

RECOMMENDED EXEMPTION FROM FURTHER PALAEOLOGICAL STUDIES:

PROPOSED KLOOFSIG 1 SOLAR PV ENERGY FACILITY ON THE REMAINDER OF FARM KALKPOORT 18, RENOSTERBERG LOCAL MUNICIPALITY NEAR PETRUSVILLE, NORTHERN CAPE

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EXECUTIVE SUMMARY

Kloofsig Solar (Pty) Ltd proposes to develop a 75 MW solar photovoltaic (PV) energy generation facility and associated infrastructure on the Remaining Extent (Portion 0) of Farm 18, Kalkpoort situated c. 10 km northwest of Petrusville, Northern Cape. The Tierberg Formation (Ecca Group) and Karoo dolerite bedrocks, as well as the overlying superficial sediments, in the Kloofsig 1 study area are of low to very low palaeontological sensitivity (Almond 2015). Impacts of the proposed development – including the associated infrastructure such as the on-site substation and the 132 kV powerline grid connection – are assessed as **very low insignificant**. Cumulative impacts of the solar PV facility in the context of alternative energy and other developments in the broader region (including Kloofsig Phases 2 and 3) are likewise assessed as **very low insignificant**. No sensitive, conservation-worthy fossil sites were identified within the development footprint during fieldwork. There is no preference on palaeontological heritage grounds for any particular grid connection option. There are no objections on palaeontological grounds to authorisation of the development and, pending the potential discovery of substantial new fossil remains during development, no further specialist palaeontological studies or mitigation are recommended here.

Should any substantial fossil remains (e.g. mammalian bones and teeth, petrified wood, concentrations of well-preserved trace fossils or plant remains) be encountered during construction, 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 (SAHRA Contact details: Natasha Higgitt or Dr Ragna Redelstorff. 111 Harrington Street, Cape Town 8001. P.O. Box 4637, Cape Town 8000. Tel: 021 202 8651. Fax: 021 202 4509. Email: nhiggitt@sahra.org.za or rredelstorff@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. Full implementation of these mitigation measures would constitute a positive impact in terms of an improved palaeontological database for this poorly-studied region of the Northern Cape.

1. OUTLINE OF THE PROPOSED DEVELOPMENT

Kloofsig Solar (Pty) Ltd proposes to develop a solar photovoltaic (PV) energy generation facility and associated infrastructure on the Remaining Extent (Portion 0) of Farm 18 Kalkpoort situated some 10 km to the northwest of Petrusville in the Northern Cape. The proposed development with a total power generation capacity of 225 MW consists of three project phases (Kloofsig 1, 2 and 3) each of 75 MW generation capacity and covering a total area of approximately 970 ha. For technical reasons, each phase requires a separate environmental authorisation.

Kloofsig 1 (the subject of this report) is at the centre of the site and includes a 132 kV powerline (approximately 8.5 km long) and a substation to enable connection to the grid at the existing 132 kV line running to the south-east of the site (Fig. 1). An on-site substation and short connection to the 400 kV powerline crossing the site is also proposed (This infrastructure will support all phases of the development, should they be developed).

The required Environmental Impact Assessment process associated with each phase of the Kloofsig Solar development is being co-ordinated by SRK Consulting (South Africa) (Pty) Ltd, Port Elizabeth (Contact details: Ms Nicola Rump, SRK Consulting (South Africa) (Pty) Ltd. Ground Floor, Bay Suites, 1a Humewood Rd, Humerail, Port Elizabeth, 600. P O Box 21842, Port Elizabeth, 6000. Tel: +27-041-5094800. Fax: +27-041-5094850. Email: NRump@srk.co.za).

A combined desktop and field-based assessment of the entire Kloofsig Solar PV facility study area - including the Kloofsig 1, 2 and 3 project areas - on the Remainder of Farm Kalkpoort 18 was submitted by Almond (2015). The 132 kV powerline corridor to the Eskom grid was subsequently surveyed briefly on 16th January 2016. The present palaeontological heritage comment applies to the Kloofsig 1 Solar PV project area, including the on-site substation as well as the associated 132 kV powerline corridor.

