

Palaeontological Heritage Impact Assessment of a proposed
Wind Energy Facility to be situated on a site south-east of
Cookhouse and south of Bedford in the Eastern Cape Province.
The Amakhala Emoyeni Wind Energy Facility.

Assessment conducted in terms of
Section 38 (8) of the National Heritage Resources Act (Act 25 of 1999)

Prepared for:
Savannah Environmental (Pty) Ltd

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Report by

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EXECUTIVE SUMMARY	3
Declaration	3
Glossary	3
1. INTRODUCTION	4
Location	4
Overview of the Beaufort Group and its fossil potential	5
2. METHODS	6
3. OBSERVATIONS	6
Landscape and bedrock exposures	6
Fossil Localities	9
4. IMPACT ASSESSMENT	14
5. CONCLUSIONS & RECOMMENDATIONS	15
6. BIBLIOGRAPHY	15

EXECUTIVE SUMMARY

Dr Billy de Klerk, Curator of Earth Sciences at the Albany Museum, Grahamstown was appointed by Savannah Environmental (Pty) Ltd of behalf of Windlab Developments South Africa Pty Ltd which is proposing to establish a commercial wind energy facility on a site between Cookhouse and Bedford in the Eastern Cape Province. It is proposed for a cluster of up to 350 wind turbines (described as a wind energy facility) to be constructed over an area of approximately 273 km² in extent. This project is known as the Amakhala Emoyeni Wind Energy Facility. An assessment of the palaeontological heritage of the area was undertaken utilising both office and field resources. Fossil preserved in sediments that accumulated in a terrestrial environment during the early Permian period, now preserved as the Beaufort Group of rock in the Karoo Basin are generally rare. By their very nature these diverse fossil provide an important insight into the environment at that time and, more importantly, the evolutionary origins both mammals and dinosaurs.

Declaration

Dr W.J. (Billy) de Klerk (PhD) is a Palaeontologist, Specialist Scientist, employed by the Eastern Cape Department of Sport Recreation Arts and Culture (DSRAC) and is also an Associate Researcher in the Department of Geology at Rhodes University, Grahamstown. He has 34 years of working experience in the Earth Sciences and is accredited by the Palaeontological Society of Southern Africa. He occasionally does independent specialist consulting and is in no way connected with the proponent, other than delivery of consulting services.

Glossary

Fossil: *Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.*

Heritage: *That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999.*

Permian: *A geological time period dated between 299 – 251 Ma (million years ago).*

National Estate: *The collective heritage assets of the Nation*

Palaeontology: *Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.*

SAHRA: *South African Heritage Resources Agency – the compliance authority which protects national heritage.*

1. INTRODUCTION

Location

The site proposed for the Amakhala Emoyeni Wind Energy Facility area falls within the Blue Crane Route Local Municipality (Figure 1). The wind energy facility is proposed on the following farms: Portion 1, 2 and remainder of Farm 222, Portion 3 of Farm 203 (Platt House), Remainder of Farm 205 (Kop Leegte), Portion 1 of Farm 206 (Normandale), Remainder of Farm 168 (Stompstaart Fontein), Remainder of Farm 224 (Taai Fontein), Remainder of Farm 221 (Leeuw Fontein), Portion 2 and Remainder of Farm 223 (Paarde Kloof), Remainder of Farm 227 (Wilgem Bush), Remainder of Farm 225, Portion 1, 2 and remainder of Farm 218 (Brakke Fonteyn), Remainder of Farm 259, Remainder of Farm 260, Portion 5 of Farm 149 (Great Knoffel Fonteyn), Remainder of Farm 242, Portion 1 and Remainder of Farm 220 (Brak Fontein), Remainder of Farm 219 (Vogel Fonteyn), Remainder of Farm 169 (Olive Woods Estate), Portion 3 of Farm 141 (Brakfontein), Portion 1 of Farm 187 (Kleine Knoffel Fonteyn).

