RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

PROPOSED HOTAZEL SOLAR PARK ON THE FARM HOTAZEL ANNEX LANGDON (F278/0), JOE MOROLONG LOCAL MUNICIPALITY, NORTHERN CAPE

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

juwi Renewable Energies (Pty) Ltd is proposing to construct a ≤ 200MW solar PV park on the Farm Hotazel Annex Langdon (F278/0), together with transmission lines and associated infrastructure. The project area is situated close to the small town of Hotazel, Joe Morolong Local Municipality, Northern Cape. It is largely underlain by Quaternary to Recent aeolian (wind-blown) sands of the Gordonia Formation (Kalahari Group). Deep borrow pits and mining excavations in the region show that the surface sands are underlain by a series of thick calcrete hardpans (Mokolanen Formation) as well as locally by consolidated sandy and gravelly deposits of the Kalahari Group. The calcretes crop out at surface along the Ga-Mogara River to the west of Hotazel. The Gordonia sands are themselves only very sparsely fossiliferous, while the only fossil remains recorded from the calcretes beneath them in the Hotazel region are locally abundant, low-diversity invertebrate burrows as well as casts of plant rootlets and of reedy vegetation preserved in subsurface calcrete hardpans. Such trace fossils are of widespread occurrence within the Kalahari region. Impacts on them are likely to be of low significance and special mitigation measures to protect them are not considered warranted.

The overall palaeontological sensitivity of the entire Hotazel Solar Park project area, including the alternative transmission line corridors to Umtu and Hotazel Substations, has been assessed and concluded to be LOW. Small local pockets of HIGH sensitivity might occur around pans as well as along drainage lines - notably the Ga-Mogara River valley that is crossed by the transmission line corridor to Umtu Substation. Plio-Pleistocene calcretised gravels and finer-grained alluvium in these pan and river settings may contain mammalian remains such as bones, teeth and horn cores in addition to abundant, low-diversity trace fossil assemblages.

It is concluded that the overall impact significance of the proposed Hotazel Solar Park development is VERY LOW (-). This assessment applies equally to the PV solar park itself as well as the proposed transmission lines to the national grid and other infrastructure (access roads, on-site substation, operations and maintenance building, laydown area *etc.*). There is no clear preference on palaeontological heritage grounds for any particular technology alternative (*e.g.* fixed axis *versus* single axis PV) or access and service road alignment. The transmission line route option to Umtu Substation would cross the potentially sensitive Ga-Mogara River but impacts on palaeontological heritage here are likely to be small. There is therefore no marked preference for any particular transmission line route option on palaeontological grounds.

Given the very large outcrop area of the sparsely fossiliferous Kalahari Group sediments that are impacted by the numerous mining, railway and alternative energy projects in the vicinity of Hotazel, the cumulative impact of these developments – including that of the Hotazel Solar Park - is assessed as low.

The following mitigation measures to safeguard fossils exposed on site during the construction phase of the development are proposed:

- The EO responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all deeper (> 1 m) excavations into sedimentary bedrock for fossil remains on an on-going basis. If any substantial fossil remains (*e.g.* vertebrate bones, teeth) are found during construction SAHRA should be notified immediately (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) so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer's expense.
- A chance-find procedure should be implemented so that, in the event of fossils being uncovered, the EO/Site Engineer will take the appropriate action, which includes:
    - Stopping work in the immediate vicinity and fencing off the area with tape to prevent further access;
    - Reporting the discovery to the provincial heritage agency and/or SAHRA;
    - Appointing a palaeontological specialist to inspect, record and (if warranted) sample or collect the fossil remains;
    - Implementing further mitigation measures proposed by the palaeontologist; and
    - Allowing work to resume only once clearance is given in writing by the relevant authorities.
- During maintenance and servicing of infrastructure, if excavation is required, it shall be limited to the disturbed footprint as far as practicable. Should bulk works exceed the existing disturbed footprint, SAHRA shall be notified.

If the mitigation measures outlined above are adhered to, the residual impact significance of any construction and operational phase impacts on local palaeontological resources is considered to be low.

The mitigation measures proposed here should be incorporated into the Environmental Management Plan (EMP) for Hotazel Solar Park project.

The palaeontologist concerned with mitigation work will need a valid collection permit from SAHRA. All work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere to the minimum standards for Phase 2 palaeontological studies recently published by SAHRA (2013).

