BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT

(Desktop Study)

PROPOSED KATHU & SISHEN SOLAR ENERGY FACILITIES

Portions 4 & 6 of the Farm WINCANTON 472

Kuruman District, Northern Cape

By

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For

Renewable Energy Investments SA (Kathu SEF)

VentuSA Energy (Sishen SEF)

17 January 2011

1. INTRODUCTION

This assessment has been prepared at the request of Savannah Environmental (Pty) Ltd. It is the part of the Heritage Impact Assessments in the EIA processes being undertaken by Savannah Environmental for two clients who propose to establish solar energy facilities (SEFs) for generation of electricity on two adjacent portions of the farm Wincanton 472 in the Kuruman District, Northern Cape (Figure 1). The village of Dibeng (Deben) is to the immediate west and Sishen iron-ore mine and the town of Kathu a small distance to the south.

Renewable Energy Investments SA (REISA) proposes a facility on Portion 4 of Wincanton 472, to be called the Kathu SEF.

VentuSA Energy proposes a facility on Portion 6 of Wincanton 472, to be called the Sishen SEF.

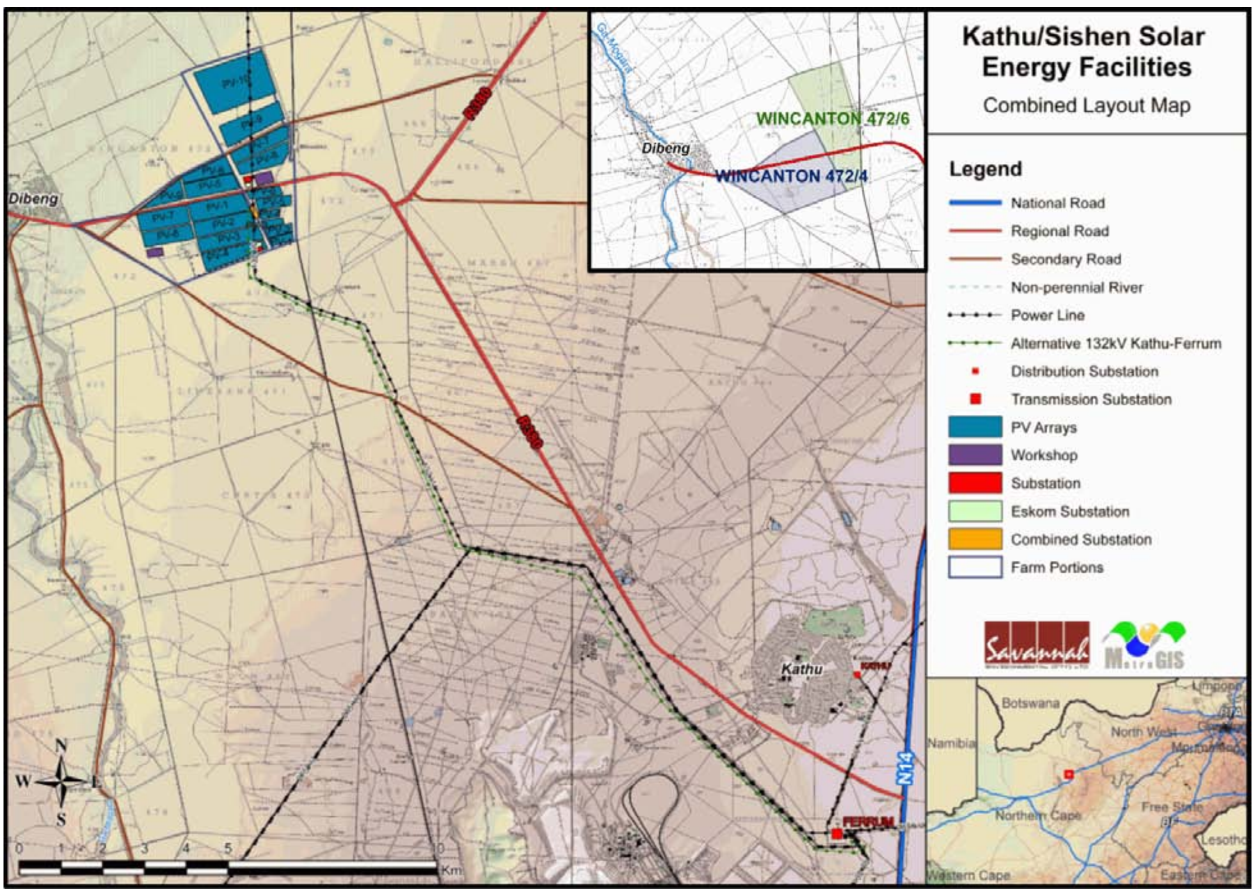

Figure 1. Location of the proposed Kathu and Sishen Solar Energy Facilities. Supplied by Savannah Environmental.

