RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

PROPOSED EPHRAIM SUN SOLAR PV FACILITY ON THE REMAINDER OF PORTION 62 (PORTION OF PORTION 9) (VRYHEID) OF FARM VAALKOPPIES NO 40, UPINGTON, ZF MGCAWU DISTRICT, NORTHERN CAPE

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1. OUTLINE OF THE PROPOSED DEVELOPMENT

The company Ephraim Sun (Pty) Ltd is proposing to develop a solar PV facility of 75 MW generation capacity on the Remainder of Portion 62 (Portion of Portion 9) (Vryheid) on Farm Vaalkoppies No. 40, situated to the south of the Gariep River and *c*. 13 km southeast of Upington**,** ZF Mgcawu District, Northern Cape (Figs. 1 & 2). The property size is *c*. 4696 ha but the total footprint of the Ephraim Sun development will not exceed 200 ha. The project area for the adjacent Joram Solar development on Farm Vaalkoppies 40 has already been assessed (Almond 2014).

The main infrastructural components of the proposed Ephraim Sun solar PV facility include:

- PV and / or concentrated PV technology with fixed, single or double axis tracking technology;
- Grid connection to the existing Gordonia Substation. This will be *via* own-built 132 kV lines or by a "loop-in;loop-out" line to the existing Gordonia Kleinbegin 1 or to planned IIlanga CSP project 132 kV powerlines. The powerlines will be supported by monopole steel pylons;
- Auxiliary buildings with a total footprint of approximately 2 ha, including (but not limited to) to ablution, workshops, storage areas and site offices;
- Access roads not exceeding 8 m in width;
- Perimeter Fencing not exceeding 5 m;
- Laydown areas with a total area of between 2 and 5 ha.

An Environmental Impact Assessment is being conducted for the Ephraim Sun solar PV facility by Cape *E*nvironmental *A*ssessment *P*ractitioners (Pty) Ltd, George (Contact details: Mr Dale Holder. Cape EAPrac. First Floor, Eagles View Building, 5 Progress Street, George. PO Box 2070, George, 6530. Telephone: (044) 874 0365 Facsimile: (044) 874 0432. E-mail: dale@cape-eaprac.co.za. Web: www.cape-eaprac.co.za). The present baseline palaeontological heritage comment for the solar facility development has been commissioned by Cape EAPrac, George.

2. GEOLOGICAL BACKGROUND

The Ephraim Solar study area features fairly flat-lying to gently sloping, arid terrain at 840 to 880 m amsl on the southern side of the Gariep River to the southeast of Upington. It is traversed by several shallow ephemeral, dendritic water courses that ultimately feed into the Gariep (Fig. 2). The geology of the study area near Upington is shown on the 1: 250 000 geology map 2820 Upington (Council for Geoscience, Pretoria; Fig. 1). A comprehensive sheet explanation for this map has been published by Moen (2007). The study area is underlain at depth by a range of ancient Precambrian basement rocks – largely high grade metamorphic rocks (*e.g.* gneisses, metapelites) and intrusive granitoids – that belong to the **Namaqua-Natal Province** of Mid Proterozoic (Mokolian) age (Cornell *et al.* 2006, Moen 2007). The rock units concerned include granites of the **Keimoes Suite** (Ms); quartzites and schists of the **Vaalkoppies Group** (Mda), and various metasedimenmts of the **Areachap Sequence** (Msp, Mbe). These basement rocks are approximately two to one billion years old and entirely unfossiliferous (Almond & Pether 2008). They only crop out as small, isolated patches of basement rocks or low *Inselberge*. A large portion of the study area is covered by fine-grained aeolian (wind-blown) sands of the **Gordonia Formation** (**Qg**, pale yellow in Fig. 1), the youngest, Pleistocene to Recent, subunit of the **Kalahari Group**. Prominent NW-SE trending linear dunes of orange-hued sands are clearly visible on satellite images of the region to the west of Upington. The geology of the Late Cretaceous to Recent Kalahari Group is reviewed by Thomas (1981), Dingle *et al.* (1983), Thomas & Shaw 1991, Haddon (2000) and Partridge *et al.* (2006). The Gordonia dune sands are considered to range in age from the Late Pliocene / Early Pleistocene to Recent, dated in part from enclosed Middle to Later Stone Age stone tools (Dingle *et al*., 1983, p. 291). Other Quaternary to Recent superficial deposits in the study area include downwasted surface gravels, colluvium and gravelly to sandy stream sediments.

