

Phase 1 Paleontological Impact Assessment Report

Dorper Wind energy facility

Molteno, Eastern Cape

DEA 12/12/20/1778

Farms: Uitkeyk 67, Cypher Gat 69 and Farm 68, Inkwancka Local Municipality

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Commissioned by: Savannah Environmental Pty/Ltd

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B. Executive summary

Outline of the development project: Savannah Environmental has appointed Dr H. Fourie, a palaeontologist, to undertake a Phase 1 Paleontological Impact Assessment scope of the 100MW Dorper Wind Farm project. This report represents the outcome of the scope.

A Phase 1 Palaeontological Impact Assessment is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

It is proposed to comment and recommend on the impact of the development on fossil heritage mitigation or conservation necessary.

Outline of the geology and the palaeontology: The area studied is between the small towns of Molteno (next to the R56) and Sterkstroom next to the R397. Several passes (Boesmanshoek, Penhoek) are present indicative of the mountainous escarpment. Fossiliferous outcrops are normally abundant in areas where erosion has taken place. This area is lacking in erosion dongas. The area fits snugly between the Bamboesberg to the west and the Stormberg to the east. A railway line is located to the east of the site in a NW-SE direction.

The escarpment to the south and east is build up by the Early to Mid-Triassic fluvial sediments of the Burgersdorp Formation. This area is underlain with rocks of the Karoo Supergroup (Upper Mesozoic), the Molteno Formation. Early Jurassic Karoo dolerite from the Dolerite Suite may be present. The aim of the scope is a walkthrough to map the fossiliferous outcrops. The Late Triassic Molteno Formation is ranked as high as it contains fossil plants in abundance. It is proposed that the presence of these would have to be mitigated by the removal of the valuable fossils during construction, should they be found to occur. It may be necessary to remove fossils during the excavation of the material for foundations of the turbines and associated structures and underground cabling.

Sporadic overlying Elliot Formation is mapped in the southern and north eastern portions of the study area and minor underlying Burgersdorp Formation is mapped in the western and southern edges of the study area.

The Molteno Formation is known to have the richest Triassic (c. 220 million year old) fossil floras recorded anywhere in the world, as well as some of the oldest known dinosaur trackways. Several key fossil sites are already recorded within the Molteno Formation in the Molteno-Sterkstroom outcrop area.

Grassland and karroid vegetation types cover the topsoil. The site is located on the southern escarpment of the Stormberg Plateau. The Bamboesberg Mountains run in a north-east to southwest direction and form part of the great Escarpment. Its peak is 1983m above sea level. The base of this mountain is at approximately 1700m. The maximum elevation of the development site is 100m.

Summary of findings: The palaeontological impact assessment scope was undertaken during August of 2012 and the following is reported:

Most soils encountered are very fine-grained sandy clays and clayey silty sands and gravels produced from the chemical weathering of nearby dolerite, sandstone and mudstone on the flatter slopes. Trenches were dug at several points showing the silty sands underlain by residual clayey soils at a depth of plus-minus a half meter. The area was found to be very water logged with a relatively flat topography covered with grassland. The area is utilised for sheep farming and small cultivated fields. No dolerite dykes were observed.



Figure 1: Trench. Shows topsoil, subsoil and some bedrock.

Next to the proposed cable line at positions $31^{\circ} 28' 914''$ S, $26^{\circ} 27' 406''$ E; $31^{\circ} 28' 946''$ S, $26^{\circ} 27' 354''$ E there are trenches with at least 0.5m of silty clay and some Molteno. *No fossils were observed.*

Recommendation: Monitoring, and mitigation/removal of fossils during the excavation process of the development.

Stakeholders:

Applicant - Dorper Wind Farm (Pty) Ltd

Environmental - Savannah Environmental (Pty) Ltd, PO Box 148, Sunninghill, 2157.

C. Background information

This study forms part of a Phase 1 palaeontological scope: The 100MW phase has in total 40 planned wind turbines and associated structures on farms Uitkeyk 67 (portion 1), Cypher Gat 69 (portion 6 and 7) and Farm 68.

Wind turbines: The turbines have a hub height of 80m and a tip height of 130m with a foundation of approximately 20m x 20m x 2m. Turbines will be connected by underground cabling towards the substation (150mx250m). Access roads, internal access roads (3-6m wide) and a maintenance workshop will also be constructed. All these mentioned structures will involve some form of excavation. During this process valuable fossils might be destroyed should they be present in the ground.

