

**Palaeontological Impact Assessment for the proposed
construction of a service station and amenities on
farm Hangklip 508 LQ, Lephalale,
Limpopo Province**

Desktop Study

For

Heritage Consultants

11 November 2018

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 22 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Heritage Consultants, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A palaeontological Impact Assessment was requested for the construction of a filling station and amenities on portions of Erven 14748 to 14751, situated on a portion of Portion 3 of the Farm Hangklip 508 LQ, approximately 13,3km to the west of Lephalale at the intersection of the turnoff to Medupi powerstation. The investigated area is approximately 3.65Ha in size. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development of a sand mining area.

The proposed site lies on the sandstone, gritstone and mudstones of the Swartrand Formation, Ecca Group of early Permian age and could potentially preserve fossil plants of the *Glossoteris* flora. No fossils have been reported from this area and the twelve test pits excavated for the Geotechnical Report did not yield any fossils. Nonetheless a Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required and the project may continue.

Table of Contents

Expertise of Specialist.....	1
Declaration of Independence.....	1
1. Background.....	4
2. Methods and Terms of Reference	6
i. Project location and geological context.....	6
ii. Palaeontological context	8
4. Impact assessment.....	9
5. Assumptions and uncertainties	10
6. Recommendation.....	10
7. References.....	10
8. Chance Find Protocol	11
Appendix A (examples of fossils)	12
Appendix B (short CV of specialist)	14

1. Background

A palaeontological impact assessment was requested for proposed construction of a filling Station on portions of Erven 14748 to 14751, situated on a portion of Portion 3 of the Farm Hangklip 508 LQ, to the west of Lephalale at the intersection of the turnoff to Medupi power station. The investigated area is approximately 3.65Ha in size. The site is located east of Medupi power station and south of Matimba power station, approximately 13.3km west of Lephalale. The portion of interest is bisected by a number of registered servitudes.

A Palaeontological Impact Assessment was requested for this project. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and construction of the facility.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	Relevant section in report
Details of the specialist who prepared the report	Appendix B
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section ii Error! Reference source not found. 5
An identification of any areas to be avoided, including buffers	N/A
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
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
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
Any mitigation measures for inclusion in the EMPr	N/A

Any conditions for inclusion in the environmental authorisation	N/A
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
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
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A



Figure 1: Google Earth map of the proposed sites, northern and southern, for a filling station and amenities on the farm Hangklip 508 LQ, west of Lephalale, Limpopo Province with the sections shown by the red outline. Map supplied by Heritage Consultants.

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

The site is positioned on sandstone, gritstone and mudstone of the Swartrant Formation, Dwyka Group, Karoo Supergroup. To the south are sandstones and conglomerates of the Mogalakwena Formation, Waterberg Group, while to the north are the mudstones and carbonaceous shales of the Grootegeluk Formation, Karoo Supergroup. There are coal seams within the Swartrant and Grootegeluk Formations that are mined for the nearby coal-fired power stations, Medupi and Matimba. Numerous structural features such as faults and linear features are indicated on the geological sheet. The features include fault, geological contact and possible diabase intrusions/dykes but those are considered in the geotechnical report.

The Mogalakwena Formation, Kransberg Subgroup, Waterberg Group, is the oldest deposit in the area and comprises arenites and rudites and that were probably deposited by large braided rivers that flowed from highlands in the north-northeast towards a distant sea in the southwest some 2000 million years ago (Barker et al., 2006).

Upper Carboniferous to early Permian sediments are well represented but poorly exposed in the Ellisras Basin, equivalent in age to the main Karoo Basin. There are eight formations recognised by their lithologies with from the base to the top, the Waterkloof, Wellington, Swartrant, Goedgedacht, Grootgeluk, Eendragtpan, Greenwich and Lisbon Formations (Johnson et al., 2006). The environmental setting was that of a variety of fluvial, channel and braided river settings, including peats and swamps that later formed coals.

Overlying the Permian sediments are the upper Triassic Elliot Formation and a much more recent covering of Kalahari sands.