2. GEOLOGICAL BACKGROUND

The geology of the entire Kloofsig Solar PV project area has been outlined in the previous report by Almond (2015) (See also geological map, Fig. 2). The Kloofsig Phase 1 Solar PV Facility project area shows very little topographic relief and is largely underlain by recessive-weathering Middle Permian basinal mudrocks of the **Tierberg Formation (Ecca Group)**; this also applies to the on-site substation and laydown area. The Ecca country rocks are intruded by Early Jurassic dolerites of the **Karoo Dolerite Suite** in the NW corner of the Phase 1 project area, while the 132 kV powerline corridor also crosses major dolerite intrusions at two points.

Field studies in January 2016 show that the potentially-fossiliferous, dark grey Tierberg Formation mudrocks underlying a large fraction of the 132 kV powerline corridor are weathered and crumbly near-surface where they are often traversed by a network of narrow calcrete veins (Fig. 3). In the vicinity of dolerite intrusions, the Tierberg mudrocks and fine sandstones / wackes have been baked to more resistant-weathering, pale grey-green hornfels (Fig. 4), as well-seen on the small *koppie* marked with a star symbol in Figs. 1 and 2. In the lower-lying *vlaktes* where the powerline will be constructed the Palaeozoic bedrocks are pervasively mantled with coarse alluvial and sheetwash gravels of brown-weathering hornfels (often anthropogenically flaked) and sandy to silty soils, as seen in stream exposures along and close to the powerline corridor (Fig. 5). A thin calcrete hardpan often lies between these superficial sediments and the underlying bedrock.

