Palaeontological Impact Assessment for the proposed Surface Infrastructure changes at the UMK Mine on Farm Botha 313, the Remaining Extent (Re) of the Farm Smartt 314, and Portion 1 and Remaining Extent (RE) of the Farm Rissik 330, Northern Cape Province

Desktop Study (Phase 1)

For

Heritage Contracts and Archaeological Consulting

March 2022

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 32 years research; 24 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Heritage Contracts and Archaeological Consulting, Modimolle, 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 surface infrastructure changes at the United Manganese of the Kalahari Mine (UMK). The mine is located approximately 13 km to the south of Hotazel, in the Joe Morolong Local Municipality and the John Taolo Gaetsewe District Municipality in the Northern Cape Province. 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 project.

The proposed project lies on the aeolian sands of the Kalahari Group (Quaternary age). Rocks bearing iron and manganese are below the surface and they do not preserve any fossils. Aeolian sands do not preserve fossils as they are windblown. Rarely the sands will entrap more robust fossils, such as fragments of bones or wood, but these are not in situ. If palaeo-pans or palaeo-springs are in the area they might preserve fossils but no such feature is evident from the Google Earth imagery. There is an extremely small chance that fossils occur on the land surface, nonetheless a Fossil Chance Find Protocol should be added to the Environmental Management Programme (EMPr). Based on this information it is recommended that no palaeontological site visit is required and the proposed project may be authorised.

Impact assessment:

	Pre-mitigation	Post-mitigation
Significance	Very low	Insignificant

Mitigation: If fossils are found by the environmental officer or other responsible person, they should be photographed in situ and the location recorded by GPS. The fossils can be placed in a safe place until the palaeontologist has assessed their scientific importance and advised of the way forward.

Table of Contents

1. Background

The UMK Mine is an opencast manganese mine located approximately 13 km to the south of the town of Hotazel in the Joe Morolong Local Municipality and the John Taolo Gaetsewe District Municipality in the Northern Cape Province. The manganese mine lies directly adjacent and to the west of the R380 provincial road.

UMK currently holds the following authorisations:

- A mining right (30/5/1/2/3/2/1(113) MR) issued by the Department of Mineral Resources (DMR) now known as the Department of Mineral Resources and Energy (DMRE);
- An Environmental Management Programme Report (EMPr) approved by DMRE;
- An Environmental Authorisations (NC/KGA/HOT7/15/2006 & NC 30/5/1/2/2/113 MR) issued by the Department of Environment and Nature Conservation (DENC) and the DMRE respectively; and
- A Water Use License (IWUL) (10/D41K/ABEGJ/2814) issued by the Department of Water and Sanitation (DWS) now known as the Department of Human Settlements, Water and Sanitation (DHSWS).

UMK is proposing to change the approved surface layout for the mine to optimize their mining operations. The proposed changes to the approved layout are discussed in detail below:

<u>Proposed new surface infrastructure at the mine:</u>

- New parking area (0.52 Ha);
- Solar equipped boreholes and associated storage tanks;
- Tyre fitting bay, workshop/ tyre centre and oil storage (7 Ha);
- Waste rock and sand stockpiles:
    - Central West Waste Rock Dump (WRD) (84 Ha)
    - Central West Sand Stockpile (40.9 Ha)
    - J Block West WRD (133 Ha)
    - J Block West Sand Stockpile (46.5 Ha)
    - J Block East WRD (63.5 Ha)
    - J Block East Sand Stockpile (16.5 Ha)
    - Powerline West WRD (196 ha)
    - Powerline West Sand Stockpile (35,9 Ha)
    - A Block West WRD (145 Ha)
- Product stockpile area within the approved sinter plant area (21.4 Ha);
- TUP stockpile (12.4 Ha);
- Truck staging area (20.4 ha);
- Hard park areas (Phase 1 and 3) (14.3 Ha);
- Barlow's Store (1 Ha);
- Explosive depo and associated service road (13.1 Ha); and
- Engineering salvage yard (temporal and permanent) (2.43 Ha).

<u>Upgrade of existing approved infrastructure:</u>

- Prentec Sewage Plant; and
- Existing weigh bridge and associated access road.

Expansion of existing approved infrastructure

- Open pit (458.7 ha);
- Product stockpile (53.6 Ha);
- Modular crushing plant (34.6 Ha);
- Fuel storage farm (0.45 Ha);
- EME workshop for major repair and maintenance (3.6 Ha);
- Road truck staging area (1.6 Ha); and
- Offices (19.1 Ha).

