

Palaeontological Impact Assessment for the proposed Prospecting Rights Application on Erf 657 and a Portion of the Remainder of Erf 1526, Barkly West, Northern Cape Province

DESKTOP STUDY (PHASE 1)

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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 Archaeological and Heritage Services Africa (Pty) Ltd, 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 'M Bamford', with a horizontal line underneath.

Signature:

Executive Summary

A Palaeontological Impact Assessment was requested for the Prospecting Rights application on approximately 5 ha on Erf 687 and a portion of Erf 1526, adjacent to the Orange River and west of Barkly West, Northern Cape Province, for diamonds.

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 project.

The prospecting site lies on the Quaternary alluvium, sands and diamondiferous gravels and there is a very small chance that fossils occur here as they would have been transported by the river recently or in the past. Nonetheless, a Fossil 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 by the environmental officer or other responsible person, then a palaeontologist should be called to rescue a representative sample.

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1. Background

A Prospecting Rights Application is being put forward by Azania JB KM Pty Ltd, with the assistance of Thaya Environmental Consultants, for diamonds on approximately 5 ha in extent on Erf 687 and a portion of Erf 1526 Remainder, Barkly West, in the Magisterial District of Barkly West, Northern Cape Province (Figure 1).

The property is on the north bank of the Vaal River and just southwest of the built-up area. The Prospecting method is unknown.

A Palaeontological Impact Assessment was requested for the Barkly West Prospecting Rights Application in order 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: 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 2
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	N/A

	buffers;	
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	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