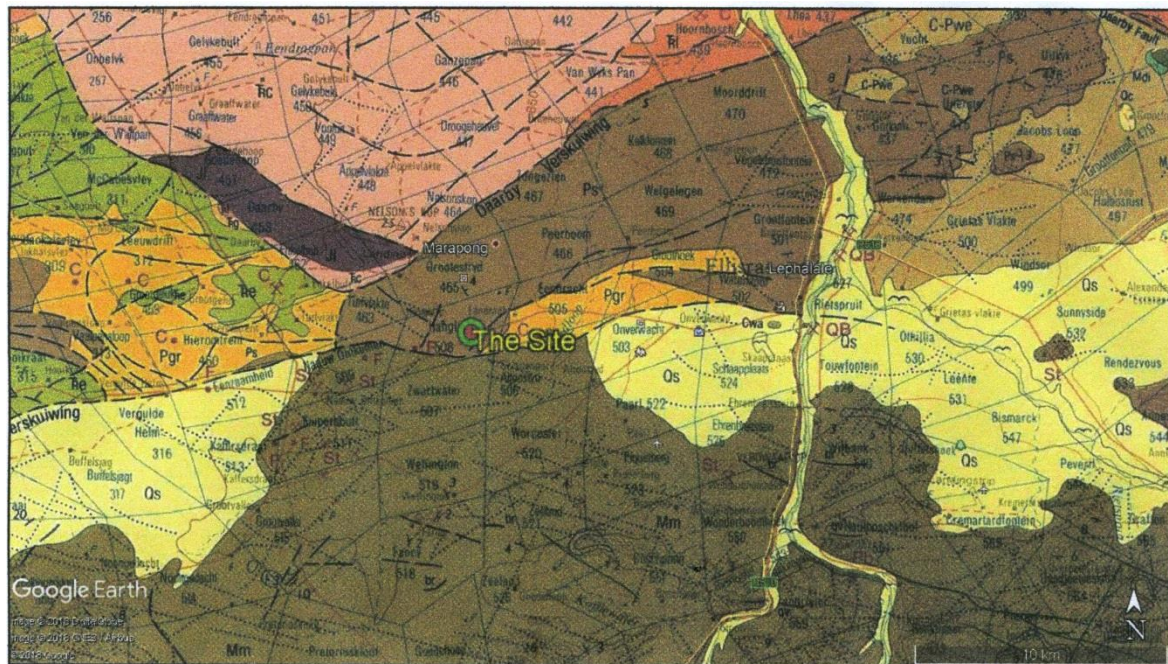


Figure 2: Geological map of the area around Lephalele. The location of the proposed project is indicated by the green circle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 1993.

Table 2: Explanation of symbols for the geological map and approximate ages (Barker et al., 2006. Johnson et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary	Alluvium, sand, calcrete	Neogene, ca 25 Ma to present
Tr-e	Elliot Formation, Karoo Supergroup	Sandstone, mudstone	Ca 180 Ma
Pgr	Grootegeluk Fm, Ellisras Basin, Ecca Group, Karoo SG.	Coal, carbonaceous shale, mudstone	Ca 280-270 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Sandstone, mudstone, shale, coal	Ca 280 Ma
Ps	Swartrant Fm, Ellisras Basin, Ecca Group, Karoo SG.	Sandstone, mudstone, coal	Ca 280 Ma
C-Pwe	Ellisras Basin, Ecca Group, Karoo SG.	Mudstone, siltstone	Ca 300 Ma
Mm	Mogalakwena Fm, Kransberg Group, Waterberg SG.	Sandstones, conglomerates, arenites, lutites	Ca. 2000 Ma

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for development is on the Swartrant Formation which has very minor coal seams amongst the shales. The Grootegeluk Formation and the underlying Vryheid Formation (widespread in the Karoo Basin too), have eight coal seams, the thicker and more economically viable ones being the basal four seams (Snyman, 1998).

