Palaeontological Impact Assessment for the proposed Quantum 1 Solar Energy Facility (SEF) near Krugersdorp, Gauteng Province

CTS23_071_Savannah_Quantum 1 SEF

Site Visit Report (Phase 2)

For

CTS Heritage

25 June 2023

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf, PSSA
Experience: 34 years research; 26 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by CTS Heritage, Simons Town, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed development of the Quantum 1 Solar Energy Facility (SEF) near Krugersdorp, Gauteng Province.

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the potentially fossiliferous Malmani Subgroup (Transvaal Supergroup) that could preserve trace fossils such as stromatolites or microbialites in the dolomites. The site visit and walk through on 20th June 2023 confirmed that there were NO FOSSILS in the area for the proposed Solar collectors. The area is covered by soils and no dolomites were present. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, developer, environmental officer or other designated responsible person once excavations for pole foundations or solar collectors and infrastructure have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	High	Low	Paleontological Impact Assessment	Section 7.2. SAHRA Requirements

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1. Background

South Africa Mainstream Renewable Power Developments (Pty) Ltd is proposing the construction and operation of a solar photovoltaic (PV) facility and associated infrastructure on Portion 285 (a portion of portion 19) of the Farm Vlakplaats 160, located approximately 7.2km west of Krugersdorp, within the Mogale City Local Municipality in the West Rand District Municipality in the Gauteng Province. The facility will have a contracted capacity of up to 10MW and will be known as Quantum 1 Solar Energy Facility.

A preferred development area with an extent of ~94.1479ha has been identified by South Africa Mainstream Renewable Power Developments (Pty) Ltd as technically suitable for the development of the Quantum 1 Solar Energy Facility. The facility will comprise the following infrastructure:

- Solar PV array comprising solar modules.
- Mounting System Technology
- Inverters and transformers.
- Low voltage cabling between the PV modules to the inverters.
- Overhead power lines
- Onsite substation, switching substation and laydown areas.
- Battery Energy Storage System (BESS) and associated infrastructure.
- Internal access roads.
- Fence around the project development areas.

A summary of the details and dimensions of the planned infrastructure associated with the project is provided in Table 1.

Table 1: Details of typical infrastructure required for the 10MW Quantum 1 SEF.

Component	Description / Dimensions
District Municipality	West Rand District Municipality
Local Municipality	Mogale City Local Municipality
Ward Number (s)	Ward 30
Nearest town(s)	Krugersdorp (7.2km east)
Farm name(s) and number(s) of properties affected by the PV Facility, incl SG 21 Digit Code (s)	Portion 265 (a portion of portion 19) of the Farm Vlakplaats 160 (T0IQ00000000016000265)
Current zoning	Agriculture
Site Coordinates (centre of development area)	26° 4'8.17"S, 27°38'55.89"E
Total extent of the Affected Properties, also referred to as the project site[1]	~94.1479ha

[1] The project site is that identified area within which the development area and development footprint are located. The project site is ~93ha in extent and only consist of one affected property.

Total extent of the Development area[2]	~94.1479ha
Total extent of the Development footprint[3]	To be confirmed following specialist input during the scoping phase
Contracted capacity of the PV facility	10MW
PV panels	Height: up to 5m from ground level (installed)
Power line capacity	11kV
Power line servitude width	Up to 18m
Grid connection	To be evacuated from the onsite substation via 11kV Monopole or lattice structure pylons to the Eskom Tarlton 132/44/11kV substation located on the same land parcel as the proposed PV facility. This will form part of a separate EA process.
On-site Facility Substation, and O&M buildings	Located within the development area. Approximately 1.5ha in extent.
Battery Energy Storage System (BESS)	The BESS area will form part of the 1.5ha allocated for other infrastructure.
Access roads and internal roads	Existing roads will be used as far as possible. There are existing gravel roads that can be utilized for site access (width of up to 6m). Upgrading of existing roads or new roads may be required.

