

Palaeontological Heritage Impact Assessment of the proposed Happy Valley Wind Energy Facility on a site east of Humansdorp, Eastern Cape.

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

Prepared for:
Savannah Environmental (Pty) Ltd
On behalf of Renewable Energy Investments South Africa (Pty) Ltd

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Report by

W.J. de Klerk, PhD, FGSSA

**Curator: Earth Science
Albany Museum
Somerset Street
Grahamstown 6139**

tel: 0845826072
email: b.deklerk@ru.ac.za

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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 Renewable Energy Investments South Africa (Pty) Ltd ('REISA') who is proposing the establishment of a commercial wind energy facility and associated infrastructure on a site located on Portion 1 of Farm 810, which lies ~9 km north -west of Humansdorp in the Eastern Cape. This facility is referred to as the "**Happy Valley Wind Energy Facility**" on a site measuring ~5 km² in extent. This facility would be comprised of up to 15 wind turbines with a proposed total generating capacity of ~ 30 MW

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 35 years of working experience in the Earth Sciences and, having served two terms as President of the Palaeontological Society of Southern Africa, is accredited by the society to conduct Palaeontological Heritage Impact assessments. 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

Renewable Energy Investments South Africa (Pty) Ltd is proposing the establishment of a commercial wind energy facility and associated infrastructure on a site located on Portion 1 of Farm 810, which lies ~9 km north -west of Humansdorp in the Eastern Cape. The locality of this proposed Happy Valley Wind Energy Facility is illustrated in (Figure 1). The brief was to conduct a data survey / database assessment of the palaeontology and the fossil potential within the Happy Valley footprint as outlined in Figure 1.

