

**Palaeontological Impact Assessment for the Mining  
Right Application near Delportshoop  
(Remaining Extent of Erf 28, a Portion of Erf 30, Erf  
1565, a Portion of a Gravel Road Named Saamloop  
Street and a Portion of an Unnamed Gravel Road, in  
extent 4.9979 Ha, at Delportshoop)  
Dikgatlong Local Municipality  
Northern Cape Province**

**DESKTOP STUDY (PHASE 1)**

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**PREPARED FOR**



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## **Expertise of Specialist**

The Palaeontologist Consultant: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf  
Experience: 33 years research and lecturing in Palaeontology  
25 years PIA studies and over 300 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 (Pty) Ltd, Pretoria, 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, appearing to read 'MKBamford', with a horizontal line underneath it.

Signature:

## **Executive Summary**

A Palaeontological Impact Assessment was requested for a Mining Permit Application on the Remaining Extent of Erf 28; a Portion of Erf 30; Erf 1565; a Portion of a Gravel Road Named 'Saamloop Street'; and a Portion of an Unnamed Gravel Road, in extent: 4.9979 Ha at Delportshoop in the Dikgatlong Local Municipality, Northern Cape 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 desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the moderately sensitive aeolian and fluvial Kalahari Sands but any fossils would be out of context because the sands have been transported by wind and water. 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 developer/ environmental officer/ other designated responsible person once excavations/drilling/mining activities have commenced. As far as the palaeontology is concerned, the project should be authorised.

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# 1. Background

Berné Bergh has submitted a Mining Permit Application on the Remaining Extent of Erf 28; a Portion of Erf 30; Erf 1565; a Portion of a Gravel Road Named 'Saamloop Street'; and a Portion of an Unnamed Gravel Road, in extent: 4.9979 Ha at Delportshoop in the Dikgatlong Local Municipality, Northern Cape Province (Figures 1, 2).

A Palaeontological Impact Assessment was requested for the Delportshoop 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
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

	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
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 land marks. The Mining Right area is shown by the black outline.**



**Figure 2: Google Earth Map of the proposed MRA in Delpoortshoop shown by the black outline. Map supplied by AHS.**

## 2. Methods and Terms of Reference

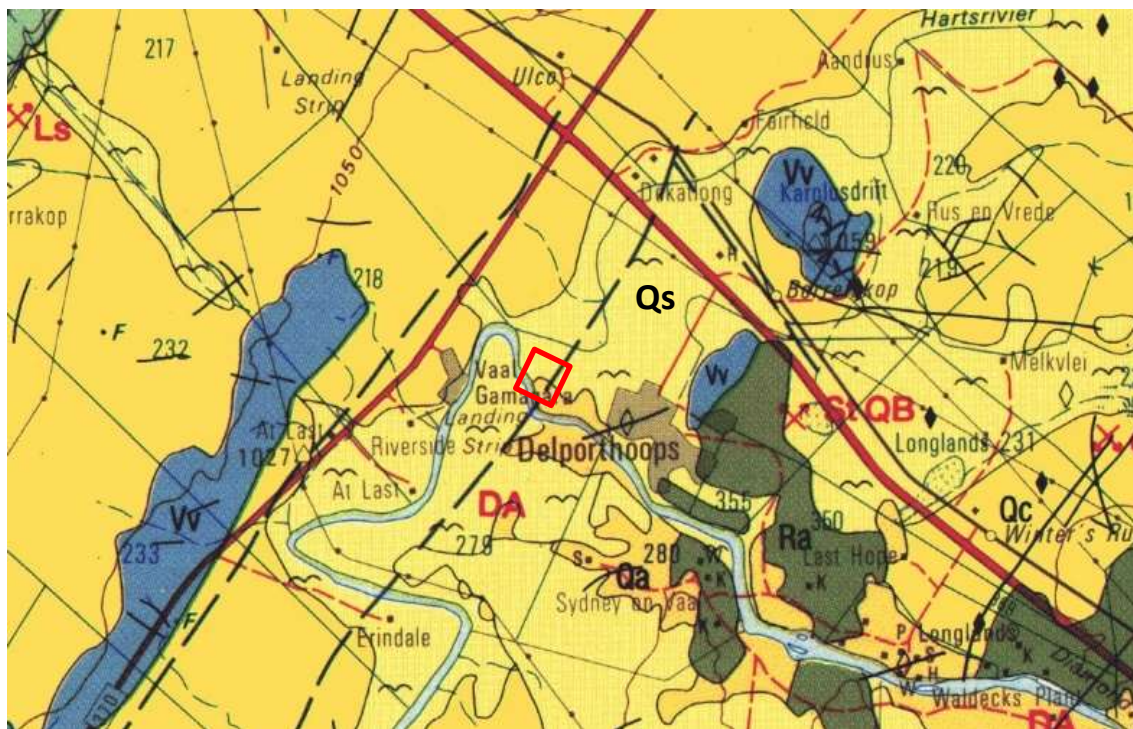
The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