The Quantum 1 SEF is proposed in response to the identified objectives of the national and provincial government and local and district municipalities to develop renewable energy facilities for power generation purposes. It is the developer's intention to submit a bid in terms of a regulated power purchase procurement process (e.g., REIPPPP) with the aim of evacuating the generated power into the national grid or obtaining a commercial PPA (Power Purchase Agreement). This will aid in the diversification and stabilisation of the country's electricity supply, in line with the objectives of the Integrated Resource Plan (IRP) with the Quantum 1 SEF set to inject up to 10MW (peak AC power) into the national grid.

From a regional perspective, the area within the West Rand District Municipality identified for the project is considered favourable for the development of a commercial PV facility due to the low environmental sensitivity of the identified site, excellent solar resource, and availability of land on which the development can take place. There is also potential for evacuating the power to the national grid via a direct grid connection at the Eskom Tarlton 132/44/11kV substation which is adjacent to the proposed site. The site is also in proximity to large electricity users which opens opportunities for commercial PPAs (Behind the meter connection Or Wheeling to a 3rd party off-taker).

<u>For the purposes of the BA process, the following terms will be used:</u>

Project: Project includes the PV facility and all of the associated infrastructures.

[2] The development area is that identified area where the 10MW PV facility is planned to be located. This area has been selected as a practicable option for the facility, considering technical preference and constraints. The development area is ~94.1479ha in extent.

[3] The development footprint is the defined area (located within the development area) where the PV panel array and other associated infrastructure for the Quantum 1 Solar Energy Facility is planned to be constructed. This is the actual footprint of the facility, and the area which would be disturbed.

Project Site/Area: The Project Site/Area is the area with an extent of approx. 94.1479ha, within which the Quantum 1 Solar PV Facility development footprint will be located.

A Palaeontological Impact Assessment was requested for the Quantum 1 Solar Energy Facility. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit and walkthrough (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 2: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report,	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