The proposed projects will deploy photovoltaic (PV) technology exclusively. Each is intended to have a maximum generating capacity of 100 MW.

Associated infrastructure involves either a single, shared substation, or separate substations on each site. The existing 132 KV powerline will connect to the Ferrum Substation. Alternatively, a new 132 KV powerline will parallel the existing one (Figure 1).

Other infrastructure involves workshops, offices and storage areas and internal roads. Water supply and sanitation will be linked to the local Gamagara Municipality infrastructure.

This Palaeontological Impact Assessment (PIA) assesses the probability of palaeontological materials (fossils) being uncovered in the subsurface and being disturbed or destroyed in the process of making excavations (bulk earth works). The main purposes are to:

- Outline the nature of possible palaeontological heritage resources in the subsurface of the affected area.

- Suggest the mitigatory actions to be taken with respect to the occurrence of fossils during the construction phase.

2. APPROACH AND METHODOLOGY

2.1 Available Information

The main information sources consulted are the 1:1 million and 1:250000 CGS geological maps and the relevant chapters in "The Geology of South Africa" (Johnson *et al*., (eds.), 2006). Other references are cited in the normal manner and included in the References section. Specific details of geological sections of the bedrock-mantling deposits in the area are not readily available. No subsurface geotechnical investigation reports of the site are available.

2.2 Assumptions and Limitations

It is not possible to predict the buried fossil content of an area other than in general terms. In particular, the important fossil bone material is generally sparsely scattered in most deposits and much depends on spotting this material as it is uncovered during digging *i.e.* by monitoring excavations.

The foundations for the PV panels are to be excavated to a depth of 30-50 cm.

Internal electrical reticulation will be buried in trenches 0.4 to 1.0 m deep.

Details of any other bulk earth works required for the installations (water pipes and sewerage) are not available.

2.**3.** **Palaeontological Heritage Management**

The rescue of fossils or sampling of fossil content (palaeontological mitigation) cannot usually be done prior to the commencement of excavations for infrastructure and foundations. Palaeontological interventions happen once the EIA process is done, the required approvals have been obtained and excavation of the bulk earth works is proceeding. The intent of palaeontological mitigation is to sample the *in situ* fossil content and describe the exposed, pristine stratigraphic sections.

The action plans and protocols for palaeontological mitigation must therefore be <u>included in the Environmental Management Plan</u> (EMP) for the Construction Phase of the project.

