

**Palaeontological Impact Assessment for the proposed  
new 388.40m MV powerline to a borehole for  
Mogohlwaneng village on Portion 3 Syferkuil 15-JR,  
Moretele Local Municipality,  
North West Province**

**SWA382169483 - PALEONTOLOGICAL DESKTOP STUDY**

**SAHRA CASE ID: 16516**

**16 August 2021**

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



**(AHSA) Archaeological and Heritage Services Africa (Pty) Ltd**  
Reg. No. 2016/281687/07

48 Jacqueline Street, The Reeds, 0157, Centurion, Pretoria

Email: [e.matenga598@gmail.com](mailto:e.matenga598@gmail.com).

Cell: +27 73 981 0637

Website: [www.archaeologicalheritage.co.za](http://www.archaeologicalheritage.co.za)

## **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 (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 'M Bamford', with a horizontal line underneath.

Signature:

## **Executive Summary**

A Palaeontological Impact Assessment was requested for the an electrification of the a new 388.40m MV that will be connected from pole number WP191/62 and will be supplying a borehole in the village in the Mogohlwaneng village on Portion 3 of Farm Syferkuil 15-JR, Moretele Local Municipality, of Bojanala District Municipality of North West Province (SAHRA CaseID:16516).

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 route lies on the fine-grained sandstones of the Clarens Formation (Stormberg Group, Karoo Supergroup) that could potentially preserve vertebrate fossils or silicified wood. No fossils have been reported from this area and are not likely to be preserved in the soils covering the route. Nonetheless, a Fossil Chance Find Protocol should be added to the site monitoring programme. Based on this information it is recommended that no palaeontological site visit is required unless the environmental officer or responsible person finds fossils once excavations for the poles have commenced.

## Table of Contents

|  |    |
|--|----|
| Expertise of Specialist.....                     | 2  |
| Declaration of Independence.....                 | 2  |
| 1. Background.....                               | 5  |
| 2. Methods and Terms of Reference .....          | 7  |
| 3i. Project location and geological context..... | 7  |
| 3ii. Palaeontological context .....              | 8  |
| 4. Impact assessment .....                       | 10 |
| 5. Assumptions and uncertainties.....            | 11 |
| 6. Recommendation.....                           | 11 |
| 7. References.....                               | 12 |
| 8. Chance Find Protocol .....                    | 11 |
| Appendix A (examples of fossils) .....           | 12 |
| Appendix B (short CV of specialist) .....        | 13 |

# 1. Background

Eskom Holdings SOC Ltd, Limpopo Operating Unit (LOU) intends to construct a section of overhead powerline near Moretele. The powerline will include new 388.40m MV that will be connected from pole number WP191/62 and will be supplying a borehole in Mogohlwaneng village on Portion 3 of Farm Syferkuil 15-JR in Moretele Local Municipality of Bojanala District Municipality, North West Province (Figure 1).

Eskom has submitted an application in terms of section 38(1) of the National Heritage Resources Act, Act 25 of 1999 (NHRA) for a proposed Moretele powerline. The proposed powerlines will be connected to pole WP191/62 which is close to the road and will run south toward sparse trees. The impact of the proposed development to archaeological resources is unlikely. The proposed development is located in an area of high palaeontological sensitivity as per the SAHRIS Palaeosensitivity map and SAHRA has requested that a Palaeontological impact Assessment be completed (CaseID: 16516).

In order to comply with 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), and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

|     | <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 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 buffers;                             | N/A                   |
| i   | A description of any assumptions made and any uncertainties or gaps in knowledge;  | Section 5             |
| j   | A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment  | Section 4             |
| k   | Any mitigation measures for inclusion in the EMPr  | Section 8, Appendix A |
| l   | Any conditions for inclusion in the environmental authorisation  | N/A                   |
| m   | Any monitoring requirements for inclusion in the EMPr or environmental authorisation   | Section 8, Appendix A |
| ni  | A reasoned opinion as to whether the proposed activity or portions thereof should be authorised  | 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: Google Earth map of the proposed construction of a 388.40m MV powerline from the existing line alongside the road, to a borehole pump for the Mogohlwaneng village on Portion 3 Syferkuil 15-JR in Moretele Local Municipality. Map supplied by TAP.

