RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

PROPOSED DYASONS KLIP 5 SOLAR PHOTOVOLTAIC FACILITY ON THE REMAINDER OF THE FARM DYASONSKLIP 454 AND ASSOCIATED CONNECTION TO THE NATIONAL GRID *VIA* THE UPINGTON MAIN TRANSMISSION SUBSTATION, ZF MGCAWU DISTRICT MUNICIPALITY NEAR UPINGTON, NORTHERN CAPE

John E. Almond PhD (Cantab.)
***Natura Viva* cc,**
PO Box 12410 Mill Street,
Cape Town 8010, RSA
naturaviva@universe.co.za

February 2020

EXECUTIVE SUMMARY

The project areas for the proposed 100 MW Dyasons Klip 5 solar photovoltaic (PV) facility on the Remainder of the farm Dyason's Klip 454 near Upington as well as for the associated 132 kV grid connection to the Upington Main Transmission Substation (MTS) located *c.* 9.5 km to the ESE are both underlain by (1) unfossiliferous Precambrian basement rocks as well as (2) Late Caenozoic windblown sands, calcretes and alluvial deposits of the Kalahari Group. All these rock units are of low to very low palaeontological sensitivity and the impact significance of the proposed renewable energy developments is rated as LOW. Cumulative impacts of the developments in the context of other renewable energy projects in the Upington – Keimoes region, situated within the gazetted Upington Renewable Energy Development Zone 7, are also rated as LOW. There are no preferences on palaeontological heritage grounds for any particular PV site or layout option under consideration, including grid connection corridor to the Upington MTS. Cumulative impacts of the proposed developments in the context of several other proposed or authorized alternative energy projects in the Keimoes – Upington region, including those on the Remainder of Farm Dyason's Klip 454 itself, are rated as LOW. There are no objections on palaeontological heritage grounds to authorization of the Dyasons Klip 5 solar PV facility and associated grid connection. **It is recommended that, pending the potential discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed solar PV facility as well as for the associated 132 kV grid connection to the Upington MTS**. A Chance Fossil Finds Procedure for the construction phase is appended to this report.

1. OUTLINE OF THE PROPOSED DEVELOPMENT

The company Dyasons Klip PV 5 (Pty) Ltd (Reg. No. 2019/627994/07) is proposing to develop a solar photovoltaic (PV) facility, to be known as Dyasons Klip 5, on the Remainder of the farm Dyason's Klip 454, situated on the northern side of the Orange River (Gariep) some 20.3 km NE of Keimoes and 22.3 km WSW of Upington in the ZF Mgcawu District Municipality, Northern Cape (Figs. 1 & 2). The solar PV facility will have a generation capacity of up to 100 Megawatts and will comprise the following main infrastructural components:

- Arrays of solar photovoltaic (PV) panels reaching up to ± 3.5 m from ground level with either of fixed-tilt-, single-axis tracking- or dual-axis tracking- mounting structures;

- Laydown area of approximately 2 to 5 ha extent;
- On-site switching-station / substation (2 site options under consideration);
- 132 kV powerline connecting the solar PV facility to the national grid at the Upington Main Transmission Substation (MTS) located *c*. 9.8 km ESE of the solar PV facility. Route options under consideration include a direct connection to the MTS or an indirect connection *via* the existing Dyasonsklip 1 & 2 or Dyasonsklip Solar Energy Facility 1 Substation (*cf* Fig. 3);
- Auxiliary buildings (gate-house and security building, control centre, office, warehouse, canteen & visitors centre, staff lockers *etc*.);
- Inverter-stations, transformers and internal electrical reticulation (underground cabling);
- Access and internal road network (various route options under consideration; *cf* Fig. 2);
- Rainwater tanks; and
- Perimeter fencing and security infrastructure.

The total footprint of the proposed development , will be approximately 267 hectares.