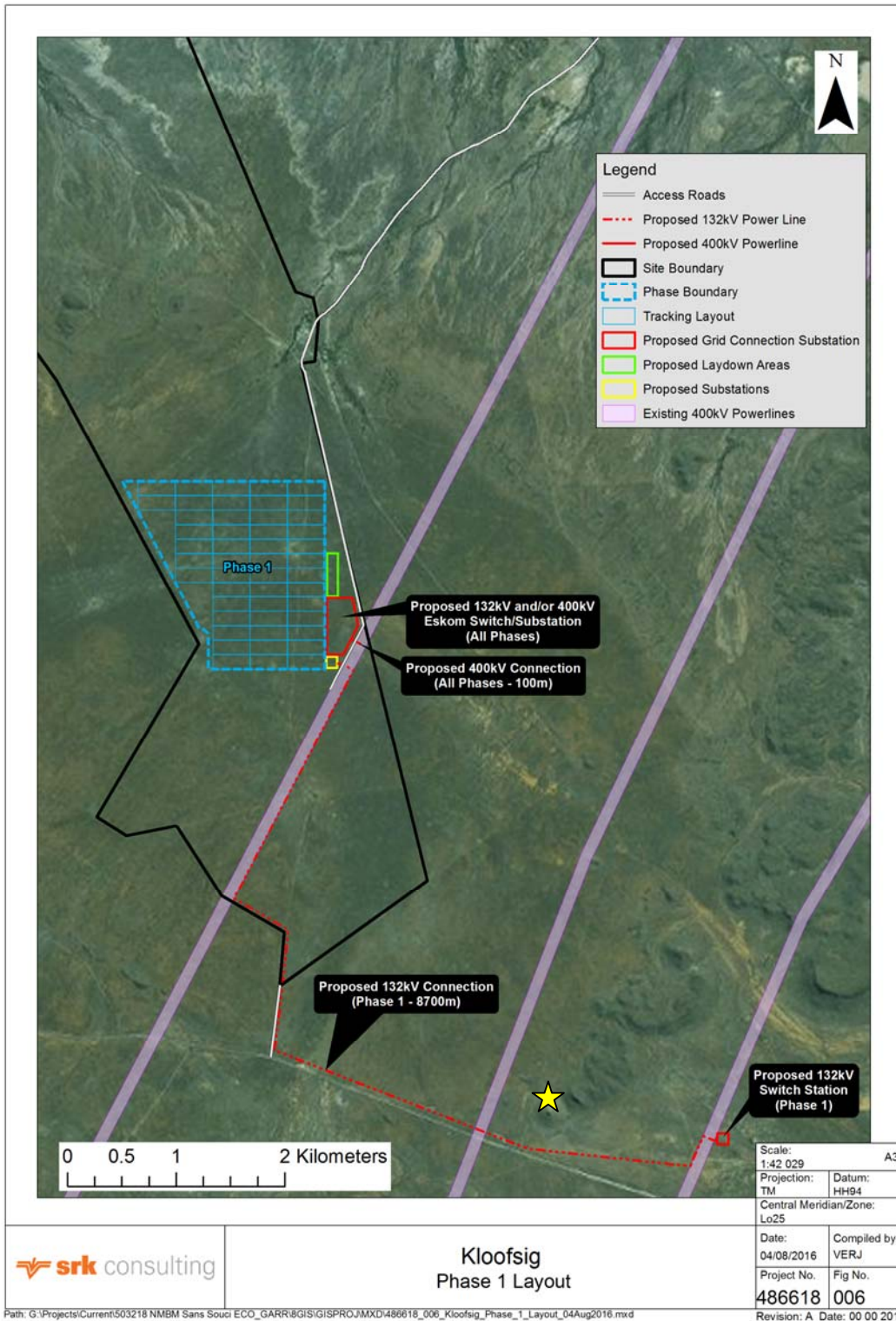


Figure 1: Satellite image showing the location of the Kloofsig Phase 1 project area (pale blue grid) as well as associated infrastructure such as the on-site substation and 132 kV powerline to the Eskom grid (red dotted line). The yellow star indicates a trace fossil site to the north and outside of the powerline corridor (See Fig. 6) (Image supplied by SRK Consulting).

