

**FIELD-WORK PALAEOLOGICAL
ASSESSMENT REPORT:**

**BHEKUZULU, EPANGWENI: POTABLE WATER
RETICULATION TO WARDS 1-5 AND PORTION
OF WARD 6, INKOSI LANGALIBALELE
MUNICIPALITY, KWAZULU-NATAL**

FOR

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EXECUTIVE SUMMARY

A palaeontological field assessment was conducted on 15-16 August, 2019. The Beaufort Group lithology is present on this site. This comprises the Estcourt Formation, the Adelaide Sub-group and possibly the Tarkastad Formation. These lithologies are all internationally renowned for palaeontological material. Although no rare or significant palaeontological material was found during this brief survey, it is highly likely that palaeontological material will be found during excavation of this large area. A “Chance Find” Protocol has been incorporated into this report and MUST be incorporated into the EMP. Due to the specialization of this field, this should include regular site inspections by a qualified person

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1. BACKGROUND AND PROPOSED PROJECT

The applicant, uThukela District Municipality, proposes to upgrade and extend water reticulation to Bhekuzulu - Epangweni settlements. The project entails laying approximately 26.2 kilometres of pipeline covering some 2000 hectares (Beater, 2019) (Fig.1) over a number of phases. The area concerned is located 25 km west of Estcourt (Fig. 1)

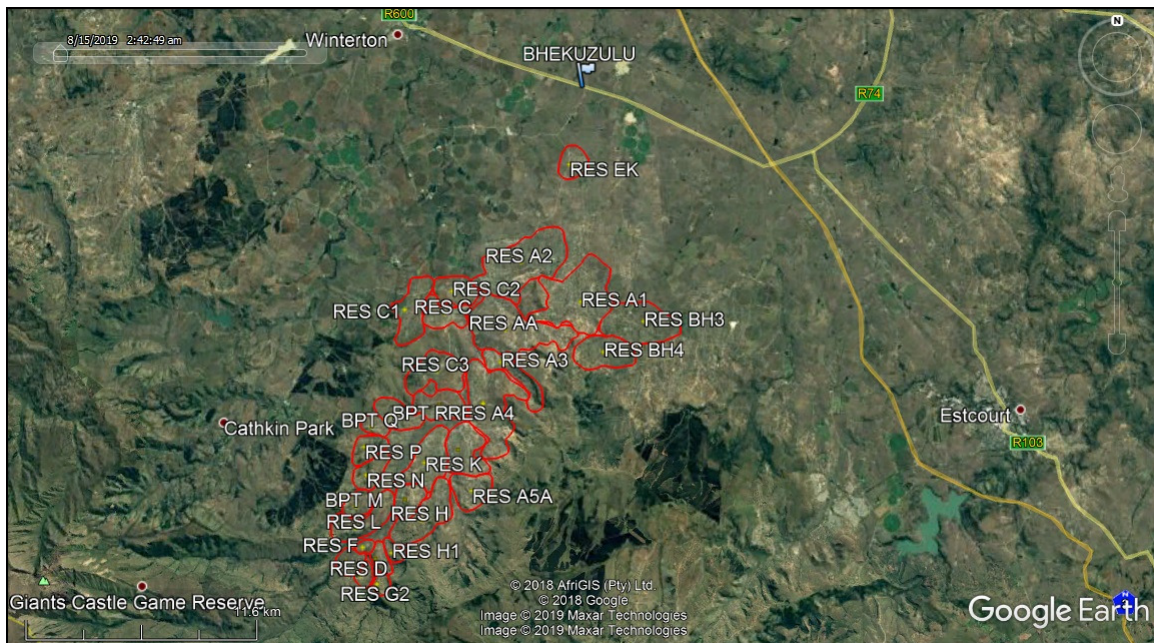
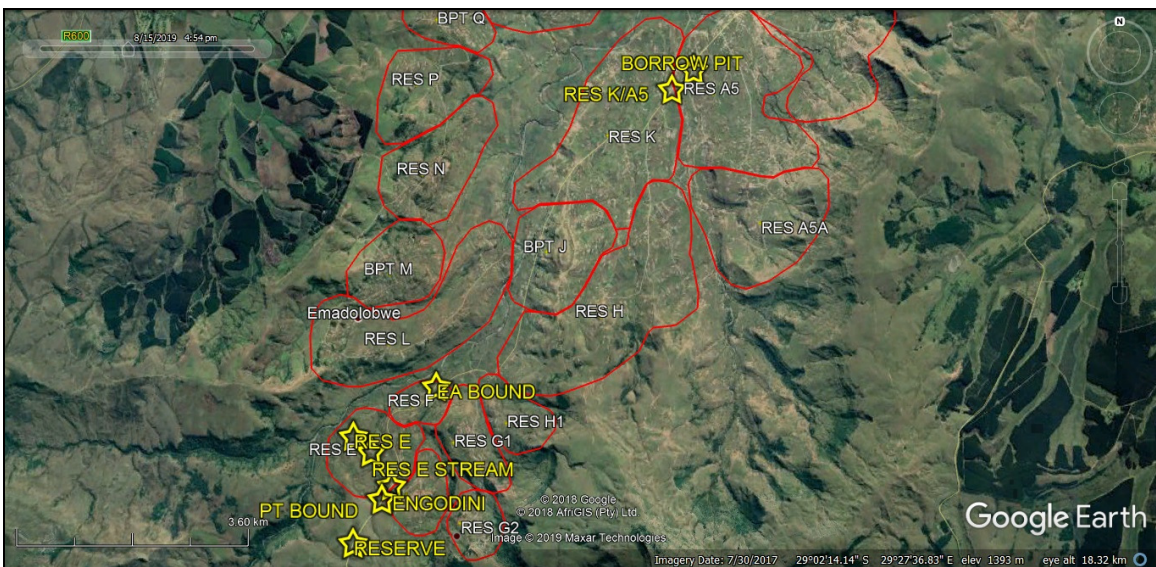


