A PALAEONTOLOGICAL DESKTOP STUDY OF THE AREA TO BE AFFECTED BY THE PROPOSED PHOTOVOLTAIC POWER PROJECT ON PORTION 3 OF FARM HARTEBEESTPLAATS 135

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INTRODUCTION

The aim of this study was to gather and describe the relevant information pertaining to the palaeontological record of the study area, using the available information, to allow an impression of the likelihood of preservation of palaeontological materials. The study area was not visited. Thus, based on this information, the potential impact on the palaeontological heritage of the area proposed for development is assessed and recommendations are made on how to minimise such impact.

It should be noted as background that the geological history of the interior of southern Africa is such that vertebrate fossil preservation is mostly from two broad time periods – from before the Cretaceous in Karoo-aged sedimentary rocks or from the later part of the Cainozoic. This is due to the Gondwana and post-Gondwana geological history of southern Africa. Before the breakup of the Gondwana supercontinent, the Karoo basin acted as an important catchment for the preservation of early vertebrates, early plants and invertebrates (McCarthy & Rubidge 2005). After the separation of the Africa from the other southern continents, various events of tectonic uplift, such as during the end-Mesozoic and early Cainozoic (Partridge & Maud 2000), caused much or most of the early- to mid-Cainozoic to be eroded away. Thus, fossil preservation in the interior of southern Africa can be expected to either predate the late Mesozoic or to postdate the mid-Cainozoic. This is reflected in a substantial hiatus in the southern African fossil record, including the end-Cretaceous extinction event and the early mammal radiation. In this way late Cainozoic fossils can be found either preserved in cave sites or in the sedimentary deposits associated with drainages. The latter are often exposed due to down-cutting of the rivers and wetlands (Tooth *et al.* 2004), causing natural areas of erosion, also known as ‘dongas’. Such exposures can be prolific sources of late Cainozoic fossils.

METHODS

A literature search was undertaken to establish the existence of any published accounts of fossil discoveries in the De Aar area. When no such published records relating to the area proposed for development and its immediate surroundings could be traced, the present study was continued by:

1. using the 1:250 000 scale geological map for the area (3024 Colesberg) (Figure 1) to plot the area to be developed. This provided some indication of the pre-Cainozoic palaeontological potential of the area, i.e. the likelihood of finding fossils in the Karoo-aged bedrock.

and

2. by analysing the modern drainages (Figures 2& 3). The modern drainages are indicators of areas where sedimentation took place and can provide

RESULTS

Karoo geology

The oldest deposits of the study area are Karoo sedimentary rocks of the Adelaide Subgroup if the Beaufort Group (Figure 1). The rocks of the Adelaide Subgroup are known to be fossil-bearing and correlate with the following SACS recognized assemblage zones; *Cistecephalus*, *Tropidostoma*, *Pristerognathus*, *Tapinocephalus* and *Eodicynodon* at the base (McCarthy & Rubidge 2005; SACS 1980). These rocks are found in the northeastern part of the study area and overlap substantially with the proposed layout of the photovoltaic panels. In the west and south of the study area mainly dolerite occurs, which is of igneous origin and are not fossil-bearing.

The Late Cainozoic

In Figure 2 a 1:50 000 topographical overlay superimposed on a satellite image shows that the eastern portion of the study area is elevated, which also coincides with a substantial part of the dolerite in the study area (See Figure 1). These areas of higher elevation on dolerite are unlikely to contain sedimentary deposits of more recent origin and, therefore, probably will not preserve later Cainozoic fossils.