3. PALAEONTOLOGICAL HERITAGE

The igneous and metamorphic **basement rocks** are entirely unfossiliferous. The fossil record of the **Kalahari Group** is generally sparse and low in diversity. The **Gordonia Formation** dune sands were mainly active during cold, drier intervals of the Pleistocene Epoch that were inimical to most forms of life, apart from hardy, desert-adapted species. Porous dune sands are not generally conducive to fossil preservation. However, mummification of soft tissues may play a role here and migrating lime-rich groundwaters derived from the underlying bedrocks (including, for example, dolerite) may lead to the rapid calcretisation of organic structures such as burrows and root casts. Occasional terrestrial fossil remains that might be expected within this unit include calcretized rhizoliths (root casts) and termitaria (*e.g. Hodotermes*, the harvester termite), ostrich egg shells (*Struthio*) and shells of land snails (*e.g. Trigonephrus*) (Almond 2008, Almond & Pether 2008). Other fossil groups such as freshwater bivalves and gastropods (*e.g. Corbula, Unio*) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones) are associated with local watercourses and pans. Microfossils such as diatoms may be blown by wind into nearby dune sands. These Kalahari fossils (or subfossils) can be expected to occur sporadically but widely, and the overall palaeontological sensitivity of the Gordonia Formation is therefore considered to be low. Underlying calcretes of the **Mokolanen Formation** might also contain trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways.

4. CONCLUSIONS & RECOMMENDATIONS

The igneous and metamorphic Precambrian basement rocks underlying the Ephraim Sun solar PV facility study area at depth are entirely unfossiliferous. The overlying aeolian sands and stream gravels of the Kalahari Group mantling the older bedrocks are generally of low palaeontological sensitivity. The main project area lies too far from the river to affect any possible – but unmapped - older (Tertiary) fossiliferous river gravels along the southern banks of the Gariep. The footprint of the 132 kV transmission line monopoles is too small to have a significant impact on fossil heritage (This applies to all route options under consideration).

It is concluded that the proposed Ephraim Sun solar PV facility near Upington, including the associated short transmission line, is unlikely to have significant impacts on local palaeontological heritage resources.

It is therefore recommended that, pending the discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed Ephraim Sun solar PV facility on the farm Vaal Koppies 40 near Upington, Northern Cape.

Should any substantial fossil remains (*e.g.* mammalian bones and teeth) be encountered during excavation, however, these should be safeguarded, preferably *in situ*, and reported by the ECO to SAHRA, *i.e.* The South African Heritage Resources Authority, as soon as possible (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502. Email: cscheermeyer@sahra.org.za) so that appropriate action can be taken by a professional palaeontologist, at the developer's expense. Mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy) by a professional palaeontologist.

5. KEY REFERENCES

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6. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development 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 the objectivity of my performing such work.