Figure 1: Location Map (Image source GoogleEarth). Proposed water reticulation pipes are indicated in red, with residential areas indicated in white font.

This area is partially zoned red on the SAHRIS map (refer Fig. 3(b)), consequently a Field Assessment was considered necessary. This was conducted on 15-16 August 2019. Figure 2 (a)-(c) shows waypoints taken from the field survey. The proposed project covers a large area and survey work was limited to key areas determined by topography and accessibility.

Figure 2 (overleaf): Zoomed in views of the area, indicating locations where waypoints were taken during the field survey, (a) northern section, (b) middle section, and (c) southern section. See Appendix 1 for details of waypoints visited and where corresponding images referred to in the text within this report were captured.



2. GEOLOGY

The Beaufort Group, part of the (Karoo Supergroup), is 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). The geology of the area comprises the Upper Permian- to Triassic- aged Beaufort Group (Fig. 3).

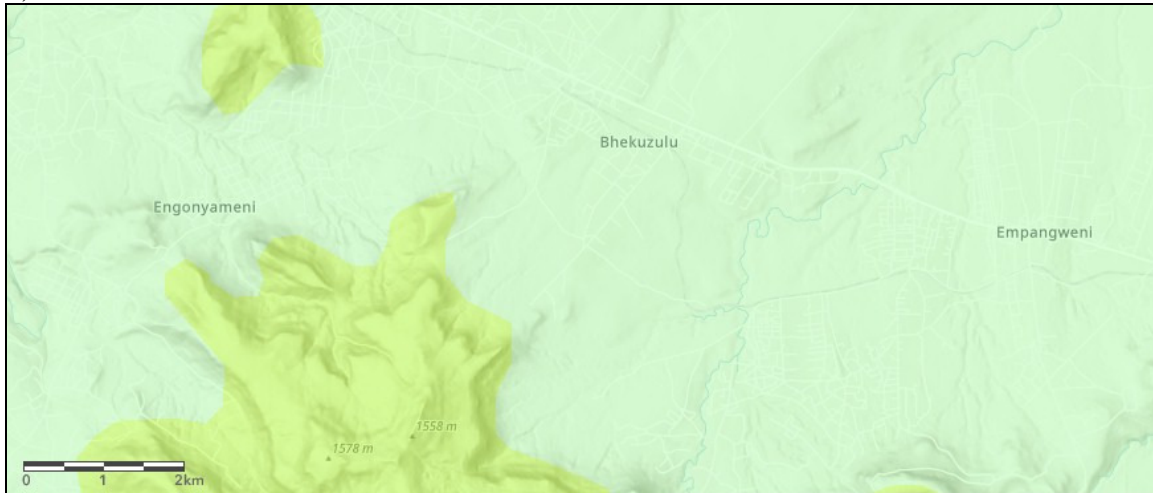


Figure 3 (a): Extract from ArcGis 1; 1 000 000 scale Geological Map. Blue is the Estcourt Formation and yellow is the Adelaide Sub-Group The Tarkastad Subgroup may be present in the west.

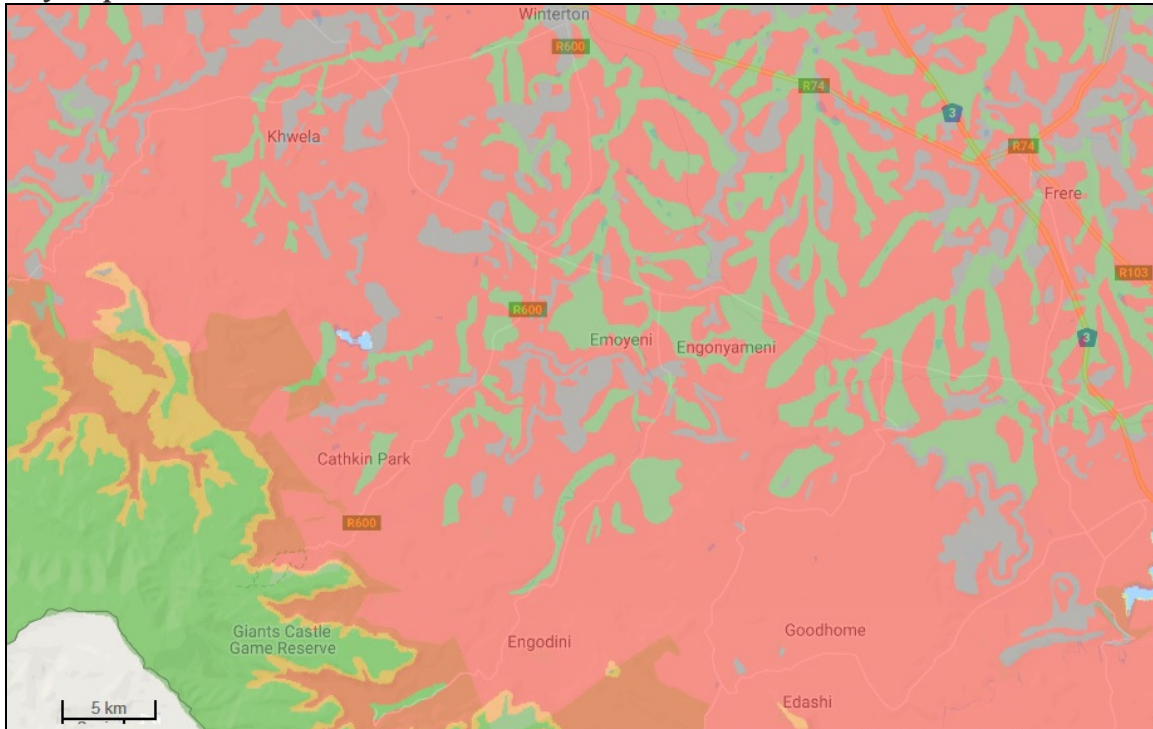


Figure 3 (b): Extract from SAHRIS PalaeoSensitivity Map. Red = very high, green = moderate, blue = low (<https://sahris.sahra.org.za/map/palaeo>). The red area will correspond to the Beaufort Group and the blue will be intrusive dolerite.