Location

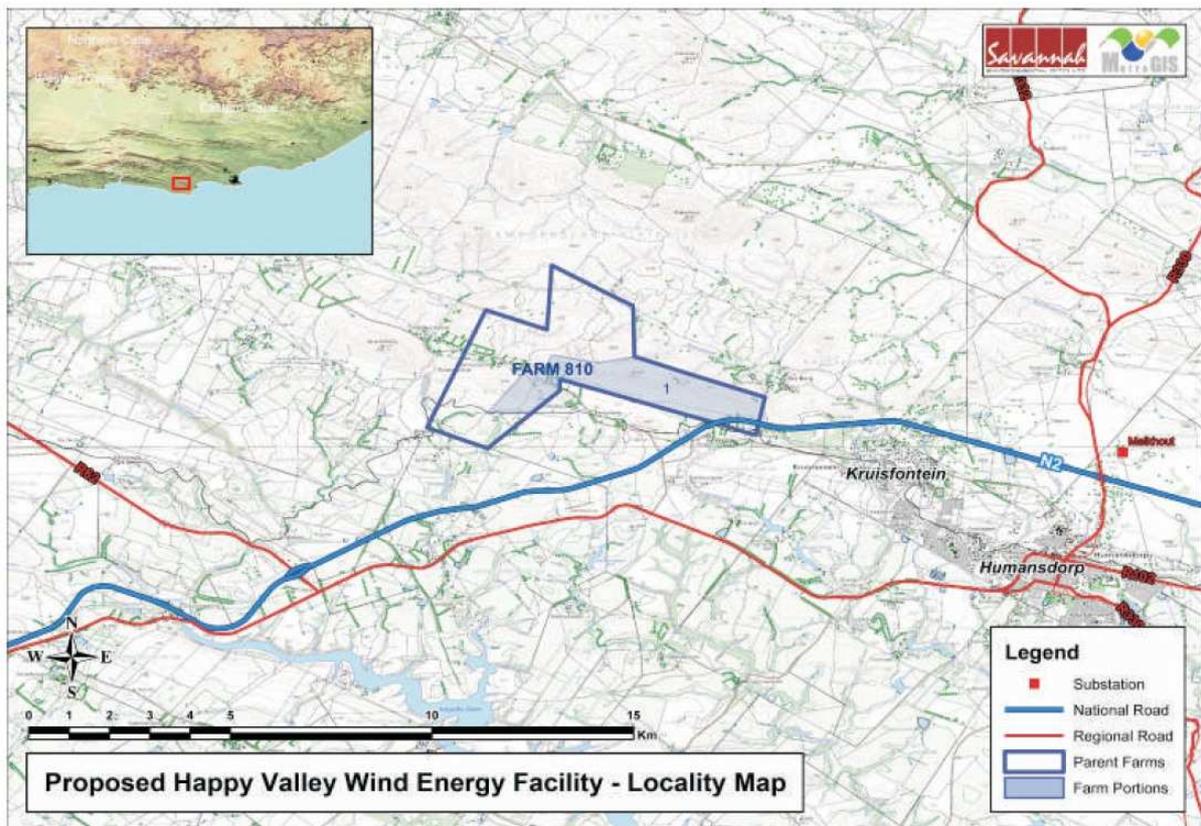


Figure 1a. Locality map showing the footprint of the proposed Happy Valley Wind Energy Facility (Farm 810 portion 1) north-east of Humansdorp, Eastern Cape.