These wind turbines will be constructed in the valley adjacent to the plateau on a relatively flat topography. Construction involves the stripping of topsoil with foundation holes of 2m deep for the foundation of the turbine. Lay down (80m x 100m) and storage areas, hardstand areas for cranes of 25m x 50m and 80m x 100m will also be constructed on site. A site facility area of 5000m² is needed and trenches of at least 1m deep for underground cabling.

D. Description of property

Location and depth: Map

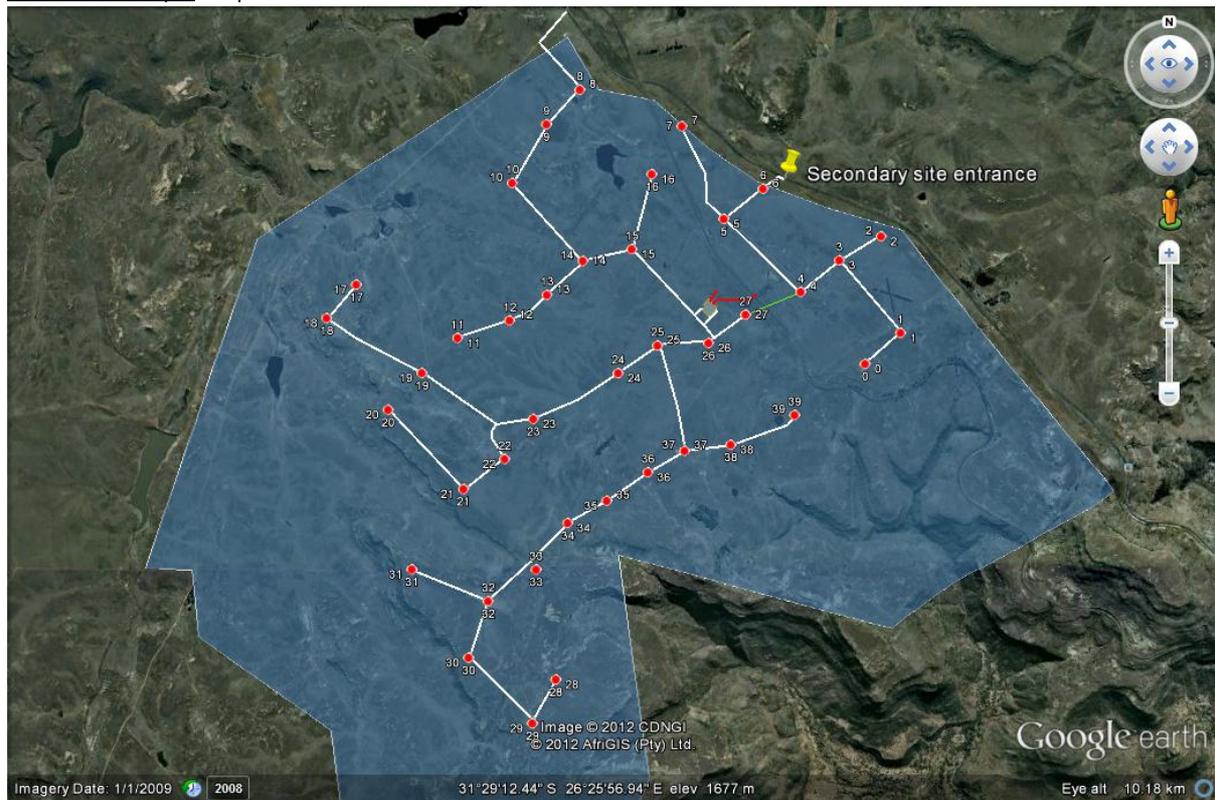


Figure 2: Map to show location of turbines (Courtesy of Savannah Environmental)

E. Description of Geology

Description: Gritstone, sandstone, mudstone, and shale of the Molteno Formation are present on the site. The Elliot Formation comprises mainly mudstone and subordinate sandstone, and the Burgesdorp Formation comprises mudstone and sandstone.