3. GEOLOGICAL SETTING

3.1. Local Geology

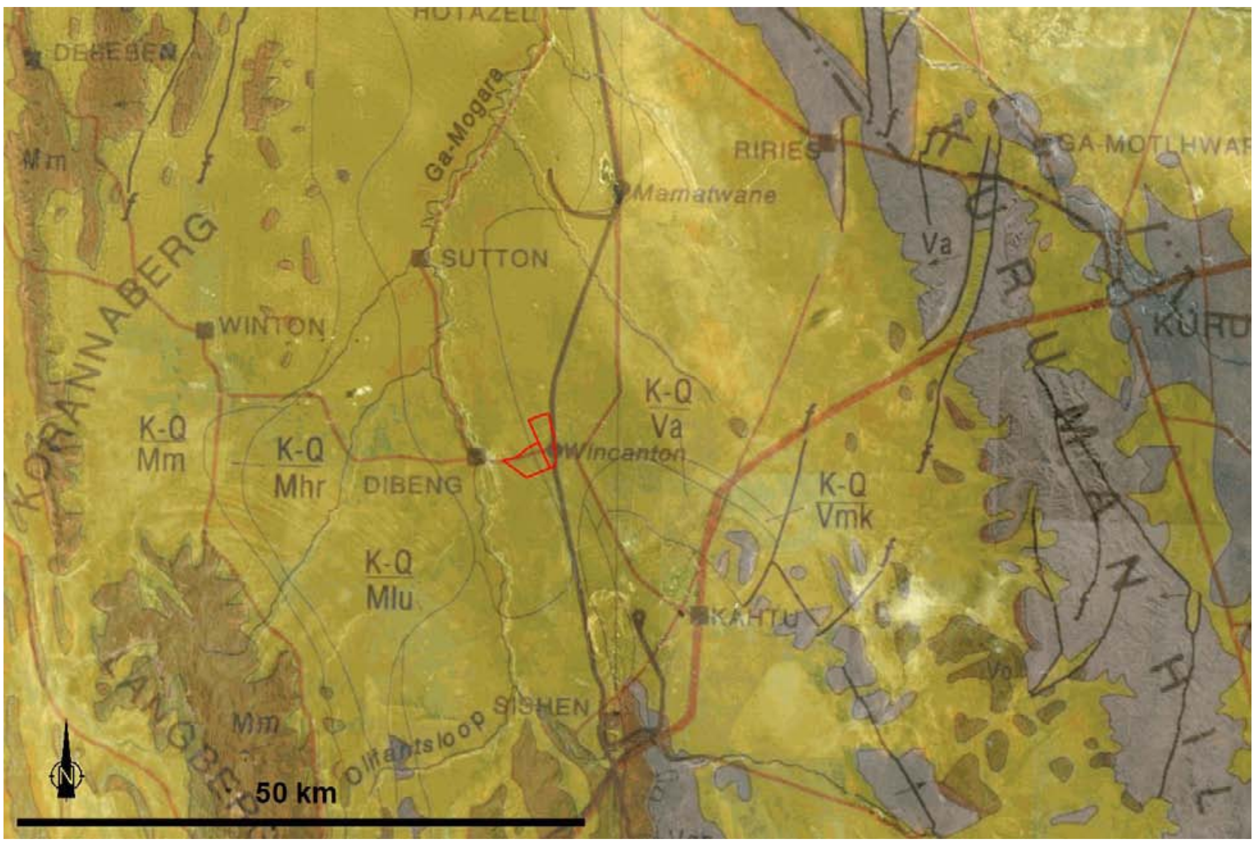

Figure 2. Aerial view of the setting of the proposed Kathu and Sishen Solar Energy Facilities. Image from Google Earth overlain by 1:1000000 Geological Map (CGS, 1997).

The Wincanton project area is situated on the gently-sloping eastern plain of the Ga-Mogara River (Figure 2), an ephemeral drainage that flows northwards to join the Kurumanrivier, itself a tributary of the Molopo. Elevations across the area rise from 1130 to 1145 m asl.

Bedrock is not exposed in the project area. To the east are the Kuruman Hills (Figure 2), composed of the rocks of the Asbestos Hills Subgroup (Va), Ghaap Group of the Transvaal Supergroup (Eriksson *et al*., 2006). These ancient ~2500 Ma (Ma=Million years ago) sediments host the "Banded Iron Formations" (BIF) that are the source of the iron ores. Overlying the BIF rocks is the Makganyene Formation (Vmk) of glacial origin, followed by the lavas of the Ongeluk Formation (Vo). To the west are the metasediments of the Olifantshoek Supergroup (Mm) of age ~1900 Ma (Moen, 2006). These rocks are too old for macrofossils, but involve evidence of teeming microbacterial life.