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 3: Geological map of the area around Delporthoop. The location of the proposed project is indicated within the red rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2824 Kimberley.**



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

Symbol	Group/Formation	Lithology	Approximate Age
Qa	Quaternary alluvium	Alluvium, sand, calcrete	Neogene, ca 1 Ma to present
Qs	Quaternary Kalahari sands	Red-grey aeolian sands	Neogene, ca 1 Ma to present
Qc	Quaternary Kalahari sands	Calcrete, calcified pan-dune, surface limestone	Neogene, ca 1 Ma to present
Vv	Vryburg Fm, Campbell Rand Subgroup, Transvaal SG	Siltstone, shale, quartzite, gritstone, conglomerate	Ca 2590 – 2500 Ma
Ra	Allanridge Fm, Pniel Group, Ventersdorp SG	Mafic lava, tuff; amygdaloidal at base	2664 – 2654 Ma

The project lies on the margin of the Griqualand West Basin that is one of three Palaeoproterozoic basins filled with sediments and volcanic tuffs of the Transvaal Supergroup. The latter overlies the Ventersdorp Supergroup. Much of the area has been covered by aeolian and fluvial sands of the much younger Kalahari Group.

The Quaternary Kalahari sands form an extensive cover of much younger deposits over much of the Northern Cape Province and Botswana. Haddon and McCarthy (2005) proposed that the Kalahari basin formed as a response to down-warp of the interior of the southern Africa, probably in the Late Cretaceous. This, along with possible uplift along epeirogenic axes, back-tilted rivers into the newly formed Kalahari basin and deposition of the Kalahari Group sediments began. Sediments included basal gravels in river channels, sand and finer sediments. A period of relative tectonic stability during the mid-Miocene saw the silcretisation and calcretisation of older Kalahari Group lithologies, and this was followed in the Late Miocene by relatively minor uplift of the eastern side of southern Africa and along certain epeirogenic axes in the interior. More uplift during the Pliocene caused erosion of the sand that was then reworked and redeposited by aeolian processes during drier periods, resulting in the extensive dune fields that are preserved today.

There are numerous pans in the Kalahari, generally 3–4 km in diameter (Haddon and McCarthy, 2005). Most pans in the Kalahari Basin are filled by a layer of clayey sand or calcareous clays and are flanked by lunette dunes formed as a result of deflation of the pan floor during arid periods (Lancaster, 1978a, b; Haddon and McCarthy, 2005). At some localities in the south western Kalahari spring-fed tufas have formed at the margins of pans during periods where groundwater discharge was high (Lancaster, 1986). Associated with some palaeo-pans and palaeo-springs are fossil bones, root casts, pollen and archaeological artefacts. Well-known sites are Florisbad and Deelpan in the Free State, Wonderkrater in Limpopo and Bosluispan in the Northern Cape.