However, from Figure 3, the modern-day drainages are indicated and of these, drainage no. 1 and no. 2 are of interest. These drainages eventually feed into the Brak River, further to the east, and of these the southern drainage (no. 2) is also referred to in the scoping report. However, it is evident that the southeastern portion of the study area is relatively flat and lies in between the two drainages. Thus, the blue-shaded area in Figure 3 is in the catchment of the two drainages and past agricultural activities in this area, as seen in the satellite image, as well as the section on soils in the scoping report, confirm that the soils may be somewhat deeper here. Thus, this area will contain sediments of late Cainozoic age, which may be quite young, possible not much older than the Middle Pleistocene, but which are non-acidic in nature and therefore potentially fossil-bearing. Active erosion, which is not visible on the satellite image, would have shown any late Cainozoic fossil preservation. However, there is reasonable expectation that this part of the study area may contain late Cainozoic fossils. In a similar setting near Britstown, further to the west of the study site, late Cainozoic fossils have been recorded in a red sedimentary matrix (Brink et al. 1995), possibly similar to the soils described in the scoping report.

DISCUSSION

The likelihood of fossil material in the proposed area of development

It is known that the rocks of the lower Beaufort are fossil-bearing (McCarthy & Rubidge 2005) and thus the area indicated in Figure 1 to contain rocks of the Adelaide Subgroup may contain Karoo-aged fossils. However, the density of such fossil occurrences can be quite low and the likelihood of encountering such fossils cannot be predicted. They may occur in the eastern portion of the study area, but will be covered by a more recent mantle of late Cainozoic sediments, due to the lack of erosion in the study area.

Given the wide-spread presence of carbonates in the surficial sediments and the high base status of the soils generated by the rocks in the Karoo basin, one may predict favourable conditions for late Cainozoic fossil preservation in the study area, as in the case of the Britstown occurrence (cf. Brink et al. 1995). This applies particularly to the blue-shaded area in Figure 3, where there is evidence for recent sedimentation. It can also be predicted that there will be some spatial variability in the occurrence of Pleistocene and Holocene deposits, but that the area earmarked for the placement of the photovoltaic panels may contain some late Cainozoic fossil record.

Possible impact on the subsurface palaeontological deposits and materials

1. The placement of the photovoltaic panels in the lower-lying part of the study area;

2. The excavations for internal road construction;

3. The excavations for the foundation of the inverter and transformer structures;

4. The placement of the power line connection to the Hydra substation.

ASSESSMENT OF IMPACT

1. Placement of the photovoltaic panels

If a piled system for mounting the panels is to be used, there will be some disturbance of the substrate for creating the foundations and this will have potential impact on the younger, surficial deposits, which are most likely to contain late Cainozoic fossil-occurrences. It is not foreseen that this activity will impact on the Karoo-aged deposits of the study area.