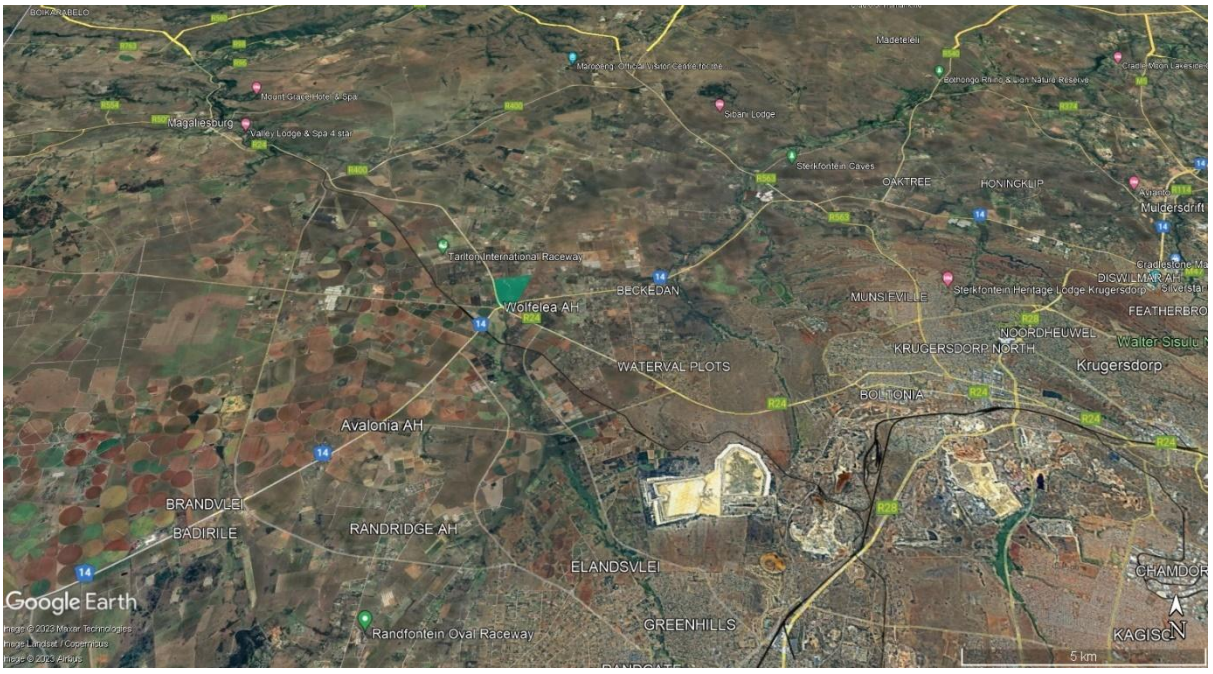

Figure 1: Google Earth map of the proposed development showing the relevant landmarks.

Figure 2: Google Earth map for the proposed Quantum 1 SEF on Farm Vlakplaats 160.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance, as is the case here;
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