Tertiary calcretes cover large parts of the Northern Cape but they are difficult to date and there are several schools of thought (see Partridge et al., 2006). Nonetheless, it is accepted that calcretes form under alternating cycles humid and arid climatic conditions in strata that have calcium carbonate (Netterberg, 1969). More recent research using geophysical techniques to measure uplift of the continent during the Cretaceous and tertiary, combined with the fossil record (Braun et al., 2014) suggest that there were two predominant humid periods during the Tertiary. The whole of the Eocene (56-33 Ma) and a short period during the early Miocene (ca 20-19 Ma) were humid according to their estimation. It is possible that the Northern Cape calcretes formed during one of these periods.

Overlying many of these rocks are loose sands and sand dunes of the Gordonia Formation, Kalahari Group of Neogene Age. The Gordonia Formation is the youngest of six formations and is the most extensive, stretching from the northern Karoo, Botswana, Namibia to the Congo River (Partridge et al., 2006). It is considered to be the biggest palaeo-erg in the world (ibid). The sands have been derived from local sources with some additional material transported into the basin (Partridge et al., 2006). Much of the Gordonia Formation comprises linear dunes that were reworked a number of times before being stabilised by vegetation (ibid).

New cosmogenic burial ages obtained from a 55 m section of Kalahari Group sediments (Matmon et al., 2015), South Africa, indicate that in the southern Kalahari, the majority of deposition occurred rapidly at 1.0–1.2 Ma. All earlier sediments in this region were eroded during previous sedimentary cycles. In summary, they showed that the stratigraphy, sedimentology, and cosmogenic nuclide data indicate:

- 1) the existence of a stable, shallow and low-energy water body over the southern Kalahari for at least 450 ka prior to 1–1.2 Ma;
- 2) rapid sediment accumulation that filled up the basin at 1–1.2 Ma; and
- 3) the establishment of the Kalahari sand cover shortly thereafter.

The authors acknowledge that this timeframe is far younger than expected from the conventional estimates for the Kalahari Group sediments (Haddon and McCarthy, 2005). The significant hiatus between the Pleistocene sequence and the underlying Archaean basement implies that evidence of earlier cycles of deposition and erosion are no longer preserved in the sedimentary record.

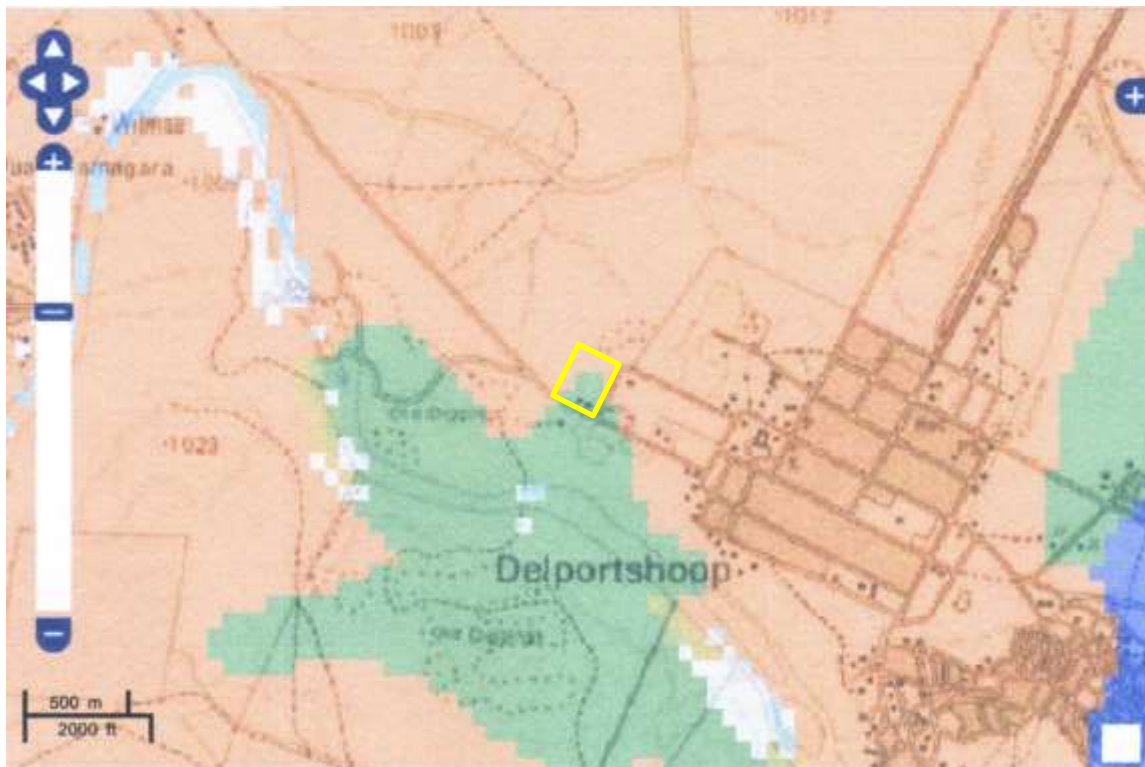
## ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site for development is in the Quaternary alluvium and sands (orange and green, respectively).