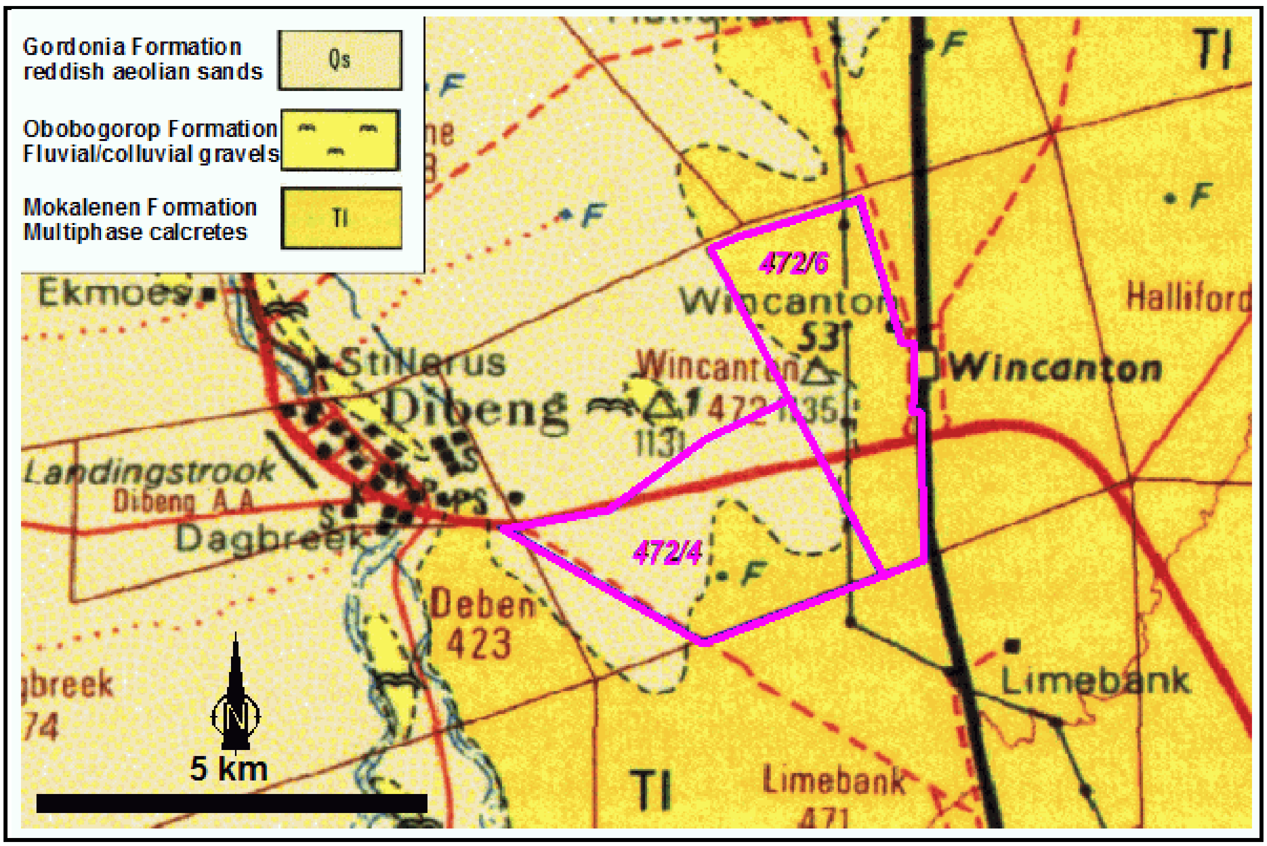

Figure 3. Kalahari Group sediments in the Wincanton area. From 1:250000 Geological Map Kuruman 2722, CGS, 1979.

The Ga-Mogara valley is situated on the southern edge of the Kalahari Basin and has been infilled with a substantial thickness of Kalahari Group sediments, mainly during the Cenozoic Era (the last 65 Ma). The valley is considerably older as Dwyka Group rocks occur in it beneath the Kalahari Group sediments. Evidently these were encountered by drilling for water or minerals. The Dwyka sediments were deposited by glaciers some 300 Ma and the bedrock topography in the region was apparently carved by ice movement. Kalahari sediments up to 120 m thick occur in the Ga-Mogara palaeovalley (Partridge *et al*., 2006).

The lower formations of the Kalahari Group, consisting of the Wessels Formation coarse gravels, the Budin Formation clays and the Eden Formation pebbly sands, do not crop out in the area and will not be encountered in shallow excavations.

Calcretes of the Mokalanen Formation (Figure 3) are widely developed and have formed in a variety of sediments such as the deposits of ephemeral streams, pans, colluvium and windblown sands. The calcrete thickness is sometimes considerable and represents polyphase development, mainly since the late Miocene/early Pliocene ~5 Ma.

The Obobogorop Formation comprises gravels that mainly overlie the calcrete, but are sometimes interbedded with the overlying sands. Gravel is widespread over the area (Paton, 2010). Deposition in ephemeral watercourses and by sheetwash is envisaged. It is possible that most of this material may have previously been in the calcrete and has been released during phases of its degradation by erosion and dissolution.

Overlying the previous and the calcretes are the red aeolian sands classic of the Kalahari, now termed the Gordonia Formation. In places there are deposits accumulated in pans, beneath and within the aeolian sequence.

3.2. Expected Palaeontology

The Kalahari sediments and calcretes have low fossil potential, but the possibility of fossils being encountered in diggings cannot be totally excluded. Buried, stable surfaces (palaeosurfaces), where time has permitted fossils to accumulate, are particularly important. The surface of the calcrete, particularly hollows and dissolution holes, is an important palaeosurface. Pans have also formed in places on top of the calcrete. Most of fossils obtained from the Kalahari deposits have been from pans.

Palaeosurfaces marked by various degrees of soil development also occur in aeolian dune accumulations and represent periods of stability due to wetter climate and/or decreased wind strengths. Fossils are more common within these layers. The common fossils include shells of land snails, fossil tortoises, ostrich incl. egg fragments, sparsely scattered bones etc. "Blowout" erosional palaeosurfaces may carry fossils concentrated by the removal of sand by the wind. Hollows between dunes (interdune areas) are the sites of ponding of water seeping from the dunes, leading to the deposits of seeps and pans/vleis. Being water sources, such may be richly fossiliferous.