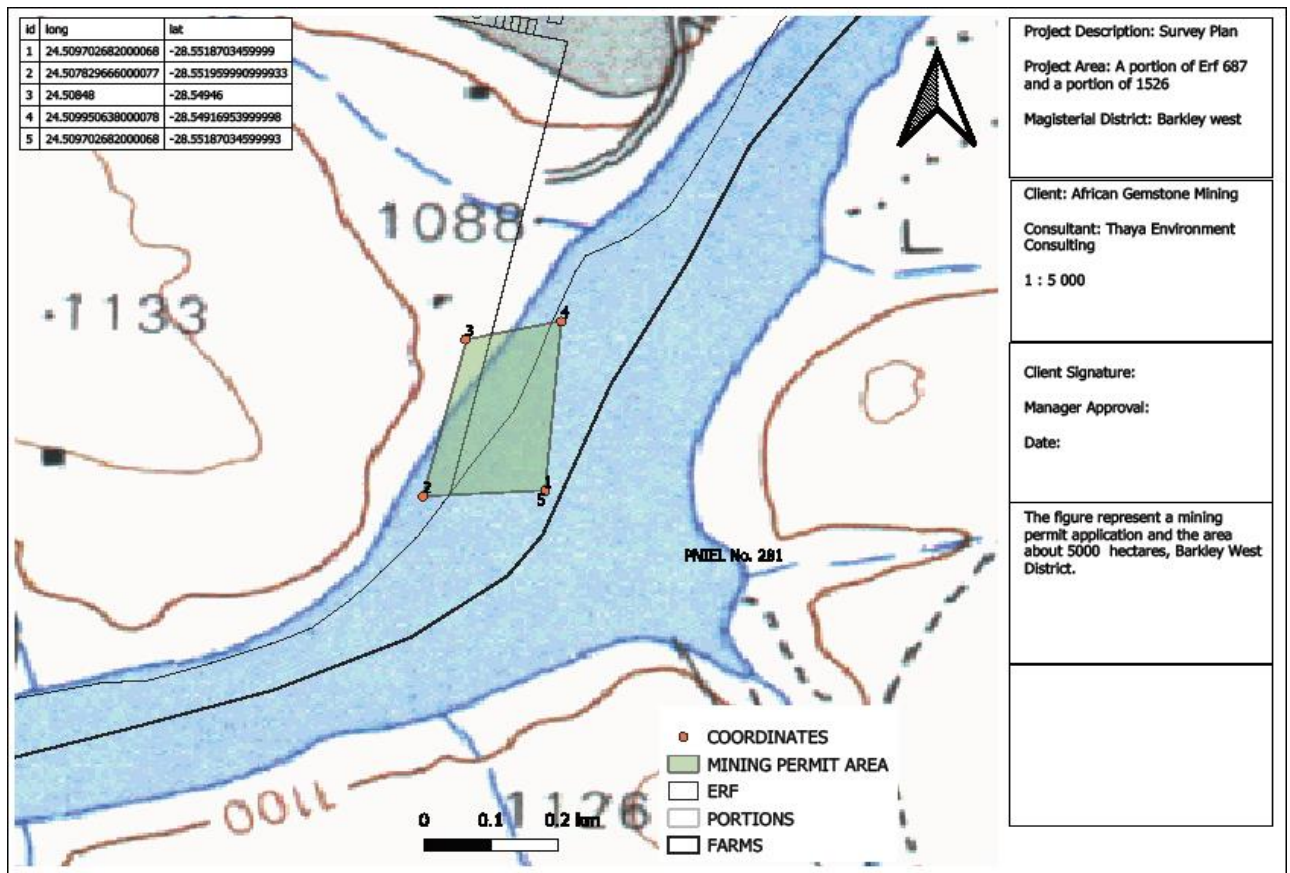


Figure 1: Locality map of the proposed Prospecting Rights Application on Erf 687 and a port of Erf 1526 Rem, Barkly West with the sections shown by the black outline.

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 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

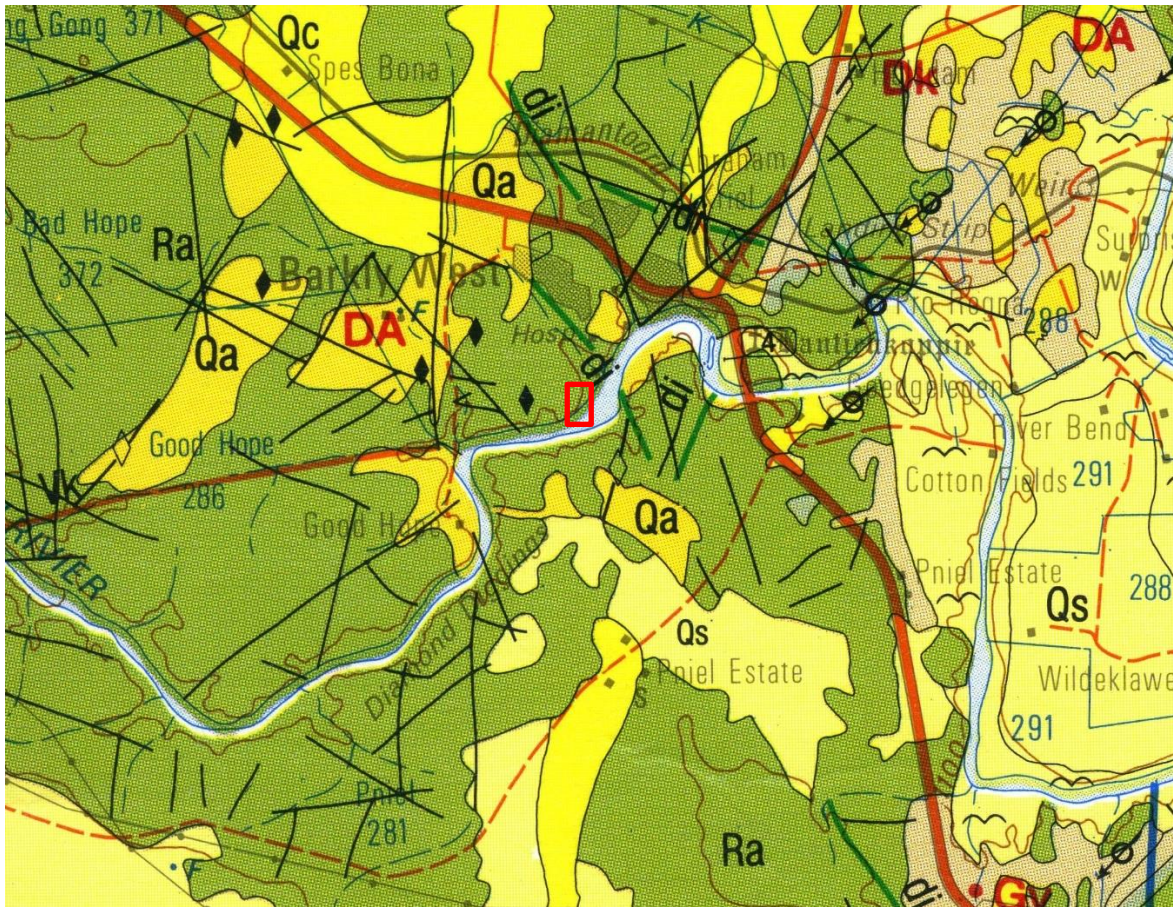


Figure 2: Geological map of the area around the Erf 687 and Erf 1526 Barkly West PR area. The location of the proposed project is indicated within the red outline. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2824 Kimberley.

