

**Palaeontological Impact Assessment for the Prospecting Right on  
Portion 20  
of Farm Mamatwan 331  
Between Hotazel and Kuruman  
Northern Cape Province**

**Desktop Study (Phase 1)**

**For**

**Archaeological and Heritage Services Africa (Pty) Ltd**

**22 July 2023**

**Prof Marion Bamford**  
Palaeobotanist  
P Bag 652, WITS 2050  
Johannesburg, South Africa  
[Marion.bamford@wits.ac.za](mailto:Marion.bamford@wits.ac.za)

## **Expertise of Specialist**

The Palaeontologist Consultant: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf, PSSA  
Experience: 34 years research and lecturing in Palaeontology  
26 years PIA studies and over 350 projects completed

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Archaeological and Heritage Services Africa, Pty) Ltd, Fourways, 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

A handwritten signature in blue ink that reads "MK Bamford". The signature is written in a cursive style and is positioned above a horizontal line.

Signature:

## **Executive Summary**

A Palaeontological Impact Assessment was requested for the application for a prospecting right on Portion 20 of Farm Mamatwan 331 in terms of Regulation 2(2) read with regulation 2(3) of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 30 of 2002) is in progress. The farm Mamatwan 331 is located about 25 km southeast of Hotazel and about 40 km northwest of Kuruman.

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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies mostly on Quaternary sands that are most likely underlain by the Danielskuil and the Kuruman Formations that host manganese and iron ore deposits. and the Ghaap Group. Although sands do not preserve fossils they might cover fossil traps such as palaeo-pans or palaeo-springs but none is evident in the satellite imagery. 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, environmental officer or other designated responsible person once excavations, drilling or mining activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

## Table of Contents

Expertise of Specialist .....	1
Declaration of Independence .....	1
1. Background .....	4
2. Methods and Terms of Reference.....	7
3. Geology and Palaeontology.....	8
i. Project location and geological context .....	8
ii. Palaeontological context.....	10
4. Impact assessment.....	11
5. Assumptions and uncertainties.....	13
6. Recommendation.....	13
7. References .....	14
8. Chance Find Protocol .....	15
9. Appendix A – Examples of fossils .....	16
10. Appendix B – Details of specialist.....	17
Figure 1: Google Earth map of the general area to show the relative land marks. ....	6
Figure 2: MPRD Reg 2.2. map.....	6
Figure 3: Google Earth Map of the proposed development .....	7
Figures 4-5: Geological maps of the area around the project site.....	8-9
Figure 6: SAHRIS palaeosensitivity map for the site .....	11

# 1. Background

A Palaeontological Impact Assessment was requested for the application for a mining right on Portion 20 (Semba Insinyiti North) of Farm Mamatwan 331 in terms of Regulation 2(2) read with regulation 2(3) of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 30 of 2002) is in progress. The applicant is Yone Stem Frontiers (Pty) Ltd. The Farm Mamatwan 331 is located about 25 km southeast of Hotazel and about 40 km northwest of Kuruman.

The site is vacant land with scanty vegetation. It is adjacent to active mining operations of the Tshipi Mine and Mamatwan Open Cast manganese mine (Figures 1-3), Northern Cape Province.

A Palaeontological Impact Assessment was requested for the Mamatwan 331 Portion 1 mining right application (MRA) project. 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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

