**BRIEF PALAEONTOLOGICAL IMPACT ASSESSMENT**

**(Desktop Study)**

**PROPOSED POFADDER SOLAR THERMAL PLANT**

**Portion 4 of the Farm SCUIT-KLIP 92**

**Kenhardt District, Northern Cape**

**By**

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**Prepared at the Request of**

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**For**

**Ka Xu CSP South Africa (Pty) Ltd**

3 December 2010

## 1. INTRODUCTION

This assessment has been prepared at the request of Savannah Environmental (Pty) Ltd. I is the part of the Heritage Impact Assessment in the EIA process being undertaken by Savannah Environmental for their client, Ka Xu CSP South Africa (Pty) Ltd.

Ka Xu CSP South Africa (Pty) Ltd is proposing the establishment of a solar electricity generating facility on Portion 4 of the Farm Scuit-Klip 92, ~30 km northeast of the town o Pofadder in the Northern Cape (Figures 1 & 2).

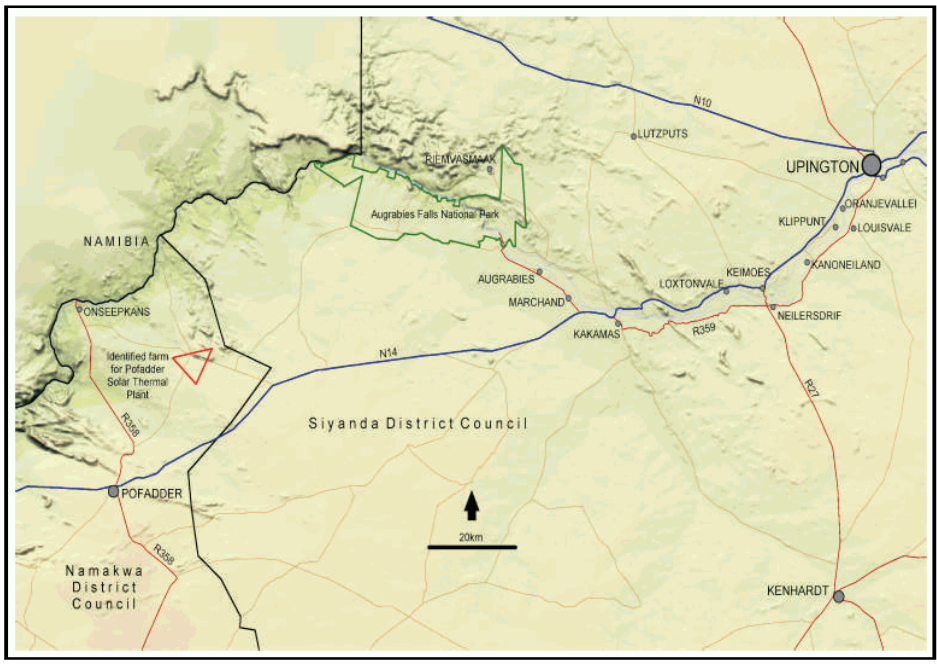



**Figure 1. Location of the proposed Pofadder Solar Thermal Plant. Supplied by Savannah Environmental.**

The proposed project, known as the Pofadder Solar Thermal Plant, will use both Concentrating Solar Power (CSP) and Photovoltaic (PV) technologies to deliver up to 310 MW. The footprint of the facility will be significantly less than the ~33 km$^2$ property. A combination of CSP parabolic troughs, CSP tower and tracking mirrors (heliostats) and PVs with tracking/concentrating, is to be installed. The technology mix will be decided at furthe stages in the feasibility studies.

Associated infrastructure involves a steam turbine, generator, generator transformer overhead power line feeding into the grid at the nearby Paulputs Substation, water supply pipeline/s from the Orange River, water treatment plant and storage facilities, workshop office and storage areas, access roads and internal roads (Savannah Environmental, EIA Background Info. Doc, August 2010).

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. The main purposes are to:

- Outline the nature of possible palaeontological heritage resources in the subsurface o the affected area.
- Suggest the mitigatory actions to be taken with respect to the occurrence of fossils during the construction phase.