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

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary	Red and grey aeolian sand and sand dunes	Neogene, ca 2.5 Ma to present
Qa	Quaternary	Alluvial diamondiferous gravel	Neogene, ca 2.5 Ma to present
Ppr	Prince Albert Fm, Ecça Group, Karoo SG	Shales	Middle Ecça, Early Permian
Ra	Allanridge Fm, Platberg Group, Ventersdorp SG	Andesite, in places amygdaloidal and/or porphyritic	2754–2709 Ma.

Four basins developed on the Kaapvaal Craton between 3000 and 2100 Ma, after it had stabilised (van der Westhuizen and de Bruijn, 2006). The second last of these basins contains the Ventersdorp Supergroup that is a large volcano-sedimentary supracrustal record (ibid). The sequence has been divided into several groups whose members have changed over time as the classification of the rocks has been refined. The most recent classification is that of the basal Klipriviersberg Group, central Platberg Group and upper Pniel Group that includes the Bothaville and Allanridge Formations (Meintjes and van der Westhuizen, 2018). Andesites that are in places amygdaloidal and/or porphyritic are the rocks that make up the Allanridge Formation. These volcanics have been dated between 2709–2683 Ma by Gumsley et al. (2020).

Considerably younger basal rocks of the Karoo Supergroup, the Prince Albert Formation (Ecca Group) are exposed in this area. The shales were deposited in the huge inland sea that had formed in the Karoo Basin and was being filled with melt water and sediments eroding from the Cargonian Highlands in the north and the Cape Mountains in the south.

Unconformably overlying the Ventersdorp and Karoo Supergroup rocks are Quaternary aged sands of the Kalahari Group. Some of these are associated with the Cenozoic alluvial gravels of the Vaal River and may have diamonds that have eroded out of the kimberlite pipes upstream (de Wit et al., 2016). Other sands in the region are younger and are windblown from areas farther to the northwest.

ii. Palaeontological context

From the SAHRIS map (Figure 3) the area is indicated as moderately sensitive for the Quaternary alluvium, aeolian sands and diamondiferous gravels, and of low sensitivity for the Allanridge Formation (blue). The maps (Figures 2, 3) for this section and small area are of low resolution so it is not clear if the Prospecting Rights area is moderately sensitive or not.

Quaternary sands very rarely preserve fossils and these are usually robust but fragmentary because they have been transported by wind, in the case of aeolian sands, or by water, in the case of the river gravels (Partridge et al., 2006). Any fossils would be out of context so that reduces their scientific interest.

Along the major rivers such as the Vaal and Orange Rivers, where there are abandoned channels from tectonic activity, fossils can be preserved in these palaeochannels (de Wit and Bamford, 1993; de Wit et al., 2009). Such deposits are rare and the fossils that survive such transport are robust, such as fossil wood or bones. The site is close to the current river so it is unlikely that there is a palaeochannel.