1 OUTLINE OF PROPOSED DEVELOPMENT

juwi Renewable Energies (Pty) Ltd (juwi) is proposing to construct a ≤ 200MW solar PV park on the Farm Hotazel Annex Langdon (F278/0) together with transmission lines to the national grid and associated infrastructure including a 100MWh battery storage facility. The core study area is situated 5 km southeast of the town Hotazel in the Joe Morolong Local Municipality, Northern Cape Province (Fig. 1). Three transmission line route options to evacuate power from the solar facility to the national grid are under consideration. They involve connecting the Solar Facility to one or other of the existing Eskom substations, namely the Hotazel and Umtu substations (< 12 km and < 17.8 lines respectively), or alternatively a shorter Loop-in Loop-Out (LILO) connection option (< 450 m line).

The Hotazel Solar Park project will be submitted as two applications following a Scoping and Environmental Impact Report (S&EIR) process in accordance with the NEMA EIA regulations, 2014, GN R 982 for the solar facility and ancillaries, and a basic assessment for the power evacuation alternatives.

The present palaeontological desktop study covers the project areas of the Hotazel Solar Park as well as the various transmission line route options, as indicated in Figs. 1 and 2. The report has been commissioned by Environmental Services, Aurecon (Contact details: Patrick Killick, Environmental

Services, Aurecon. PO Box 509, George, 6530. Tel: +27 44 8055432. Fax: +27 44 8055454. E-mail: Patrick.Killick@aurecongroup.com).

2 GEOLOGICAL BACKGROUND

The Hotazel Solar Park project area is situated in flat-lying, sandy, semi-desert terrain at 1100 mamsl within the southern Kalahari Region lying between the Korannaberg in the west and the Kurumanheuwels in the East (Fig. 1). The terrain here is fairly featureless Kalahari thornveld. This region is drained by the Ga-Mogara River (a southern tributary of the Kuruman River) and its tributaries, and bedrock exposure is extremely limited due to the thick cover by Kalahari Group sediments. An existing manganese mine is located on the western side of the Farm Hotazel Annex Langdon (F278/0).

The geology of the area around and to the south of Hotazel is covered by the 1: 250 000 scale geological map 2722 Kuruman (Fig. 2). A brief sheet explanation is printed on the map. The Hotazel Solar Park project area is underlain by Pleistocene to Recent aeolian sands of the **Gordonia Formation** (**Kalahari Group**) (Qs in Fig. 2). The geological map as well as recent field studies in the region (Almond 2013a, 2013b) show that the Kalahari sands here are extensively underlain by hardpan calcretes (Tl in Fig. 2), some of which at least can be assigned to the **Mokalanen Formation** of the Kalahari Group. Subdued linear sand dunes trending NW-SE as well as pale calcrete exposures along the Ga-Mogara River and an adjacent pan are clearly visible on satellite images (Fig. 1).There is also a pale zone of probable near-surface calcrete running just to the east of Farm Hotazel Annex Langdon.

The following account of the geology of the Hotazel region has largely been abstracted from previous PIA reports by Almond (2103a, 2013b). Ancient bedrocks of the Transvaal Supergroup and other Precambrian sediments in the Hotazel area are mantled by a thick succession of **superficial sediments** of probable Late Caenozoic (*i.e.* Late Tertiary or Neogene to Recent) age, most of which are assigned to the **Kalahari Group**. 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). Other superficial sediments whose outcrop areas are often not indicated on geological maps include colluvial or slope deposits (scree, hillwash, debris flows *etc.*), sandy, gravelly and bouldery river alluvium, surface gravels of various origins, as well as spring and pan sediments. The colluvial and alluvial deposits may be extensively calcretised (*i.e.* cemented with pedogenic limestone), especially in the neighbourhood of dolerite intrusions or overlying Ghaap Group carbonate rocks.

Calcretes or **surface limestones** (**Ql** in Fig. 2) in the southern Kalahari Region are pedogenic limestone deposits that reflect seasonally arid climates in the region over the last five or so million years. They are briefly described by Truter *et al.* (1938) as well as Visser (1958) and Bosch (1993). The surface limestones may reach thicknesses of over 20 m, but are often much thinner, and are locally conglomeratic with clasts of reworked calcrete as well as exotic pebbles. The limestones may be secondarily silicified and incorporate blocks of the underlying Precambrian carbonate rocks. The older, Pliocene - Pleistocene calcretes in the broader Kalahari region, including sandy limestones and calcretised conglomerates, have been assigned to the **Mokalanen Formation** of the **Kalahari Group** and are possibly related to a globally arid time period between 2.8 and 2.6 million years ago, *i.e.* late Pliocene (Partridge *et al.* 2006).

