PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED GAROB WIND ENERGY FACILITY PROJECT, NORTHERN CAPE PROVINCE

Prepared for:

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14 August 2012

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Permit No. 80/10/08/009/60

EXECUTIVE SUMMARY

A wind energy facility is proposed by Garob Wind Farm (Pty) Ltd (a juwi Renewable Energies (Pty) Ltd initiative) in the Northern Cape Province near Copperton. Due to the National Heritage Resources Act, a palaeontological impact assessment is required to detect the presence of fossil material at the proposed development. The development will affect non-fossiliferous Precambrian metamorphic rocks, a very small area of Permo-Carboniferous Dwyka deposits of low palaeontological sensitivity, and Quaternary deposits that in this case are unlikely to contain fossils. The rarity of fossil-bearing sediments and lack of appropriate exposure at the proposed site indicates that the impact on palaeontological material on Portion 5 of Farm 103 is negligible (rated Low or negative). Thus, subject to approval from the relevant authorities, the establishment of the proposed wind farm should proceed.

1. INTRODUCTION

A Wind Project is proposed on Portion 5 of Farm 103 (Nelspoortje) by Garob Wind Farm (Pty) Ltd (a juwi Renewable Energies (Pty) Ltd initiative) in the Northern Cape Province. This development will involve the implementation of wind turbines, laying down concrete foundations and roads, placing underground cabling, and building a substation and workshop area. All these excavations will modify the existing topography. As palaeontological material is unique and non-renewable, it is protected by the National Heritage Resources Act (Act No. 25 of 1999, section 35). A Palaeontological Impact Assessment of the proposed development is thus necessary to ensure that palaeontological material is either removed, or is not present.

1.1 Objective

To conduct a desktop study on Farm 103, Portion 5 (Nelspoortje farm), Karoo District Municipality, Siyathemba Local Municipality, Northern Cape Province to determine the potential impact of the proposed project by assessing the sensitivity and significance of the palaeontological heritage at the site, evaluating the potential impact of the construction of the site on the palaeontological heritage and recommending mitigation measures to reduce any negative impacts on the palaeontological heritage at the site.

2. BACKGROUND TO THE GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

Portion 5 of Farm 103 is an area of low relief with no steep river gulleys or steep outcrops (Figures 1 and 2). It contains a few low outcrops of Precambrian basement rocks belonging to the Uitdraai Formation of the Brulpan Group (Mu in Figure 3). These rocks are metamorphic in origin and non-fossiliferous.

Small outcrops on Portion 5 contain Permo-Carboniferous deposits belonging to the Dwyka Group (C-Pd, Figure 3), which forms the basal stratigraphic unit of the Karoo Supergroup. These deposits are between 300 and 290 million years old (Catuneanu et al., 2005). Dwyka facies were deposited in a cold, glacially-dominated environment (the glacial history of which has been summarized by Visser, 1983, 1989), which occurred when southern Africa lay below a massive ice sheet some 4 km thick. Deposits comprise clast-rich diamictites and clast-poor argillaceous diamictites overlain by a thin zone of laminated dropstone argillite with outsized clasts consisting mostly of quartzite and gneiss. The Dwyka Group deposits in the study area are thought to belong to the Mbizane Formation (Visser et al., 1990; Von Brunn and Visser, 1999), which marks the uppermost portion of the Dwyka Group. This formation is heterolithic with clear vertical and horizontal facies variation. There is very little diamictite in these deposits. As Gondwana (the southern portion of a super-continent called Pangaea and includes what is today South Africa) moved northwards, the climate became more moderate and the massive ice sheets decreased.

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 chondrichthyians (sharks, skates and rays). Body fossils

include aranaceous 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).