The Dyasons Klip 5 project area lies within the gazetted Renewable Energy Development Zone 7 (REDZ7, Upington Focus Area; *cf* Fourie *et al.* 2014) and is therefore only subject to a Basic Assessment rather than a full EIA Process. The present palaeontological heritage desktop assessment for the proposed Dyasons Klip 5 solar PV facility as well as the associated grid connection has been commissioned on behalf of the proponent by Cape EAPrac, George (Contact details: Mr Dale Holder. Cape EAPrac, 17 Progress Street, George. PO Box 2070, George 6530. Tel: 044 874 0365. E-mail: dale@cape-eaprac.co.za). It will contribute to the combined Basic Assessment processes for the PV facility as well as the associated grid connection.

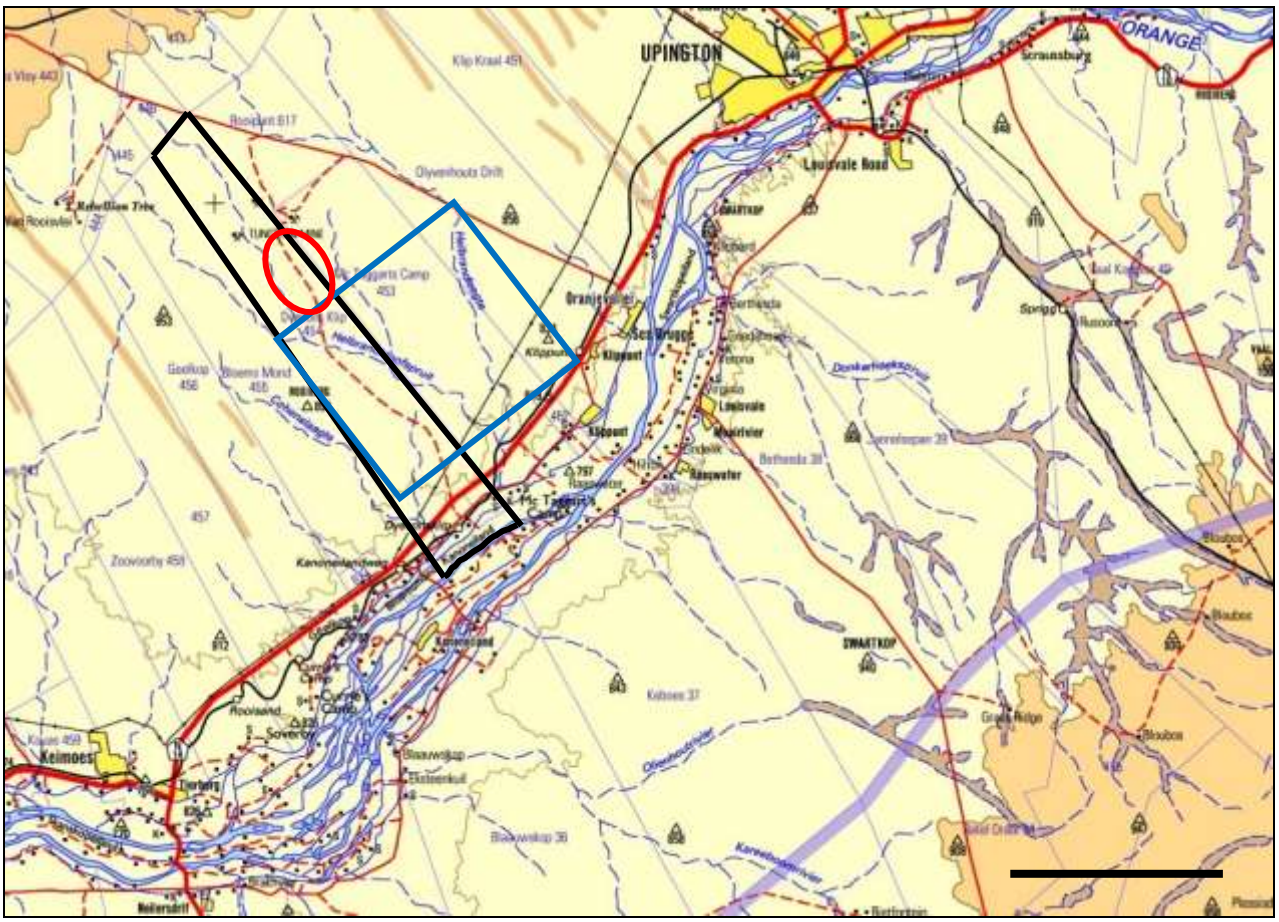

Figure 1. Extract from 1: 250 000 topographical map 2820 Upington (Courtesy of The Chief Directorate: National Geo-spatial Information, Mowbray) showing the boundaries (black polygon) of Farm Dyasons Klip 454/ RE, situated *c*. 20.3 km NE of Keimoes in the ZF Mgcawu District Municipality, Northern Cape. The red ellipse indicates the *approximate* location of the Dyasons Klip 5 project area while the blue rectangle encloses the additional study area for the associated 132 kV grid connection to the Upington Main Transmission Station *c*. 9.8 km to the ESE (See satellite images Figures 2 & 3 for more detail of the development footprint and layout options). Scale bar = *c*. 8 km. N towards the top of the image.