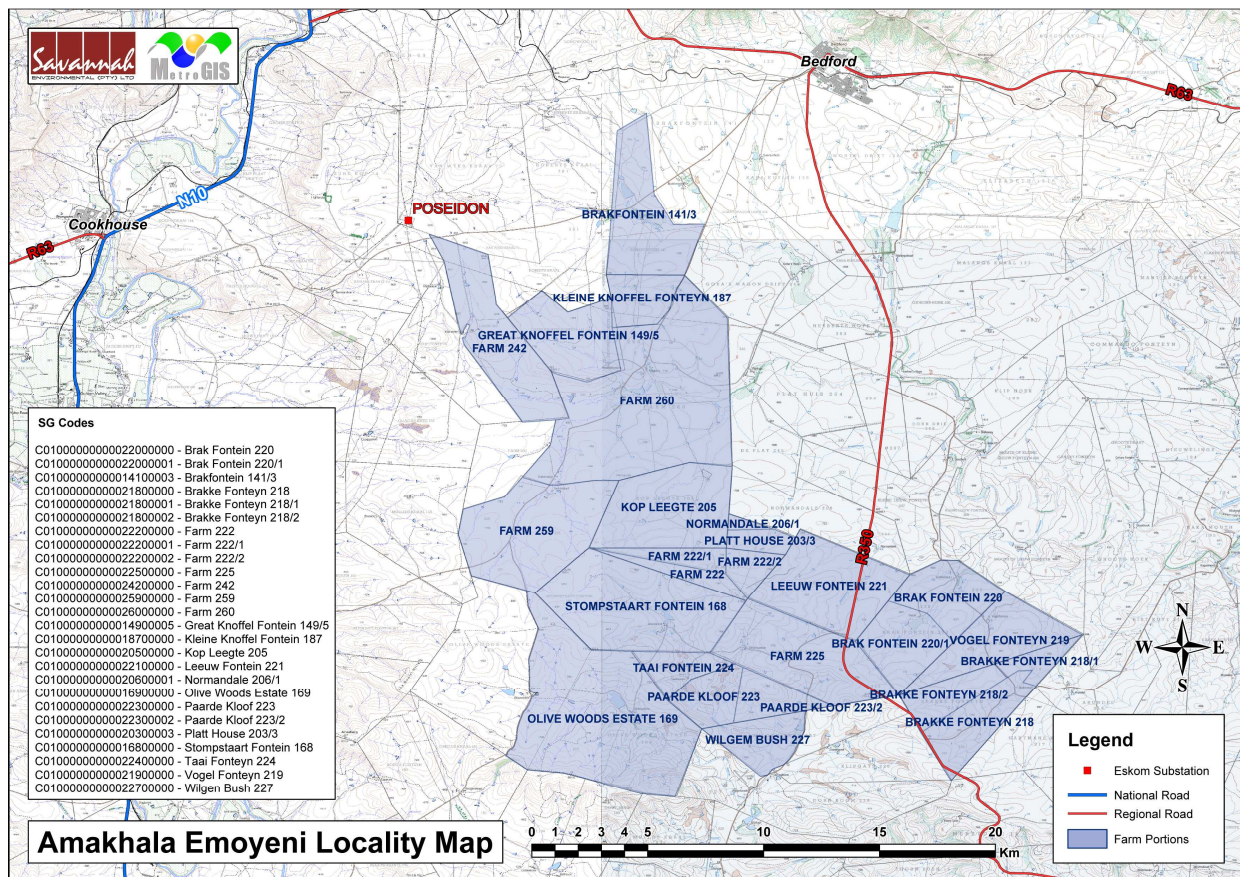


Figure 1. Locality map showing the footprint of the Amakhala Emoyeni Wind Energy facility.

The brief was to conduct a data survey/database assessment of the palaeontology and the fossil potential on the farms mentioned above and outlined within the footprint shown in Figure 1.

The area in question is underlain by sediments of the lower Beaufort Group, Karoo Supergroup. The succession of sediments increases in age from c. 260Ma in the south to 255Ma in the north. These sediments were laid down by ancient river systems that were flowing from south toward the north and preserve a variety of fossil organisms of this time

from therapsids (mammal-like reptiles), amphibians, fishes, freshwater invertebrates (mainly bivalves) and plants. Fossils of these organisms have been collected from the layers of sediment, making up the Beaufort Group, over the past 150 years and are today preserved in South African museum and universities (part of the National Estate) and some in other countries as well.

Overview of the Beaufort Group and its fossil potential.