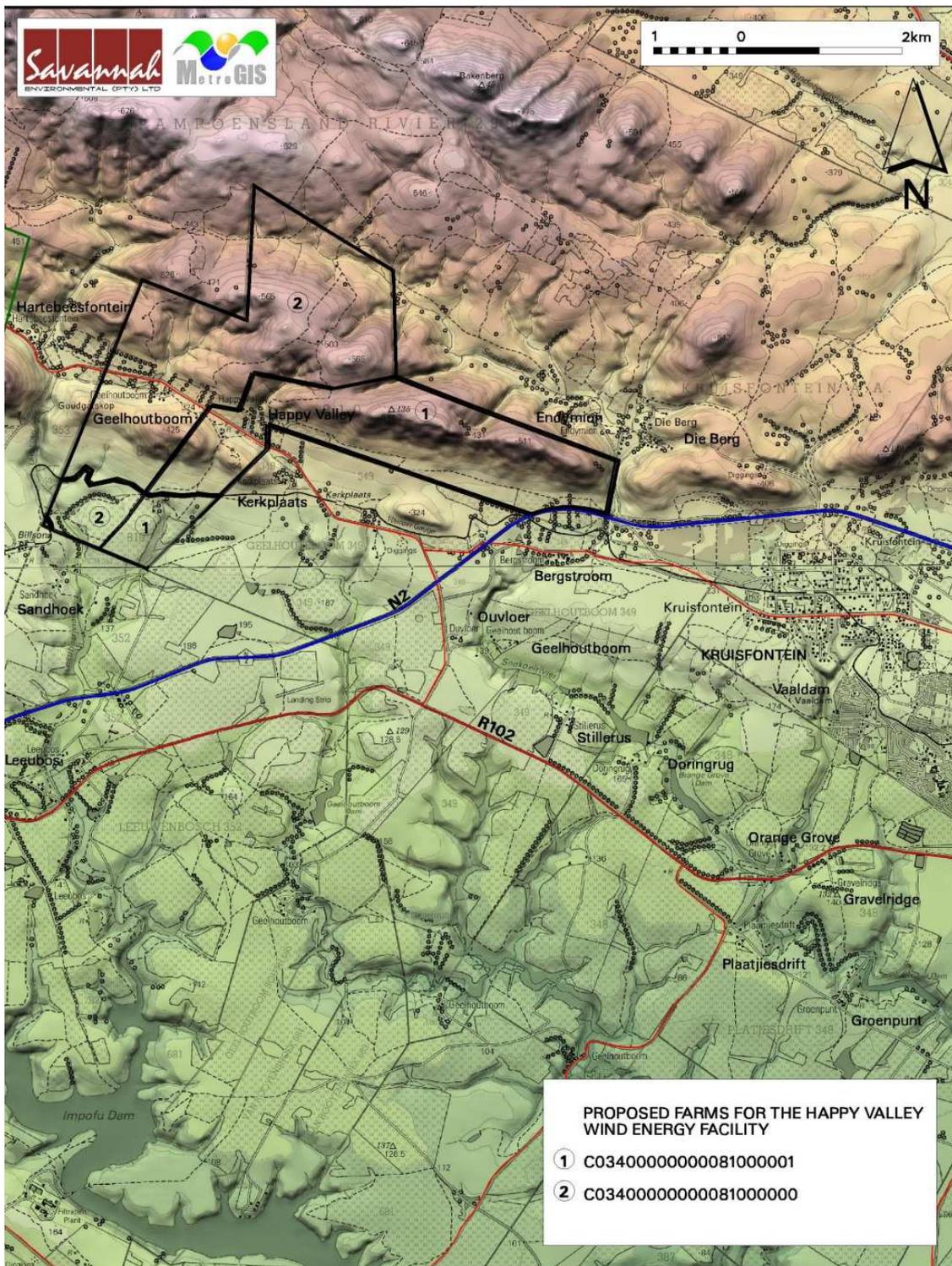


Figure 1b. Locality map showing the footprint of the proposed Happy Valley Wind Energy Facility (Farm 810 portion 1) north-east of Humansdorp, Eastern Cape.

The area in question is underlain by Palaeozoic sandy sediments of the Table Mountain Group (“Table Mountain Sandstones”) and a very small section of the lower Bokkeveld Group. The Table Mountain Group rocks are generally sparsely fossiliferous. Fossils of marine organisms have over the past 150 years been collected from these sedimentary rocks and are today preserved in South African museums and universities, making up part of the National Estate.

2. GEOLOGICAL BACKGROUND & SETTING

Rifting occurred across what is today known as the southern Cape about 450 million years ago. This rifting had the effect of thinning the crust and resulted in the invasion of the sea, giving rise to the “Agulhas Sea” across the southern Cape (McCarthy and Rubidge, 2005). Sediments that subsequently accumulated in this newly formed basin produced what is today seen as the Cape Supergroup of rock (Figure 2).