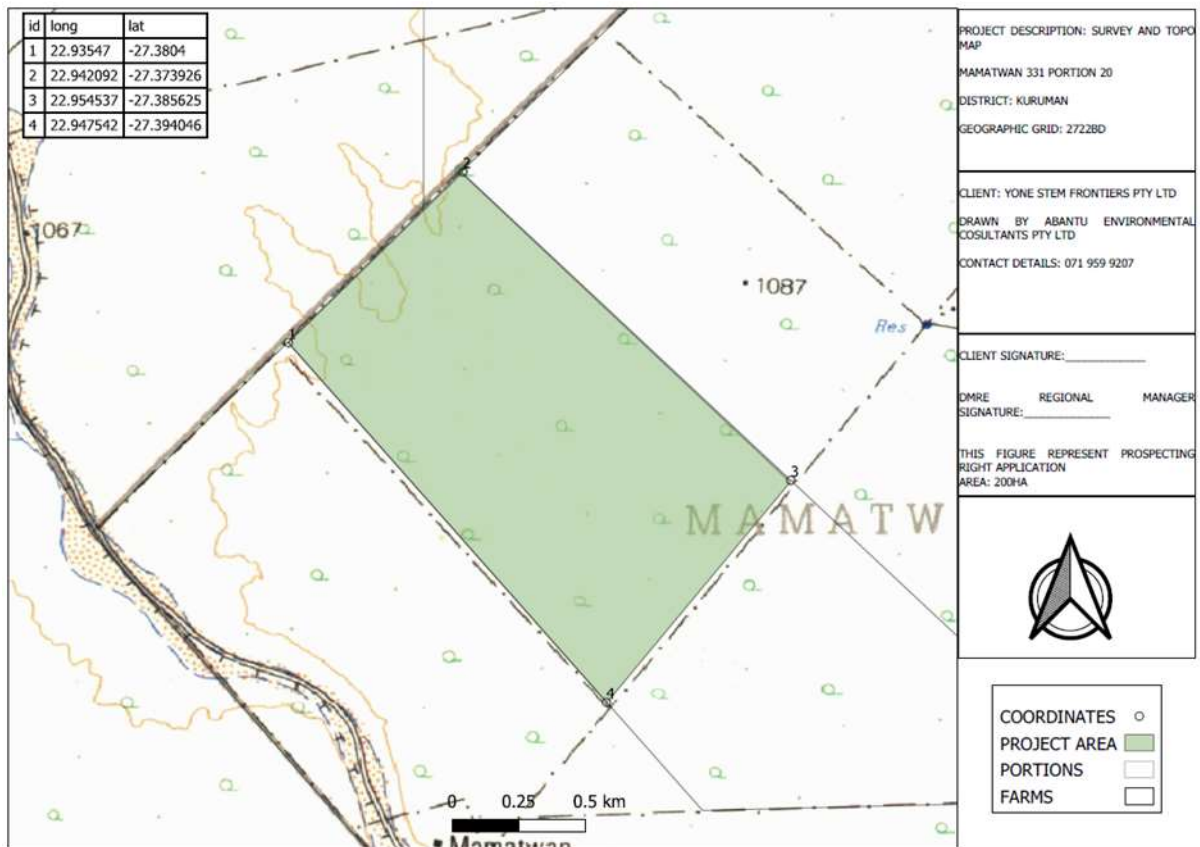
**Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).**

	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
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

	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
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	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 general area to show the relative landmarks. The Mamatwan mining application area is shown by the purple outline..**



**Figure 2: Reg 2.2 Plan for MPRD locality map for the Mamatwan 331/20 MRA**



**Figure 3: Google Earth Map of the proposed Mamatwan 331/20 mining area shown by the purple outline.**

## 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 include 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 4: Geological map of the area around the Farm Mamatwan 331. 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 (Eriksson et al., 2006; Schier et al., 2018;). 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	Quaternary, ca 1.0 Ma to present
Tl	Tertiary limestone	limestone	Tertiary
Vo	Ongeluk Fm, Postmasburg Group, Transvaal SG	Amygdaloidal and andesitic lava, with tuff agglomerate, chert and red jasper	Palaeoproterozoic Ca 2436 Ma
Vad	Griquatown/Danielskuil Fm; Asbestos Hills Subgroup, Ghaap Group, Transvaal SG	Banded iron formation	Palaeoproterozoic Ca 2489 Ma
Vak	Kuruman Fm, Asbestos Hills Subgroup, Ghaap Group, Transvaal SG	Banded iron formation	Palaeoproterozoic Ca 2460 Ma

The project lies in the southern part of the large Maremane Dome that is in the western side of the Griqualand West Basin. This basin is one of three large, ancient basins that contain sediments of the Transvaal Supergroup. Underlain by the Ventersdorp Supergroup and overlain by the Olifantshoek Supergroup, the Transvaal Supergroup rocks preserve 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.