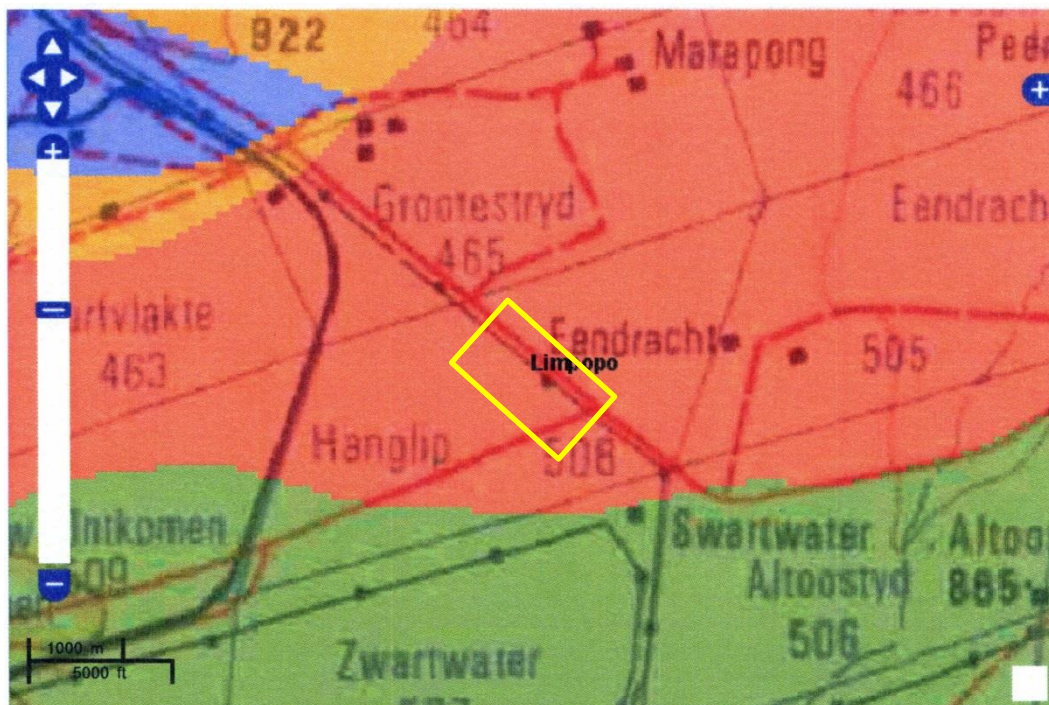


Figure 3: SAHRIS palaeosensitivity maps for the site for the proposed Hangklip service station to the west of Lephalale shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as highly sensitive (red) because the Swartrant Formation is potentially fossiliferous. From the Geotechnical report (Wessels and Roux, 2018) in which the soils and underlying rock have been assessed and based on 12 test pits, there are no coal seams or potentially fossiliferous shales, only surface sands and below that coarse-grained sandstone and mudstone. It is extremely unlikely that any fossils were missed by this intensive geotechnical investigation.

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 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 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	H	-
	M	-
	L	The Swartrant Formation, Eccca Group could preserve plant impressions from the <i>Glossopteris</i> but these are extremely sporadic. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since only the possible fossils within the area would be fossil plants from the <i>Glossopteris</i> flora in the shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the sands and sandstones that will be excavated. Nonetheless a 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 however the Geotechnical Report indicates that there are no suitable sediments for the preservation of fossils. The geological structures suggest that the rocks are too coarse to contain fossils and that there are no coal seams in the vicinity. Since there is an extremely small chance that fossils were not detected in the 12 test pits already excavated a 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 sandstones, shales and sands are typical for the country and could contain fossil plant, insect, invertebrate and vertebrate material. However none was encountered in the test pits and the sediment is very coarse-grained.

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 loose sands of the Quaternary or in the Swartrant Formation. This was confirmed in the Geotechnical Report. Since there is very small chance that fossil may occur in the adjacent shales a Chance Find Protocol should be added to the EMPr: if fossils are found once mining 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: Prodrum of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Barker, O B., Brandl, G., Callaghan, C.C., Erikssen, P.G., van der Neut, M., 2006. The Soutspanberg and Waterberg Groups and the Blouberg Formation. 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 301-318.

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.

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.

Snyman, C.P., 1998. Coal. In: Wilson, M.G.C., and Anhaeusser, C.P., (Eds), The Mineral Resources of South Africa: Handbook, Council for Geosciences 16, 136-205.

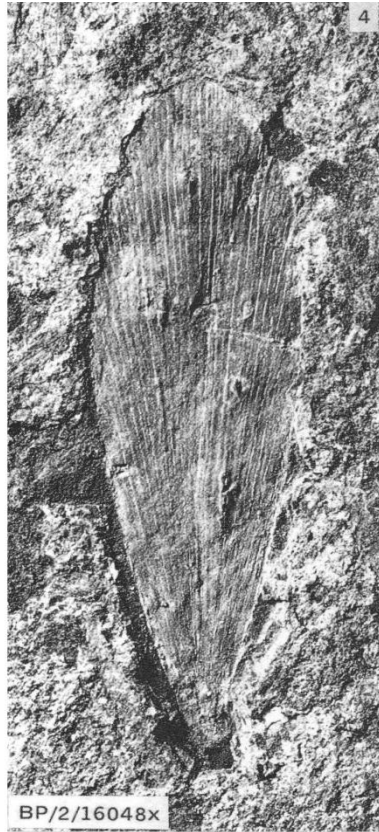
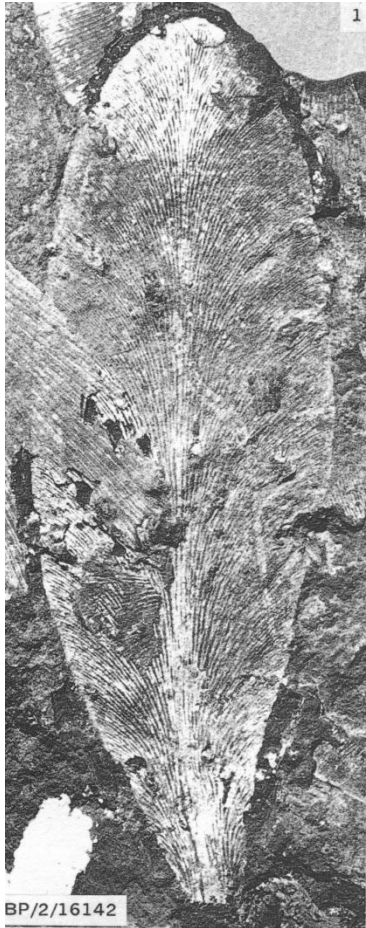
Wessels, D.H., Roux, J.I., 2018. Near surface Phase 1 basic geotechnical site investigation report conducted on portions of Erven 14748 to 14751 of the Farm Hangklip No. 508-LQ, Limpopo Province. WSM Leshika Consulting (Pty) Ltd. Project Number: WH18065

