Palaeontological Impact Assessment for the proposed Residential development on RE228 Fouriesburg, Free State Province

Site Visit (Phase 2) Report

For

Mang Geoenviro Services

30 January 2022

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

Expertise of Specialist

The Palaeontologist Consultant is: 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 Mang Geoenviro Services, 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 site visit (phase 2) palaeontological impact assessment was requested by for the proposed development of a residential area on RE228, just north of Fouriesburg, Dihlabeng Local Municipality, Free State Province because the site is indicated as very highly sensitive on the SAHRIS palaeosensitivity map.

The site visit was carried out on 24th January by Brandon Stuart, University of the Free State. The site is vacant land with disturbed vegetation and **no fossils** were seen on any part of the property. However, it is possible that fossils of Late Triassic age from the Elliot Formation (Stormberg Group, Karoo Supergroup) might occur below ground. Therefore, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological site visit is required unless fossil bones are discovered once excavations commence. As far as the palaeontology is concerned, the project should be authorised.

Table of Contents

1. Background

A site visit (phase 2) palaeontological impact assessment was requested by for the proposed development of a residential area on RE228, just north of Fouriesburg, Dihlabeng Local Municipality, Free State Province because the site is indicated as very highly sensitive on the SAHRIS palaeosensitivity map. (Figures 1-4). The rocks are those of the Elliot Formation.

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 site visit and survey (Phase 2) Palaeontological Impact Assessment (PIA) was completed on 24th January 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	Page 1
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 for fossils
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	Section 6
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;	Sections 1, 6
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4

k	Any mitigation measures for inclusion in the EMPr	Appendix A
l	Any conditions for inclusion in the environmental authorisation	Section 8
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	Sectioned 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	Section 6
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

Figure 1: Google Earth map to show the relative landmarks for the area around Fouriesburg.

Figure 2: Google Earth map showing the outline of the proposed residential development on RE228, northern Fouriesburg.

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 (as reported herein, and collect or rescue fossils if required);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*as indicated in section 4 below)*; and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a just a representative sample collected and housed in a recognised repository.