The Beaufort Group is subdivided into the Lower, Middle and Upper. The Lower Beaufort Group is part of the Adelaide Subgroup, and the Middle and Upper Beaufort Groups are part of the Tarkastad Subgroup (SACS, 1980). The Lower Beaufort Group is represented in KwaZulu-Natal by the Estcourt Formation (Fm), which forms a flat terrain (Fig. 4). The Middle Beaufort is represented by the Belmont Fm and the Upper Beaufort by the Otterburn Fm (Green, 1998). The Estcourt Fm comprises alternating sandstones, siltstones and mudstones. This Formation was laid down in a fluvial-floodplain constructed by meandering rivers on a semi-arid floodplain. Lacustrine environments were also present (Figs 5 & 6). These sub-environments alternate in the rock record, indicating transgressive-regressive lacustrine episodes (Green, 1998). Karoo Dolerite, which forms “koppies” and dykes, is common within this area (Fig. 7).



Figure 4: [6354]: General view at RES EK (refer Fig. 2(a)), showing the flat terrain characteristic of the Estcourt Formation.



Figure 5: [6365]: Sharp contact between a river channel (top) and lacustrine deposit (bottom grey) at RES EK QUARRY (refer Fig. 2(a)),

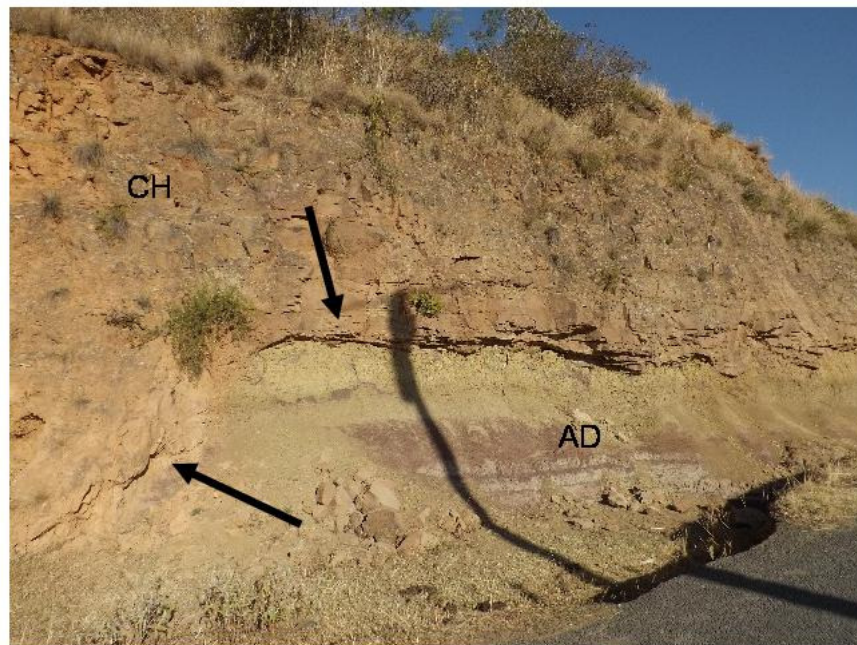


Figure 6: [6373]: Palaeo river channel (CH) cutting down into red shales (base arrowed) of the Adelaide Sub-Group (AD) at waypoint PT BOUND near Engodini (refer Fig. 2(c)).



Figure 7: [6369]: Flat Estcourt Formation in the foreground, with hill in the background capped by dolerite at the southern boundary of Res A2 (Maqabaqabeni area), refer Fig. 2(a).

The Estcourt Fm is Upper Permian in age. The Adelaide Subgroup straddles the Upper Permian and Triassic. The Upper Permian is separated from the Triassic by an Extinction Event (known as the Great Dying) when 95% of life on Earth became extinct. The reasons for this are still controversial. Tarkastad Subgroup (Triassic in age) rocks may be found within the west part of the proposed reticulation area.

The Estcourt Fm makes up the flat-lying areas (Fig. 7). It is dominated by a succession of alternating sandstones, siltstones and mudstones, which are interpreted as representing sediments deposited in a fluvial-floodplain environment, which can be divided into two sub-environments. The first sub-environment is dominated by sediments that were deposited by meandering rivers on a semi-arid floodplain, and the second sub-environment is lacustrine (lake) deposition. These sub-environments are closely linked and alternate in the rock record indicating repeated episodes of transgressive-regressive lacustrine episodes (Green, 1998).