Portion 5 mostly contains superficial deposits, which are Late Cenozoic (Quaternary [2.6 million years old] to Recent) in age (Walker and Geiss, 2009). Those on Farm 103 comprise unconsolidated aeolian sands (i.e. red wind-blown sand and dunes) of the Quaternary Gordonia Formation of the Kalahari Group (Qg, speckled light pink in Figure 3, for detailed lithology see Appendix 1). Deposits of the Gordonia Formation were formed as dune sands during cold, dry intervals of the Pleistocene Epoch. This type of climate limited the biodiversity of the region and the dune sands did not facilitate good fossil preservation. Consequently, few fossils have been recovered from the Gordonia Formation; they include rhizoliths or root casts, termitaria (e.g. *Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (e.g. *Trigonephrus*) (Almond and Pether, 2008). Watercourses and pans may also yield fossil freshwater bivalves and gastropods (e.g. Corbula, Unio), ostracods (see shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones). Fish, amphibian, reptilian and mammalian bones, teeth and horn cores are very rarely recovered from Kalahari Group deposits (Almond and Pether, 2008).

3. NAME AND GEOGRAPHICAL LOCATION OF THE SITE

Garob Wind Energy Facility Project: Farm 103, Portion 5 (Nelspoortje farm), Karoo District Municipality, Siyathemba Local Municipality, Northern Cape (29° 55’ 19.66” S, 22° 24’ 44.49” E), 39.21 km South West of Prieska and approximately 6.8 km North East of Copperton.

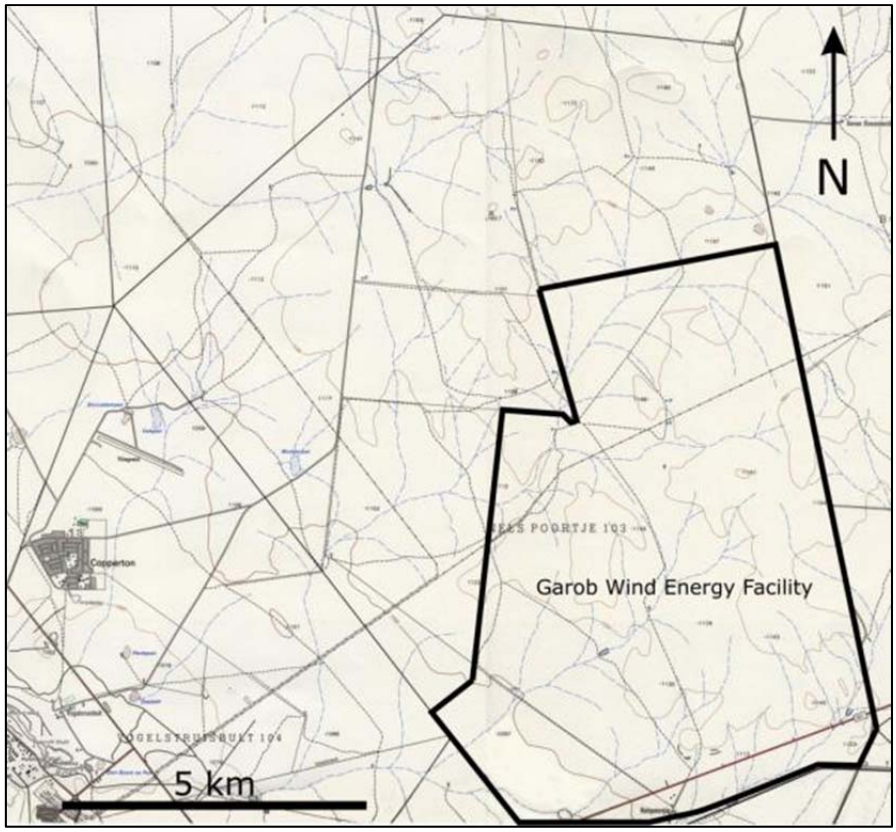

Figure 1. Topographical map of the proposed Garob Wind Energy Facility on Portion 5 of Farm 103 (Nelspoortje), Northern Cape (1: 50 000 map of 2922CD Copperton, Data source: Council for Geoscience, Pretoria), showing the low relief of the development site.