3. Geology and Palaeontology

i. Project location and geological context

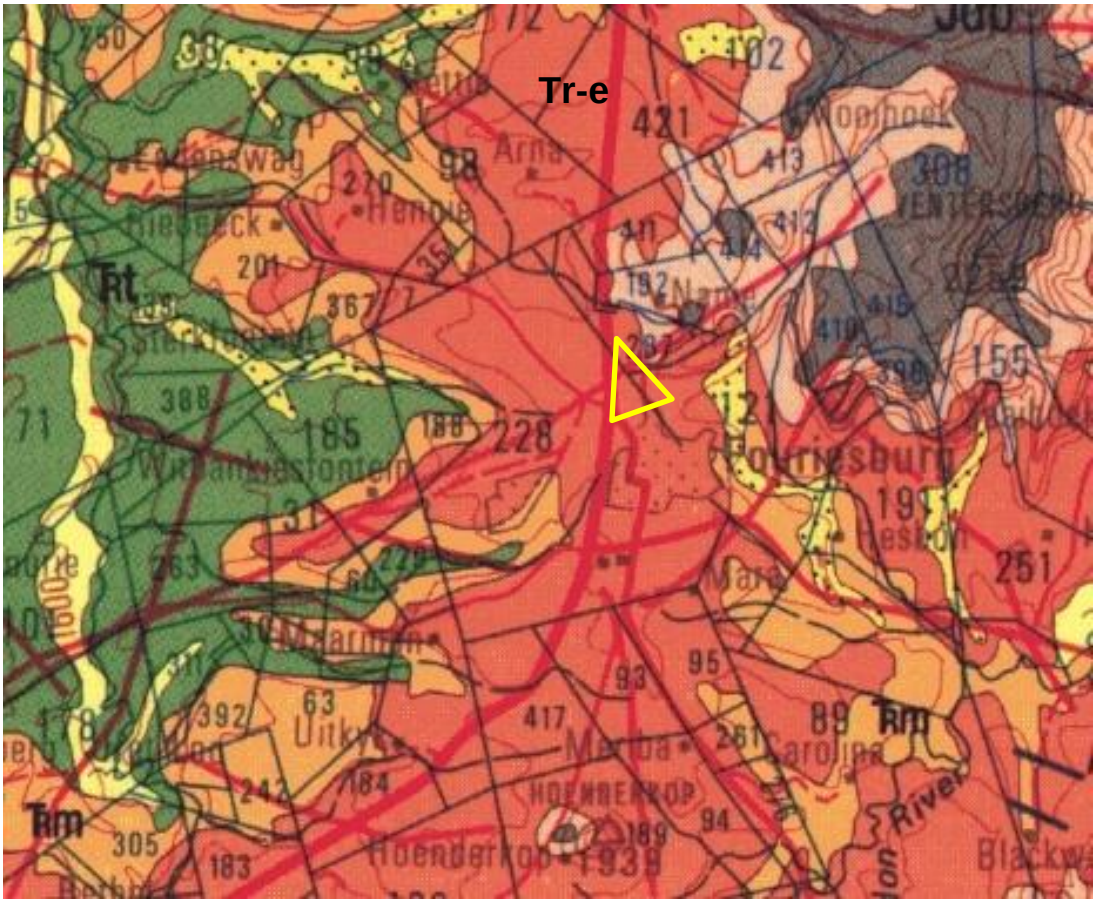

Figure 3: Geological map of the area around Fouriesburg. The location of the proposed project is indicated within the yellow triangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2828 Harrismith.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson 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 sand	Aeolian sand, with gravelly areas (triangles)	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Jdb	Drakensberg Fm, Karoo SG	basalt	Jurassic, approx., 180 Ma
Tr-c	Clarens Fm, Stormberg Group, Karoo SG	Light pink and white sandstone	Early Jurassic
Tr-e	Elliot Fm, Stormberg Group, Karoo SG	Red-purple mudstone	Late Triassic to early Jurassic
Tr-m	Molteno Fm, Stormberg Group, Karoo SG	Sandstone, grit, mudstone, carbonaceous shale	Mid to late Triassic

Symbol	Group/Formation	Lithology	Approximate Age
Tr-t	Tarkastad Subgroup, Beaufort Group, Karoo SG	Sandstone, red, green, blue mudstone	Early Triassic

The site lies in the central Karoo Basin and northwest of the Drakensberg Mountains so the sediments of the upper Karoo Supergroup are well exposed here. The Karoo Supergroup rocks cover a very large proportion of South Africa and represent some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates. The basal Dwyka Group rocks represent the early stages of basin infil and are widespread. Overlying these are the Ecca Group rocks from warmer climates and a diversity of fossil plants. Next is the Beaufort Group the represents a different depositional style in a drier environment but with a diversity of plants and vertebrates. Only the uppermost Beaufort is shown in this area. The upper sediments are those of the Stormberg Group, also from a drier climate. Deposition was terminated and capped by the Drakensberg basalt out-pourings

In the central part of the Karoo Basin the Tarkastad Subgroup is composed of two formations, the lower Katberg and upper Burgersdorp Formations. In the Free State and KwaZulu Natal the Tarkastad Subgroup comprises the lower Verkykerskop Formation and upper Driekoppen Formation. No distinction is made on the geological map.

Overlying the Beaufort Group are the three formations of the Stormberg Group. They are absent from the western part of the basin but are more uniform across the eastern part of the basin. Large exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

Associated with the massive basalt eruptions that formed the Drakensberg Group, which cap the Karoo Supergroup sediments and signalled the end of those cycles of deposition, there were numerous intrusive dolerite sills and dykes through the Karoo sediments (Johnson et al., 2006). These volcanic rocks do not preserve any fossils, and in fact tended to destroy any fossils in the immediate vicinity. Dolerite dykes for the more resistant hills and ridges that are familiar today in the Karoo Basin. They are of Jurassic age.

ii. Palaeontological context

The Elliot formation spans the Triassic-Jurassic boundary and has been divided into the lower and upper Elliot Formation, more or less correlating with the boundary. Plants are very rare but are a continuation of the *Dicroidium* flora with conifers, cycads and Bennettitaleans could be expected (Plumstead, 1969). The *Scalenodontoides* Assemblage Zone typifies the lower Elliot Formation while the *Massospondylus* AZ is characteristic of the upper Elliot formation (See lists of vertebrate taxa in Appendix A).