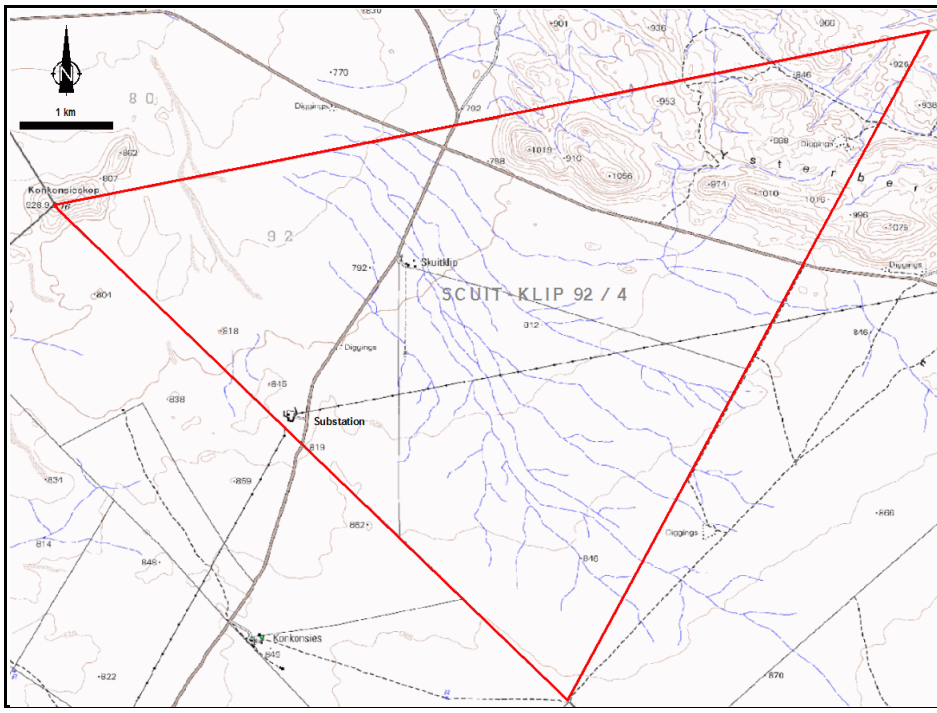



**Figure 2. Scuit-Klip 92/4. Extract from 1:50000 topo-cadastral map 2891DC SWARTOUP (2891DC_2003_ED2_GEO.TIF). Chief Directorate: Surveys & Mapping.**

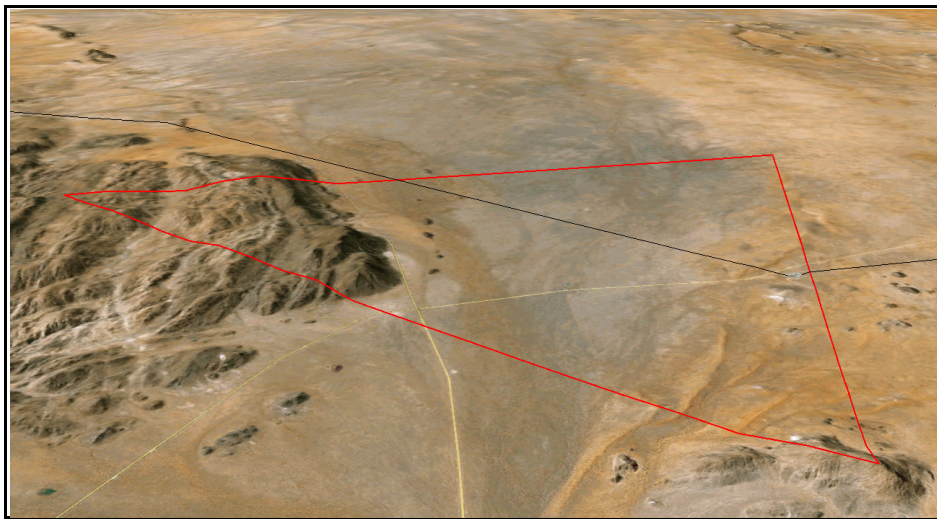


**Figure 3. Simulated oblique aerial view of the setting of the proposed Pofadder Solar Thermal Plant, looking from the northwest. Black line is the powerline. Paulputs Substation is on the right at the powerline kink. From Google Earth.**

## 2. APPROACH AND METHODOLOGY

### 2.1 Available Information

The main information sources consulted are the 1:250000 CGS Geological Map of South Africa 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.