The Adelaide Subgroup occupies higher ground than the Estcourt Fm and occurs as “koppies” throughout the area (Fig. 7). This Fm comprises a succession of alternating siltstone, mudstone and sandstone terrestrial deposits (Smith, 1993a; and le Roux, 1992). These rocks comprise fluvial channels and floodplain deposits. The Tarkastad Subgroup, which may be present, is also an important fossil bearing rock (Neveling et al., 2006).

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

3. PALAEOLOGY

2.1 Trace fossils

Evidence of bioturbation is ubiquitous within the Beaufort siltstones and mudstones, however the various trace fossil (ichnofossil) types are not always identifiable (Fig. 8). At some localities traces were observed (Fig. 9 & 10). In both these cases these could not be ascribed to an ichnofossil type, although the trace in Fig. 10 may be that of a large shrimp. In general, trace fossils are very common within the Beaufort Group.



Figure 8: [6384]: This rock, located in the river bed on the Res K/A5 boundary (refer Fig. 2(c)), has an overall bioturbated appearance, but no distinct trace fossils are evident here.



Figure 9: [6392] BORROW PIT (refer Fig. 2(c)): These may be trace fossils, although the organism which created them is unknown. These may be nodules, but the weathering pattern (flush with the rock) is not typical, as nodules normally have a negative or positive aspect.



Figure 10: [1411]: Trace fossils of unknown species, possibly a shrimp, located within Estcourt fine-grained sandstone at RES BH3 RIVER (refer Fig. 2(b)).

2.2 Vertebrate Fossils

The Beaufort Group is known internationally for its fossils (Cisneros et al., 2008). The Estcourt Formation contains trace-, plant- and animal- fossils. It contains a wide variety of body fossils, including the mammal-like reptiles such as the Upper Permian-Dicynodon and the Triassic- aged Lystrosaurus (Neveling et al., 2005) and trace fossils (Green, 1998) (Fig. 11 & 12, respectively). The Adelaide Subgroup is known world-wide for its fossils (reference?)

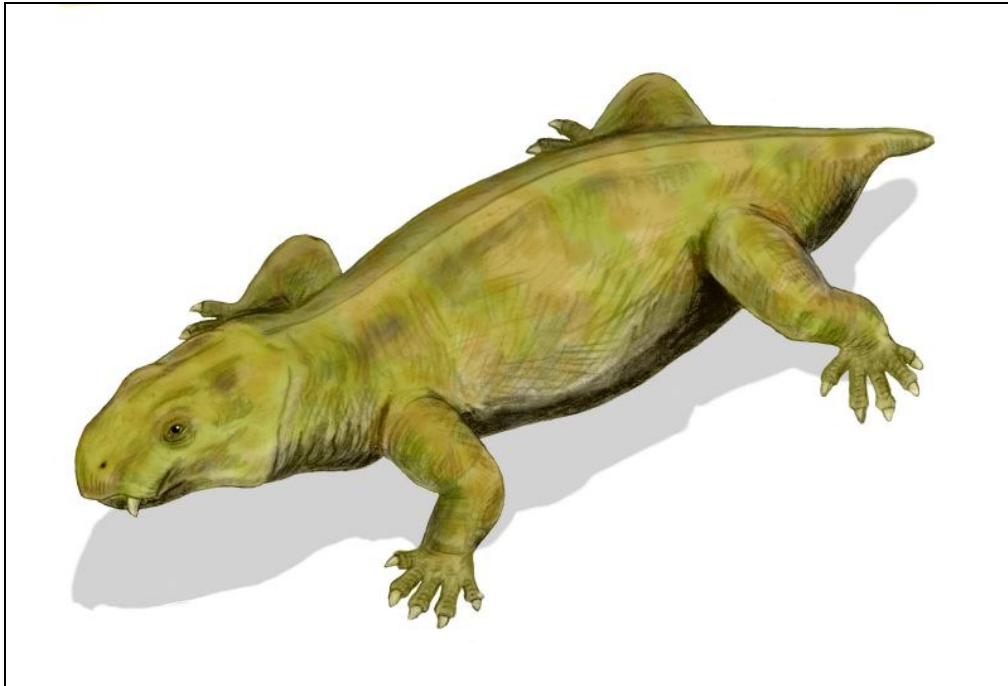


Figure 11: Dicynodon reproduction (Wikipedia).



