CTS HERITAGE

## APPENDIX 2: Palaeontological Assessment

# Palaeontological Impact Assessment for the proposed development of the Khunab Photovoltaic facility to the west of Upington, Northwest Province

**Desktop Study**

**For**

**CTS Heritage and Savannah**

**20 June 2019**

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## Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 22 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, Cape 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 Khunab Photovoltaic facility for Atlantic Renewable Energy Partners that will comprise the construction and operation of four Solar Energy Facilities and two associated grid solutions to the west of Upington. The project will be on portions of the Farms Kalkpunt 452 and McTaggart's camp 453. To comply with 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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site (PV facilities, infrastructure and powerline corridors) lies on the red aeolian and alluvial sands of the Quaternary Gordonia Formation, Kalahari Group, that are underlain by other Kalahari Group sediments, probably calcretes. Fossils are not preserved in loose sands but can occur in palaeo-pans and palaeo-channels from past rivers. None has been recorded in this footprint and are not evident from the geological maps or Google-Earth imagery. The area is indicated as moderately sensitive on the SAHRIS map but this seems unlikely. Nonetheless a Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required unless fossils are discovered when excavations commence. As far as the palaeontology is concerned there is no preferred alternative route.

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# 1. Background

A Palaeontological Impact Assessment was requested for the proposed construction of a Photovoltaic facility, west of Kimberley, the Khunab Photovoltaic (PV) facilities and associated overhead powerline (OHP) project. The project will be on central portions of Farms Kalkpunt 452 and McTaggart's Camp 453 (Figure 1).

Atlantic Renewable Energy Partners are proposing the construction and operation of four Solar Energy Facilities and two associated grid solutions on a site located within the Upington REDZ, close to and south west of Upington in the Northern Cape. Each proposed solar energy project is proposed to be 75MW in capacity. Each facility will consist of an on-site substation and a 132kV power line. The 132kV power line associated with each facility will connect to a proposed collector substation and an associated 400kV power line which will connect the four PV facilities to the national grid. The power lines associated with the facilities and the collector substation will be assessed as part of a 300m power line corridor (two alternatives are proposed) and as part of two separate basic assessment processes.

The location of the project site within a REDZ and Power Corridor makes it possible to undertake Basic Assessment (BAR) processes for the projects in support of the application for authorisation. Separate applications for Authorisation are to be made for each solar energy facility and for each grid connection solution (i.e. collector substation and 400kV power line).

To comply with 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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development of the PV facilities as well as the powerlines.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2017)

| | **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 1 |
| 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: | Yes |

| | | |
|---|---|---|
| | SAHRIS palaeosensitivity map accessed – date of this report | |
| 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 |
| 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 | 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 | Appendix A |
| ni | A reasoned opinion as to whether the proposed activity or portions thereof should be authorised | N/A |
| 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 | N/A |
| 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 if any comments that were received during any consultation process | N/A |
| q | Any other information requested by the competent authority. | N/A |