Figure 2. Google Earth satellite image of Garob Wind Energy Facility (section bordered in white) on Portion 5 of Farm 103 (Nelspoortje), Northern Cape Province, showing the low relief of the area.

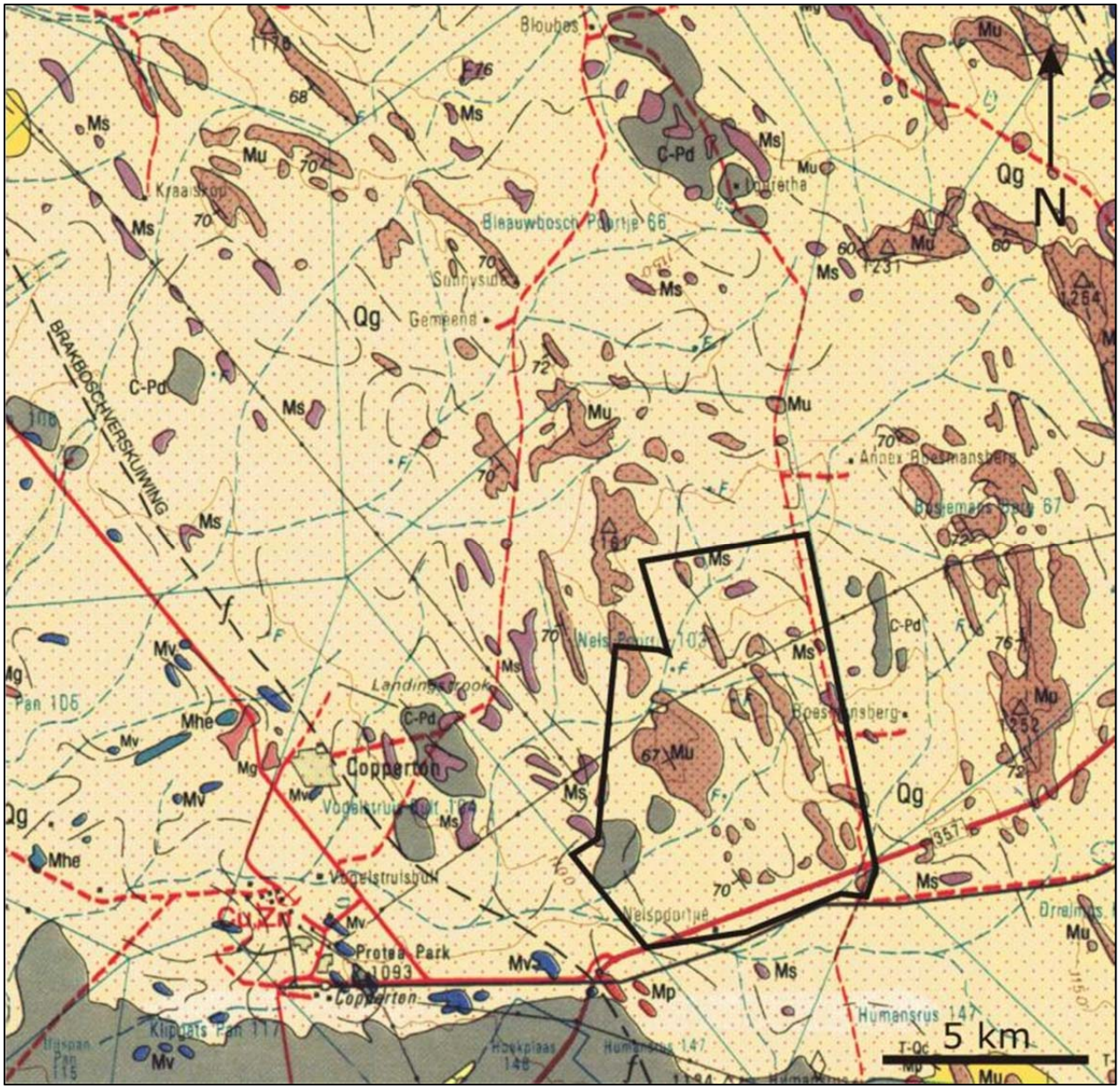

Figure 3. Extract from geological map 1: 250 000 Prieska 2922, showing the geology of Portion 5 of Farm 103 (bordered in black). C-pd (grey), Karoo Supergroup, Dwyka Group, Mbizane Formation; Ms (purple), Precambrian basement rocks, Marydale Group, Spioenkop Formation; Mu (speckled dusty pink), Precambrian basement rocks, Brulpan Group, Uitdraai Formation; Mv (blue), Precambrian basement rocks, Jacobsmyn Pan Group, Vogelstruisbult Formation, all non-fossiliferous; Qg (speckled light pink), Quaternary, Gordonia Formation (Data Source: Council for Geoscience, Pretoria).

4. METHODS

A desktop study was conducted to assess the potential risk to palaeontological material (fossils, trace fossils) in the proposed areas of development. The author's experience, aerial photos (using Google, 2012), topographical and geological maps were used to assess the proposed area of development.

4.1 Assumptions and Limitations

The accuracy of desktop Palaeontological Impact Assessments may be limited by old fossil databases that have not been kept up-to-date or are not computerized and/or do not include pertinent locality or geological information, and the accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been overlooked. Much of South Africa has not been studied palaeontologically due to there being so few palaeontologists in the field. As with most desktop studies, this PIA infers the presence of fossil heritage in the development area based on the presence of such heritage in the same rock units elsewhere.

5. FINDINGS AND RECOMMENDATIONS

The Garob Wind Energy Facility will affect areas on Portion 5 of Farm 103 (Nelspoortje farm) that contain Precambrian metamorphic rocks which do not contain fossils, Permo-Carboniferous Dwyka deposits of the Mbizane Formation and Quaternary deposits belonging to the Gordonia Formation. The Dwyka deposits comprise a very small portion of Portion 5 and rarely contain fossils. Fossils recovered from Quaternary deposits are almost always found in caves or in the banks of steep-sided river gulleys.