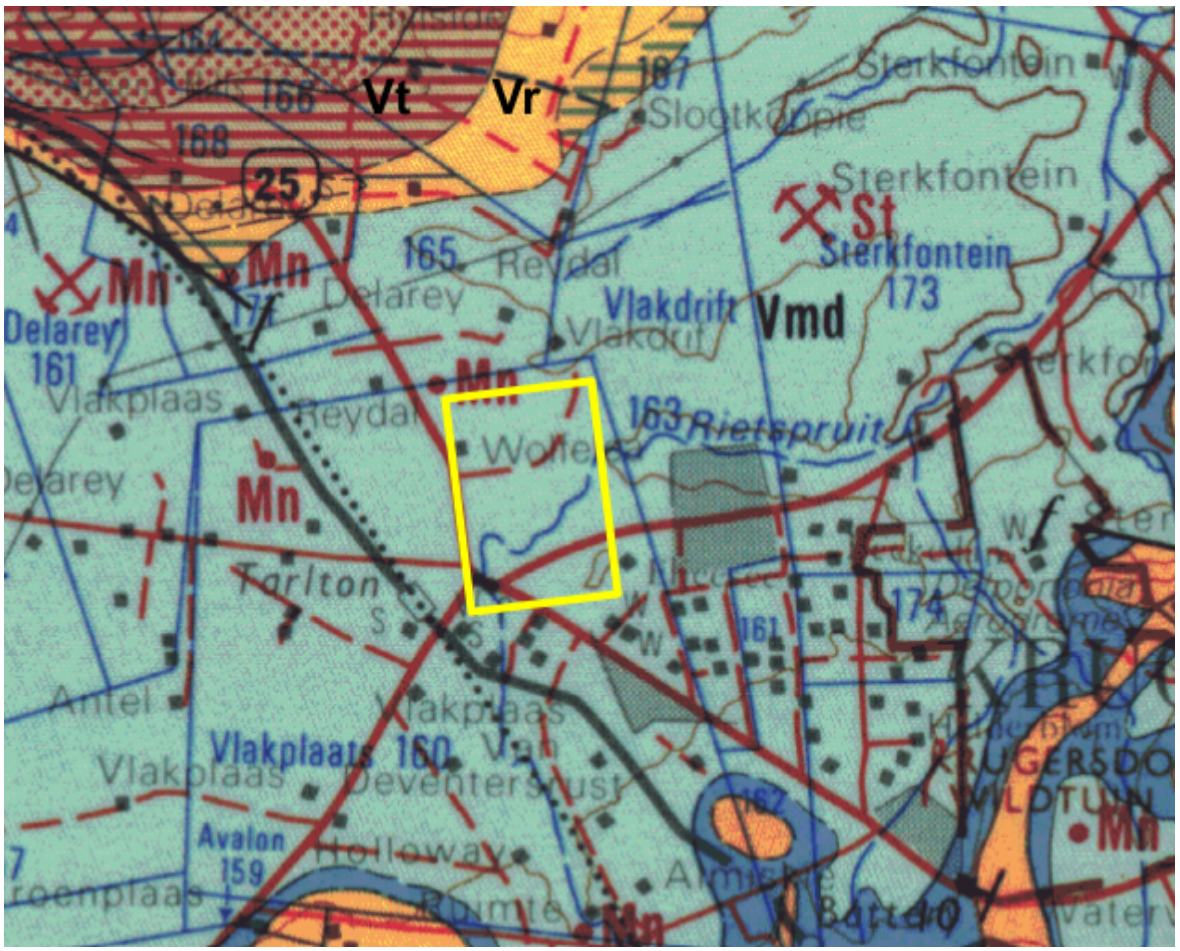

Figure 3: Geological map of the area around the Farm Vlakplaats 160 with the Quantum SEF site within the yellow polygon. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2626 West Rand.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006; Eriksson et al., 2006; Zeh et al., 2020). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Vdi	diabase	Diabase	Post-Transvaal SG
Vr	Rooihoogte Fm, Pretoria Group, Transvaal SG	Andesite, agglomerate, tuff	Palaeoproterozoic
Vt	Timeball Hill Fm Pretoria Group, Transvaal SG	Quartzite	Palaeoproterozoic < 2420 Ma
Vmd	Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dolomite, chert	Palaeoproterozoic Ca 2650 – 2640 Ma
Vbr	Black Reef Fm, Transvaal SG	Quartzite, conglomerate, shale, basalt	Palaeoproterozoic Ca 2750 – 2650 Ma

Symbol	Group/Formation	Lithology	Approximate Age
Rh	Hospital Subgroup, West Rand Group, Witwatersrand SG	Quartzite, shale, greywacke, conglomerate	Mesoarchaean Ca 2890 Ma
Rg	Government Subgroup, West Rand Group, Witwatersrand SG	Quartzite, shale, greywacke, conglomerate	Mesoarchaean Ca 2890 Ma

The project lies in the south western part of the Transvaal Basin where the lower rocks of the Transvaal Supergroup are exposed, in particular the dolomites of the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup; ca 2585-2480 Ma), Figure 3. These rocks unconformably overlie the ancient rocks of the Witwatersrand Supergroup.

The Late Archaean to early Proterozoic Transvaal Supergroup is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Griqualand West Basin is divided into the Ghaap Plateau sub-basin and the Prieska sub-basin. Sediments in the lower parts of the basins are very similar but they differ somewhat higher up the sequences. Several tectonic events have greatly deformed the south western portion of the Griqualand West Basin between the two sub-basins

In the Transvaal Basin the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group and the upper Pretoria Group (with ten formations; Eriksson et al., 2006). The Chuniespoort Group is divided into the basal **Malmani Subgroup** that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces. The top of the Chuniespoort Group has the Penge Formation and the Duitschland Formation.

Making up the lower Pretoria Group are the Timeball Hill Formation and the Boshoek Formation. The Hekpoort, Dwaalheuwel, Strubenkop and Daspoort Formations form a sequence as the middle part of the Pretoria Group, Transvaal Supergroup, and represent rocks that are over 2060 million years old. The Hekpoort Formation is a massive lava deposit and is overlain by the rest of the Transvaal Supergroup.

The Transvaal sequence has been interpreted as three major cycles of basin infill and tectonic activity with the first deep basin sediments forming the Chuniespoort Group, the second cycle deposited the lower Pretoria Group, and the sediments in this area are from the interim lowstand that preceded the third cycle. These sediments were deposited in shallow lacustrine, alluvial fan and braided stream environments (Eriksson et al., 2012).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is in the very highly sensitive Malmani Subgroup (Transvaal Supergroup).