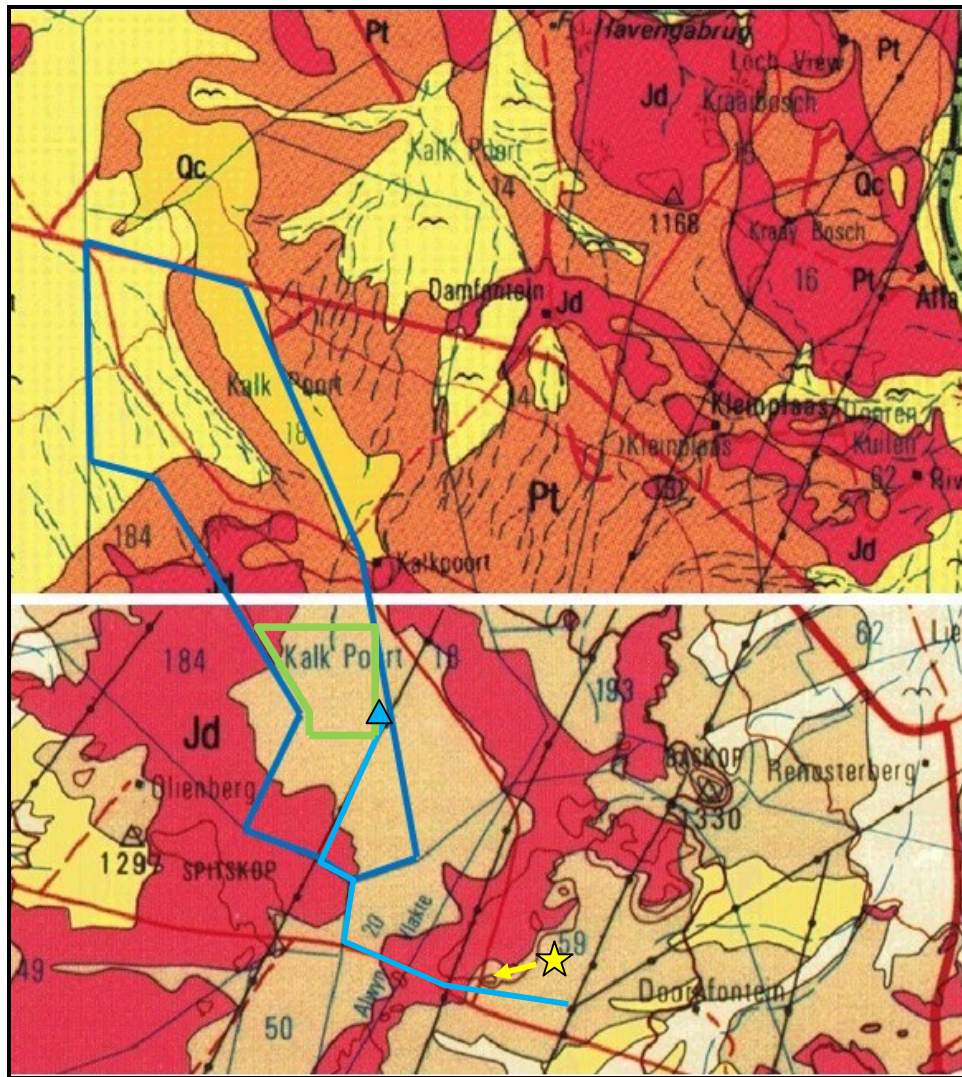


Figure 2. Geological map of the Kloofsig Solar 1 PV Solar Energy Facility project area on Farm RE/18 (green polygon), located near Petrusville and c. 95 km northwest of Colesberg, Northern Cape (Figure based on extracts from adjoining 1: 250 000 geology sheets 2924 Koffiefontein and 3024 Colesberg, Council for Geoscience, Pretoria). The larger dark blue polygon shows the entire Kloofsig Solar project area previously assessed by Almond (2015). The pale blue line indicates the proposed 132 kV transmission line connection between the on-site substation (blue triangle) and the Eskom grid (Compare Fig. 1). A Tierberg Formation trace fossil site is indicated by the yellow star. The main rock units represented within the Kloofsig Solar study area are:

1. KAROO SUPERGROUP (ECCA GROUP)
Tierberg Formation (Pt, orange / pale brown)
2. KAROO DOLERITE SUITE
Dolerite sills and dykes (J-d, red)
3. LATE CAENOZOIC SUPERFICIAL SEDIMENTS
Stream and river alluvium (pale yellow with flying bird symbol), calcrete hardpans (Qc, dark yellow)