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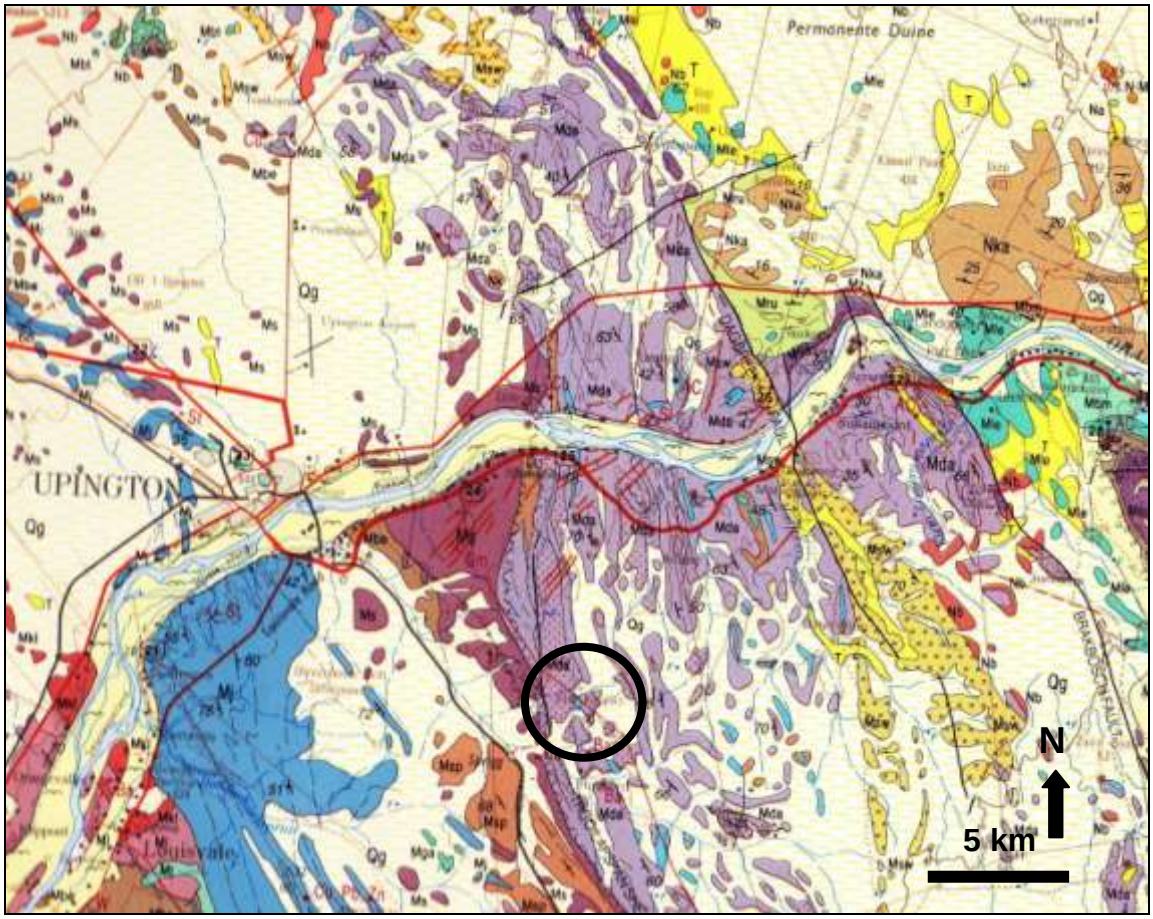

Figure 1. Extract from 1: 250 000 geological map 2820 Upington (Council for Geoscience, Pretoria) showing the *approximate* location of study area for the proposed Ephraim Sun solar PV facility (black circle) on the Remainder of Portion 62 (Portion of Portion 9) (Vryheid) on Farm Vaalkoppies No. 40, situated on the southern side of the Gariep River *c*. 13 km SE of Upington, Northern Cape Province. The study area is underlain at depth by unfossiliferous Precambrian (Middle Proterozoic / Mokolian) basement rocks of the Namaqua-Natal Metamorphic Province, including a wide range of highly metamorphosed sediments and intrusive igneous rocks (*e.g.* Ms – granites of the Keimoes Suite; Mda = quartzites and schists of the Vaalkoppies Group; Msp, Mbe – metasediments of the Areachap Sequence). The basement rocks are mantled by red aeolian (wind-blown) sand of the Gordonia Formation (Kalahari Group) (Qg, white with yellow stripes) as well as alluvial gravels and colluvium. The overall palaeontological sensitivity of the entire study area is LOW.