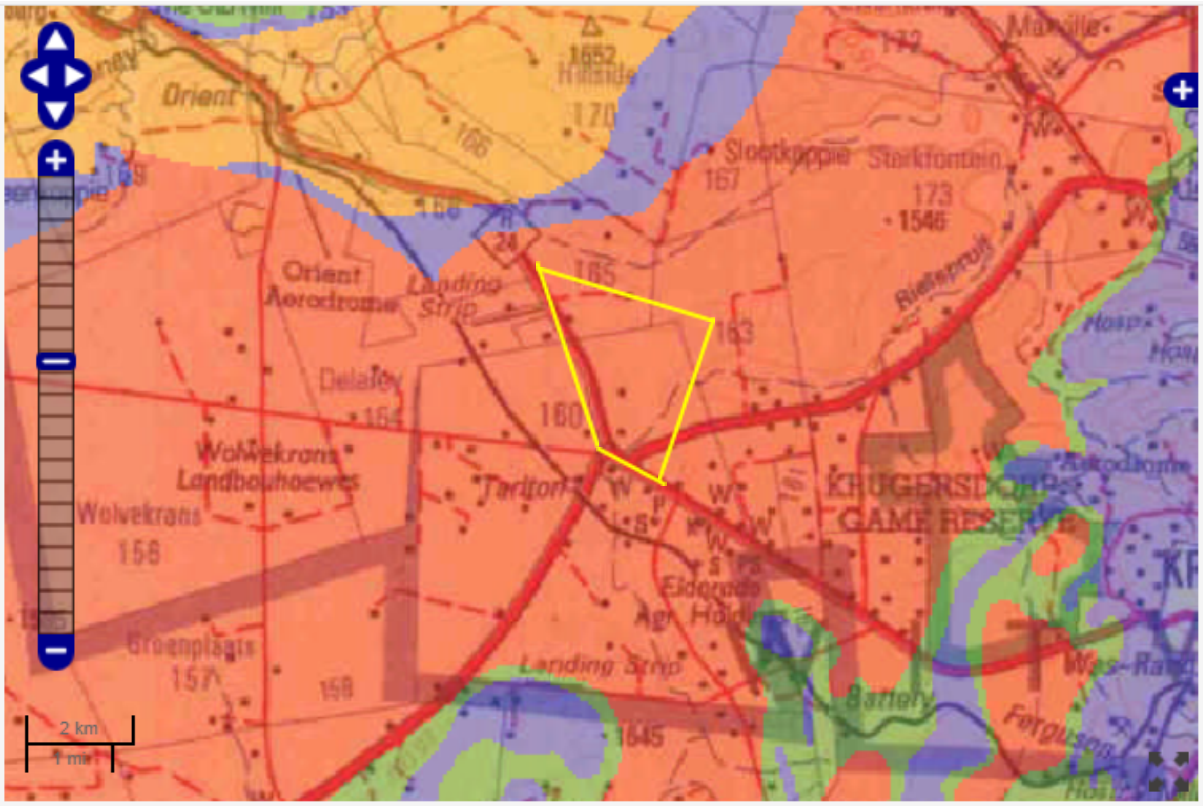

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed Quantum 1 SEF (yellow polygon). Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The Transvaal Supergroup rocks represent on a very large scale, a sequence of sediments filling the basins under conditions of lacustrine, fluvial, volcanic and glacial cycles in a tectonically active region. The predominantly carbonaceous sediments are evidence of the increase in the atmosphere of oxygen produced by algal colony photosynthesis, the so-called Great Oxygen Event (ca 2.40 – 2.32 Ga) and precursor to an environment where diverse life forms could evolve. The Neoarchean-Paleoproterozoic Transvaal Supergroup in South Africa contains the well-preserved stromatolitic Campbellrand -Malmani carbonate platform (Griqualand West Basin – Transvaal Basin respectively), which was deposited in shallow seawater shortly before the Great Oxidation Event (GOE).