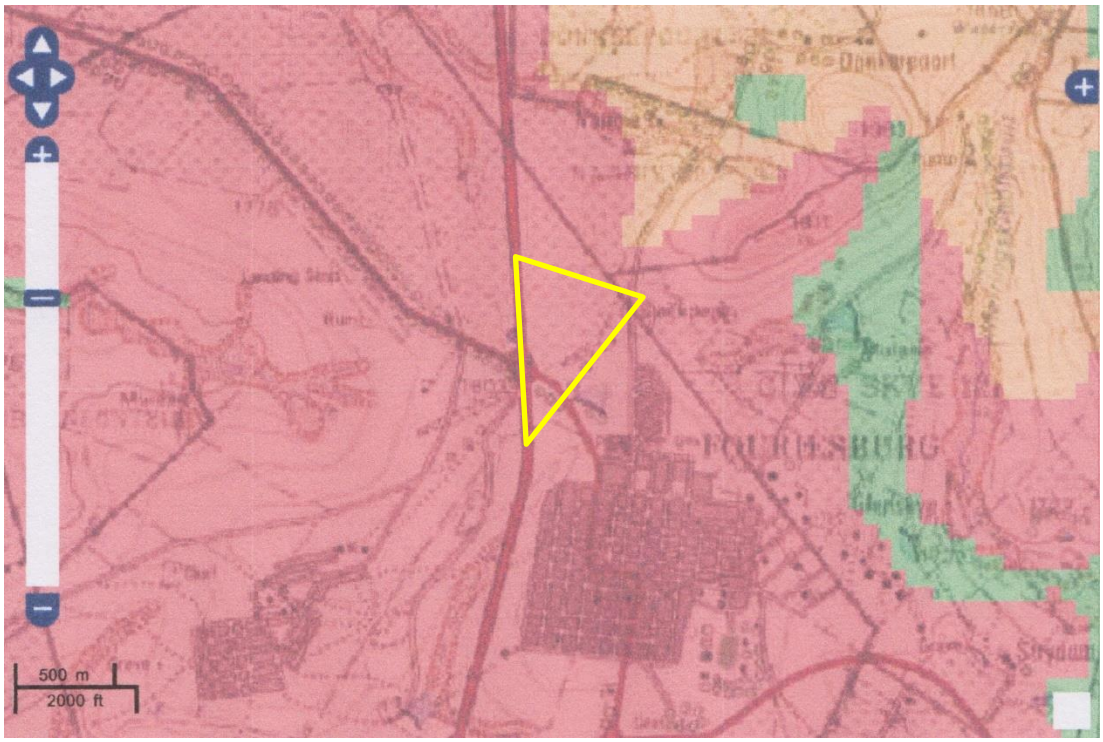

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed Fouriesburg RE228 residential site shown within the yellow triangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Iii **Site visit observations**

A site visit and survey of the project area was completed on 24th January by Brandon Stuart. The whole area was walked through, and the route GPS coordinates are available on request. Photographs and observations were taken along the route from the northern point in a more or less anticlockwise route south and back to start. This information is presented in Table 3, Figures 5-7 for site photographs. All photographs were taken by Brandon Stuart.

Table 3: Site visit observations and relevant site photographs as indicated.

Observations	Figure
Northern section: open, flat topography; land covered by low and disturbed vegetation but visibility of the ground surface was very good. No rocky outcrops that could potentially contain fossils were observed and the ground was covered by soils to a moderate depth	5A-D
Southern section: open, flat topography; land covered by low and disturbed vegetation but visibility of the ground surface was very good. No rocky outcrops that could potentially contain fossils were observed and the ground was covered by soils to a moderate depth. The road shows the soils present.	6A-D

Eastern section: open, flat topography; land covered by low and disturbed vegetation but visibility of the ground surface was very good. No rocky outcrops that could potentially contain fossils were observed and the ground was covered by soils to a moderate depth. There is one exposure of shaley material that could preserve fossils but on examination was found to be sterile. Depth of these rocks is unknown	7A-D

Figure 5: Site photographs for the proposed Fouriesburg RE228 residential development. Northern section. A – B - general views across the site; C – D – close-up of the vegetation indicating good soils.

Figure 6: Site photographs for the proposed Fouriesburg RE228 residential development. Southern section. A - track across the property showing sandy sols and adjacent vegetation cover. B – view towards the tar road (R26). C – disturbed vegetation of *Stoebe vulgaris* from overgrazing. D – view to the east.

Figure 7: Site photographs for the proposed Fouriesburg RE228 residential development. Eastern section. A - track showing sandy soil. B – C – only exposure of shales and mudstones. No fossils found here. D – low vegetation and shallow soils in the section.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 4:

TABLE 4A: CRITERIA FOR ASSESSING IMPACTS

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

TABLE 4B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	Soils do not preserve plant fossils; so far there are no records from the Elliot Fm of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be vertebrates from the Scalenodontoides or Massospondylus AZs or possible fossil plants from the *Dicroidium* flora in the shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-

PART B: ASSESSMENT		
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the loose sand and soils that will be excavated for foundations. NO FOSSILS WERE FOUND. 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 the correct age and type to contain fossils, namely the Elliot Formation but no fossils were found. Furthermore, the material to be excavated for foundations is soils and loose sand and this does not preserve fossils. Since there is an extremely small chance that fossils may occur below ground 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 dolomites, sandstones, shales and sands are typical for the country and do contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils. The site visit confirmed that there are no fossils visible in the project area.

6. Recommendation

Based on experience and the lack of any fossils found when the site was visited and walked through, it is extremely unlikely that any fossils would be preserved in the loose sands of the Quaternary, or just below ground. There is a very small chance that fossil may occur farther below ground in the mudstones of the Elliot Formations so Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once excavations for foundations and amenities has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. 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.

Bamford, M.K. 2004. Diversity of woody vegetation of Gondwanan southern Africa. Gondwana Research 7, 153-164.