Molteno Formation

Coal layer (typically found within this formation, but on this site there are only small quantities of millimetre-thick layers, as confirmed during previous geotechnical drilling surveys carried out)
Finer to medium-grained feldspathic sandstone (with quartz) layer
Olive-grey to reddish mudrock layer
Medium to coarse-grained feldspathic sandstone (with quartz) layer
Olive-grey to reddish mudrock layer
Medium to coarse-grained feldspathic sandstone (with quartz) layer
Basal conglomerate with quartz pebbles layer

Fossils listed by Almond (2010) that may be present – *Dicroidium* flora, *Allisporites* / *Falcisporites* assemblages, as part of the megaf flora; silicified woods; rare fossil fish; fossil insects; conchostracans and bivalves; and trace fossils.



Figure 3: 1:000 000 Geological Map

Sensitivity: Molteno = high. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field scoping study by a professional palaeontologist is usually warranted. The main purpose of a field scoping study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase might be required.

The small peripheral exposures of the Burgersdorp and Elliot Formations are unlikely to be directly affected by the proposed development.

Impact: Fossils such as plants, insects and dinosaur trackways were not observed due to the thick layer of topsoil and subsoil. Small Molteno outcrops were observed, but will not influence the placement of the wind turbines, but may be considered in the placement of the internal access roads and underground cabling.

F. Methodology

The palaeontological impact assessment scope was undertaken during August of 2012.

Assumptions and Limitations:-

The accuracy and reliability of the report is limited by the following constraints:

1. Most development areas have never been previously surveyed by a palaeontologist or geophysicist, and so no site survey data is on record.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of geophysical data as Molteno formation is covered by topsoil and subsoil.

G. Statement of significance (Heritage value)

The Molteno Formation is known to have the richest Triassic (c. 220 million year old) fossil floras recorded anywhere in the world, as well as some of the oldest known dinosaur trackways. Several key fossil sites are already recorded within the Molteno Formation in the Molteno-Sterkstroom outcrop area.



Figure 4: Typical road cutting through Molteno Formation.

Plant fossil layers usually contain thin layers of abundant leaf fossils together with fructifications, stems and other plant material. These layers are tightly stacked and contain very little matrix, whereas vertebrate fossils occur far less abundantly and are usually scattered over a large area. Therefore a huge amount of plant, insect and associated fossils can be destroyed in a small area such as a foundation pit (See Almond, J.E. 2010).

H. Recommendation

The removal of valuable fossils during excavation as relocation of the wind turbines, roads or associated structures are unlikely to be necessary on palaeontological grounds alone, provided that appropriate mitigation is ensured. Mitigation would involve the recording and removal of fossil material and collection of associated geological data.

Turbine no.	Y coordinates S	X coordinates E	Elevation in m.	Notes
39	31° 29' 15.33	26° 26' 52.70	1679	No outcrop
38	31° 29' 23.11	26° 26' 33.34	1680	No outcrop
37	31° 29' 24.34	26° 26' 19.00	1685	No outcrop
36	31° 29' 30.24	26° 26' 07.78	1689	No outcrop
35	31° 29' 38.08	26° 25' 54.95	1699	No outcrop
34	31° 29' 43.68	26° 25' 42.78	1703	No outcrop
31	31° 29' 55.53	26° 25' 33.17	1744	No outcrop