The Transvaal Supergroup comprises one of world's earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas and deposited layer upon layer of minerals, often in domes or columns. The minerals are predominantly calcium carbonate, calcium sulphate, magnesium carbonate and magnesium sulphate. Only very rarely are the bacteria and algae preserved but the stromatolites are traces of their activity, hence call trace fossils. These fossils are protected by legislation, therefore the Malmani Subgroup palaeosensitivity is very high (Figure SAHRIS).

iii. Site visit observations

Figure 5: Quantum Solar 1 site visit route map (red line). Site photographs are given in figures …. And the captions provide the observations.

In summary, the area is generally flat and open with low secondary grassland, and in some places, burned, grassland. Visibility was very good. Exotic trees are scattered around. It is very disturbed from previous urban or agricultural activities and the soils appear to be fairly deep.

There were no rocky outcrops of any kind. There were no outcrops of dolomites and hence no trace fossils such as stromatolites or microbialites (Figures 6-8).


A


B

Figure 6: Quantum site visit photographs. Northern section with housing along the margin (A) and a powerline (B). Open field with burned grass showing the lack of any rocky outcrops.

Figure 7: Central part of the Quantum SEF area. Open flat areas with no rocks, no dolomites and no fossils.

Figure 8: Quantum site visit photographs. A – gum trees in the distance and evidence of demolished structures. B – Power lines and substation. No rocks, no dolomites and no fossils.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 4:

Table 4a: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 4b: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-
	L	Soils do not preserve plant fossils; so far there are no records from the Malmani Subgroup of trace fossils of straomatolites in this region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-

PART B: Assessment		
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be trace fossils such as stromatolites in the dolomites, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the loose sand that will be excavated but there might be stromatolites in the dolomites. Therefore, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the correct age and type to preserve fossils. The site visit and walk through confirmed that there were NO FOSSILS in the project footprint. Since there is an extremely small chance that trace fossils from the Malmani Subgroup may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and only some do contain trace fossils, fossil plant, insect, invertebrate and vertebrate material. The site visit and walk through on 20th June 2023 by palaeontologists Rick Tolchard and Brandon Stuart confirmed that there are NO FOSSILS in the proposed area for the solar collectors. The overlying sands and soils of the Quaternary period would not preserve fossils.

6. Recommendation

Based on the fossil record but confirmed by the site visit and walk through there are NO FOSSILS of the project footprint. Although stromatolites have been recorded from some exposures of the Malmani Subgroup, enabling the recognition of the Formations within this group, stromatolites, oolitic and algal dolomite are absent from this region. It is

extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that trace fossils may occur below the ground surface in the dolomites of the Malmani Subgroup so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer or other responsible person once excavations and drilling have commenced, then they should be rescued and a palaeontologist called to assess and collect a representative sample.

Since there is an extremely small chance of fossils being impacted by this project, as far as the palaeontology is concerned, the project should be authorised.

7. References

Beukes, N.J., 1987. Facies relations, depositional environments and diagenesis in a major early Proterozoic stromatolitic carbonate platform to basinal sequence, Campbellrand Subgroup, Transvaal Supergroup, southern Africa. Sedimentary Geology 54, 1-46.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. 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. pp 237-260.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Zeh, A., Wilson, A.H., Gerdes, A., 2020. Zircon U-Pb-Hf isotope systematics of Transvaal Supergroup – Constraints for the geodynamic evolution of the Kaapvaal Craton and its hinterland between 2.65 and 2.06 Ga. Precambrian Research 345, 105760. https://doi.org/10.1016/j.precamres.2020.105760

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, fossils of plants, insects, bone or coalified material) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the

shales and mudstones (for example see Figure 9). This information will be built into the EMP's training and awareness plan and procedures.

4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – Examples of fossils from the Malmani Subgroup

Figure 9: Photographs of dolomite and stromatolites as seen in the field.