Details of bulk earth works required for the installations 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 included in the Environmental Management Plan (EMP) for the Construction Phase of the project.

## 3. GEOLOGICAL SETTING

### 3.1. Local Geology

The triangle-shaped project area straddles a sediment-choked drainage line that traverses the gentle decline from the Bushmanland Plateau down towards the Gariep River (Figures 2 & 3). This broad, flat area occupies ~80% of the property, sloping gently from ~860 m asl at the south apex, to ~770 m asl. in the north. The northwestern apex is situated at the top of the steep inselberg of Konkonsieskop that rises ~120 m above the sandy plain.. The northeastern part of the property laps over the Ysterberg and this hilly terrain occupies ~20% of the property and is flanked by a ridge rising ~200 m above the plain.

The geological setting is the Namaqua-Natal Metamorphic Province, Namaqua Sector Kakamas Terrane (Cornell *et al*., 2006), where metasediments, gneisses and granites ranging in age from 2000-1000 Ma, comprise an unfossiliferous bedrock (Figure 4).

Covering the flatter bedrock areas are extensive colluvial ramps around bedrock outcrops that merge with sediment-filled drainages. In this example, the drainage is an almost flat plain crossed by two main loci of ephemeral, braided stream flow that converge in the north (Figure 3). Smaller-scale local flow features cover the remainder of the plain. The current sediment-transport regime is sheetflood and flashflood. Windblown sands and dune ridges occur in the west on slightly higher ground, but not on the drainage plain.

The proposed siting of the installation is on the southern portion of the property where it will primarily be built on the drainage plain. These drainage features flanking the Gariep River are essentially palaeovalleys that, due to aridification, are now filled with locally-derived material because the diminished rainfall runoff has not been sufficient for effective downstream transport. Another aspect of the age of these palaeovalleys are their stream profiles that steepen towards the Gariep River, indicating that downcutting by this perennial river has outpaced its local tributaries. Considerable thicknesses of sediment fill occur in these palaeovalleys, as is evident from boreholes put down for water.