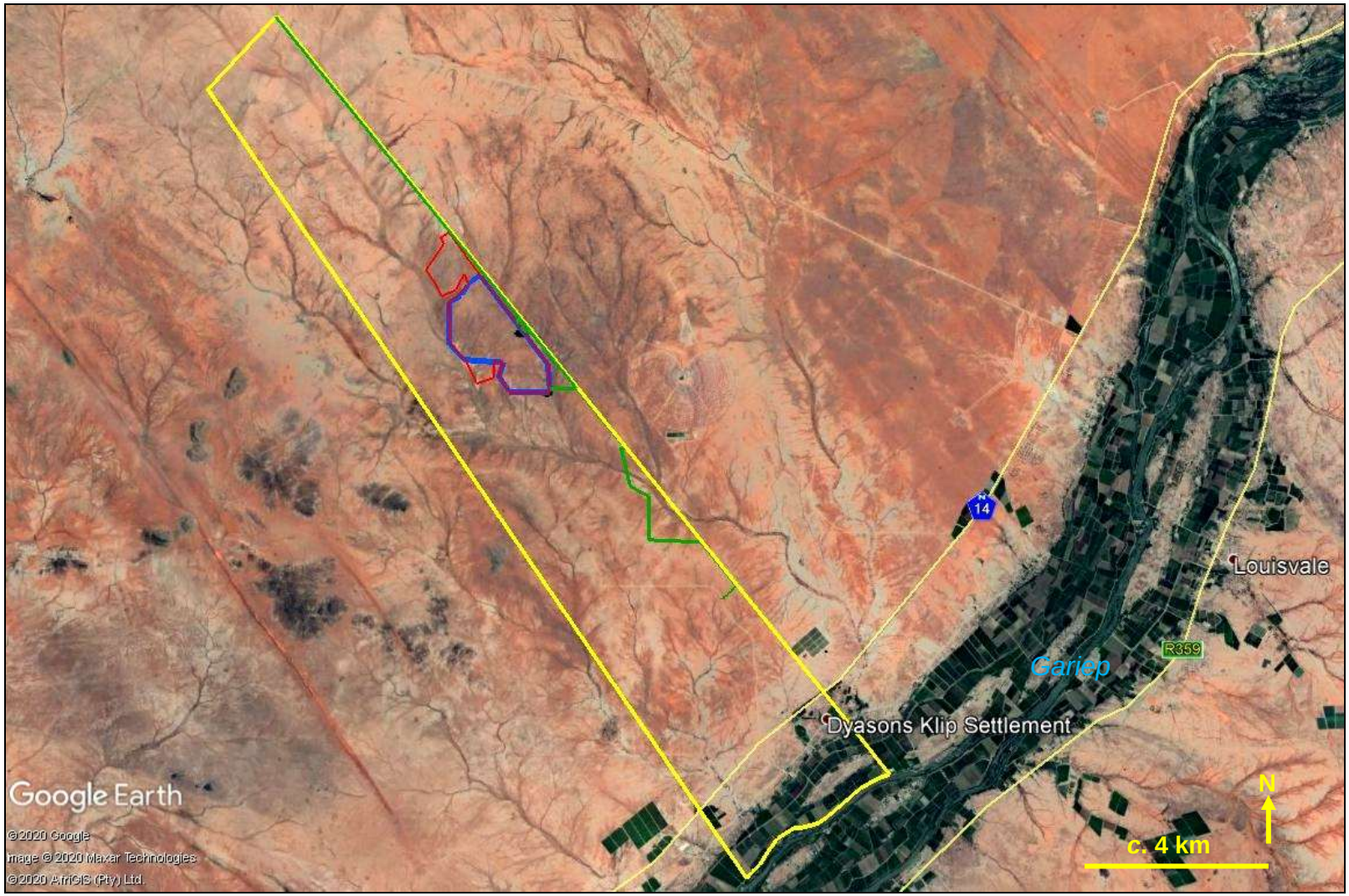

Figure 2. Google Earth© satellite image showing the location of Farm Dyasons Klip 454/RE (yellow polygon) on the north-eastern bank of the Orange River (Gariep) between Upington and Keimoes, Northern Cape. The preferred footprint for the proposed Dyasons Klip 5 project is shown in blue while the scoping area is outlined in red. Access road route alternatives are shown in green.