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.

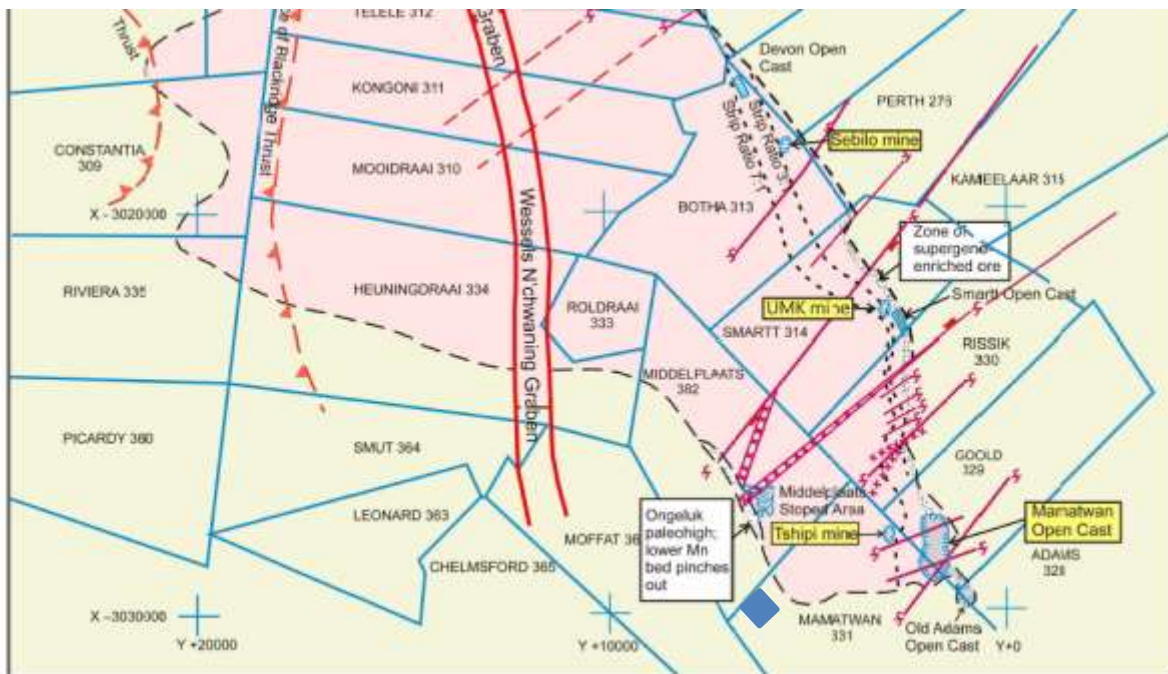


Fig. 6. Geological map of the Main Kalahari deposit of the KMF (shaded in pink) indicating existing producing mines (highlighted yellow).

**Figure 5: Southern part of the BIF-hosted Kalahari Manganese Field (KMF) with the Mamatwan Portion 20 site indicated in the solid blue rectangle. (Fig 6 of Beukes et al., 2016).**

The Transvaal Supergroup rocks in the Griqualand West Basin can be correlated with the rocks in the Transvaal Basin, closely according to Beukes and colleagues, or not so closely according to Moore and colleagues. Nonetheless, these 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 Neoproterozoic-Paleoproterozoic Transvaal Supergroup in South Africa contains the well-preserved stromatolitic Campbellrand - Malmani carbonate platform (Griqualand West Basin – Transvaal Basin respectively), which were deposited in shallow seawater shortly before the Great Oxidation Event (GOE).