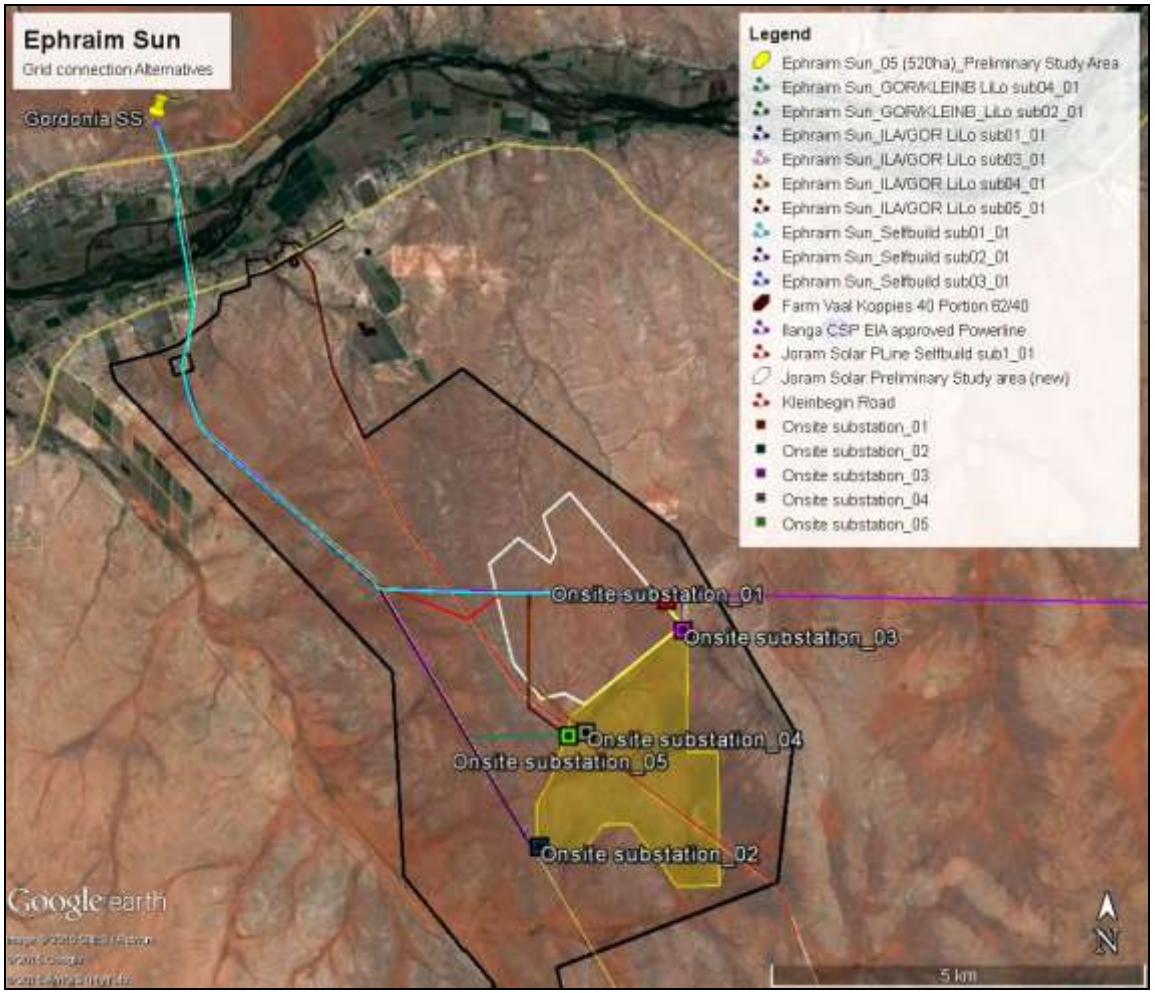

Figure 2: Google earth© satellite image showing the location of the study area for the proposed Ephraim Sun solar PV facility on the Remainder of Portion 62 (Portion of Portion 9) (Vryheid) on Farm Vaalkoppies No. 40, situated on the southern side of the Gariep River *c*. 13 km SE of Upington, ZF Mgcawu District, Northern Cape (yellow polygon). The preferred footprint will be determined within this study area, based on the outcome of the specialist investigations. The location of the existing Gordonia Substation north of the Gariep as well as the various grid connection options under consideration are also indicated. The adjacent Joram Solar project area (white polygon) has already been assessed (*cf* Almond 2014).