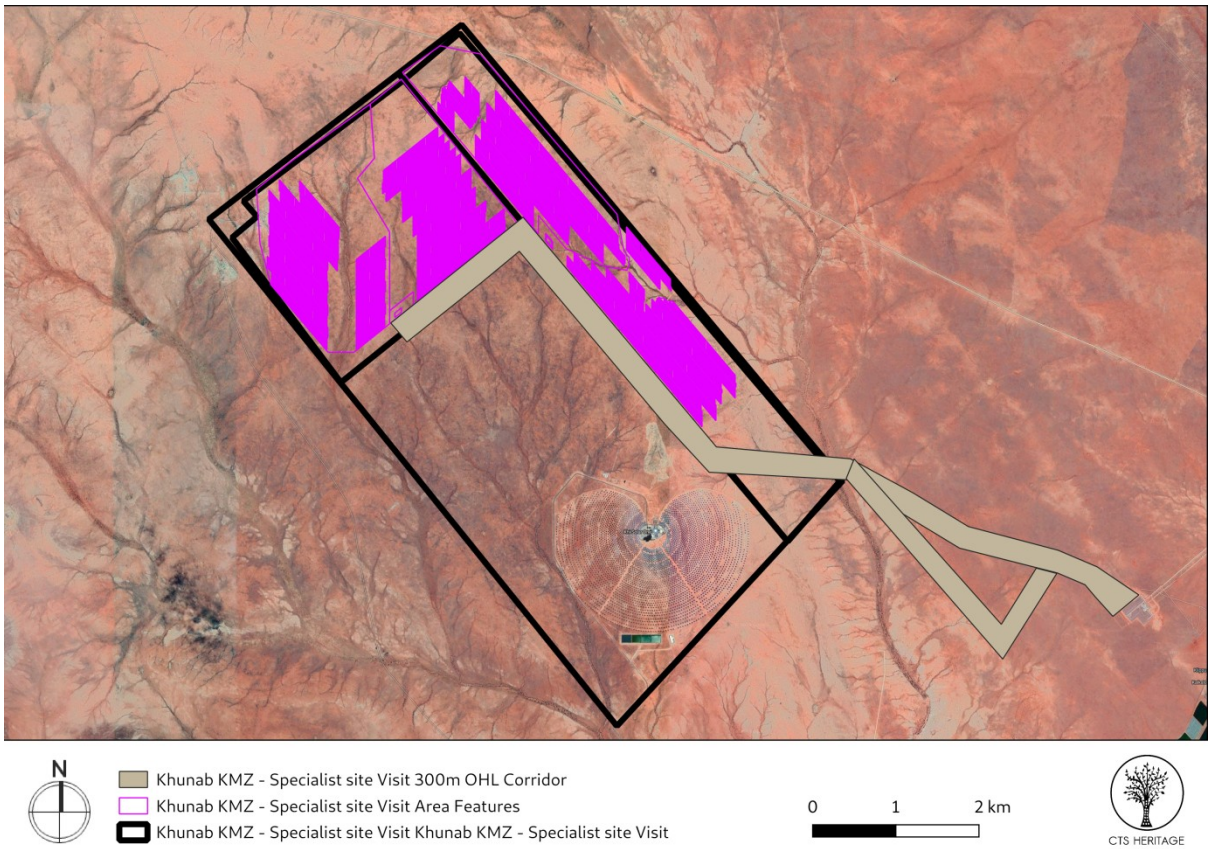


Figure 1: Google Earth map of the proposed development of the Khunab Photovoltaic facilities and OHP corridors to the west south west of Upington on portions of Farms Kalkpunt 452 and McTaggart's Camp 453. Map supplied by CTS Heritage.

## 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 (*not applicable to this assessment*);
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