Mamatwan 331 (Figure 3) BIF-hosted Kalahari Manganese Field (KMF) that is in the Hotazel area and has by far the largest of such deposits holding some 4,200 Mt of manganese metal that represents about 77% of the world's known land-based resource (Beukes et al., 2016). The ferruginous ore bodies of the Western Belt are less irregular and laterally more continuous and extensive than those of the Eastern Belt due to their apparent original deposition as surficial sediment in small lakes or depressions on the ancient pre-Gamagara karstic land surface (ibid). This is one reason why these deposits have been mined for a longer period (up to the early 1980s), at a relatively large scale, in mines such as Glosam, Lohatlha and Bishop in the centre of the Mareman dome (ibid).

To the east are dolomites, limestones and cherts of the Ghaap Group, according to the geological map (Figure 4). Overlying much of the area are the aeolian sands and alluvium of the Quaternary Kalahari Group.

There were two large basins dominating southern Africa during the Cenozoic, with the Kalahari Basin to the west and the Bushveld basin to the east. Both basins are bounded along their southern extent by the more or less west-east trending Griqualand-Transvaal Axis (Partridge et al., 2006). These sediments are not easy to date but recent attempts are gradually filling in the history of the sands, sand dunes and inter-dunes (Botha, 2021).

Quaternary Kalahari sands cover large parts of the rocks in this region, especially to the west. 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. Most geological maps indicate these sands simply descriptively (aeolian sand, gravelly sand, calcrete) or they are lumped together as the Gordonia Formation because the detailed regional lithostratigraphic work has not been done. Nonetheless, these sands have eroded from the interior and have been transported by wind or water to fill the basin. Reworking of the sands or stabilisation by vegetation has occurred. Probable ages of dune formation are around 100 kya (thousand years), 60 kya, 27-23 kya and 17-10 kya (in Botha, 2021).

## ii. Palaeontological context



**Figure 6: SAHRIS palaeosensitivity map for the site for the proposed Mamatwan 331 MRA for gravel 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.**

The palaeontological sensitivity of the area under consideration is presented in Figure 6. The site for mining is overlain by Quaternary Kalahari Group sands, the Gordonia Formation but the target will be the underlying rocks. Although oxygen released by photosynthesising blue green algae and green algae was essential for the formation of the banded iron of these two formations, no microbes are preserved.

Quaternary aeolian sands and alluvium are fairly mobile and very porous so they not provide suitable conditions for preservation of organic matter (Cowan, 1995). Only in places where the sands have been waterlogged, such as palaeo-pans or palaeo-springs, is there any chance of fossilisation. For example, roots can be encased in calcium-rich or silica-rich sands and crusts, known as rhizoliths or rhizocretions, can form around the roots, invertebrates or bones around the margin of a pond, pan or spring (Klappa, 1980; Cramer and Hawkins, 2009; Peters et al., 2022).

## 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**

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

**Table 3b: Impact Assessment**

<b>PART B: Assessment</b>		
<b>SEVERITY/NATURE</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	Sands do not preserve fossils; so far there are no records of fossil traps below the so it is very unlikely that fossils occur on the site. The impact would be negligible
	<b>L+</b>	-
	<b>M+</b>	-
	<b>H+</b>	-
<b>DURATION</b>	<b>L</b>	-
	<b>M</b>	-
	<b>H</b>	Where manifest, the impact will be permanent.

<b>PART B: Assessment</b>		
<b>SPATIAL SCALE</b>	<b>L</b>	Since the only possible fossils within the area would be fossils trapped below the sand cover, the spatial scale will be localised within the site boundary.
	<b>M</b>	-
	<b>H</b>	-
<b>PROBABILITY</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	It is extremely unlikely that any visible fossils would be found in the loose soils and sands that cover the area or in traps below the sand. Nonetheless, 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 much too old to contain visible body fossils. Since there is an extremely small chance that fossils might be trapped in palaeo-pans or palaeo-springs that have been obscured by the sand cover and 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 lavas, 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 period would not preserve fossils but might cover traps (palaeo-pans or palaeo-springs) although no such feature is visible in the satellite imagery.

## 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 overlying soils and sands of the Quaternary. There is no evidence in the satellite imagery and any potential fossil traps such as palaeo-pans or palaeo-springs occur below the sand, nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once mining has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, so as far as the palaeontology is concerned, the project should be authorised.