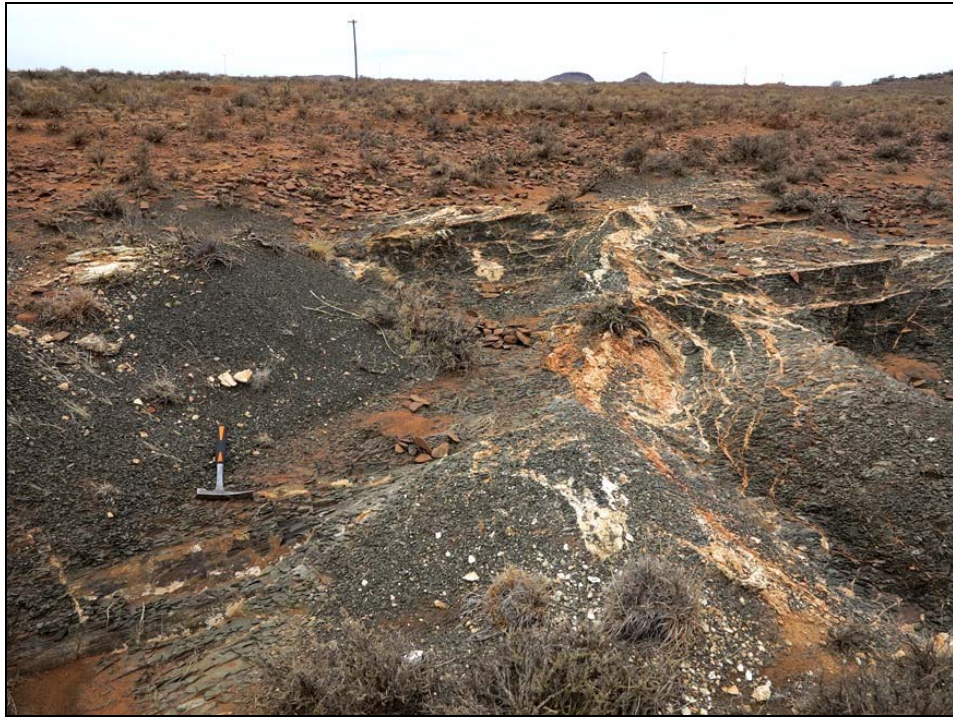


Figure 3: Dark-grey, laminated mudrocks of the Tierberg Formation exposed in a roadside borrow pit close to the powerline corridor. Note network of thin calcrete veins (Hammer = 30 cm).



Figure 4: Resistant-weathering, baked sediments of the Tierberg in the vicinity of an inclined, well-jointed dolerite dyke, north-western slopes of the small *koppie* marked with a star in Figs. 1 and 2 (The *koppie* is also seen in the background in Fig. 5).



Figure 5: Thin calcrete hardpan underlying brownish hornfels gravels and alluvial soils exposed along a shallow stream close to the powerline corridor. The small *koppie* in the background is built of Tierberg Formation bedrocks.

3. PALAEOLOGICAL HERITAGE

Apart from rare small blocks of petrified wood in surface gravels as well as concentrations of subfossil (possibly historical) bones in finer-grained river alluvium, no fossil remains were recorded from the Kloofsig Solar study area by Almond (2015). It was concluded that the palaeontological sensitivity of the study area as a whole is low. Subsequent field studies (January, 2016) found no fossil remains in the bedrocks or Late Caenozoic cover sediments within or close to the powerline corridor, with the sole exception of occasional strap-shaped burrows (1.5 to 6 cm wide) within baked siltstones of the Tierberg Formation (Fig. 6). Such burrows occur widely within the very large outcrop area of this formation, lie outside and well above the development footprint (yellow star in Figs. 1 & 2), and are not considered to be of special conservation significance. The palaeontological sensitivity of the powerline corridor is accordingly also assessed as low.

There have been very few field-based palaeontological studies into comparable sedimentary rocks in the broader study region (See References). Gess (2012) has recorded moderate diversity trace fossil assemblages as well as plant remains (sphenophyte compressions, petrified wood) from the Tierberg Formation at a site near Petrusville some 50 km south of the present study area. Tierberg Formation bedrocks examined along the Kimberley – Hopetown – De Aar railway line by Almond (2013) were highly weathered and calcretised, with no significant fossils reported.



Figure 6: Broad, strap-shaped burrow preserved within pale, baked Tierberg Formation siltstones on the NW slopes of the small *koppie* indicated with a star in Figs. 1 & 2 (30° 03' 21.0" S, 24° 34' 55.5" E) (Scale in cm).

4. PALAEOLOGICAL IMPACT ASSESSMENT

The inferred impact of the proposed Kloofsig 1 Solar PV Energy Facility on local fossil heritage resources is evaluated in Table 1 below, based on the system used by SRK Consulting. This assessment applies only to the *construction phase* of the development, since further significant impacts on fossil heritage during the planning, operational and decommissioning phases of the solar facilities are not anticipated.

In general, the destruction, damage or disturbance out of context of fossils preserved at the ground surface or below ground that may occur during construction represents a *negative* impact that is limited to the development footprint (*local extent*). Given the low palaeontological sensitivity of the study area, the intensity of impacts is rated as *low*. Such impacts can usually be mitigated but cannot be fully rectified or reversed (*i.e. long term duration, irreversible*). Most of the sedimentary formations represented within the study area contain fossils of some sort, so impacts *at some level* on fossil heritage are definite. However, most fossil occurrences probably occur widely within the study region (*i.e. not unique / irreplaceable*) and are not considered to be of great scientific significance. Exceptional fossils such as well-preserved, well-articulated vertebrate skeletons, vertebrate trackways or petrified wood that are scientifically valuable and conservation-worthy appear to be very rare in the study area. The probability of *loss of such conservation-worthy fossil heritage* due to the proposed development is considered to be low (*improbable*). This is because of (a) the very sparsely-scattered distribution of exceptional, well-preserved fossils within the bedrocks as well as within the overlying superficial sediments (e.g. older alluvium, surface gravels), (b) the near-surface weathering and mantling of the bedrocks with superficial sediments in most areas, so that major impacts on potentially-fossiliferous fresh (*i.e. unweathered*) bedrock are limited. The significance of low-intensity, low-probability impacts on conservation-worthy fossil

heritage that are restricted to the development footprint and of permanent duration is rated as *very low* (~~insignificant~~) without mitigation.