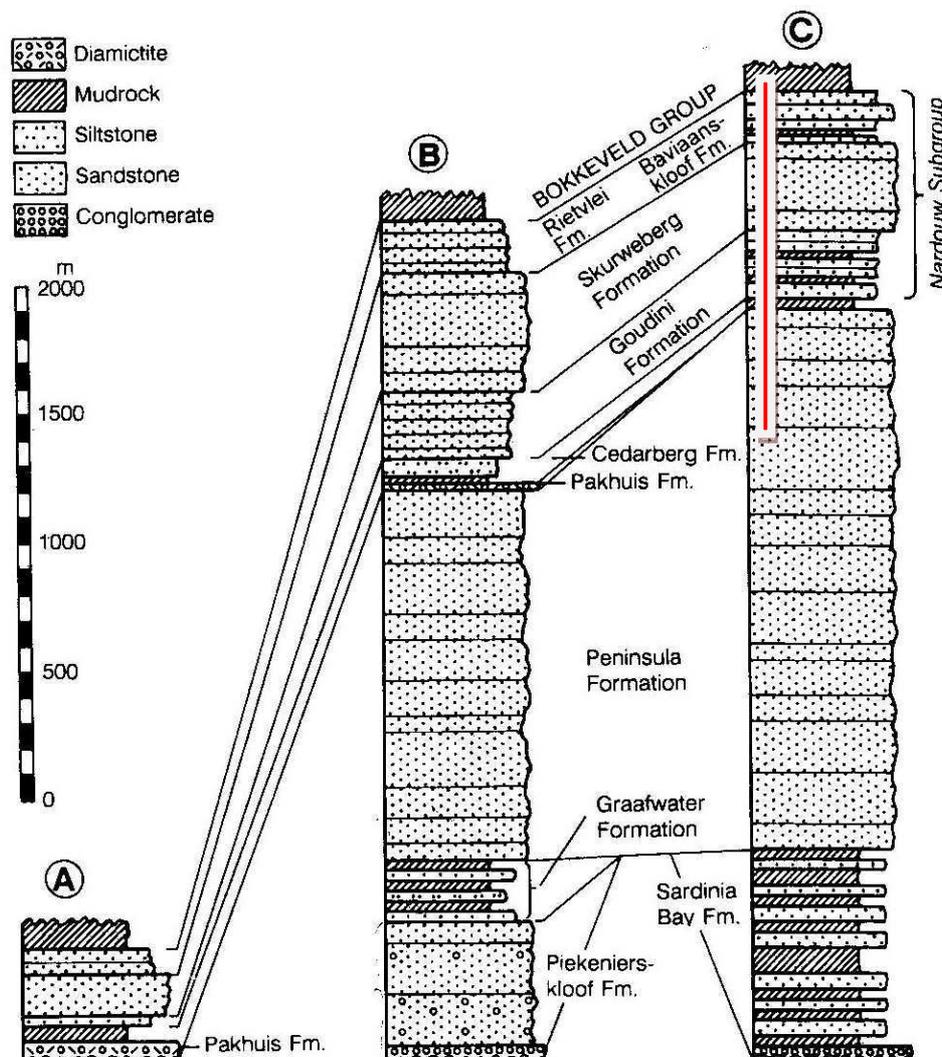


Figure 2. Stratigraphic subdivision of the Table Mountain Group (From Johnson *et al.* 1999). Column C, measured in the Eastern Cape, is most relevant to the Happy Valley field area. The six formations that occur within the yellow outlined footprint in Figure 3 are indicated here by the vertical red line.

As indicated on the 1: 250 000 geological map 3324 Port Elizabeth (Figure. 3), the Happy Valley area is entirely underlain by mid-early Palaeozoic (Ordovician – lower Devonian) sediments of the **Table Mountain Group** (Cape Supergroup) and the basal part of the **Bokkeveld Group**. Relevant geological references include Rust (1967), Hiller (1982), Malan & Theron (1989), Broquet (1992), Johnson *et al.*, (1999), De Beer (2002), Thamm & Johnson (2006), and Tankard *et al.*, (2009). These rocks are mostly craggy, resistant-weathering fluvial sandstones and minor pebbly conglomerates of the **Peninsula Formation** (Ordovician) and **Nardouw Subgroup** (Silurian) that respectively underlie and overlie the thin **Cederberg Formation (Oc)**. This last unit consists of much softer-weathering mudrocks

(laminated claystones and siltstones) grading up into interbedded fine sandstones and mudrocks which contain an abundance of invertebrate fossils. This important fossil bearing unit, although recorded in the SW corner of Figure 3, does not appear to be mapped on the contact between the Peninsula Formation (Op) and the Goudini Formation (Sg) within the Happy Valley footprint. It either it does not occur at this locality or it was not observed by the mapping geologist of the Council for Geosciences in 1991. I was unable to find any evidence of the Cedarberg Formation (Oc) in the field so I suspect that it has been attenuated and does not occur here at all thus supporting the original mapping as reflected in Figure 3.