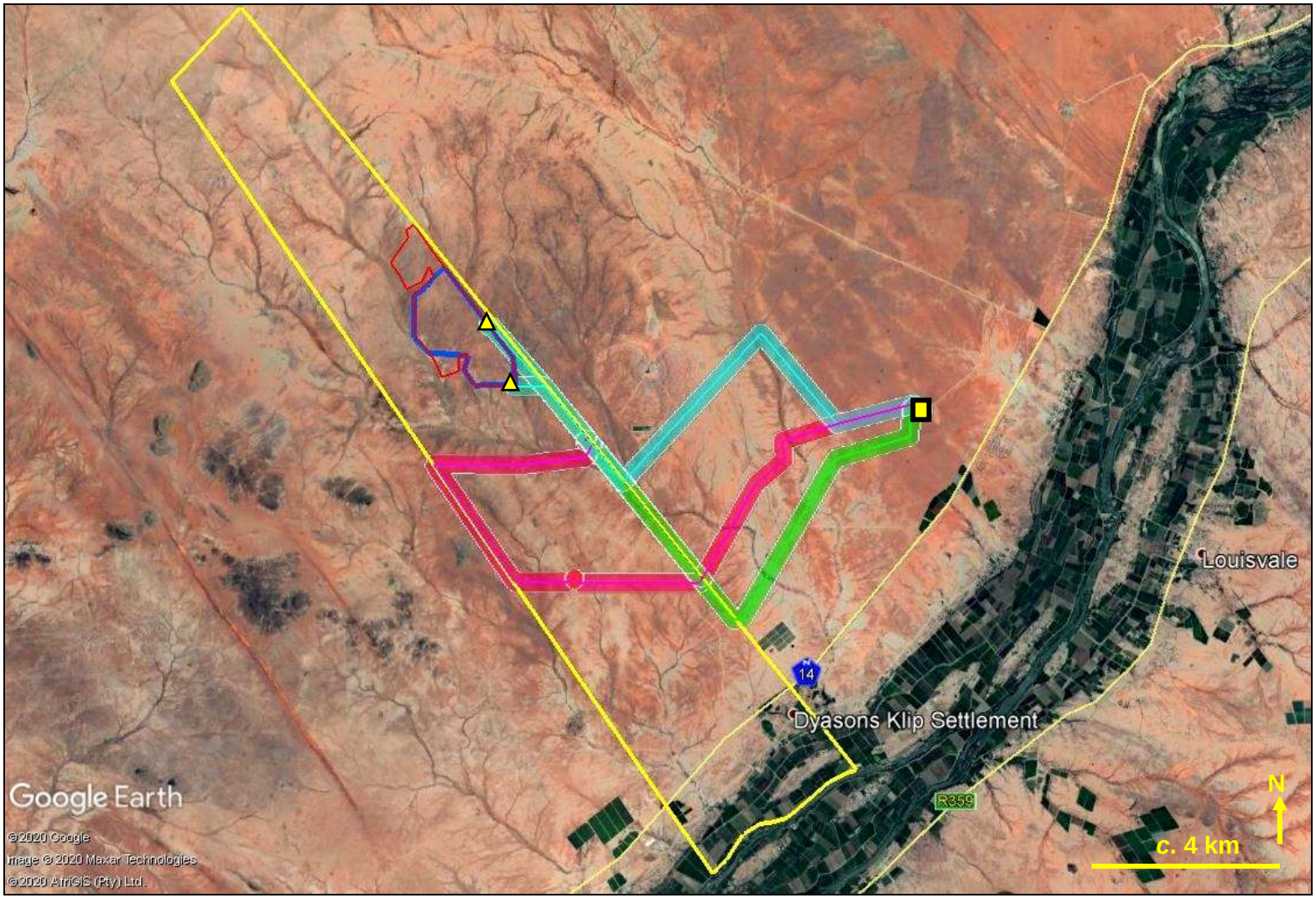

Figure 3. Google Earth© satellite image of the Dyasons Klip 5 project area showing corridors for the various grid connection options under consideration (blue / pink / green). These include a direct connection from the on-site switching-station / substation (small yellow triangle with 2 location options) to the existing Upington MTS (yellow square) or an indirect connection *via* either the Dyasonsklip 1 & 2 Substation or the Dyasonsklip Solar Energy Facility 1 Substation.

2. GEOLOGICAL CONTEXT

The combined Dyasons Klip 5 solar PV facility and associated 132 kV grid connection project areas on the Remainder of the Farm Dyason's Klip 454 and terrain to the east as far as the Upington MTS comprises fairly flat-lying to gently-sloping, arid *veld* between *c*. 800 and 860 m amsl that stretches away from the northern banks of the Gariep River *c*. 22 km WSW of Upington, Northern Cape. The sparsely-vegetated, sandy to gravelly terrain here to the NW of the Gariep River is transected by several shallow, ephemeral water courses, including tributaries of the Helbrandkloofspruit and Helbrandleegte (Figs. 1 TO 3).

The geology of the combined solar PV and grid connection project areas near Upington is shown on the 1: 250 000 geology map 2820 Upington (Council for Geoscience, Pretoria; Fig. 4). A comprehensive sheet explanation for this map has been published by Moen (2007). The 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), such as the **Dyason's Klip Gneiss, Louisvale Granite** and **Kanoneiland Granite**, among other units. 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*. Large portions of the study area – including most of the solar PV project area itself - are covered by fine-grained aeolian (wind-blown) sands of the **Gordonia Formation** (**Qg**, pale yellow in Fig. 4) as well as **Late Caenozoic calcretes** (**T**, dark yellow in Fig. 4). Prominent NW-SE trending linear dunes of orange-hued sands are clearly visible on satellite images of the region outside and to the west of the study area. These superficial deposits are assigned to the Late Cretaceous to Recent Kalahari Group, the geology of which 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) while the Kalahari calcretes are probably for the most part also of Pleistocene or younger age. Additional Late Caenozoic superficial deposits present in the project area include **surface gravels** as well as **alluvial sands and gravels**, especially along drainage lines, which are not mapped at 1: 250 000 scale. Outcrops of Orange River alluvial deposits are not mapped within the solar PV project footprint which lies over 10 km NW of the present course of the river. They are also unlikely to be represented within the grid connection corridors which approach to within *c*. 4 km of the river.