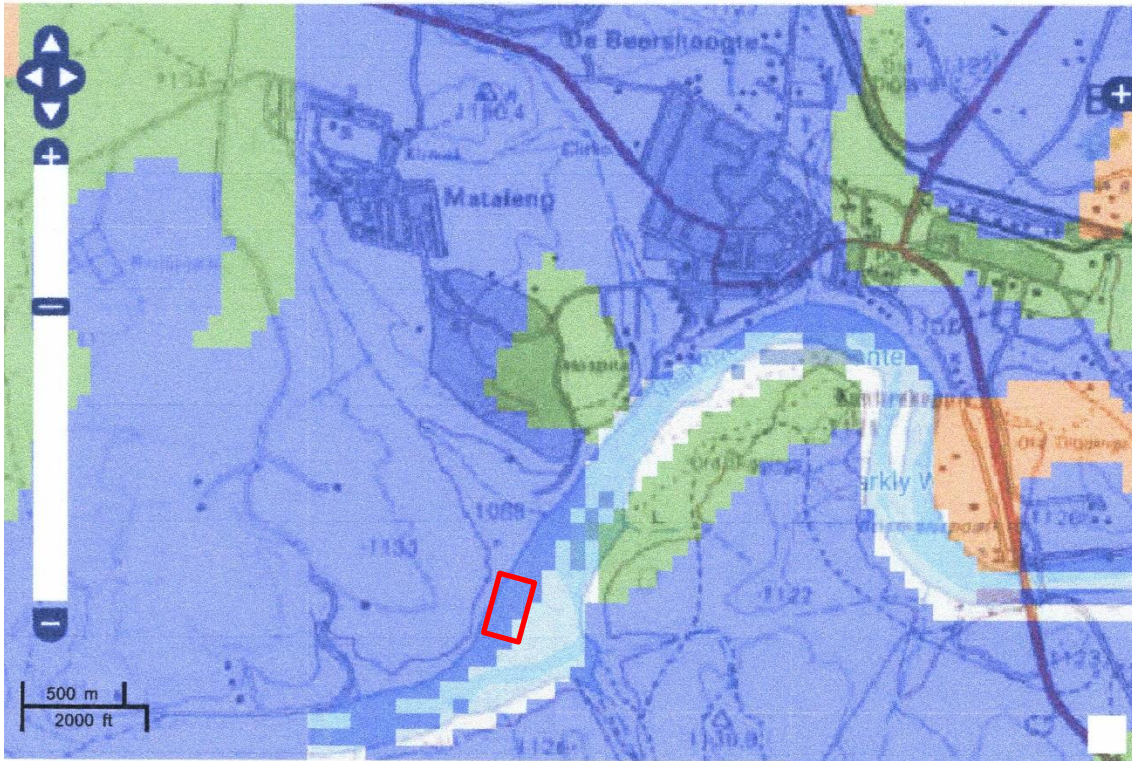


Figure 3: SAHRIS palaeosensitivity map for the site for the proposed Erf 687 and Erf 1526 Barkly West PR area shown within the red rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

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

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	L	Quickly reversible. Less than the project life. Short term

DURATION of impacts	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	Volcanic rocks do not preserve fossils; Quaternary sands are unlikely to preserve fossils but it is possible. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since the only possible fossils within the area would be transported robust but fragmentary fossils of bone or silicified wood in the sands and gravels, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is unlikely that any fossils would be found in the loose sands that will be removed during prospecting, 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 prospecting footprint. The geological structures suggest that some of the rocks are the correct age and type to contain fossils. Since there is a small chance that fossils transported in the gravels and sands along the river 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 andesites, dolomites, sandstones, shales and sands are typical for the country and some do contain fossil plant, insect, invertebrate and vertebrate material. There have been no records of fossils from this area to date so it is unknown if they occur here. The sands of the Quaternary period would not preserve fossils but might have entrained fossil fragments.

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 only a small chance that fossils may have been transported so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found once excavating and prospecting have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. References

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., Bhebhe, Z., Davidson, J., Haggerty, S.E., Hundt, P., Jacob, J., Lynn, M., Marshall, T.R., Skinner, C., Smithson, K., Stiefenhofer, J., Robert, M., Revitt, A., Spaggiari, R., Ward, J., 2016. Overview of Diamond Resources in Africa. *Episodes* 39(2), 199-237.

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.

Gumsley, A., Stamsnijder, J., Larsson, E., Söderlund, U., Naeraa, T., de Kock, M., Sałacińska, A., Gawęda, A., Humbert, F., Ernst, R., 2020. Neoproterozoic 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.

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.

Meintjes, P.G., van der Westhuizen, W.A., 2018. Stratigraphy and Geochemistry of the Goedgenoeg and Makwassie Formations, Ventersdorp Supergroup, in the Bothaville area of South Africa. *South African journal of Geology* 121, 339-362.

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.

Van der Westhuizen, W.A., de Bruijn, H., Meintjes, P.G., 2006. The Ventersdorp 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 187-208.

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 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.
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 Figures 4, 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.

Appendix A – Examples of fossils from the Quaternary sands



Figure 4: Fragments of silicified wood from a fluvial deposit. Scale bar = 12 cm.



Figure 5: Fragments of fossil bones from a site next to a river in the Free State.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD January 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-
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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.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):

1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps

1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer

1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa

Royal Society of Southern Africa - Fellow: 2006 onwards

Academy of Sciences of South Africa - Member: Oct 2014 onwards

International Association of Wood Anatomists - First enrolled: January 1991

International Organization of Palaeobotany – 1993+

Botanical Society of South Africa

South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
 SASQUA (South African Society for Quaternary Research) – 1997+
 PAGES - 2008 –onwards: South African representative
 ROCEEH / WAVE – 2008+
 INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	11	0
Masters	10	4
PhD	11	4
Postdoctoral fellows	10	5

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 –

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
- 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

xi) Research Output

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 10 book chapters.

Scopus h-index = 29; Google scholar h-index = 35; i10-index = 92

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)