The Tertiary calcretes can trap fossils and artefacts when associated with palaeo-pans or palaeo-springs (Partridge et al., 2006). Where deflation has occurred, for example along the west coast of South Africa, any trapped materials in the different levels can be concentrated in the depo-centre of the pan or dune and thus it can be challenging to interpret the deposit (Felix-Henningsen et al., 2003).

The Aeolian sands of the Gordonia Formation do not preserve fossils because they have been transported and reworked. Conditions required for the preservation of organic material and formation of fossils are burial in a low energy, anoxic environment such as overbank deposits, lake muds or clays (Briggs and McMahon, 2016). Aeolian sands are high energy, well-oxygenated environments. In some regions the sands may have covered pan or spring deposits and these can trap fossils, and more frequently archaeological artefacts. Usually these geomorphological features can be detected using satellite imagery. No such features are visible.

Exploration and research along the palaeo-rivers of Southern Africa, now only present as abandoned palaeochannels, or captured by the present day rivers, the Vaal and Orange Rivers in this case, the gravels and sands might include transported robust and fragmentary fossils. Examples of these are heavy bone fragments and silicified wood fragments, as well as diamonds (de Wit, 1999; de Wit et al., 2000).



**Figure 4: SAHRIS palaeosensitivity map for the site for the Mining Right Application in Delpportshoop 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.**

## 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 but might trap transported fossils; so far there are no records of plant or animal fossils in this site so it is very unlikely that fossils occur on the site. The impact would be negligible
	<b>L+</b>	-
	<b>M+</b>	-

<b>PART B: Assessment</b>		
	<b>H+</b>	-
<b>DURATION</b>	<b>L</b>	-
	<b>M</b>	-
	<b>H</b>	Where manifest, the impact will be permanent.
	<b>L</b>	Since the only possible fossils within the area would be transported fossil fragments in the aeolian and fluvial sands or in the calcrete, the spatial scale will be localised within the site boundary.
<b>SPATIAL SCALE</b>	<b>M</b>	-
	<b>H</b>	-
	<b>H</b>	-
<b>PROBABILITY</b>	<b>M</b>	It is unlikely that any fossils would be found in the loose soils and sands that cover the area and that will be mined or processed. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr-
	<b>L</b>	.
	<b>H</b>	-

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 much too old to contain fossils or the materials have been transported. Furthermore, the material to be mined or sifted through is transported, high energy and well oxygenated sand and this does not preserve fossils. Since there is a small chance that fossils from the Quaternary 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, granites, sandstones, shales and sands are typical for the country and might contain fossil plant or vertebrate material that has been transported from another site, and fragmented. The sands of the Quaternary period would not preserve fossils.