Deposition of the thick pile of Karoo sediments took place in an intracratonic basin (on the African plate) and commenced with the Permo-Carboniferous glaciation which deposited the **Dwyka Formation** (tillite) at the base of the Karoo basin. This unit is followed, conformably, by shallow marine shales and sandstones of the **Ecca Group** and then by the fluvial and lacustrine mudstones, shales and sandstones of the **Beaufort Group**. It is only the very lowest units of the Karoo sediments that have been affected by the Cape Folding event. As a consequence, only the Dwyka, Ecca, and to a lesser degree the lower Beaufort rocks are folded.

The Beaufort Group sediments are subdivided into eight biozones (Rubidge, 1995) on the basis of the vertebrate fossil assemblages found in each zone. From the lowest most biozone they are as follows (oldest to youngest): Eodicynodon, Tapinocephalus, Pristerognathus, Tropidostoma, Cistecephalus, Dicynodon, Lystrosaurus and Cynognathus.

The Amakhala Emoyeni Wind Energy Facility area is underlain only by lower Beaufort Group rocks. To date the exact boundaries between individual biozones in this area have not been well defined because of a paucity of outcrops and hence the low number of identifiable fossils that have been collected in the past. With currently available data it is estimated that the Amakhala Emoyeni Wind Energy Facility footprint straddles three Biozones (oldest at the base):

- *Cistecephalus Biozone (age at top 255 Ma).*
- *Tropidostoma Biozone*
- *Pristerognathus Biozone (age at base – 262 Ma).*

A comprehensive list and description of the vertebrate fossils that may well occur in these three biozones can be found in Rubidge (1995). It must be emphasized that the colour of the fossil bone can be quite variable from a blue-black colour to very light grey depending on the degree of weathering.

Fossil Potential

The predominantly terrestrial sediments of the Beaufort Group have, throughout South Africa, yielded a large number of vertebrate fossils in the form of amphibians, early primitive reptiles (the captorhinids), mammal-like reptiles (therapsids), and fish. Minor freshwater invertebrates (molluscs) and plant fossils have also been recovered. For the most part, the fossils found in the Beaufort sediments are RARE – particularly in the lowermost part of the succession.

2. METHODS

1. Literature review & Museum Catalogue Search. A comprehensive review of the literature pertaining to the lower Beaufort Group sediments was undertaken. In addition, a search of known fossil housed in South African museums was undertaken from a GIS database of Karoo fossil.
2. Field Work. The sedimentary beds of the lower Beaufort Group have, for a number of years, formed a part of my research focus in sedimentology and vertebrate palaeontology along an east-west trend between Jansenville and Fort Brown. Fieldwork in these areas has been ongoing for the past ten years so I'm particularly familiar with these lithologies.

Two field days (17th and 21st September 2010) were spent in the footprint area to ascertain what the fossil potential would be. To improve the likelihood of finding any fossils I was accompanied by Prof Mike Davies-Coleman (RU, Chemistry) and Prof John Moore (RU, Geology) and Mr Luvuyo Mayi (Palaeontology technician) on the first day. On the second day only Prof John Moore joined me in the field.

3. OBSERVATIONS

Landscape and bedrock exposures.

The majority of the area under consideration consists of generally flat and rolling countryside with little or no sedimentary rock outcrop (Figure. 2). However the southern area, approaching the Great Fish River valley, reflects more broken ground where the drainage systems have carved small valleys down to bedrock. And it is here, on the flanks of the valleys that one would expect to find fossils more readily (Figure 3).



Figure 2. General view (looking north) of the Amakhala Emoyeni Wind Energy area showing the paucity of bedrock outcrop. In places there is an abundance of resilient

sandstone “float” in the form of boulders and rock fragments. There is also an abundance termite mounds with high concentrations in some areas, particularly in the north.