Large areas of unconsolidated, reddish-brown to grey aeolian (*i.e.* wind-blown) sands of the Quaternary **Gordonia Formation** (**Kalahari Group**; **Qs** in Fig. 2) are mapped in the southern Kalahari study region. According to Bosch (1993) the Gordonia sands in the Kimberley area reach thicknesses of up to eight meters and consist of up to 85% quartz associated with minor feldspar, mica and a range of heavy minerals. 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). Note that the recent extension of the Pliocene - Pleistocene boundary from 1.8 Ma back to 2.588 Ma would place the Gordonia Formation almost entirely within the Pleistocene Epoch. Reworked

and diagenetically altered sands of probable aeolian origin in the Kimberley area are often referred to as Hutton Sands.

3 PALAEONTOLOGICAL HERITAGE

The palaeontological record of the rock units represented in the Hotazel region has been reviewed by Almond (2013a, 2013b) as well as in the desktop study by Groenewald (2013). Fossil biotas recorded from each of the main rock units mapped here are briefly reviewed in Table 1 (based largely on Almond & Pether (2008) and references therein) where an indication of the palaeontological sensitivity of each rock unit is also given. Pervasive calcretisation and chemical weathering of many near-surface bedrocks in the Northern Cape has further compromised their original fossil heritage in many areas.

3.1 Fossils within the Kalahari Group

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 groundwater 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 (Du Toit 1954, Dingle *et al*., 1983). 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. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings such as pans) may be expected occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient, Plio-Pleistocene alluvial gravels.

Table 1. Fossil heritage of rock units represented in the Hotazel study region

GEOLOGICAL UNIT	ROCK TYPES & AGE	FOSSIL HERITAGE	PALAEONT-OLOGICAL SENSITIVITY	RECOMMENDED MITIGATION
OTHER LATE CAENOZOIC TERRESTRIAL DEPOSITS OF THE INTERIOR **(Most too small to be indicated on 1: 250 000 geological maps)**	**Fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes, spring tufa / travertine, cave deposits, peats, colluvium, soils, surface gravels including downwasted rubble** **MOSTLY QUATERNARY TO HOLOCENE (Possible peak formation 2.6-2.5 Ma)**	**Bones and teeth of wide range of mammals (*e.g.* mastodont proboscideans, rhinos, bovids, horses, micromammals), reptiles (crocodiles, tortoises), ostrich egg shells, fish, freshwater and terrestrial molluscs (unionid bivalves, gastropods), crabs, trace fossils (*e.g.* termitaria, horizontal invertebrate burrows, stone artefacts), petrified wood, leaves, rhizoliths, diatom floras, peats and palynomorphs. calcareous tufas at edge of Ghaap Escarpment might be highly fossiliferous (*cf* Taung in NW Province – abundant Makapanian Mammal Age vertebrate remains, including australopithecines)**	**LOW** **Scattered records, many poorly studied and of uncertain age**	**Any substantial fossil finds to be reported by ECO to SAHRA**
Gordonia Formation (Qs) **KALAHARI GROUP *plus*** **SURFACE CALCRETES (Tl / Qc)**	**Mainly aeolian sands *plus* minor fluvial gravels, freshwater pan deposits, calcretes** **PLEISTOCENE to RECENT**	**Calcretised rhizoliths & termitaria, ostrich egg shells, land snail shells, rare mammalian and reptile (*e.g.* tortoise) bones, teeth** **freshwater units associated with diatoms, molluscs, stromatolites *etc***	**LOW**	**Any substantial fossil finds to be reported by ECO to SAHRA**

Palaeontological fieldwork at several sites some 10 to 15 km south of Hotazel (Almond 2013a, 2013b) indicated that the Gordonia sands and underlying calcretes here are very sparsely fossiliferous. The only fossil remains recorded from these sediments in the wider study region are locally abundant, low-diversity invertebrate burrows as well as casts of plant rootlets and of reedy vegetation preserved in subsurface calcrete hardpans. These trace fossils were probably associated with damp *vlei* settings within largely abandoned river channels. Such trace fossils are of widespread occurrence within the Kalahari region so impacts on fossil heritage here are likely to be of low conservation significance and special mitigation measures to protect them are not considered warranted.