Levels of confidence for this impact assessment are *moderate* given (1) the unpredictable occurrence of well-preserved, scientifically-valuable fossils, (2) the limited scope and number of field-based palaeontological studies carried out in the broader region.

Should any substantial fossil remains (e.g. mammalian bones and teeth, petrified wood, concentrations of well-preserved trace fossils or plant remains) be encountered during construction, 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 (SAHRA Contact details: Natasha Higgitt or Dr Ragna Redelstorff. 111 Harrington Street, Cape Town 8001. P.O. Box 4637, Cape Town 8000. Tel: 021 202 8651. Fax: 021 202 4509. Email: nhiggitt@sahra.org.za or rredelstorff@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.

It should be noted that, should the recommended mitigation measures for the pre-construction and construction phase of the WEF development be consistently followed-though, the impact significance would remain very low but would entail both positive and negative impacts. Residual negative impacts from inevitable loss of some fossil heritage would be partially offset by an improved palaeontological database for the study region as a direct result of appropriate mitigation. This is a *positive* outcome because any new, well-recorded and suitably-curated fossil material from this palaeontologically little-known region would constitute a useful addition to our scientific understanding of South African fossil heritage.

Table 1: Significance rating of impacts of the Kloofsig 1 Solar PV Energy Facility and associated infrastructure (including powerline, on-site substation) on palaeontological heritage resources and recommended management measures

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence
Before Management	Local	Low	Long term	Very low	Improbable	Very Low insignificant	-	Moderate
Management Measures								
<ul style="list-style-type: none"> • Safeguarding of chance fossil finds (preferably <i>in situ</i>) during the construction phase by the responsible ECO, followed by reporting of finds to SAHRA. • Recording and judicious sampling of significant chance fossil finds by a qualified palaeontologist, together with pertinent contextual data (stratigraphy, sedimentology, taphonomy). • Curation of fossil material within an approved repository (museum / university fossil collection) by a qualified palaeontologist. 								
After Management	Local	Low	Long term	Very low	Improbable	Very Low insignificant		Moderate

4.1. Assessment of cumulative impacts

For the purposes of the cumulative impact assessment for the Kloofsig 1 Solar PV Energy Facility project, a small number of proposed or approved major developments within a radius of some 50 km of the present project area have been taken into consideration. They include the Kloofsig 1, 2 and 3 Solar PV projects as well as two other solar projects to the north and south - Swartwater (Gess 2012) and Grootpoort (Almond 2016) *plus* the 16 MTPA railway line upgrade *via* Hopetown. As already noted, there are very few relevant, field-based palaeontological studies, whether academic studies or impact assessments, for the broader study region. It should be emphasized that, in the case of palaeontological heritage, it only makes sense to consider cumulative impacts on *comparable fossil assemblages* present in the same formations that are represented in the broader study region. For example, impacts on Permian fossil vertebrates in the Whitehill Formation are not directly relevant to impacts on petrified wood and trace fossils in the Tierberg Formation, although both belong to the Ecca Group. The analysis in Table 2 is therefore restricted to considering cumulative impacts on fossil heritage preserved within rock units that are represented in the Kloofsig Solar study area as well as nearby projects.

In all the relevant *field-based* palaeontological studies listed above the palaeontological sensitivity of the project area and the palaeontological heritage impact significance for the relevant developments has been rated as low. While fossils do occur within some of the formations present, they tend to be sparse and represent common forms that occur widely within the outcrop areas of the rock units concerned. It is concluded that the cumulative impact significance of the Kloofsig 1, 2 and 3 Solar PV Energy Facilities in the context of alternative energy and other developments in the region is very low, *i.e. insignificant* (See Table 2).