8. Chance Find Protocol

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

1. The following procedure is only required if fossils are seen on the surface and when excavations for building constructions 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 construction 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 Figure 1.5). 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 the site inspections by the palaeontologist will not be necessary. Annual reports by the palaeontologist must be sent to SAHRA.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – Examples of fossil plants that might occur in the area.



Noeggerathiopsis and
Glossopteris leaves

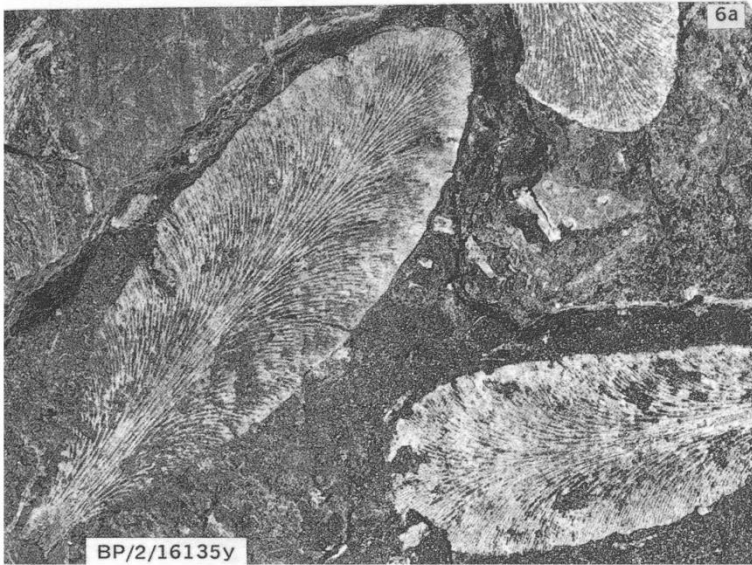
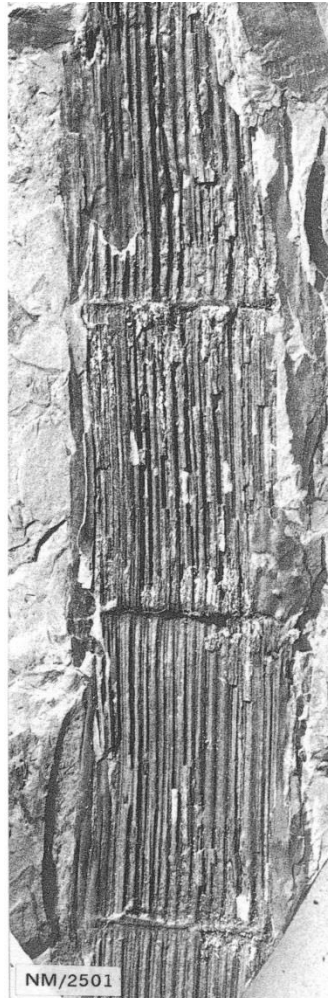


Figure 4: Examples of leaf impressions of *Glossopteris* and *Noeggerathiopsis* from the Ecca Group of South Africa.



Fern: *Asterotheca* sp.



Sphenophytes: whorls of leaves on a striated stem



Figure 5: more examples of fossil plant impressions from the Ecca Group of South Africa.

Curriculum vitae (short) - Marion Bamford PhD October 2018

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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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	6	1
Masters	8	1
PhD	10	3
Postdoctoral fellows	9	3

viii) Undergraduate teaching

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

ix) Editing and reviewing

Editor: *Palaeontologia africana*: 2003 to 2013; 2014 – Assistant editor
 Guest Editor: *Quaternary International*: 2005 volume
 Member of Board of Review: *Review of Palaeobotany and Palynology*: 2010 –
Cretaceous Research: 2014 -

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
-

xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 120 articles published; 5 submitted/in press; 8 book chapters.

Scopus h index = 26; Google scholar h index = 28;

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)