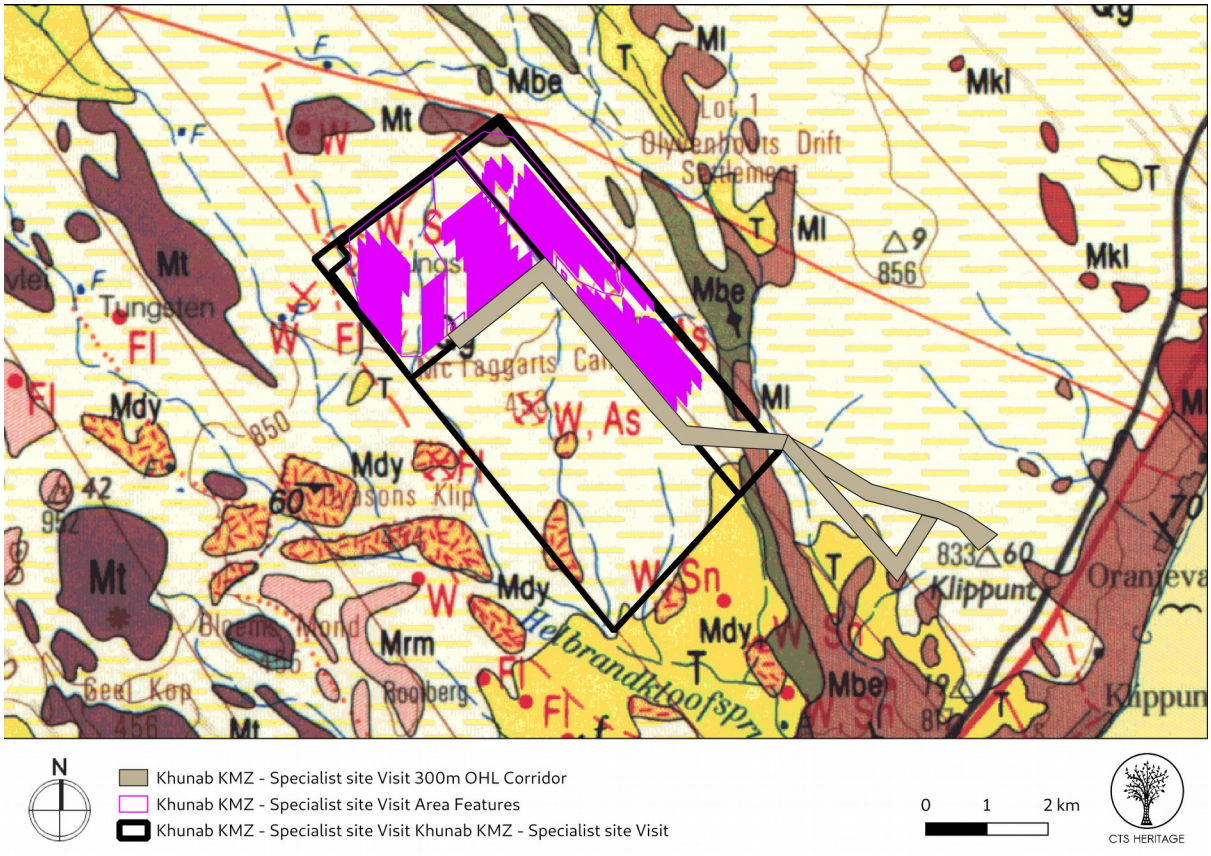


Figure 2: Geological map of the area around the proposed Khunab Photovoltaic Facilities. The location of the proposed project is indicated within the lilac colour and the overhead powerline corridors in grey. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Cornell et al., 2006; Partridge et al., 2006). SG = Supergroup; Fm = Formation. Ma = million years. Grey shading = potentially fossiliferous lithology in the project footprint.

| Symbol | Group/Formation | Lithology | Approximate Age |
|---|---|---|---|
| Qg | Gordonia Fm, Kalahari Group | Red-brown alluvial and aeolian sands | Last 2.5 Ma |
| T | Tertiary | Calcrete | Last 65 Ma |
| Ml | Louisvale Granite, Keimos Suite, Natal-Namaqua Province | Light-grey moderately to well foliated granite | Ca 1000 Ma |
| Mbe | Bethesda Fm, Areachap Sequence, Natal-Namaqua Province | Migmatitic, biotite-rich and aluminous gneisses | 1200 – 1000 Ma |
| Mt | Toeslaan Fm, Biesjepoort Group, Korannaland Sequence, Natal - Namaqua Province | Kinzigite, politic gneisses, biotite gneiss, leucocratic paragneisses | 1200 – 1000 Ma |

The Namaqua sector of the Namaqua-Natal Province is the geological setting of the region around Upington. These are igneous and metamorphic rocks that were formed or metamorphosed during the Namaqua Orogeny approximately 1200 – 1000 million years ago. The Namaqua-Natal Province has been divided into a number of tectonostratigraphic terranes based on common rock types and bounded by shear zones. There have also been some mafic or ultramafic intrusions into the terranes. Upington falls in the Areachap terrane and is bounded to the northeast by the Brakbosch-Trooilaspan Shear Zone and to the southwest by the Boven Rugzeer Shear Zone (Cornell et al., 2006).

There are scattered outcrops of the intrusive Louisvale Granites, Bethesda Formation gneisses and Toeslaan Formation Gneisses (Figure 2). Apart from the age of these rocks pre-dating body fossils, these are all volcanic rocks and have been metamorphosed, so they do not preserve any fossils. They will not be considered any further.

Overlying these complex ancient rocks are much younger sediments of the Tertiary and Quaternary, in particular calcretes that indicate drying out of the surface, and alluvial and aeolian sands of the Gordonia Formation.

### ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The proposed site for the Khunab Photovoltaic facility and OHP corridors lie on the alluvial and aeolian sands of the Gordonia Formation that is Quaternary in age.