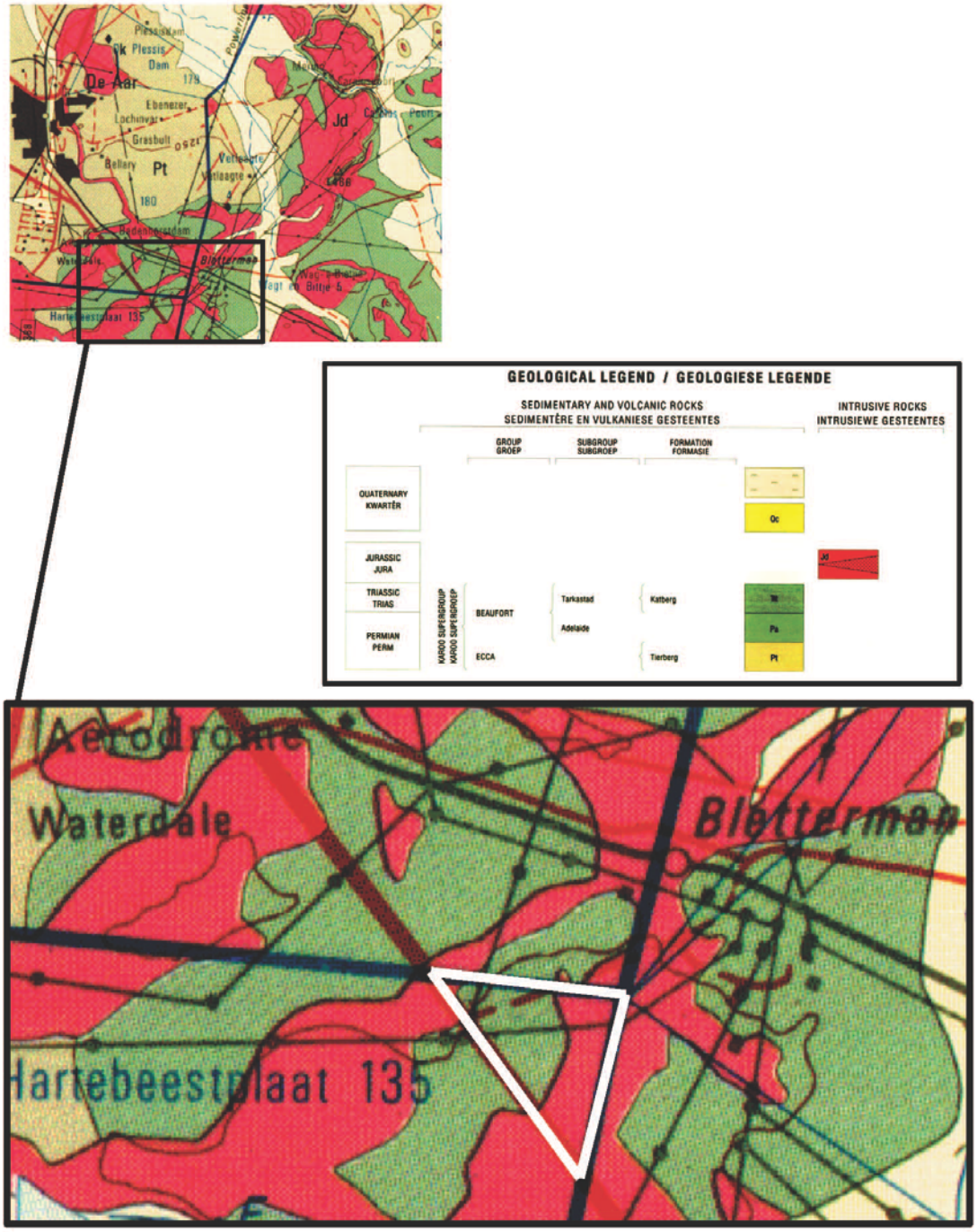

Figure 1. An extract form the 1:125 000 geological map of the study area (outlined as a white triangle) , showing rocks of the Karoo Supergroup. In the southern and eastern parts of the study area the sedimentary rocks of the Adelaid Subgroup of the Beaufort Group are intruded by Jurassic-aged igneous rocks. The late Cainozoic record is not indicated here and is illustrated in Figure 2.