9. Appendix B – Details of specialists

Marion Bamford (PhD)

Short CV for PIAs – June 2023

I) **Personal details**

Present employment: Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa

Telephone : +27 11 717 6690
Fax : +27 11 717 6694
Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) **Academic qualifications**
Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) **Professional qualifications**
Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) **Membership of professional bodies/associations**
Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) **Supervision of Higher Degrees**
All at Wits University

Degree	Graduated/completed	Current
Honours	11	0
Masters	14	1
PhD	11	6
Postdoctoral fellows	12	2

viii) **Undergraduate teaching**
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12 - 20 students per year.

ix) **Editing and reviewing**
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) **Palaeontological Impact Assessments**

Selected from recent project only – list not complete:

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2021 for AHSA

Xi) **Research Output**

Publications by M K Bamford up to July 2022 peer-reviewed journals or scholarly books: over 170 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 31; Google Scholar h-index = 39; -i10-index = 116
Conferences: numerous presentations at local and international conferences.

Mr Frederick Tolchard

Brief Curriculum Vitae – June 2023

Academic training
BA Archaeology – University of the Witwatersrand, graduated 2015
BSc (Honours) Palaeontology – University of the Witwatersrand, 2017 with distinction
MSc Palaeontology – University of the Witwatersrand, 2018 – 2019. Graduated 2020 with Distinction
PhD Palaeontology – Wits – 2020 - current

Field Experience
Honours Fieldtrip – Karoo biostratigraphy – April 2017
Research fieldwork – Elliot Formation with Prof Choiniere – April 2018, Nov 2018; April 2019; Sept 2021

Publications
Tolchard, F., Nesbitt, S.J., Desojo, J.B., Viglietti, P.A., Butler, R.J. and Choiniere, J.N., 2019. 'Rauisuchian' material from the lower Elliot Formation of South Africa: Implications for late Triassic biogeography and biostratigraphy. Journal of African Earth Sciences, 160, 103610.

Viglietti, P.A., McPhee, B.W., Bordy, E.M., Sciscio, L., Barrett, P.M., Benson, R.B.J., Wills, F., Tolchard, F., Choiniere, J.N., 2020. Biostratigraphy of the Scalenodontoides Assemblage Zone (Stormberg Group, Karoo Supergroup), South Africa. South African Journal of Geology 123, 239-248.

Tolchard F., Kammerer C., Butler R.J., Abdala F., Hendrickx C., Benoit J., Choinière J.N. (2021.) A very large new trirachodontid from the Triassic of South Africa and its implications for Gondwanan biostratigraphy. Journal of Vertebrate Paleontology. DOI: 10.1080/02724634.2021.1929265.

PIA fieldwork projects
2018 May – Williston area – SARAO project, Digby Wells
2018 September – Lichtenburg PVs – CTS Heritage
2018 November – Nomalanga farming – Digby Wells
2019 January – Thubelisha coal – Digby Wells
2019 March – Matla coal – Digby Wells
2019 March – Musina-Machado SEZ – Digby Wells
2019 June – Temo coal – Digby Wells
2019 September – Makapanstad Agripark – Plantago
2020 January – Hendrina, Kwazamakuhle – Kudzala
2020 February – Hartebeestpoort Dam - Prescali
2020 March – Twyfelaar Coal mine – Digby Wells
2020 March – Ceres Borrow Pits – ACO Associates
2020 March – Copper Sunset Sand – Digby Wells
2020 October – Belfast loop and Expansion – Nsovo
2020 October – VLNR lodge Mapungubwe – HCAC
2020 November – Delmore Park BWSS - HCAC