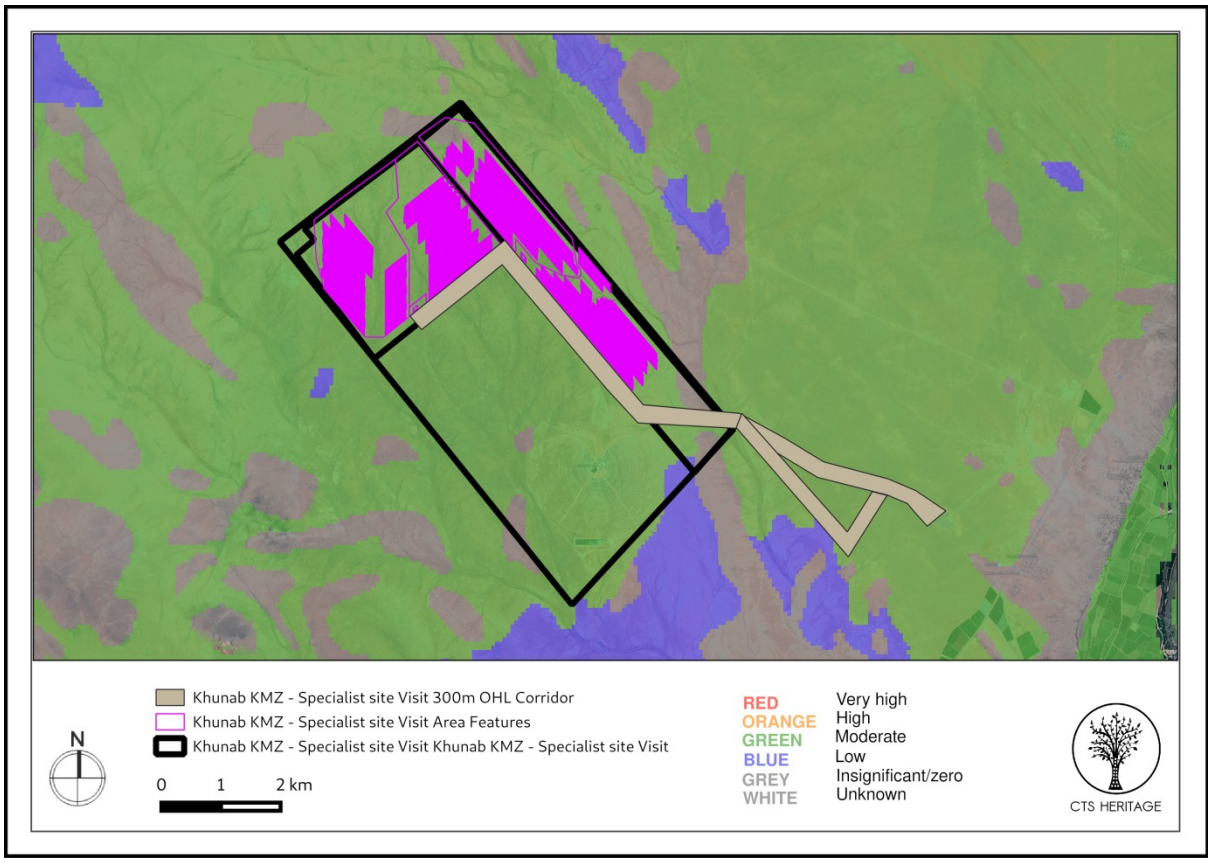


Figure 3: SAHRIS palaeosensitivity map of the site for the proposed Khunab Photovoltaic Facility, The project footprint is within the lilac colour and the OHP corridors in grey. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the areas for the PV collectors and the OHP corridors are indicated as moderately sensitive (green) so a palaeontological impact assessment is presented here. The Gordonia Formation rests on calcretes or directly on pre-Kalahari bedrock (Partridge et al., 2006). The sands can be up to 30m thick and frequently are linear dunes that have been stabilised by vegetation (ibid). In areas to the south there is evidence of palaeo-rivers, for example the Koa Valley where the so called Kalahari River flowed during wetter Cenozoic times before continental uplift occurred together with global aridity. After the mid Miocene pluvial phases the Koa River was captured by the Orange River and only palaeochannels remain (de Wit et al., 2000; Partridge et al., 2006). Some palaeochannels contain gravel clasts, diamonds, silicified wood and vertebrate bones (Dingle and Hendey, 1984; Pickford et al., de Wit and Bamford, 1993; De Wit et al., 2009).

Some Quaternary pans have fossil fauna and artefacts preserved within them, such as Kath Pan and Townlands near Kuruman (Beaumont, 2004; Walker et al., 2014) but no pans are visible on Google Earth and none have been reported from here.

# 4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

**TABLE 3A: 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 3B: IMPACT ASSESSMENT**

| **PART B: ASSESSMENT** | | |
|---|---|---|
| **SEVERITY/NATURE** | **H** | - |
| | **M** | - |
| | **L** | Fluvial and aeolian sands do not preserve fossils; only palaeo-pans might but none has been recorded from here. Palaeo-channels might contain fossil wood and bones but none has been recorded from this site.The impact would be very unlikely. |
| | **L+** | - |
| | **M+** | - |
| | **H+** | - |
| **DURATION** | **L** | - |
| | **M** | - |
| | **H** | Where manifest, the impact will be permanent. |
| **SPATIAL SCALE** | **L** | Since only the possible fossils within the area would be from palaeo-pans or palaeo-channels if present so the spatial scale will be localised within the site boundary. |
| | **M** | - |
| | **H** | - |

| PART B: ASSESSMENT | | |
|---|---|---|
| PROBABILITY | H | - |
| | M | - |
| | L | It is extremely unlikely that any fossils would be found in the alluvial and aeolian sand s but the site is indicated as moderately sensitive. 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 either igneous and much too old to contain fossils, or are alluvial and aeolian sands. The Gordonia Formation alluvial and aeolian sands are young and have been transported so are unlikely to preserve any fossils. Only if palaeo-pans or palaeo-channels are present is there a small chance of finding fossils, however none have been recorded and the geological maps and Google Earth imagery do not indicate the presence of these features in the project footprint. The SAHRIS palaeosensitivity map indicates that the area is moderately sensitive so 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 do not contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary Gordonia Formation would not preserve fossils.