The overall palaeontological sensitivity of the entire Hotazel Solar Park project area is assessed as LOW, although pockets of HIGH sensitivity may occur locally, especially along drainage lines (*e.g.* Ga-Mogara River) and around any pans. Plio-Pleistocene calcretised gravels and finer-grained alluvium in these last settings may contain mammalian remains such as bones, teeth and horn cores in addition to abundant, low-diversity trace fossil assemblages.

4 CONCLUSIONS & RECOMMENDATIONS

The overall palaeontological sensitivity of the entire Hotazel Solar Park project area, including the alternative transmission line corridors to Umtu and Hotazel Substations, is assessed as LOW. Small pockets of locally HIGH sensitivity might occur along drainage lines - notably the Ga-Mogara River valley that is crossed by the transmission line corridor to Umtu Substation - and around any pans. Plio-Pleistocene calcretised gravels and finer-grained alluvium in these last settings may contain mammalian remains such as bones, teeth and horn cores in addition to abundant, low-diversity trace fossil assemblages.

It is concluded that the overall impact significance (pre-mitigation) of the proposed Hotazel Solar Park development is VERY LOW (-). This assessment applies equally to the PV solar park itself as well as the proposed transmission lines and other infrastructure (access roads, on-site substation, battery storage facility operations and maintenance building, laydown area *etc.*). There is no clear preference on a palaeontological heritage grounds for any particular project alternatives (*e.g.* fixed axis *versus* single axis

PV *versus* with or without battery storage), access and service roads, or transmission line route option. The transmission line to Umtu Substation would cross the potentially sensitive Ga-Mogara River but impacts on palaeontological heritage here are likely to be very low.

As shown on the SAHRIS website, there are numerous ongoing and proposed mining, railway and other developments located in the immediate vicinity of Hotazel and the present solar park project. To the author's knowledge, the only palaeontological impact assessments submitted for these projects are those by Almond (2013a, 2013b) as well as Groenewald (2013). In all three cases, the impact significance of the proposed developments were assessed as low. Given the very large outcrop area of the sparsely fossiliferous Kalahari Group sediments involved here, the cumulative impact of the proposed developments around Hotazel is assessed as low.

The following mitigation measures to safeguard fossils exposed on site during the construction phase of the development are proposed:

- The EO responsible for the development must remain aware that all sedimentary deposits have the potential to contain fossils and he/she should thus monitor all deeper (> 1 m) excavations into sedimentary bedrock for fossil remains on an on-going basis. If any substantial fossil remains (*e.g.* vertebrate bones, teeth) are found during construction SAHRA should be notified immediately (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) so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer's expense.
- A chance-find procedure should be implemented so that, in the event of fossils being uncovered, the EO/Site Engineer will take the appropriate action, which includes:
    - Stopping work in the immediate vicinity and fencing off the area with tape to prevent further access;
    - Reporting the discovery to the provincial heritage agency and/or SAHRA;
    - Appointing a palaeontological specialist to inspect, record and (if warranted) sample or collect the fossil remains;
    - Implementing further mitigation measures proposed by the palaeontologist; and
    - Allowing work to resume only once clearance is given in writing by the relevant authorities.
- During maintenance and servicing of infrastructure, if excavation is required, it shall be limited to the disturbed footprint as far as practicable. Should bulk works exceed the existing disturbed footprint, SAHRA shall be notified.

If the mitigation measures outlined above are adhered to, the residual impact significance of any construction and operational phase impacts on local palaeontological resources is considered to be very low.

The mitigation measures proposed here should be incorporated into the Environmental Management Plan (EMP) for Hotazel Solar Park project.

The palaeontologist concerned with mitigation work, if needed, will need a valid collection permit from SAHRA. All work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere to the minimum standards for Phase 2 palaeontological studies recently published by SAHRA (2013).

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

Figure 1: Google earth© satellite image of the Hotazel Solar Park project area, Northern Cape. The yellow polygon indicates Farm Hotazel Annex Langdon (F278/0). Transmission line route options to Umtu and Hotazel Substations are indicated in purple and green respectively. Access road options are shown by the red lines. The small blue rectangle is the proposed location of the onsite substation.