3. PALAEONTOLOGICAL HERITAGE

The fossil heritage associated with each of the rock units represented in the broader study region between Keimoes and Upington has been outlined in several previous desktop studies by Almond (2011a, 2011b, 2014a, 2014b, 2014c, 2015, 2019) in which the majority of the gridline corridor options have already been assessed.

The Precambrian 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 local concentrations of trace fossils such as rhizoliths, termite and other insect burrows, or even mammalian trackways, especially in areas associated with ancient wetlands.

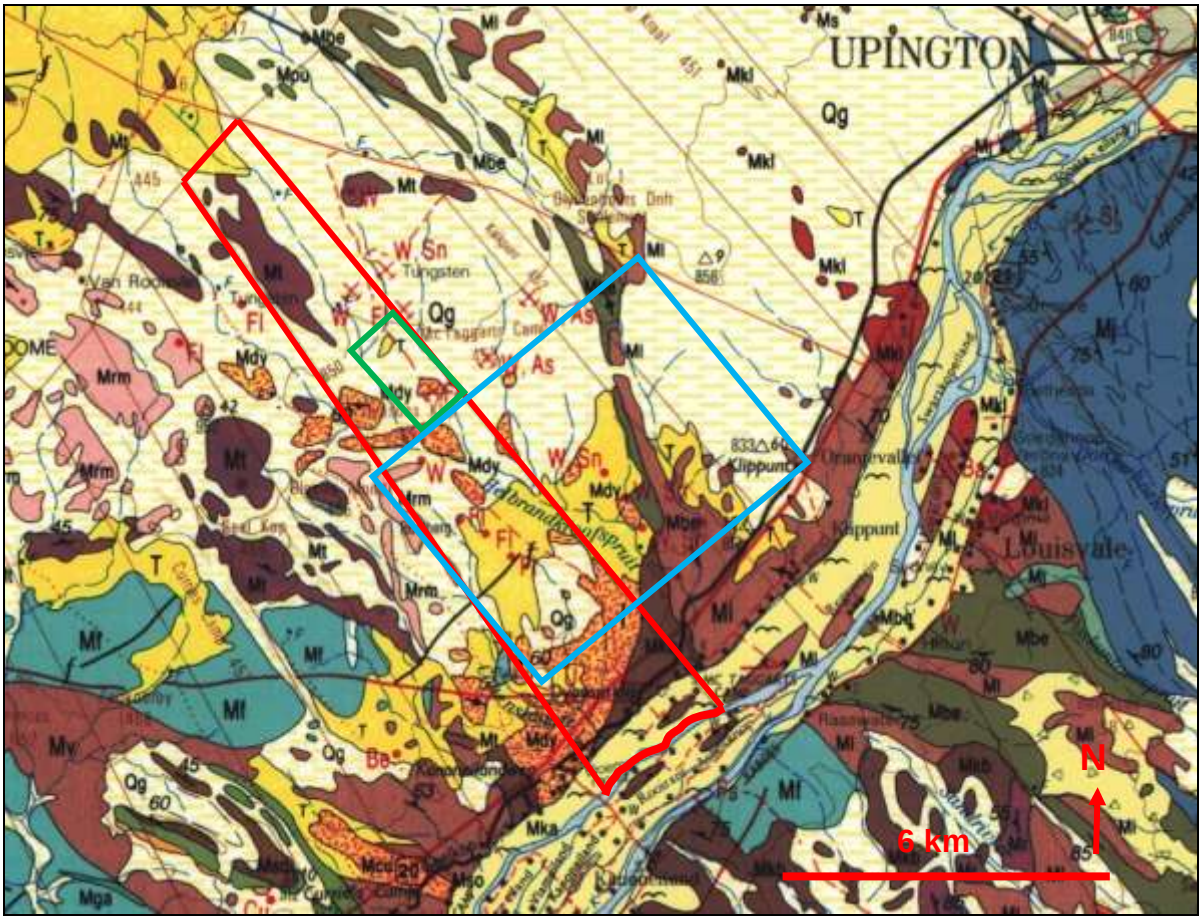

Figure 4. Extract from 1: 250 000 geological sheet 2820 Upington (Council for Geoscience, Pretoria) showing the location of Farm Dyasonsklip 454/ RE (red polygon), *c*. 23 km WSW of Upington, Northern Cape Province. The small green rectangle approximately indicates the project area for the proposed Dyasons Klip 5 solar PV facility while the larger pale blue rectangle covers the additional project area for the associated 132 kV grid connection to the Upington MTS. The combined solar project and grid connection 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.* Mdy – Dyason's Klip Gneiss; Mka – Kanoneiland Granite; Ml – Louisvale Granite). The basement rocks are extensively mantled by red aeolian (wind-blown) sand of the Gordonia Formation (Kalahari Group) (Qg, white with yellow stripes), Late Caenozoic calcretes (T, dark yellow), surface gravels as well as alluvial sands and gravels (*N.B*. several of these superficial deposits are not mapped at

1: 250 000 scale). The overall palaeontological sensitivity of the entire study area is rated as LOW.

4. CONCLUSIONS & RECOMMENDATIONS

The Precambrian igneous and metamorphic basement rocks underlying the project areas for the Dyasons Klip 5 solar facility and the associated grid connection at depth are entirely unfossiliferous. The Late Caenozoic aeolian sands, calcretes and stream gravels of the Kalahari Group mantling the older bedrocks are generally of low to very low palaeontological sensitivity, although occasional concentrations of fossil material (*e.g.* mammalian bones and teeth, trace fossils) might occur here.