Figure 12: Lystrosaurus reproduction (Wikipedia).



Figure 13: [6361]: Possible bone fragments (arrowed) in a sandstone within the Adelaide sub-Group, located within a trench next to the road at RES EK

Whilst no significant or rare palaeontological material was found on this brief field survey, based on existing literature (references), this does not exclude the possibility that palaeontological material may be encountered when excavating for the reticulation pipelines.

4. CHANCE FIND PROTOCOL

As this site includes areas flagged red on the SAHRIS PalaeoSensitivity Map (Fig. 3(b)), a “Chance Find Protocol” is Recommended. This Protocol is based on that of Groenevald (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

The proposed project covers a large area and survey work was limited to key areas determined by topography and accessibility. The Beaufort Group Estcourt Fm geology is flat-lying. This is succeeded by Adelaide Sub-Group within “koppies”, capped by dolerite. Tarkastad Sub-Group may be present at higher levels. No rare or significant palaeontological material was encountered during this brief survey, although evidence of trace fossils and small vertebrate bone fragments were found. Based on the geology and extent of the development area, palaeontological material is **VERY** likely to be found on this site. It is more likely to be found in mudstone and siltstone lithologies. Palaeontological material is less likely to be found in the sandstones, but is still possible. Whether any of this palaeontological material is rare or significant, only time will tell. A “Chance Find” Protocol has been incorporated into this report and this **MUST** be incorporated into the EMP. Due to the specialization of this field, this should include regular site inspections by a qualified person.

6. REFERENCES

Beater, J (2019). Bhekuzulu, Epangweni: potable water reticulation to wards 1-5 and portion of ward 6, Inkosi Langalibalele Municipality, KwaZulu-Natal, HIA(for Mike Webster, Hornby Smyly Glavovic.

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Neveling, P.J. Hancox & B.S. Rubidge (2005) Biostratigraphy of the lower Burgersdorp Formation (Beaufort Group; Karoo Supergroup) of South Africa – implications for the stratigraphic ranges of early Triassic tetrapods. *Palaeont. afr.*) 41: 81–87.

Watkeys, M.K., 2006. Gondwana break-up: a South African perspective. In: M.R. Johnson, C.R. Anhaeusser and R.J. Thomas (Editors), *The Geology of South Africa*, Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria, 531-539.

APPENDIX 1: WAYPOINT DETAILS.

Latitude	Longitude	Elevation (m)	Waypoint name	Photos
Day 1				
-28.8429	29.63702	1146.02	BHEKUZULU	
-28.8739	29.62734	1136.65	RES EK	6353-6363
-28.876	29.62813	1130.95	RES EK QUARRY	6364-6366
-28.9082	29.6175	1181.97	B4 RESA2	6367-6368
No wpt				6369-6370
-29.0907	29.50468	1491.92	RESERVE	6371
-29.0842	29.50949	1429.23	PT BOUND	6373-6377
-29.0822	29.51109	1397.86	ENGODINI	
-29.0749	29.50424	1315.28	RES E	
-29.0772	29.50736	1308.34	RES E STREAM	6378
-29.0674	29.51852	1223.18	EA BOUND	6379-6380
-29.0216	29.55981	1134.89	RES K/A5	6381-6389
-29.0186	29.56361	1146.48	BORROW PIT	6390-6392
-28.98	29.58718	1144.93	RES A3	6393-6395
-28.9748	29.58814	1128.86	RIVER X	6397-6401
Day 2				
-28.9483	29.53933	1113.72	RES C1	1355
-28.9647	29.6914	1213.08	RES BH3 END	1345
-28.9387	29.60189	1137.13	MTN PIC	1351
				1358
-28.9554	29.6592	1181.70	RES BH3	
-28.9556	29.66002	1175.98	RES BH3 RIVER	1403-1411

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.
- 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.