Relocation of the following surface infrastructure at the mine:

- Approved dirty water dams/pollution control ponds; and
- 132 KV powerline from current location to its old location.

As part of the new EIA process, a Palaeontological Impact Assessment was requested for the project. 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 project and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 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: 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 **Error! Reference source not found.**
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 5
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: Locality map of the United Manganese of Kalahari Mine proposed amendments to the mine layout and infrastructure with the sections shown by the green and orange outlines and green and orange shading. Map supplied by HCAC.

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:

- 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;
- Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (not applicable to this assessment);
- 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
- 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

3.1 Project location and geological context

The United Manganese of the Kalahari (UMK) Mine site is on the northeastern margin of the Griqualand West Sequence of Neoarchaean intrusive rocks, in the Prieska Subbasin of the Transvaal Basin that is filled with the sequence of the Transvaal Supergroup (Figure 2). Outcrops of the two main iron and manganese-bearing rocks are exposed to the east of the mine, but below the Kalahari sands are layers of banded iron formation (BIF) that is in primary context in the Kuruman Formation and reworked in the overlying Danielskuil Formation (Beukes et al., 2016). These ancient rocks are the target of the mining operation, but they are non-fossiliferous so will not be considered any further in this palaeontological report.

Overlying much of the area are the Kalahari Group sands. This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common.

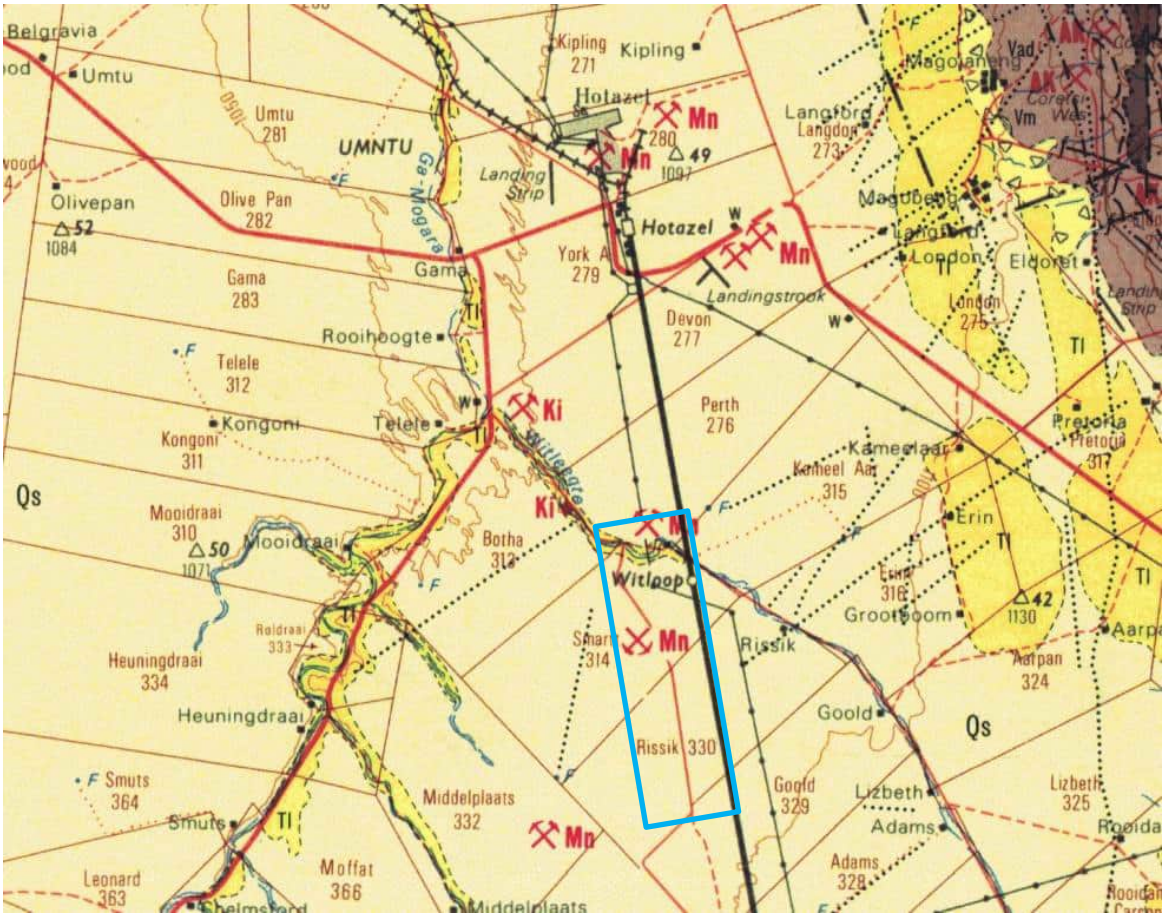

Figure 2: Geological map of the area around Hotazel, Northern Cape Province. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