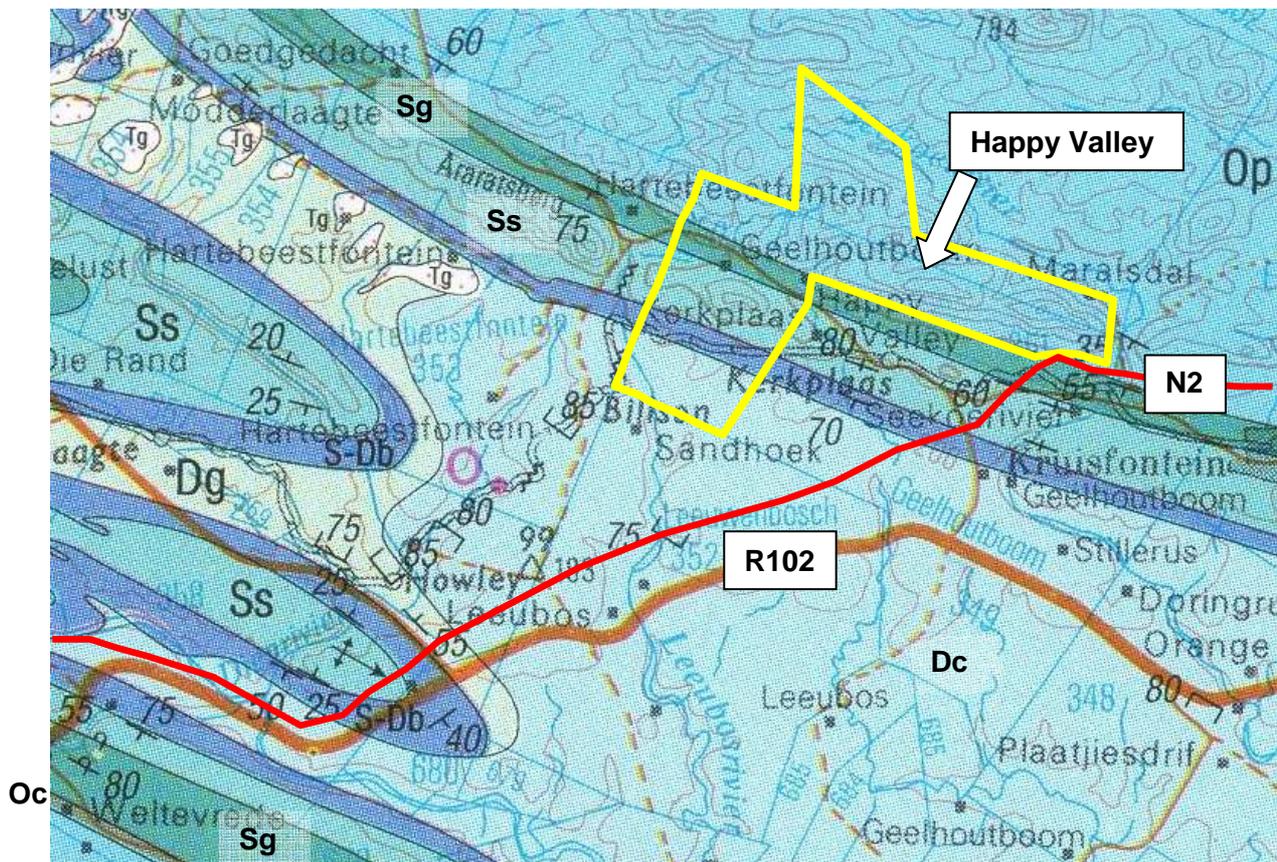


Figure 3. Portion of the 1: 250 000 scale geological map 3324 Port Elizabeth (Published by the Council for Geoscience, Pretoria, 1991) showing bedrock geology of the study region (indicated by yellow outline). Stratigraphic units and legend are shown in Table 1 below.

Supergroup	Group	Subgroup	Formation
Cape	Bokkeveld	Ceres Subgroup (Dc)	Gydo (Dg) – v. pale green
			Baviaanskloof (S-Db) - purp
	Table Mountain	Nardouw	Skurweberg (Ss) – dark blue
			Goudini (Sg) - dark green
			Cedarberg* (Oc) - grey
			Peninsula (Op) - blue

Table 1. Stratigraphic sequence of the Cape Supergroup lithologies as presented in Figure 3
 * The outcrop of the palaeontologically sensitive Cederberg Formation (Oc) occurs as the thin grey line in the south-west corner of the map (Figure 3). For the rest, most of the sandstones of the Table Mountain Group are only sparsely fossiliferous.

Fossil Potential

The footprint area, on which the Happy Valley wind turbines are planned to be erected, is underlain by (meta-) sediments of the lower Cape Supergroup (Figure 3). Specifically they are the very basal succession of the Bokkeveld Group (Ceres Formation (**Dc**), Gydo member (**Dg**) of lower Devonian age - 400 Ma) and the upper part of the Table Mountain Group, the Nardouw Subgroup that is made up of the Goudini (**Sg**), Skurweberg (**Ss**) and Baviaanskloof (**Db**) Formations of upper Silurian age (420 Ma). These three formations of the Nardouw are in turn underlain by the topographically prominent Peninsula Formation (**Op**) which composed of a monotonous succession of medium- to coarse-grained, thickly bedded grey sandstone. Thin layers of conglomerate are present in places

The bulk of all the sediment that makes up these rocks are generally sandy in nature (MacRay, 1999, p.106) and apart from occasional trace fossils are generally devoid of invertebrate body fossils. The Baviaanskloof Formation (**Db**) however has, in the past, yielded a marine shelly fauna like brachiopods, molluscs (bivalves & gastropods) and rare trilobites, bryozoans etc. This particular unit is regarded as having a reasonably high palaeontological significance.