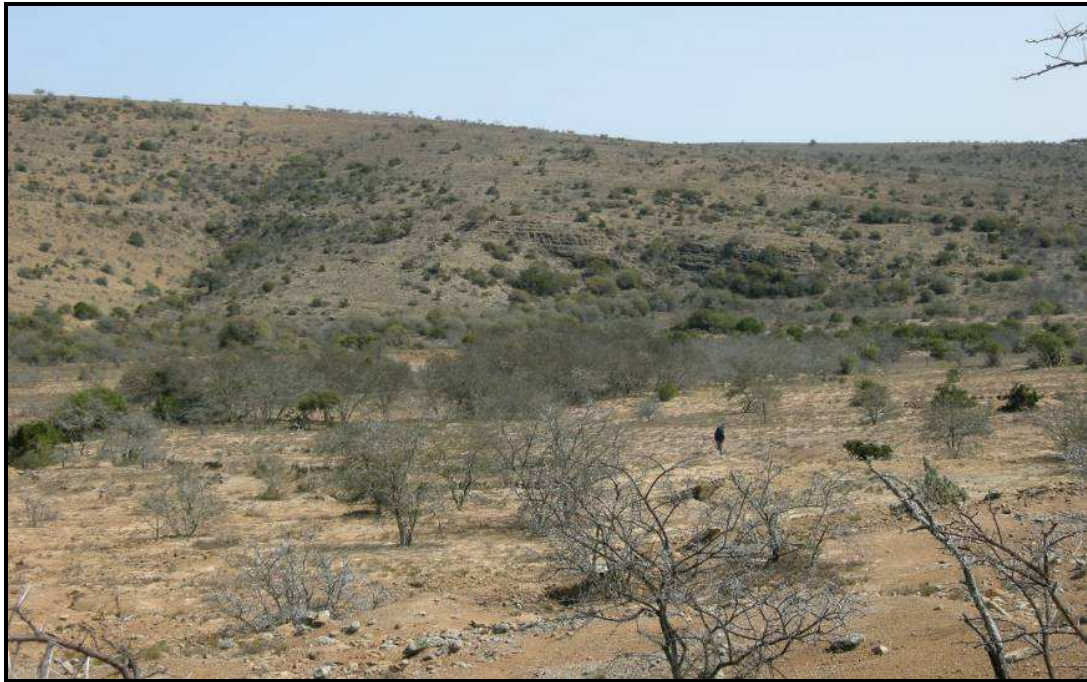


Figure 3. Broken ground topography revealing bedrock outcrops of Beaufort shale on the valley flanks. The valley floors are generally covered with alluvium with bedrock exposed in the stream/river channels. This kind of topography is prevalent in the southern part of the footprint.

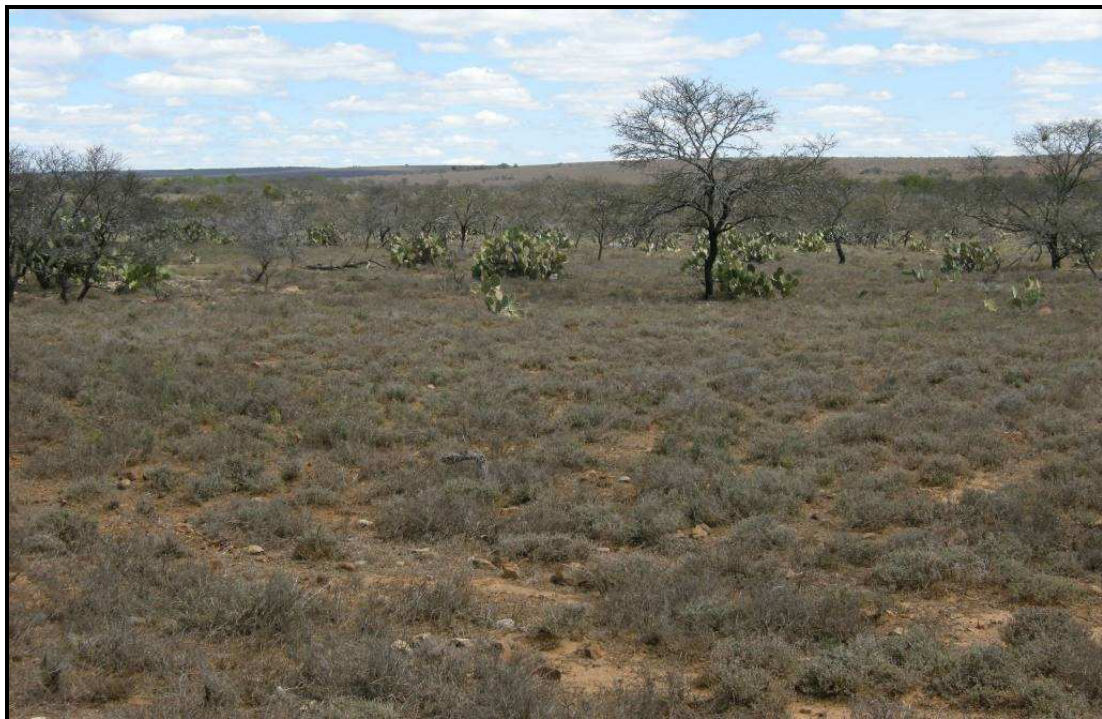


Figure 4. Sparse thorn-veld and low Karoo bushes characterises rolling country in the northeaster part of the footprint. Very little bedrock outcrop and only fragmentary sandstone float is apparent. Very low fossil potential.