It is concluded that construction of the Dyasons Klip 5 solar PV facility and the associated 132 kV grid connection are unlikely to have significant impacts on local palaeontological heritage resources. The impact significance of the construction phase is rated as VERY LOW. This applies equally to the two on-site substation site options, and to all route options under consideration for the associated 132 kV grid connection to the Upington MTS Substation. There is no preference on palaeontological heritage grounds to any specific layout option, including site alternatives for the grid connection route options. The operational and de-commissioning phases of the development will not entail significant further impacts on palaeontological heritage. No fatal flaws regarding palaeontological heritage are recognised, and there is no objection on palaeontological grounds to authorization of the proposed solar PV facility and grid connection.

As shown on the SAHRIS website, a considerable number of solar and other renewable energy developments, with associated grid line connections, have been proposed within the Upington REDZ on both sides of the Gariep River in the Upington – Keimoes region of the Northern Cape, including on the Remainder of the Farm Dyasonsklip 454 itself (*cf* Durand 2013, Almond 2011a, 2011b, 2014a, 2014b, 2014c, 2015, 2019). Several of these have already been authorized. However, palaeontological assessment reports (PIAs) are not available for all these projects. In all the PIA reports examined, the palaeontological significance of the renewable energy project was assessed as low. Given the large outcrop area of the potentially-fossiliferous, but generally low-sensitivity, Kalahari Group, it is concluded that cumulative impacts of the proposed Dyasons Klip 5 solar PV facility and the associated 132 kV grid connection in the context of other alternative energy and gridline developments in the region are of LOW impact significance.

It is therefore recommended that, pending the potential discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed Dyasons Klip 5 solar PV facility on the Remainder of the Farm Dyasonsklip 454 near Upington, Northern Cape, as well as for the associated 132 kV grid connection to the Upington MTS.

Should any substantial fossil remains (*e.g.* mammalian bones and teeth) be encountered during construction, 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: SAHRA. 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This 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. A Chance Fossil Finds Procedure for the Upington study region is appended to this report.