## 6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is unlikely that any fossils would be preserved in the sands and alluvium of the Quaternary. There is a small chance that fossils may have been transported with the sands so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, miners or other responsible person once mining has commenced

then they should be rescued and a palaeontologist called to assess and collect a representative sample. Since the impact on the palaeontological heritage would be low, it is recommended that the project be authorised.

## 7. References

- Briggs, D.E.G., McMahon, S., 2016. The role of experiments in the taphonomy of exceptional preservation. *Palaeontology* 59, 1-11.
- De Wit, M.C.J., 1999. Post-Gondwana drainage and the development of diamond placers in western South Africa. *Economic Geology*, 94, 721-740.
- Felix-Henningsen, P., Kandel, A.W., Conard, N.J., 2003. The significance of calcretes and paleosols on ancient dunes of the Western Cape, South Africa, as stratigraphic markers and paleoenvironments. In: G. Füleky (Ed.) *Papers of the 1st International Conference on Archaeology and Soils*. BAR International S1163, pp. 45-52.
- Gumsley, A., Stamsnijder, J., Larsson, E., Söderlund, U., Naeraa, T., de Kock, M., Sałacińska, A., Gawęda, A., Humbert, F., Ernst, R., 2020. Neoarchean large igneous provinces on the Kaapvaal Craton in southern Africa re-define the formation of the Ventersdorp Supergroup and its temporal equivalents. *GSA Bulletin* 132, 1829–1844. <https://doi.org/10.1130/B35237.1>
- Haddon, I.G., McCarthy, T.S., 2005. The Mesozoic–Cenozoic interior sag basins of Central Africa: The Late-Cretaceous–Cenozoic Kalahari and Okavango basins. *Journal of African Earth Sciences* 43, 316–333.
- 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.
- Lancaster, I.N., 1978a. The pans of the southern Kalahari, Botswana. *Geographical Journal* 144, 80–98.
- Lancaster, I.N., 1978b. Composition and formation of southern Kalahari pan margin dunes. *Zeitschrift für Geomorphologie* 22, 148–169.
- Lancaster, N., 1986. Pans in the southwestern Kalahari: a preliminary report. *Palaeoecology of Africa* 17, 59–67.
- Netterberg, F., 1969. The interpretation of some basic calcrete types. *South African Archaeology Bulletin* 24, 117-122.
- Matmon, A., Hidy, A.J., Vainer, S., Crouvi, O., Fink, D., 2015. New chronology for the southern Kalahari Group sediments with implications for sediment-cycle dynamics and

early hominin occupation. *Quaternary Research*. 84 (1), 118–132. <http://dx.doi.org/10.1016/j.yqres.2015.04.009>.

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.

## 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 must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone, wood) 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 5). 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 Quaternary sands



Figure 5: Photographs of robust but fragmented transported fossils recovered from other Quaternary fluvial deposits.

10. Appendix B – Details of specialist

**Curriculum vitae (short) - Marion Bamford PhD  
January 2022**



## I) Personal details

Surname : **Bamford**  
First names : **Marion Kathleen**  
Present employment: Professor; Director of the Evolutionary Studies Institute.  
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### 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.  
NRF Rating: C-2 (1999-2004); B-3 (2005-2015); B-2 (2016-2020); B-1 (2021-2026)

### 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	13	0

Masters	11	3
PhD	11	6
Postdoctoral fellows	15	1

### **viii) Undergraduate teaching**

Geology II – Palaeobotany GEOL2008 – average 65 students per year

Biology III – Palaeobotany APES3029 – average 45 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 *Open Science UK*: 2021 -

Review of manuscripts for ISI-listed journals: 30 local and international journals

Reviewing of funding applications for NRF, PAST, NWO, SIDA, National Geographic,

Leakey Foundation

### **x) Palaeontological Impact Assessments**

Selected from the past five years only – list not complete:

- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klippoortjie 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
- Lielifontein 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

### **xi) Research Output**

Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 10 book chapters.

Scopus h-index = 30; Google scholar h-index = 35; i10-index = 92

Conferences: numerous presentations at local and international conferences.