Table 2: Explanation of symbols for the geological map and approximate ages (Partridge et al., 2006; Schröder et al., 2016). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Kalahari Group	Aeolian sand,	Quaternary ca 2.5 Ma to present
Tl	Tertiary limestone	Sand and limestone	Quaternary ca 2.5 Ma to present
Vad	Danielskuil Fm, Asbestos Hills Subgroup, Ghaap Group, Griqualand West Sequence	Banded or massive jaspilite or crocidilite	Ca 2440 -2460 Ma
Vak	Kuruman Fm, Asbestos Hills Subgroup, Ghaap Group, Griqualand West Sequence	Banded iron formation	Ca 2440 -2460 Ma

3.2. Palaeontological context

The palaeontological sensitivity of the project area under consideration is presented in Figure 3. The site for mining is covered by aeolian Kalahari sands that were derived from farther to the northwest (Goudie and Wells, 1995) and finally deposited in this region during the Quaternary. Since they are windblown the sands are not in primary context, nor do they preserve any fossils.

Fossils can only be preserved if there are palaeo-spring or palaeo-pan deposits where wood, plants or bones can be entrapped and preserved in the calcrete or silcrete that occasionally forms in such settings. No such deposits have been recorded from this site, and the Google Earth imagery does not show any pan or spring deposits. According to Goudie and Wells (1995) three factors are required for the formation of pans, namely a setting where the fluvial system is not fully integrated, and where salt weathering and aeolian deflation occur. The latter two conditions apply to this environmental setting, but the first does not as the site is on a slope and is far from any major river or drainage system. Therefore, it is extremely unlikely that there are any pans in the site or any fossils in the sands. Since most of the area has been disturbed by previous mining operations it is unlikely that any pan or spring features remain (Figure 1).