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.

MacRae, C.S., 1999. Life Etched in Stone. Fossils of South Africa. Geological Society of South Africa, Johannesburg. 305pp.

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, R.M.H., Rubidge, B.S., Day, M.O., Botha, J., 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. South African Journal of Geology 123(2), 131-140.

Viglietti, P.A., McPhee, B.W., Bordy, E.M., Sciscio, L., Barrett, P.M., Wills, S., Tolchard, F., Choiniere, J.N., 2020. Biostratigraphy of the *Scalenodontoides* Assemblage Zone (Beaufort Group, Karoo Supergroup). South African Journal of Geology 123, 239-248.

Viglietti, P.A., McPhee, B.W., Bordy, E.M., Sciscio, L., Barrett, P.M., Benson., R.B.J., Wills, S., Chapelle, K.E.J., Dollman, K.N., Mdekazi, C., Choiniere, J.N., 2020. Biostratigraphy of the *Massospondylus* Assemblage Zone (Beaufort Group, Karoo Supergroup). South African Journal of Geology 123, 249-262.

8. Chance Find Protocol

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

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

Table 4: List of potential taxa from the Elliot Formation (complied from Anderson and Anderson, 1985; Bamford, 2004; Plumstead, 1969; Smith et al., 2020, Viglietti et al., 2020 a, b)

Group/subG/ Formation	Plant group	Genera	Animal Group	Common Genera
Stormberg Clarens Fm Upper Elliot Fm Massospondylus AZ	Sphenophyta	*Equisetites*	Pisces	*Ceratodus*
	Bennettitales	*Otozamites*	Amphibia	*Chigutisaurus indet*
	Coniferales	*Sphenolepidium Pinus, Agathoxylon*	Eureptilia	*Protosuchus, Lesotosaurus, Aardonyx Megapnosaurus, Eucursor, Massospondylus*
	Incertae sedis	*Phoenicopsis*	Cynodontia	*Trithelodon, Tritylodon, Diarthrognathus, Pachygenelus, Tritylodontoides*
			Mammals	*Megazostrodon, Erythrotherium*
Group/sG/Fm	Plant group	Genera	Animal Group	Common Genera
Stormberg Lower Elliot Fm Scalenodon-toides AZ	Sphenophyta	*Equisetites*	Amphibia	*Chigutisaurus indet*
	Bennettitales	*Otozamites*	Eureptila	*Rauisuchid indet, Blikanasaurus, Melanorosaurus, Ecnemasaurus*
	Coniferales	*Sphenolepidium Pinus, Agathoxylon*	Anomodontia	*Pentasaurus*
	Incertae sedis	*Phoenicopsis*	Cynodontia	*Scalenodontoides, Elliotherium, Trithelodon*

Figure 8: Photograph of a prepared skull of the sauropodomorph, *Massospondylus carinatus* (from MacRae, 1999).

Figure 9: Photograph of the prepared skeleton of the sauropodomorph *Massospondylus carinatus* (Fron MacRae, 1999).

Appendix B – Details of specialists

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. 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	11	2
Masters	10	5
PhD	11	4
Postdoctoral fellows	10	4

viii) Undergraduate teaching

Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 2-8 students per year.

ix) Editing and reviewing

Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Cretaceous Research: 2014 –
Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting

- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- 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
- 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 January 2022 peer-reviewed journals or scholarly books: over 160 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 30; Google scholar h index = 36;
Conferences: numerous presentations at local and international conferences.

Brandon Stuart CV
December 2021

After completing my BSc degree majoring in Zoology and Genetics in 2019. In 2020 enrolled and completed a BSc Hons. degree majoring in Zoology and specializing in Paleontology. My Honours research project was focused on describing the postcranial anatomy of the therocephalian *Moschorhinus kitchingi,* supervised by Dr. Jennifer Botha at the National Museum, Bloemfontein.

I am currently enrolled at the University of the Free State for my MSc degree in Palaeobiology. I am carrying out my research through the National Museum, Bloemfontein supervised by Dr. Jennifer Botha. My research is focused on studying the postcranial morphology of therocephalian therapsids from the Karoo Basin of South Africa.

Qualifications
BSc – Majors: Genetics and Geology - University of the Free State – 2019
BSc Honours – Palaeontology – University of the Free State – 2020
MSc – Palaeontology – University of the Free State – registered 2021, in progress.

PIA Fieldwork Experience
July 2021 – Sannaspos SEF, Free State, for CTS Heritage
October 2021 – Beatrix Mine-Theunissen Eskom Powerline for 1World

References:
Dr Jennifer Botha, Head of Palaeontology, National Museum, Bloemfontein
jbotha@nasmus.ac.za

Prof Jonah Choiniere, Evolutionary Studies Institute, University of the Witwatersrand, Johannesburg
Jonah.choiniere@wits.ac.za