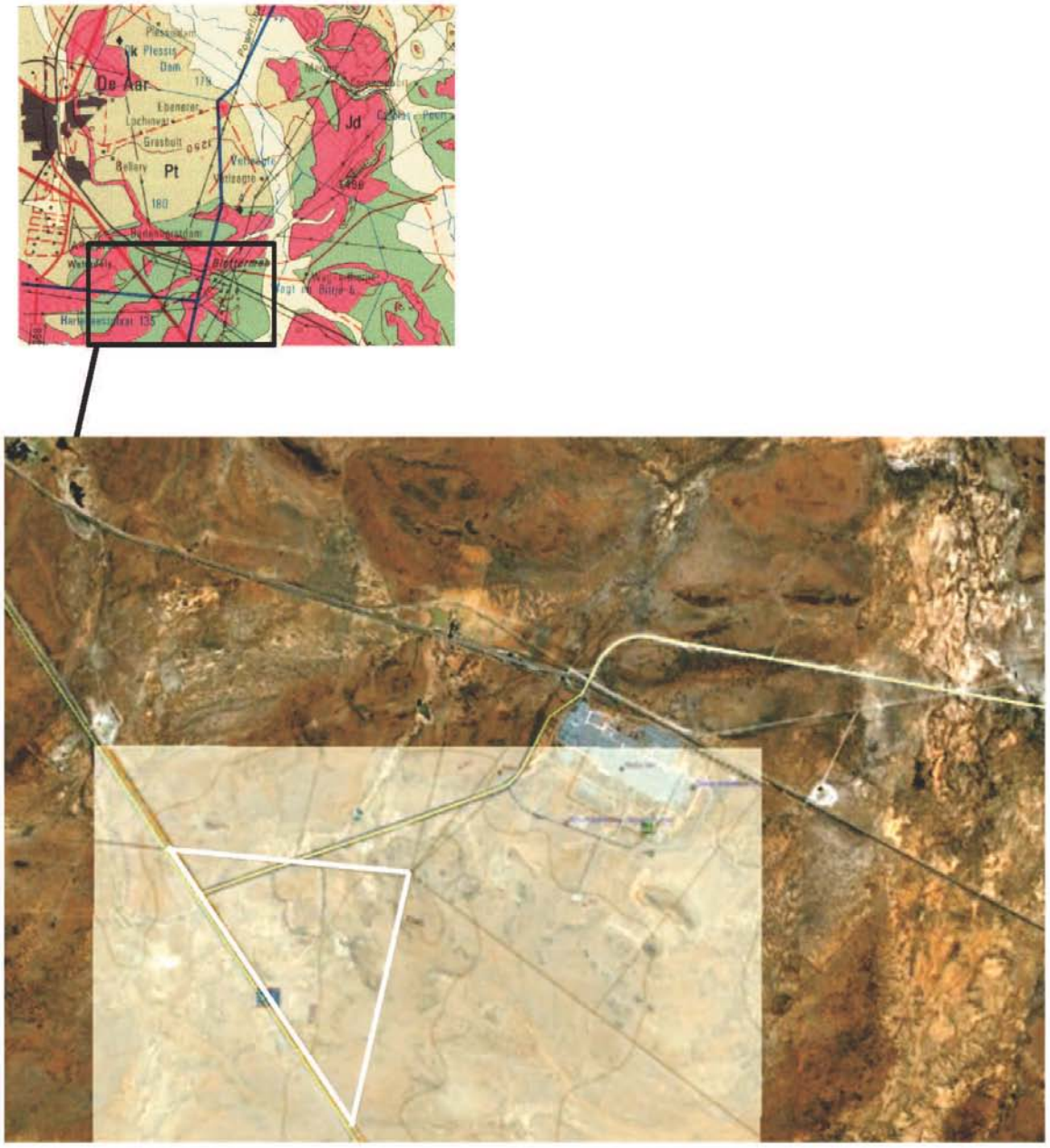

Figure 2. A Google Earth satellite image of the study area (outlined as a white triangle), overlain by a 1:50 000 topographical map, shown in relation to the 1:125 000 geological map. The surficial deposits of the late Cainozoic, including modern drainages, are outlined ion Figure 3.