Figure 5. The northern part of the footprint is characterised by a very high concentration of termite mounds on featureless rolling country. No bedrock outcrops and very little rock float is apparent. This kind of terrain has very little to not fossil potential at surface.



Figure 6. Good bedrock shale outcrop exposed adjacent to the main N-S dirt road through Brak Fontein 220 (Eastern side of the R350 to Bedford). Here the thin soil cover (pale brown) has been washed away revealing the shale (grey). These conditions provide ideal opportunities to find finding fossils. Fossil plants were found at this locality (Figure 7 point D)

Fossil localities.

During the two days spent in the field only seven fossil localities were discovered emphasising the how rare fossils are in these rock. The fossils are listed A – G in Figure 7 below and a brief description and photograph is provided.

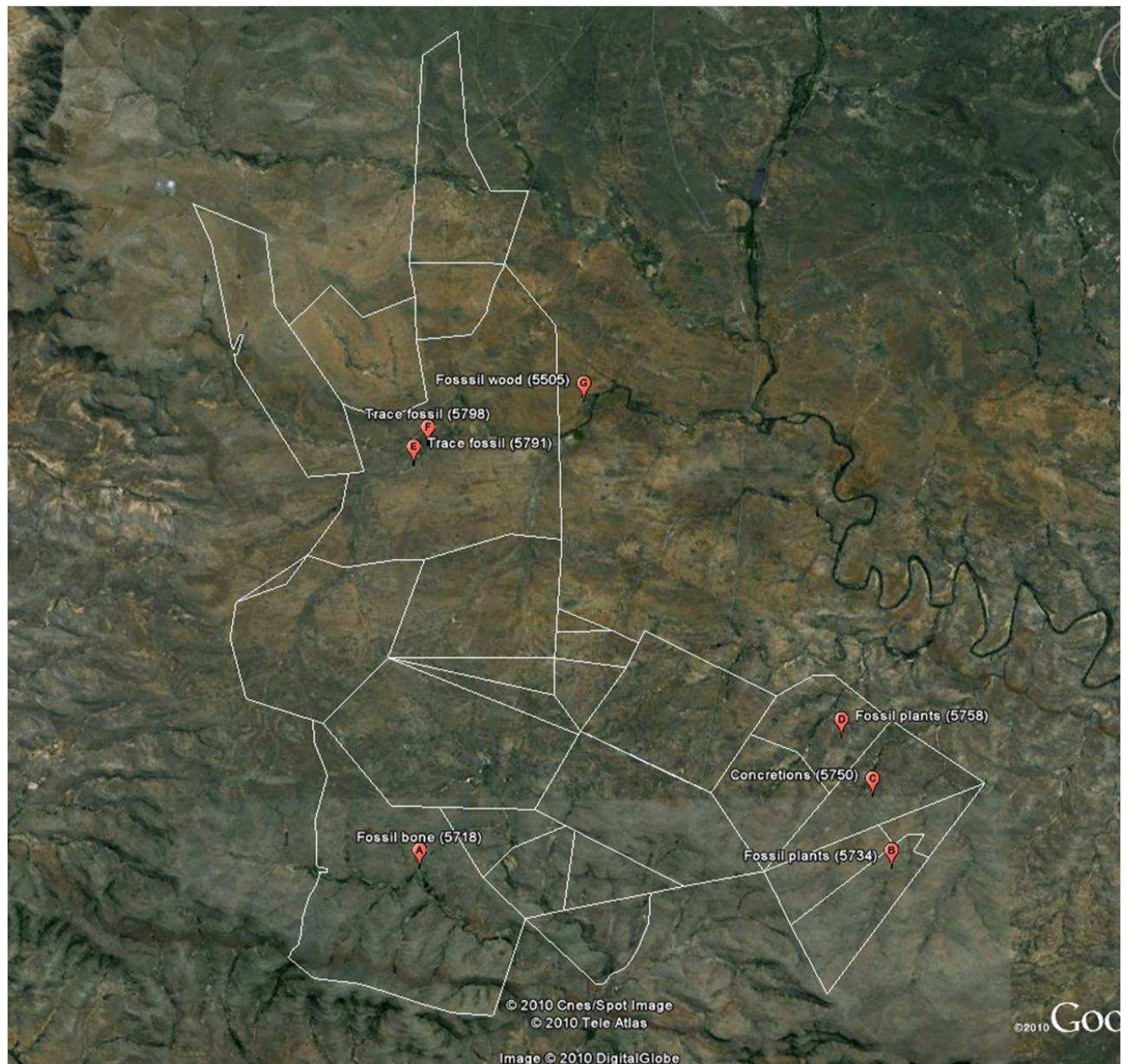


Figure 7. Locality of the seven fossil sites found during the two day investigation. The type of fossil and its associated photographic number is provided.

A – Fossil Bone (5718) 32°55.601'S: 26°00.286'E . An in-situ occurrence of what appears to be a few isolated rib bones located on the flanks of a stream bed (to the right of the persons head – 2nd photo). The bone manifests itself as grey fragments and rods and includes a natural rock mould (left of pocket knife).



B – Fossil Plants (5718). An occurrence of sphenophyte (horsetail) impressions in purple and grey-green shales.



C – Pseudo Fossils (5750) 32°55.037'S: 26°9.308'E . An occurrence of carbonate accretion nodules in grey shale that gives a false impression that they may be bone. These pseudo fossils were found in a road-side borrow pit (photo below).





D – Fossil Plants (5758) 32°54.772'S: 26°08.990'E . An occurrence of sphenophyte (horsetail) impressions in grey shales.



E – Trace Fossil (5791) 32° 49.088'S: 26° 00.174'E. An invertebrate burrow which has been filled in with sediment that is more resistant to weathering than the enclosing shale. The burrow was made in the in the plane of bedding. This kind of trace is called planolites.



F – Trace Fossil (5798) 32° 48.769'S: 26° 00.446'E. A burrow made in mudstone (now shale) by an unknown organism – possibly a small vertebrate (perhaps a mammal-like reptile) or a large invertebrate. The burrow is in the plane of the bedding. This kind of trace is called planolites.