The low-lying relief and absence of potentially fossiliferous gulleys on Portion 5 strongly suggest that fossils are absent from this site. Considering the rarity of fossil-bearing sediments and lack of appropriate exposure (i.e. steep-sided gulleys) at the proposed site, the impact on palaeontological material on Portion 5 of Farm 103 is negligible (rated Low or negative).

Thus, pending the discovery of significant new fossil material at this site, no further specialist studies are considered to be necessary.

It is recommended that:

The ECO responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all substantial excavations into sedimentary bedrock for fossil remains;

In the case of any significant fossils (e.g. vertebrate teeth, bones, burrows, petrified wood) being found during construction, they must be safeguarded and the relevant heritage management authority (SAHRA) be informed so that a professional palaeontologist may be consulted in order to facilitate the necessary rescue operations.

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Jennifer Botha-Brink has an Honours Degree in Zoology and a PhD in Palaeontology from the University of Cape Town, South Africa. She has conducted extensive field work in South Africa for the past 14 years and currently holds the position of Head of the Karoo Palaeontology Department at the National Museum in Bloemfontein. Her current research interests comprise Permo-Triassic vertebrate palaeobiology, with a special focus on the end-Permian mass extinction. She is also trained in the specialized field of palaeohistology (the study of fossil bone microstructure). Dr Botha-Brink has published more than 30 scientific articles in both national and internationally accredited journals, has written several popular articles on palaeontology and is currently lecturing Zoology students in Vertebrate Evolution at the University of the Free State. Dr Botha-Brink began conducting palaeontological impact assessments for developments in 2011. She is currently the President of the Palaeontological Society of Southern Africa (PSSA) and is registered with the South African Heritage Resources Agency.

Declaration of Independence

I, Dr Jennifer Botha-Brink, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise my objectivity in this work.

Sincerely,

Dr Jennifer Botha-Brink

Palaeontologist

Appendix 1. Stratigraphy of the Kalahari Group, Gordonia Formation (modified from Partridge et al., 2006).