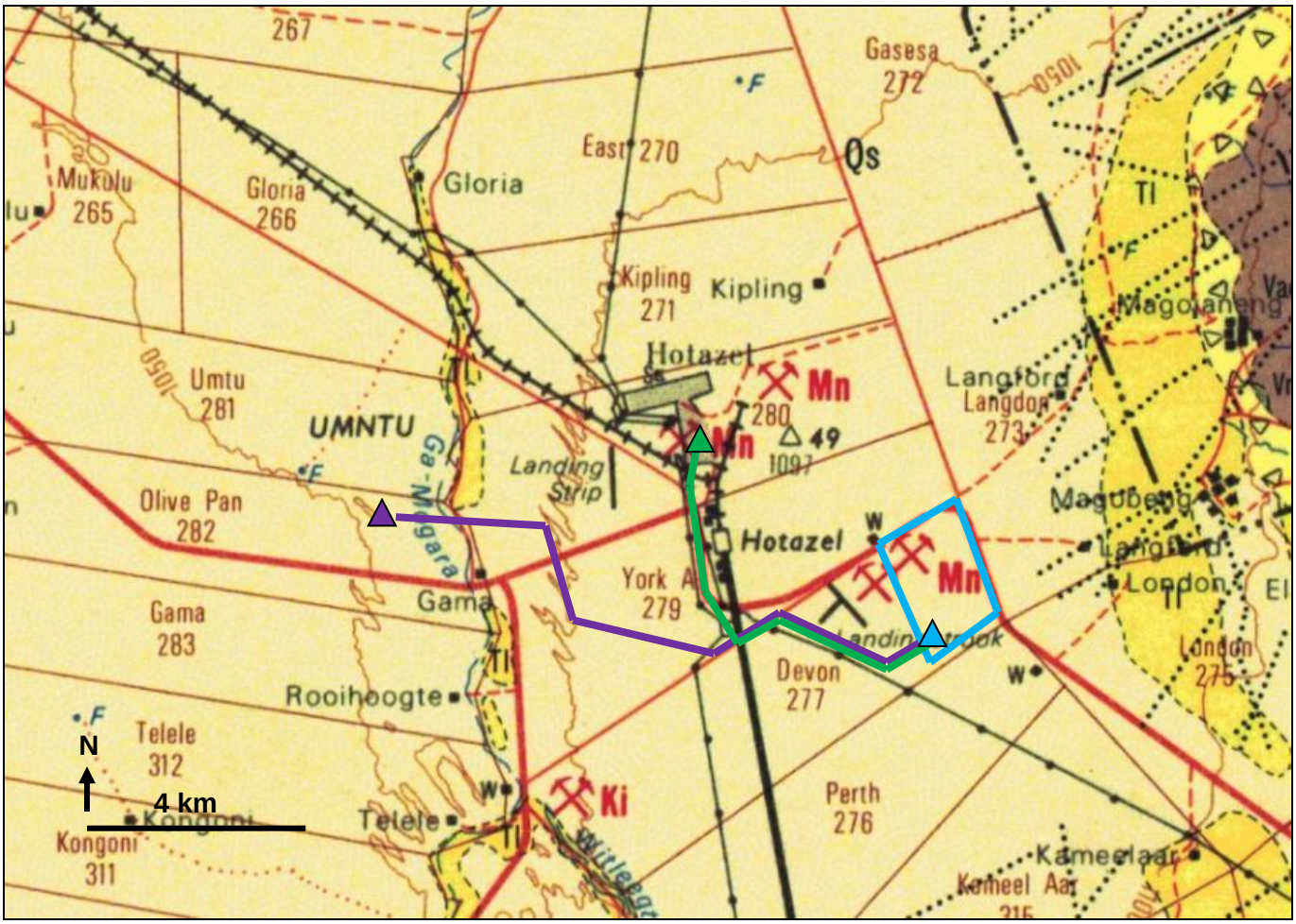

Figure 2: Extract from 1: 250 000 geology map 2722 Kuruman (Council for Geoscience, Pretoria) showing location of the Farm Hotazel Annex Langdon (F278/0) (pale blue rectangle to the SE of Hotazel, Northern Cape. Transmision line route options to Umtu (purple triangle) and Hotazel (green triangle) Substations are indicated in purple and green respectively. The blue triangle is the proposed location of the onsite substation. The great majority of the project area is underlain by aeolian sands of the Gordonia Formation (Kalahari Group) (Qs, pale yellow areas on the map). These are extensively underlain by thick near-surface calcrete that crops out at surface along the Ga-Mogara River and around pans (Tl, darker yellow).