G – Fossil Wood (5505) 32° 48.064'S: 26° 03.448'E. Fragments of well-preserved silicified wood. In cross-section the annular growth rings are very widely spaced indicating rapid seasonal growth. This occurrence falls just outside the footprint at the entrance to the “Plathuis” farmstead. It is very likely that fossil wood would also occur in the footprint.



4. IMPACT ASSESSMENT

Nature: Disturbance or destruction of valuable fossil heritage within the potentially fossiliferous lower Beaufort Group sediments		
	Without mitigation	With mitigation
Extent	International (5)	International (5)
Duration	Permanent (5)	Permanent (5)
Magnitude	Very high (10)	Very high (10)
Probability	Improbable (2)	Very Improbable (1)
Significance	Medium (40)	Low (20)
Status (positive or negative)	Negative	Negative
Reversibility	None	None
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » Should substantial fossils be exposed during construction, the ECO should safeguard these - in situ. Albany Museum or Rhodes University in Grahamstown and / or a professional palaeontologist should then be alerted as soon as possible so that appropriate mitigation measures can be implemented.		
Cumulative impacts: Any construction activities have the potential to impact on the valuable fossil heritage.		
Residual Impacts: N/A		

5. CONCLUSIONS AND RECOMMENDATIONS

Because fossils are rare in this part of the lower Beaufort Group sediments it is difficult to find them even in ideal outcrop conditions. Because of the low relief topography in the great part of the footprint area and the consequent deeper soil profile, reducing the availability of bedrock outcrop, there is a very low likelihood of finding well preserved fossils. There is however a reasonably good chance that fossils may be exposed in areas that are excavated for foundations, road or trenches. It is recommended that development may take place but if at any stage during the construction phase of the wind turbines and the associated infrastructure like roads and trenching for cables, any semblance of a fossil were to be observed, it would be vital to stop the work and report this occurrence to the geological staff at either the Albany Museum or Rhodes University in Grahamstown. Reliance would be placed on the ECO to monitor this. The footprint site is within easy travelling distance and it can be investigated speedily. Generally fossils can be removed quickly and would therefore not delay or hinder construction operations.

6. BIBLIOGRAPHY

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