## 7. References

- 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.
- Cowan, R., 1995. *History of Life*. 2nd Edition. Blackwell Scientific Publications, Boston. 462pp.
- Eriksson, P.G., Altermann, W., Hartzler, F.J., 2006. The Transvaal Supergroup and its precursors. 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.
- Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. *Earth Science Reviews* 38, 1-69.
- Holmes, P.J., Bateman, M.D., Thomas, D.S.G., Telfer, M.W., Barker, C.H., Lawson, M.P. 2008. A Holocene–late Pleistocene aeolian record from lunette dunes of the western Free State panfield, South Africa. *The Holocene* 18, 1193 – 1205.
- Klappa, C.F., 1980. Rhizoliths in terrestrial carbonates: classification, recognition, genesis and significance. *Sedimentology* 27, 613-629.
- Moen, H.F.G., 2006. The Olifantshoek 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 319-324.
- 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.
- Peters, C.R., Bamford, M.K., Shields, J.P., 2022. Ch 33. Lower Bed II Olduvai Basin, Tanzania: Wetland Sedge Taphonomy, Seasonal Pasture, and Implications for Hominin Scavenging. In Reynolds, S.C., Bobe, R., (Eds). *African Paleoeology and Human Evolution*, Cambridge University Press & Assessment. 413-434.
- 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.
- Smith, A.B.J., Beukes, N.J., 2016. Palaeoproterozoic banded iron formation hosted high-grade hematite iron ore deposits of the Transvaal Supergroup, South Africa. *Episodes* 39(2), 269-284.
- 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 / mining activities begin.**

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations/mining 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 (plants, insects, bone or coal) 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 trace fossils such as stromatolites in the dolomites or the Quaternary bones, rhizoliths, traces (for example see Figures 7-8). 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/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.
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.



9. Appendix A – Examples of fossils from the Transvaal Supergroup



Weathering of dolomite



Small domal stromatolites



Side view of a stromatolite



Surface view of domal stromatolites

**Figure 7: Photographs of various types of stromatolites in dolomite from the Malmani Subgroup, Transvaal Supergroup.**



**Figure 8: Photographs of Quaternary fossils that could be in traps below the sands.**

## 10. Appendix B – Details of specialist

### **Curriculum vitae (short) - Marion Bamford PhD January 2023**

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

Telephone : +27 11 717 6690  
Cell : 082 555 6937  
E-mail : [marion.bamford@wits.ac.za](mailto:marion.bamford@wits.ac.za) ;  
[marionbamford12@gmail.com](mailto: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

**v) Supervision of Higher Degrees**

All at Wits University

Degree	Graduated/completed	Current
Honours	13	0
Masters	13	3
PhD	13	7
Postdoctoral fellows	14	4

**vi) 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.

**vii) 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: 30 local and international journals

**viii) Palaeontological Impact Assessments**

25 years' experience in PIA site and desktop projects

- Selected from recent projects only – list not complete:
- 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 2022 for AHSA
- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage
- Hendrina North and South WEFs & SEFs 2022 for Cabanga
- Dealesville-Springhaas SEFs 2022 for GIBB Environmental
- Vhuvhili and Mukondelei SEFs 2022 for CSIR
- Chemwes & Stilfontein SEFs 2022 for CTS Heritage
- Equestria Exts housing 2022 for Beyond Heritage
- Zeerust Salene boreholes 2022 for Prescali
- Tsakane Sewer upgrade 2022 for Tsimba
- Transnet MPP inland and coastal 2022 for ENVASS
- Ruighoek PRA 2022 for SLR Consulting (Africa)
- Namli MRA Steinkopf 2022 for Beyond Heritage

#### ix) **Research Output**

Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 170 articles published; 5 submitted/in press; 14 book chapters.

Scopus h-index = 30; Google Scholar h-index = 39; -i10-index = 116 based on 6568 citations.

Conferences: numerous presentations at local and international conferences.