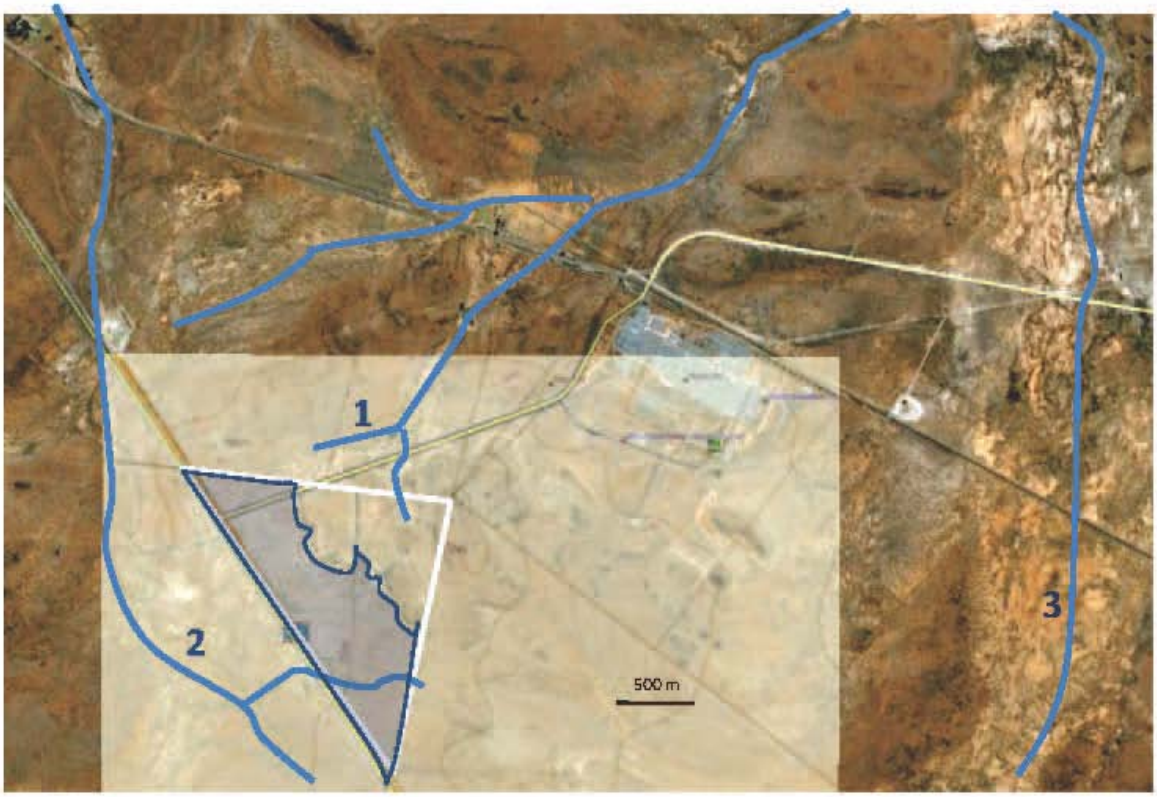

Figure 3. Figure 3. A satellite image (Google Earth) shows the study area, which is indicated by the white triangle. The topography and surface features suggest that the study area is situated in the catchment of a watershed, as seen in the drainages (nos. 1 & 2). In southern Africa where the surficial Cainozoic deposits overly Karoo geology, as in this case, the ground water tends not to be acidic and allows the preservation of vertebrate fossils. There is thus some likelihood that the blue shaded area, which contain late Cainozoic deposits, may be fossil-bearing. It is also noteworthy that this area largely coincides with the proposed placement of the photovoltaic panels.

2. Excavations for internal road construction

Excavations for the internal roads are seen as having the potential for impacting on both the Karoo-aged rocks and the surficial late Cainozoic sediments of the study area.

3. Excavations for the foundation of the inverter and transformer structures

Excavations for the foundations of these structures may impact on both the Karoo-age and the surficial late Cainozoic sediments, but this will depend on the depth of such excavations, which is not indicated in the final scoping report.

4. Power line placement

It is foreseen that the placement of the power lines will have minimal effect, since it will traverse mainly dolerites that are high-lying. An exception is the lower-lying area, one of the tributaries feeding into the drainage no. 1. If foundations for a steel tower are to be excavated into this part of the study area, there may be some possibility of impact on the surficial deposits.

Any potential impact on the palaeontological heritage of the study area will be permanent, since disturbance cannot be reversed. However, although the likelihood of disturbance cannot be predicted in any exact way, because of the unknown nature the spatial variability of local sedimentary conditions, it is likely that the impact will mainly affect the younger late Cainozoic record of the study area, given the shallow nature of the invasions into the substrate, as foreseen and as outlined above. Given the lack of studied late Cainozoic fossil occurrences in the central Karoo area, any find of this nature will be significant.

RECOMMENDATIONS

If the proposed development is to proceed and in the less likely case of encountering Karoo-aged or the more-likely case of encountering late Cainozoic fossil materials, it is recommended that a suitable specialist be contacted to assess the situation in order to recover and record any fossil materials. The cost of this process will have to be covered by the developer.

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