2020 December – Kromdraai commercial – HCAC
2021 January – Welgedacht Siding – Elemental Sustainability
2021 March – Shango Kroonstad – Digby Wells
2021 May – Copper Sunset sand mining – Digby Wells
2021 August – New Largo Pit – Golder
2021 August – Khutsong Ext 8 housing, Carletonville, for Afzelia
2021 September – Lichtenburg PV facility – CTS Heritage
2021 October – Ogies South MR – beyondgreen
2021 October – Nooitgedacht Colliery MR – Shangoni
2022 January – Sigma PVs Sasolburg – CTS Heritage
2022 March – Taaibosch Puts PVs – CTS Heritage
2022 March – Modder East Operations – Prime Resources
2022 March – Driefontein mine revised infrastructure – Amber Earth
2022 March – Transnet MPP Access routes, inland and coastal - ENVASS
2022 June – Roodepoort MRA, Rietspruit – Eco-Elementum
2022 July – Highveld Colliery for Eco-Elementum
2022 July – Doornrug and Kleinwater Collieries for Eco-Elementum
2022 November – Kendal Plots, Ogies, for Amber Earth
2022 November – Boschmanspoort, Hendrina for Eco-Elementum
2022 December – Newcastle Coal for Cabanga Environmental
2023 January – Virginia SEFs x 4 for AGES Limpopo (Pty) Ltd
2023 June – Blyvoor Gold Solar for Digby Wells

Brandon Stuart CV

June 2023

After completing my BSc degree majoring in Zoology and Genetics in 2019, in 2020 I enrolled and completed a BSc Honours degree majoring in Zoology and specializing in Paleontology. My Honours research project was focused on describing the postcranial anatomy of the therocephalian *Moschorhinus kitchingi,* supervised by Dr. Jennifer Botha at the National Museum, Bloemfontein.

I have completed my Masters degree at the University of the Free State in Palaeobiology (graduated April 2023). I carried out my research through the National Museum, Bloemfontein supervised by Dr. Jennifer Botha. My research is focused on studying the postcranial morphology of therocephalian therapsids from the Karoo Basin of South Africa. In March 2023, I registered for a doctoral degree at the University of the Witwatersrand, in the Evolutionary Studies Institute and will be supervised by Prof Botha and Prof Jonah Choiniere.

Qualifications
BSc – Majors: Genetics and Geology - University of the Free State – 2019
BSc Honours – Palaeontology – University of the Free State – 2020
MSc – Palaeontology – University of the Free State – graduated April 2023.
PhD – Palaeontology – University of the Witwatersrand – March 2023 onwards.

PIA Fieldwork Experience
July 2021 – Sannaspos SEF, Free State, for CTS Heritage
October 2021 – Beatrix Mine-Theunissen Eskom Powerline for 1World
January 2022 – Fouriesburg residential development for Mang Geoenviron-mental
February 2022 – Balkfontein-Doornhoek 11 kV powerline for 1World
March 2022 – Transnet MPP Access routes, inland and coastal for ENVASS
June 2022 – Koria-Boesmanshoek 22 kV powerline for 1World
January 2023 – Virginia SEFs x 4 Phase 2 for AGES Limpopo (Pty) Ltd.
February 2023 – Tournee SEFs for CTS Heritage
February 2023 – Ujekamanzi SEFs for CTS Heritage
March 2023 – Nala Concrete Batch Plant, Bethal, for CTS Heritage
March 2023 – Roos Solar PV Facility, Belfast, for CTS Heritage
April 2023 – Riverplaats SEF, Sasolburg, for CTS Heritage
May 2023 – Ext 69 Witfontein residential for EP3 Environmental
May 2023 – Dalpark and Struisbult Pumpstation upgrades for AquaStrat Solutions
May 2023 – Kopermyn expansion for Eco-Elementum
June 2023 – Blyvoor Gold Solar for Digby Wells

References:
Dr Jennifer Botha, Head of Palaeontology, National Museum, Bloemfontein
jbotha@nasmus.ac.za

Prof Jonah Choiniere, Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg
Jonah.choiniere@wits.ac.za