Tectonic Deformation

As can be seen in Figure 3 the rocks of the Cape Supergroup have been severely deformed (folded and faulted) during the Cape Folding Event which took place approximately 310 million years ago (McCarthy and Rubidge, 2005). The greater temperatures and pressures experienced by the Cape Supergroup sediments resulted in regional low-grade metamorphic recrystallization of the sediments. The tectonism and low-grade metamorphic overprint effectively contributed to the destruction of many fossils in the original sediment. It is only in the low pressure zones of the folds that there is any possibility of finding undamaged fossils.

Weathering

The prominent east-west trending southern Cape mountain range made up of the highly resilient Peninsula Formation (Op) and Nardouw subgroup. The extremely long period of the African Erosion Event that developed between the late Jurassic (145 Ma) until the end of the early Miocene at approximately 15 Ma (Partridge and Maud, 1987), contributed to the formation of the mountainous terrain and more importantly to the planation of the softer rocks to form the African Land Surface.

3. METHODS

1. Literature review & Museum Catalogue Search. A comprehensive review of the literature pertaining to the Peninsula Formation and the Nardouw and Ceres Subgroups was undertaken. In addition, a search of known fossils, housed in Eastern Cape museums, was undertaken from the accession catalogues.
2. Field Work. A full field day (6th December 2010) was spent in the footprint area to ascertain what the nature of the geology was and, more importantly, what the fossil potential would be.

4. OBSERVATIONS

Landscape and bedrock exposures.

The greater extent of the footprint under consideration consists mountainous terrain with predominant outcrops of the Peninsula Formation forming the high ground (Figure. 4).



Figure 4. General view of the easterly extension of the Happy Valley footprint (looking east). The east-west trending mountains are made up of resistant and folded sandstones / quartzites of the Peninsula Formation (Op). There is a paucity of bedrock outcrop within the valley which is underlain by weathered Goudini (Sg) and Skurweberg (Ss) Formations.



Figure 5. View to east showing the prominent E-W trending mountain range made up of resistant Peninsula Formation (Op) sandstones / quartzite. The valley is underlain by less resistant Goudini Formation (Sg) while the outcrop in the foreground is of the (Skurweberg Formation (Ss). Site - 33°59.214'S; 24°39.210'E.



Figure 6. View to the north (Happy Valley farmstead) - again showing the prominent E-W trending mountain range made up of resistant Peninsula Formation (Op) sandstones / quartzite. The valley is underlain by less resistant Goudini Formation (Sg) while the outcrop in the foreground is of the (Skurweberg Formation (Ss).



Figure 7. View west along surface outcrop of Skurweberg Formation (Ss) quartzite. Dip of the quartzite is at least 80° to the north (right). The strike of these steeply dipping quartzites is clearly evident in an E-W direction.



Figure 8. View to the east along surface outcrop of Skurweberg Formation (Ss). Dip of the quartzite is at least c. 80° to the north (left). The strike of these steeply dipping quartzites is clearly evident in the E-W direction. Note the prominent bedding and cross-bedding features within this outcrop. No evidence of invertebrate body or trace fossils were recorded in these rocks. Site - 33°59.214'S; 24°39.210'E.

5. CONCLUSIONS AND RECOMMENDATIONS

As outlined in the section 2 above (p.6 - Geological Background and Setting), this area is underlain by sedimentary rocks of the Cape Supergroup – predominantly of the Table Mountain group and a very small section of the overlying lower Bokkeveld Group (Gydo form). Fossil have in the past been recovered from these sediments throughout the southern Cape but in particular within the Western Cape. However, within the Happy Valley area two geological factors have effectively eliminated fossils from the underlying rocks - firstly the tectonic overprint of the Cape Folding Event that took place around 310 million years ago and secondly, the long period of weathering and erosion that produced the African Land Surface. There is therefore a very low likely hood of finding well preserved fossils within the Happy Valley footprint.

There is however a remote chance that trace or invertebrate body fossils may well be found in the development phase of foundation excavation, road building or trenching. There is no major palaeontological reason why this development cannot take place. 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 recover the fossil and report the occurrence to the geological staff at either the Albany Museum or Rhodes University in Grahamstown. Generally fossils can be removed quickly and would therefore not delay or hinder construction operations.

Dr W.J. de Klerk
Curator: Earth Sciences
Albany Museum, Grahamstown

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