32	31° 30' 04.52	26° 25' 18.66	1722	No outcrop
30	31° 30' 18.72	26° 25' 12.79	1740	No outcrop
29	31° 30' 36.03	26° 25' 32.16	1748	No outcrop
28	31° 30' 24.87	26° 25' 39.38	1740	No outcrop
33	31° 29' 55.75	26° 24' 55.75	1697	No outcrop
20	31° 29' 14.05	26° 24' 48.15	1733	No outcrop
21	31° 29' 34.79	26° 25' 11.07	1711	No outcrop
22	31° 29' 27.21	26° 25' 23.56	1693	No outcrop
23	31° 29' 16.22	26° 25' 32.47	1685	No outcrop
24	31° 29' 04.38	26° 25' 58.25	1680	No outcrop
25	31° 28' 57.04	26° 26' 10.49	1677	No outcrop
26	31° 28' 56.74	26° 26' 26.06	1674	No outcrop
27	31° 28' 49.13	26° 26' 37.29	1675	No outcrop
17	31° 28' 41.22	26° 24' 37.90	1674	No outcrop
18	31° 28' 49.97	26° 24' 28.66	1678	No outcrop
19	31° 29' 04.15	26° 24' 58.52	1700	No outcrop
8	31° 27' 49.40	26° 25' 46.71	1664	No outcrop
9	31° 27' 58.77	26° 25' 36.45	1672	No outcrop
10	31° 28' 14.00	26° 25' 25.86	1671	No outcrop
14	31° 28' 34.88	26° 25' 47.69	1671	No outcrop
13	31° 28' 43.91	26° 25' 36.44	1677	No outcrop
12	31° 28' 50.68	26° 25' 25.21	1685	No outcrop
11	31° 28' 55.18	26° 25' 09.04	1690	No outcrop
15	31° 28' 31.78	26° 26' 02.58	1672	No outcrop
16	31° 28' 11.74	26° 26' 08.54	1671	No outcrop
7	31° 27' 59.38	26° 26' 18.09	1680	No outcrop
5	31° 28' 23.89	26° 26' 30.68	1675	No outcrop
6	31° 28' 16.03	26° 26' 42.82	1686	No outcrop
4	31° 28' 42.79	26° 26' 54.45	1680	No outcrop
3	31° 28' 34.61	26° 27' 06.36	1679	No outcrop
2	31° 28' 27.86	26° 27' 19.50	1686	No outcrop
1	31° 28' 54.06	26° 27' 25.04	1692	No outcrop
0	31° 29' 01.96	26° 27' 14.32	1678	No outcrop

Elevation difference of 100m.

Sampling and collecting:

A permit would be required from the Eastern Cape Heritage Resources Agency (ECPHRA) Mr Sello Mokhanya, 74 Alexander Road, King Williams Town, 5600. smokhanya@ecphra.org.za

A Phase 2 rescue operation might be necessary during the excavation phase of the development.

- a. Objections: Dependant on the stripping of the topsoil, it is not clear how much of the topsoil will be removed prior to the digging of foundations. An acceptable amount will be 300mm. Subsoil might also be removed.
- b. Conditions of development: The suggestion is that construction is stopped as soon as bedrock is uncovered, as long as excavation is in the clayey soil and topsoil (silty sands, gravels) it can go ahead.
- c. Areas that may need a permit: Digging of foundations that support turbine towers, these are at a depth of approximately 2m to 3m. The tower is then seated in a reinforced concrete footing and would require removal of rock and subsoil at the base of each turbine.
- d. Permits for mitigation: These are generally issued for excavation or collection of samples and to assess sites that will be impacted by the development. These are issued to the specialist before the Phase 2 study, and after assessment of the Phase 1 report. A site may also require 'destruction' or 'interpretation' permits.
- e. Which areas need to be conserved: Bedrock of the Molteno Formation.

Final remarks

- a. All the land involved in the Dorper 100MW development area was assessed and none of the property is unsuitable for development.
- b. All information needed for the Phase 1 Palaeontological Impact Assessment scope was provided by Savannah Environmental, Ms K. Jodas.
- c. Areas that would involve mitigation and may need a permit from the Eastern Cape Heritage Resources Agency: Any Molteno Formation uncovered during the development. These areas could include:
 - Digging of foundations that support turbine towers, these are at a depth of approximately 2m. The tower is seated in a reinforced concrete footing and would require removal of rock and subsoil at the base of each turbine.
 - 1m Deep trenches for underground cables between turbines and substation.
 - foundation structure for substation and associated buildings
 - Internal access road between turbines and other structures.
 - Final layout of turbines can now be determined based on local outcrops and thickness of topsoil.
 - Stripping of topsoil for construction of Hardstand area for assembly of cranes. Typically a 25m x 50m area to be compacted and levelled to accommodate the assembly of the crane, and 80m x 100m for smaller cranes.
- d. It is recommended that ECPHRA grants permission for the mitigation and removal of fossils.
- e. Document EIA DEA 12/12/20/1778 contains the full details of all other investigations into the site for development of the wind turbine energy facility.
- f. As the Molteno Formation is one of the most productive rock units within the main Karoo Basin it is assumed that the underlain strata is likely to contain fossils and may therefore need mitigation. Final decision rest with the Eastern Cape Heritage Resources Agency and permission is required for either mitigation or destruction.

I. References

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Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. For the past seven years she carried out field work in the Eastern Cape. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 17 years.

Declaration

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological scope. There are no circumstances that compromise the objectivity of me performing such work.

Hfourie

Heidi Fourie
2012/08/17