## 6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the loose sands of the Quaternary. There is very small chance that fossil may occur in the adjacent shales of the early Permian Vryheid Formation so a Chance Find Protocol should be added to the EMPr: if fossils are found once Excavations for the foundations for the PV collectors, pylons and substations have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. All proposed constructions lie on the Gordonia Formation dune and aeolian sands and as far as the palaeontology is concerned there is no preferred alternative route or location.

# 7. References

Beaumont, P.B., 2004. Kathu Pan and Kathu Townlands/Uitkoms. In: Beaumont, P.B., Morris, D. (Eds.), Archaeology in the Northern Cape: Some Key Sites. McGregor Museum, Kimberley, pp. 50-52.

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. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 325-379.

De Wit, M.C.J., Bamford, M.K. 1993. Fossil wood from the Brandvlei area, Bushmanland, as an indication of palaeoenvironmental changes during the Cainozoic. Palaeontologia africana 30, 81-89.

De Wit, M.C.J., Marshall, T.R., Partridge, T.C., 2000. Fluvial depoists and drainage evolution. In: Partridge, T.C., & Maud, R.R. (Eds), The Cainozoic of Southern Africa. Oxford University Press, New York, 55-72.

De Wit, M.C.J. Ward, J.D., Bamford, M.K., Roberts, M., 2009. The significance of the Cretaceous Diamondiferous gravel deposit at Mahura Muthla in the Vryburg District of the Northern Cape Province in South Africa. South African Journal of Geology 112, 89-108.

Dingle, R.V., Hendey, Q.B., 1984. Late Mesozoic and Tertiary sediment supply to the eastern Cape Basin (S.E. Atlantic) and palaeo-drainage systems in southwestern Africa. Marine Geology 56, 13-26.

Partridge, T.C., Botha, G.A., Haddon, I.G., 2006. Cenozoic deposits of the interior. 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 585-604.

Pickford, M., Senut, B., Mein, P., Morales, J., Soria, D., Neito, M., Ward, J., Bamford, M. 1995. The discovery of Lower and middle Miocene vertebrates at Auchas, southern Namibia. Comptes Rendus de l' Académie des Sciences., Paris, Ser IIa, 322,901-906.

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.

Walker, S.J.H., Lukich, V., Chazan, M., 2014. Kathu Townlands: A high density Earlier Stone Age locality in the interior of South Africa. PLoS ONE 9(7):

e103436. doi:10.1371/journal.pone.0103436

# 8. Chance Find Protocol

**Monitoring Programme for Palaeontology – to commence once the excavations for photovoltaic structures, powerlines, roads and infrastructure begin.**

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (silicified wood, plants, insects, bone, shells) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants and bones in the pans or channels (for example see Figures 4-6). 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 excavations 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 any site inspections by the palaeontologist will not be necessary.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

## Appendix A – Examples of fossils from Quaternary deposits

Figure 4 – pieces of silicified woods.

Figure 5: Example of fragments of bone as seen in the field. (From Pleistocene deposits at Koobi Fora, Kenya)

Figure 6 – example of a fossil leaf impression on a fine-grained sandstone. (Miocene age, Rusinga Island).

## Appendix B – Details of specialist

# Curriculum vitae (short) - Marion Bamford PhD June 2019

### I) Personal details


Surname : **Bamford**
First names : **Marion Kathleen**
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 | 6 | 1 |
| Masters | 8 | 1 |
| PhD | 10 | 3 |
| Postdoctoral fellows | 9 | 3 |

### 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 2-8 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 –
Cretaceous Research: 2014 -

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

## x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.

- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- 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
- SARAO 2018 for Digby Wells
- Ventersburg B 2018 for NGT
- Hanglip Service Station 2018 for HCAC
- Woodlands MR 2019 for NGT
- Remhooghte PR 2019 for EM
- Terreco-Mdantsane bridges 2019 for CTS Heritage

## xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 130 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 30;
Conferences: numerous presentations at local and international conferences.

## xii) NRF Rating

NRF Rating: B-2 (2016-2020)
NRF Rating: B-3 (2010-2015)
NRF Rating: B-3 (2005-2009)
NRF Rating: C-2 (1999-2004)