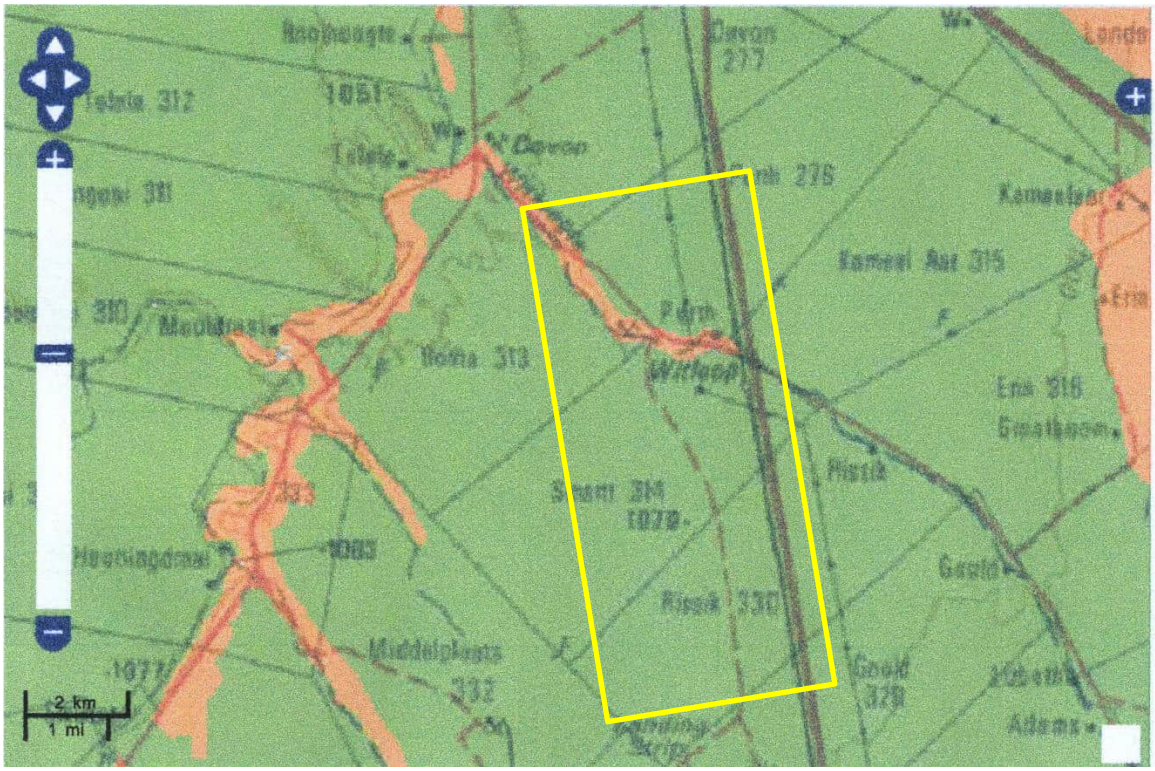

Figure 3: SAHRIS palaeosensitivity map for the UMK Mine, shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above (Figure 3) the area is indicated as moderately sensitive (green) and this applies to the Kalahari sands.

4. 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 banded iron formation, jaspilite and crocidolite, sandstones and aeolian sands are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. The aeolian sands of the Quaternary period would not preserve fossils.

5. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria according to the SLR impact Rating Method in Annex 1 (not reproduced here).

Table 3: Outcomes of the Impact Consequence and Significance Ratings

Category	Pre – mitigation	Post mitigation = site visit and removal of any fossils (if present)	Justification
Intensity	Low	Zero – very low	Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected. People / communities are able to adapt with relative ease and maintain pre-impact livelihoods
Duration	Very long term	Short	
Extent	Local	Local	Only fossils in the project area would be affected
Probability	Medium	Very low	Fossils would only occur in palaeo-pans or palaeo-springs
Degree	Low	High	> 70% sure of impact prediction
Confidence	High	High	If pans were present they would be visible in the satellite imagery
Mitigation	Low	Very low	The occurrence of fossils is unlikely but if they were present and removed there would be no impact
Loss of Resources	Low	Low	Fossils are not considered a resource
Reversibility	Irreversible	Partly reversible	If fossils are removed the impact is reduced
Consequence	Low	Very low	Pre-mitigation: of low intensity at a local level in the long term; With mitigation: Zero to very low intensity with any combination of extent and duration.
Significance	Very low	Insignificant	

The significance to the local population is very low because the presence or absence fossils does not affect their livelihood, income or health. The significance to science and society is higher because the loss of fossils might mean a loss to knowledge.

Mitigation

There would be no loss to our national heritage and science if fossils are collected and preserved in a recognised institution (museum or university with a palaeontology department) where they can be studied.

It is very unlikely that any fossils would be present in the aeolian sands unless there are palaeo-pans or palaeo-springs that could entrap fossils but no such feature is evident from the satellite imagery.

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 below the surface are much too old to contain fossils and of the wrong kind, and aeolian sands

do not preserve fossils. Only if there are palaeo-pans or palaeo-springs in the area, and none is visible from the Google Earth imagery, is there a very small chance of fossil wood or bone fragments occurring in the footprint. Furthermore, the material to be targeted does not preserve fossils. Since there is an extremely small chance that fossils from the Quaternary Kalahari sands may have entrapped fossils, 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.

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 aeolian sands of the Quaternary. There is very small chance that fossils from pans or springs may have been entrapped in the sands of the Kalahari Group (Quaternary). Therefore, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found once drilling and excavations have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. Chance Find Protocol

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

- The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
- When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone, coal) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
- Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 4, 5). This information will be built into the EMP's training and awareness plan and procedures.
- Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
- If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
- 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.

- If no good fossil material is recovered then no site inspections by the palaeontologist will not 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.
- If no fossils are found and the excavations have finished then no further monitoring is required.

8. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Beukes, N.J., Swindell, E.W.P., Wabo, H., 2016. Manganese Deposits of Africa. Episodes, 39(3), 1-33. DOI: 10.18814/epiiugs/2016/v39i2/95779

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. Earth Science Reviews 38, 1-69.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. 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 461 – 499.

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.

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.

Schröder, S., Beukes, N.J., Armstrong, R.A., 2016. Detrital zircon constraints on the tectonostratigraphy of the Paleoproterozoic Pretoria Group, South Africa. Precambrian Research 278, 362 – 393.

Appendix A – Examples of fossils from the Quaternary Aeolian sands

Figure 4: Fossil bone fragments from a Quaternary pan.

Figure 5: Silicified wood fragments from a fluvial deposit. Scale = 12cm.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
July 2021

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	7	0
Masters	11	4
PhD	12	5
Postdoctoral fellows	10	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 – 2021

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
- 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

xi) Research Output

Publications by M K Bamford up to July 2021 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 8 book chapters.
Scopus h-index = 29; Google scholar h-index = 36; -i10-index = 95
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)