Ephemeral watercourse deposits are poorly fossiliferous, but abraded bone fragments and loose teeth may occur sparsely in channel lags.

4. APPLICABLE LEGISLATION

The National Heritage Resources Act (NHRA No. 25 of 1999) protects archaeological and palaeontological sites and materials, as well as graves/cemeteries, battlefield sites and buildings, structures and features over 60 years old. The South African Heritage Resources Agency (SAHRA) administers this legislation nationally, with Heritage Resources Agencies acting at provincial level.

According to the Act (Sect. 35), it is an offence to destroy, damage, excavate, alter of remove from its original place, or collect, any archaeological, palaeontological and historical material or object, without a permit issued by the South African Heritage Resources Agency (SAHRA) or applicable Provincial Heritage Resources Agency, *viz*. Heritage Western Cape (HWC).

Notification of SAHRA or the applicable Provincial Heritage Resources Agency is required for proposed developments exceeding certain dimensions (Sect. 38).

5. THRESHOLDS

The areal scale of subsurface disturbance and exposure exceeds 300 m in linear length and 5000 m^2 (NHRA 25 (1999), Section 38 (1)). It must therefore be assessed for heritage impacts (an HIA) that includes assessment of potential palaeontological heritage (a PIA).

For the evaluation of the palaeontological impact it is the extent/scale of the deeper excavations to be made that are the main concern, such as the foundation trenches for buildings and other installations, the trenches for connecting cabling, water and sanitation piping and water storage dams.

The proposed installations mainly involve earthworks not intended to exceed about 1 m in depth. Notwithstanding, given the areal extent (Figure 1), it is likely that significant sub-surface volumes will be disturbed and exposed. The fossil potential is probably greater in the areas of thin gravel and sand cover on the surface of the calcrete (Figure 3).

6. SIGNIFICANCE

The fossil record from Kalahari deposits is very poor with respect to finds of fossil bones of vertebrates. Thus fossils finds will be considerable scientific interest. Mitigation during the construction phase of the proposed project has the potential for discoveries that stand to have heritage/scientific benefits.

The significance of fossils that may be found involves:

- Significance for the history of the Kalahari late Cenozoic deposits.

- Significance for the history of past climatic changes.
- Significance in the history of past biota and environments. Rescuing of fossil bones is very important. These may not necessarily represent species that we would expect nowadays. Modern analytical techniques such as stable isotopic analyses can reveal indications of diets and environmental conditions of the past.
- Associations of fossils with buried archaeological material and human prehistory.
- For radiometric and other dating techniques.
- Preservation of materials for the application of yet unforeseen investigative techniques.

7. NATURE OF THE IMPACT OF DEVELOPMENT EXCAVATIONS ON FOSSILS

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value w.r.t. palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there.

When excavations are made they furnish the "windows" into the past that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, provided that efforts are made to watch out for and rescue the fossils. Fossils and significant observations will be lost in the absence of management actions to mitigate such loss. This loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible.

The status of the potential impact for palaeontology is not neutral or negligible.

Although terrestrial coversands are not generally very fossiliferous, it is quite possible that fossiliferous material could occur. The very scarcity of fossils makes for the added importance of them being sought.

There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery involved in excavation may damage or destroy fossils, or they may be hidden in "spoil" of excavated material. Worse, they may simply be ignored as "Just another bone".

8. RECOMMENDATIONS

In view of the low fossil potential, monitoring of bulk earth works by a specialist is not justified.

Notwithstanding, the sporadic fossil occurrences are then particularly important and efforts made to spot them are often rewarded.

In order to spot the rare occurrences, it is very desirable to have the co-operation of the people "on the ground". By these are meant personnel in supervisory/inspection roles, such as engineers, surveyors, site foremen, etc., who are willing and interested to look out for occurrences of fossils. These personnel are also critical in informing excavator operators and manual workmen, whom being close to the sediments, would be more likely to spot smaller fossils.

It is recommended that a requirement to be alert for possible fossils be included in the EMP for the Construction Phase. This should include guidelines for potential finds and a reporting/action protocol for when finds are uncovered.

Importantly, it is also possible that buried archaeological material (stone tools and bones) may also be uncovered. The monitoring and action protocols for subsurface finds of fossil and archaeological materials thus co-incide and may be included in the EMP in agreed conjunction. There is a logistical advantage in that a specialist who is based closer to the site is likely to respond faster to finds and already be affiliated with the curating institution, *e.g.* the McGregor Museum, Kimberley.

9. REFERENCES

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