Table 2: Significance rating of cumulative impacts of the Kloofsig 1 Solar PV Energy Facility on palaeontological heritage resources in the context of alternative energy and other developments in the region

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+-	Confidence
Before Management	Local	Low	Long term	<u>Very low</u>	Improbable	<u>Very Low insignificant</u>	-	Moderate
Management Measures								
<ul style="list-style-type: none"> • Safeguarding of chance fossil finds (preferably <i>in situ</i>) during the construction phase by the responsible ECO, followed by reporting of finds to SAHRA. • Recording and judicious sampling of significant chance fossil finds by a qualified palaeontologist, together with pertinent contextual data (stratigraphy, sedimentology, taphonomy). • Curation of fossil material within an approved repository (museum / university fossil collection) by a qualified palaeontologist. 								
After Management	Local	Low	Long term	<u>Very low</u>	Improbable	<u>Very Low insignificant</u>		Moderate

5. CONCLUSIONS & RECOMMENDATIONS

Desktop and field-based palaeontological studies indicate that the Tierberg Formation (Ecca Group) and Karoo dolerite bedrocks as well as the overlying superficial sediments in the Kloofsig 1 Solar PV Energy Facility study area on Farm 18, Kalkpoort near Petrusville, Northern Cape, are of low to very low palaeontological sensitivity (Almond 2015). Impacts of the proposed development – including the associated infrastructure such as the on-site substation and the 132 kV powerline grid connection – are assessed as **very low insignificant**. Given the large outcrop areas of the potentially fossiliferous formations concerned, the loss of unique or irreplaceable fossil heritage is not anticipated here. Cumulative impacts of the solar PV facility in the context of alternative energy and other developments in the broader region (including Kloofsig Phases 2 and 3) are likewise assessed as **very low insignificant**. Confidence levels for this assessment are moderate. No sensitive, conservation-worthy fossil sites were identified within the development footprint during fieldwork. There is no preference on palaeontological heritage grounds for any particular grid connection option. There are no objections on palaeontological grounds to authorisation of the development and, pending the potential discovery of substantial new fossil remains during development, no further specialist palaeontological studies or mitigation are recommended here.

Should any substantial fossil remains (e.g. mammalian bones and teeth, petrified wood, concentrations of well-preserved trace fossils or plant remains) be encountered during construction, 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 (SAHRA Contact details: Natasha Higgitt or Dr Ragna Redelstorff. 111 Harrington Street, Cape Town 8001. P.O. Box 4637, Cape Town 8000. Tel: 021 202 8651. Fax: 021 202 4509. Email: nhiggitt@sahra.org.za or rredelstorff@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. Full implementation of these mitigation measures would constitute a positive impact in terms of an improved palaeontological database for this poorly-studied region of the Northern Cape.

6. KEY REFERENCES

N.B. Extensive references for this project are given in the earlier report by Almond (2015).

ALMOND, J.E. 2013. Proposed 16 MTPA expansion of Transnet's existing manganese ore export railway line & associated infrastructure between Hotazel and the Port of Ngqura, Northern & Eastern Cape. . Part 3: Kimberley to De Aar, Northern Cape. Palaeontological specialist assessment: combined field-based and desktop study, 65 PP. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015. Proposed Kloofsig Solar PV Facility on the Remainder of Farm Kalk Poort 18, Renosterberg Local Municipality near Colesberg, Northern Cape. Palaeontological impact assessment: basic assessment study & proposed exemption from further specialist palaeontological studies, 28 pp. Natura Viva cc.

ALMOND, J.E. 2016. Proposed Grootpoort Photovoltaic Solar Energy Facility near Luckhoff, Free State Province. Palaeontological impact assessment: desktop study, 16 pp.

GEISS, R. 2012. Palaeontological Impact Assessment for Proposed establishment of the Swartwater Solar energy Facility, Eastern Cape, 18 pp.

7. 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, Mpumalanga, Limpopo, Free State and Northwest Province under the aegis of his Cape Town-based company *Natura Viva* cc. He has been 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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