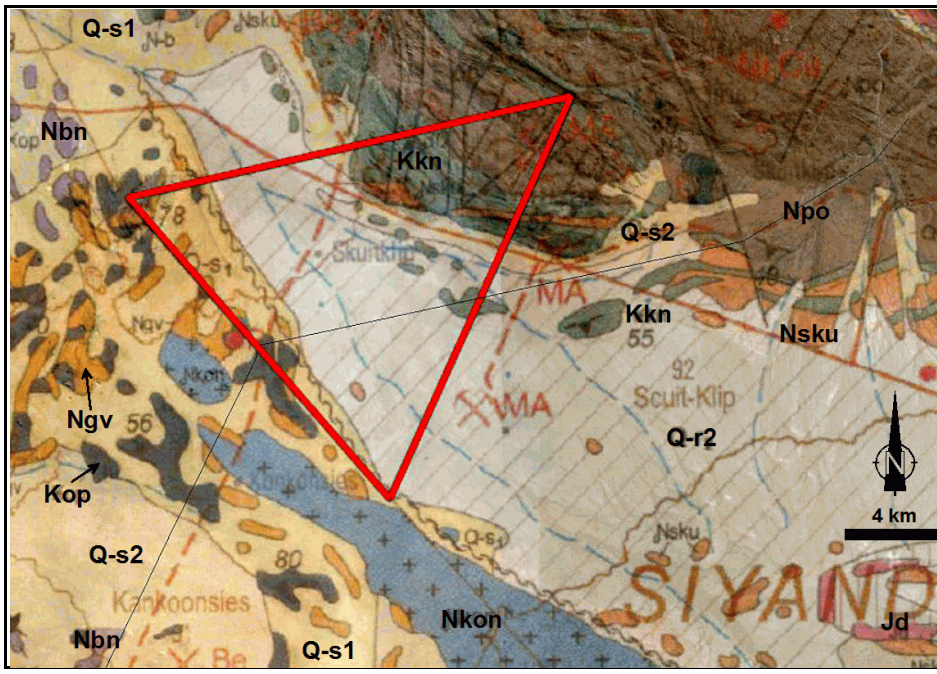



**Figure 4. Geology of the project area of the proposed Pofadder Solar Therma Plant. Image from Google Earth with overlain geology from 1:250000 Sheet 2818 Onseepkans, Council for Geoscience.**

Q-s1: Aeolian sand.
Q-r2: Feldspathic gravelly sands.
Q-s2: Colluvium. Scree, gravelly soil and red sand.
Jd: Jurassic Karoo Dolerite.

**Namaquan Intrusives**

Nkon: Konkonsies Granite
Nsku: Skuitklip Granite.
Ngv: Gemsbokvlakte Gneiss
Npo: Polisiehoek Gneiss.
Nbn: Beenbreek Gneiss.

**Arribees Group – Kheisian supracrustal metasediments**

Kkn: Koenap Formation. Kinzigite*, calc-silicate rocks, marble
Kop: Oupvlakte Formation. Two-pyroxene granulite: in places amygdaloidal or garnetiferous; metapeliti granulite, minor quartz-feldspar gneiss and calc-silicate rocks.

*A coarse-grained high-grade, granulite facies metamorphic rock of originally muddy composition. Essentia minerals are garnet and biotite, with which occur varying amounts of quartz, K-feldspar, oligoclase, muscovite cordierite, and sillimanite. The name is from Kinzig, Schwarzwald, Germany.

### 3.2. Expected Palaeontology

The drainage would have been more regularly active for periods in the past and may wel have a sparse fossil content. Freshwater clams and snail fossils have often been found i such "near-abandoned" drainages, as well as bones occasionally, but the contexts have seldom been properly described. Ephemeral watercourse deposits are poorly fossiliferous but abraded bone fragments and loose teeth may occur sparsely in channel lags. The history of these vast tracts of sands, gravels and pedocrete is very poorly known, with very few fossils to rely on (e.g. Kangnas dinosaur, Areb *Hipparion* (three-toed ancestor of the horse). Hence, though of low probability, any find will be considerable importance.

## 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 o remove from its original place, or collect, any archaeological, palaeontological and historica 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 fo 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 deepe excavations to be made that are the main concern, such as the foundations for the CSP central tower, foundation trenches for buildings, the trenches for connecting piping and cabling and water storage dams.

Plans showing the extent and depths of bulk earth works are not available yet Notwithstanding, it is likely that significant sub-surface volumes will be disturbed and exposed.

## 6. SIGNIFICANCE

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

The significance of fossils that may be found involves:

- Significance for the history of the Bushmanland 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 expec nowadays. Modern analytical techniques such as stable isotopic analyses can revea 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 no otherwise exist and thereby provide access to the hidden fossils. The impact is positive fo 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 tha 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.

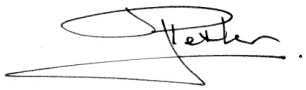
In order to spot the rare occurrences, it is very desirable to have the co-operation of the people "on the ground". By these are meant personnel in supervisory/inspection roles, such as engineers, surveyors, site foremen, etc., who are willing and interested to look out for occurrences of fossils. These 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.

There is a local branch of the CGS (Geological Survey) in Upington. A local CGS geologist could be involved to inspect excavations and liaise with the ECO and an advising palaeontologist, in the event of possible finds.

## 9. REFERENCES

Cornell D.H. *et al*. 2006. The Namaqua-Natal Province. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), *The Geology of South Africa*. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria. 325-379.



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