIND PROTOCOL

As this site includes areas flagged red on the SAHRIS PalaeoSensitivity Map (Fig. 2), a “Chance Find Protocol” is Recommended. This Protocol is based on that of Groenewald (2017).

In the case of any unusual finds, a Palaeontologist must be notified immediately by the ECO and/or EAP 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 palaeo-material:

- 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 will involve the 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, labeled, boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer

1. At full cost to the project, and guided by the appointed Palaeontological Specialist, ensure 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.
3. Facilitate systematic recording of the stratigraphic and palaeo-environmental features in exposures in the fossil-bearing excavations, by described and measured geological

sections, and by providing aid in the surveying of positions where significant fossils are found.

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 for a work area for sorting, labeling and boxing/bagging samples.

6. Costs of basic curation and storage in the sample archive at the Museum in Pietermaritzburg (labels, boxes, shelving and, if necessary, specifically-tasked temporary employees) as specified by or agreed with AMAFA. Documentary record of palaeontological occurrences must be done.

7. The contractor will, in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which appropriate information regarding plans for excavations and work schedules must be indicated on the plan of the excavation sites. This must be done in conjunction with the appointed specialist.

8. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.

9. Locations of samples and measured sections are to be pegged, and routinely and accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any “significant fossils” are recorded during the time of excavation.

Functional responsibilities of the appointed palaeontologist

1. Establishment of a representative collection of fossils and a contextual archive of appropriately documented and sampled palaeoenvironmental and sedimentological geodata at the Museum in Pietermaritzburg.

2. Undertake an initial evaluation of potentially affected areas and of available exposures in excavations.

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

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.

5. Respond to significant finds and undertake appropriate mitigation.

6. Initially, for the first three months of operation, at least two weekly visits to “touch base” with the monitoring progress, process and document interim Page 10 of 14 GBDBWSS Development Harry Gwala District Municipality 06/01/2017 “normal” finds and to undertake an inspection and documentation of new excavation faces. A strategy for further visits during the life of the excavation must then be determined.

7. Transport of material from the site to the Museum in Pietermaritzburg.

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, AMAFA, and the South African Heritage Resources Authority (SAHRA). It must fulfill 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

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 plant find, the following procedure must be adhered to:

1. The appointed specialist or alternates (AMAFA, SAHRA; ESI WITS University) 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.

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, or its designated representatives at AMAFA, have had reasonable opportunity to investigate the find. Such work will be at the expense of the Developer.

5. CONCLUSIONS

- No palaeontological material was found during the site visit.
- Some trace fossils were noted in the Volksrust Formation but these are common and NOT significant.
- Significant palaeontological material is known from the Emakwezini shales and could be encountered during excavation, even though none was evident from the field investigation.. If so this would be palaeobotanical material.
- Although palaeontological material could theoretically be found within the Vryheid Formation, it is very unlikely in this area.
- The rocks encountered during the field trip were all very weathered. Typically palaeontological material is not observed in weathered rocks as the fossils themselves have been ruined in this natural process. Fossils could be found in deeper (> 2m) excavations where fresher rock is encountered.
- A “Chance Find” Protocol has been incorporated into this report and MUST be incorporated into the EMP. Due to the specialization of this subject, regular site inspections should be conducted by a qualified person.

6. REFERENCES

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APPENDIX 1: WAYPOINT DETAILS.

Waypoint name	Latitude	Longitude	Figure reference
MPGZ 1	28°42'12.67"S	31°37'54.33"E	Figure 4
MPGZ 2	28°41'53.16"S	31°38'32.19"E	Figure 5
MPGZ 3	28°42'24.94"S	31°40'25.20"E	
MPGZ 4	28°44'29.53"S	31°46'50.83"E	Figure 6
MPGZ 5	28°45'54.41"S	31°41'23.85"E	
MPGZ 6	28°45'23.50"S	31°38'50.30"E	Figure 9
MPGZ 7	28°44'32.02"S	31°38'36.58"E	
MPGZ 8	28°47'19.90"S	31°36'40.38"E	Figure 7
M GWENYA	28°44'54.50"S	31°44'28.80"E	
KHABINGWE	28°45'58.60"S	31°41'13.80"E	

APPENDIX 2. DETAILS OF SPECIALIST

Dr Alan Smith

Private Consultant: *Alan Smith Consulting, 29 Brown's Grove, Sherwood, Durban, 4091*

&

Honorary Research Fellow: *Discipline of Geology, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban.*

Role: Specialist Palaeontological Report production

Expertise of the specialist:

- PhD in Geology (University of KwaZulu-Natal), Pr. Sc. Nat., I.A.H.S.
- Expert in Vryheid Formation (Ecca Group) in northern KZN, this having been the subject of PhD.
- Scientific Research experience includes: Fluvial geomorphology, palaeoflood hydrology, Cretaceous deposits.
- Experience includes understanding Earth Surface Processes in both fluvial and coastal environments (modern & ancient).
- Alan has published in both national and international, peer-reviewed journals. He has published more than 50 journal articles with 360 citations (detailed CV available on request).
- Attended and presented scientific papers and posters at numerous international and local conferences (UK, Canada, South Africa) and is actively involved in research.

Selected recent palaeo-related work includes:

- Desktop PIA: Proposed middle income housing units on Portion 23 of Farm Lot H Weston 13026, Bruntville, Mpofana Local Municipality. Client: UMLANDO.
- Desktop PIA: Proposed ByPass Pipeline for Ulundi bulk water pipeline upgrade. Client: UMLANDO.
- Fieldwork PIA: Bhekuzulu Epangweni KZN water reticulation project, Cathkin Park. Client: Mike Webster, HSG Attorneys.
- Fieldwork PIA: Persberg Dam. Client: Afzelia Environmental Consultants.
- Desktop PIA: Zuka valley, Ballito. Client: Mike Webster, HSG Attorneys.
- Mevamhlope proposed quarry palaeontology report. Client: Enviropro.
- Desktop PIA: Proposed Lovu Desalination site. Client: eThembeni Cultural Heritage.
- Desktop PIA: Tinley Manor phase 2 North & South banks: eThembeni Cultural Heritage
- Desktop PIA: Tongaat. Client: eThembeni Cultural Heritage.

- Palaeontological Assessment Reports (3) to Scatec Solar SA (Pty) Ltd on an Appraisal of Inferred Palaeontological Sensitivity for a Potential Photo Voltaic Park at (1) Farm Rooilyf near Groblershoop, N Cape; (2) Farm Riet Fountain No. Portions 1 and 6, 18km SE of De Aar, N Cape; and (3) Dreunberg, near Burgersdorp, Eastern Cape. Client: Sustainable Development Projects.