5. KEY REFERENCES

ALMOND, J.E. 2008. Fossil record of the Loeriesfontein sheet area (1: 250 000 geological sheet 3018). Unpublished report for the Council for Geoscience, Pretoria, 32 pp.

ALMOND, J.E. 2011a. Proposed Mainstream solar park near Keimoes, Gordinia District, Northern Cape Province. Preliminary desktop screening assessment, 12 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2011b. Proposed Rooipunt Solar Power Park on Farm Rooipunt 617, near Upington, Gordonia District, Northern Cape Province. Palaeontological specialist study: desktop assessment, 12 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014a. Proposed RE Capital 3 Solar Development on the property Dyason's Klip near Upington , Northern Cape. Palaeontological heritage basic assessment: desktop study, 13 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014b. Proposed construction of RE Capital 11 photovoltaic solar facility on the remainder of the Farm Dyasonsklip 454, Upington, Northern Cape. Recommended exemption from further palaeontological studies, 6 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2014c. Proposed construction of Dyasonsklip Solar Energy Facility 1 on the Remainder of the farm Dyasonsklip 454, Upington, Northern Cape. Recommended exemption from further palaeontological studies, 6 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2015. Proposed AEP Bloemsmond Solar 1 & Solar 2 PV Facilities on the farm Bloemsmond 455 near Upington, Siyanda District Municipality, Northern Cape.Recommended exemption from further palaeontological studies, 6 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2019. Proposed Bloemsmond 3, Bloemsmond 4 and Bloemsmond 5 Solar PV Facilities on Portions 5 and 14 of the farm Bloemsmond 455 near Upington and their connection to the National Grid *via* the Upington Main Transmission Substation, ZF Mgcawu District Municipality, Northern Cape. Recommended exemption from further palaeontological studies, 9 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

CORNELL, D.H., THOMAS, R.J., MOEN, H.F.G., REID, D.L., MOORE, J.M. & GIBSON, R.L. 2006. The Namaqua-Natal Province. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Marshalltown.

DINGLE, R.V., SIESSER, W.G. & NEWTON, A.R. 1983. Mesozoic and Tertiary geology of southern Africa. viii + 375 pp. Balkema, Rotterdam.

DURAND, J.F. 2013. Proposed solar energy facility at Tungsten Lodge near Upington, Northern Cape. Scoping report palaeontology, 10 pp.

FOURIE, F., ALMOND, J. & ORTON, J. 2014 Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa. Appendix A3. Heritage Scoping Assessment Report, 79 pp, CSIR.

HADDON, I.G. 2000. Kalahari Group sediments. In: Partridge, T.C. & Maud, R.R. (Eds.) The Cenozoic of southern Africa, pp. 173-181. Oxford University Press, Oxford.

MCCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

MOEN, H.F.G. 2007. The geology of the Upington area. Explanation to 1: 250 000 geology Sheet 2820 Upington, 160 pp. Council for Geoscience, Pretoria.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

THOMAS, M.J. 1981. The geology of the Kalahari in the Northern Cape Province (Areas 2620 and 2720). Unpublished MSc thesis, University of the Orange Free State, Bloemfontein, 138 pp.

THOMAS, D.S.G. & SHAW, P.A. 1991. The Kalahari environment, 284 pp. Cambridge University Press, Cambridge.

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, Gauteng, Limpopo, Northwest, Mpumalanga, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has previously served as 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.

Dr John E. Almond,
Palaeontologist, *Natura Viva* cc

<table>
<tr><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: Dyasons Klip 5 solar facility on RE Dyasons Klip 454 and associated grid connection near Upington</td></tr>
<tr><td>Province & region:</td><td colspan="2">Northern Cape, ZF Mgcawu District Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa.
Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Late Caenozoic alluvium along water courses and calcrete hardpans</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Bones, teeth and horn cores of mammals, freshwater molluscs, calcretised termitaria and other trace fossils</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
Context – describe position of fossils within stratigraphy (rock layering), depth below surface
Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
Photograph fossils against a plain, level background, with scale
Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>