## 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

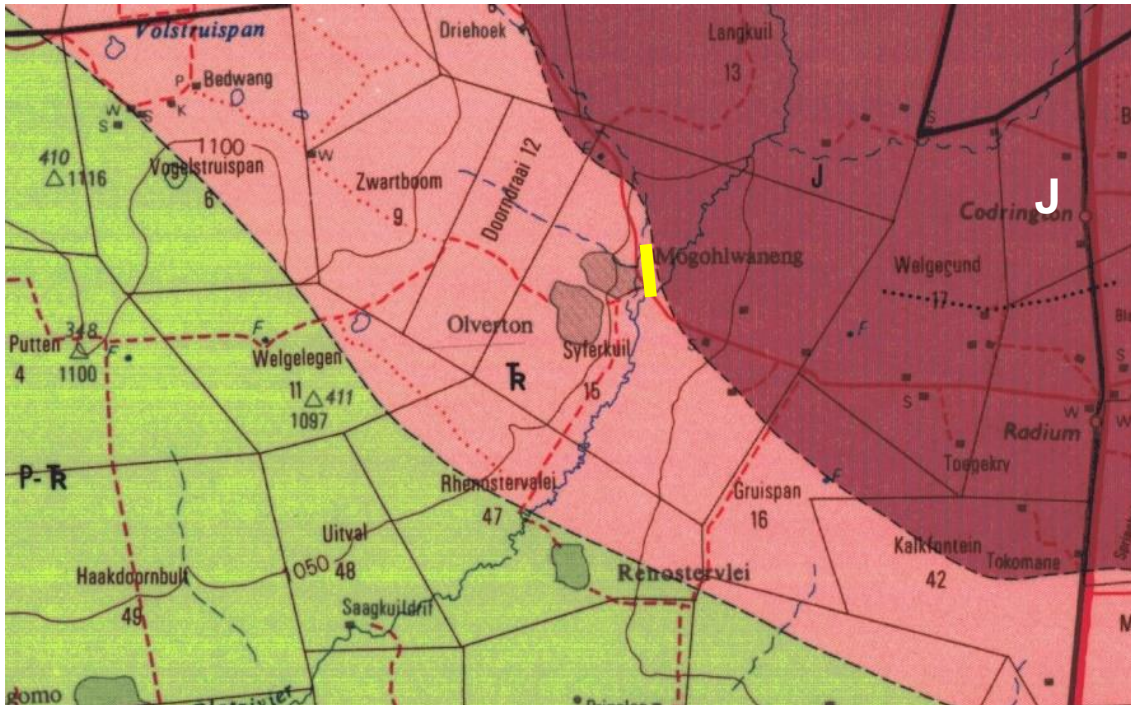


Figure 2: Geological map of the area around the Syferkuil section of the powerline. The location of the proposed project is indicated by the yellow line on Farm Syferkuil 15-JR. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2528 Pretoria.

Table 2: Explanation of symbols for the geological map and approximate ages (Duncan & Marsh, 2006; Johnson et al., 2006; McCarthy et al., 2006; Robb 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           |
|--------|---|---|---------------------------|
| J      | Letaba Fm, Lebombo Group, Karoo Igneous Province              | Volcanic rocks, sandstone                                     | Early Jurassic 195-190 Ma |
| Tr     | Clarens Fm, Stormberg Group, Karoo SG                         | Fine-grained sandstone  | Jurassic                  |
| P-Tr   | Irrigasie Fm, Beaufort Group, Springbok Flats Basin, Karoo SG | Multi-coloured sandstone, siltstone, marl, mudstone and shale | Mid Triassic              |

The site lies in the Springbok Flats Basin and has sediments of the Karoo Supergroup but the thicknesses of these units, and the names, differ somewhat from the Main Karoo Basin.



The oldest strata in this area are the mid Triassic sediments of the Irrigasie Formation that were probably laid down by sluggish, ephemeral, suspension-load rivers and deposited on floodplains (Johnson et al., 2006). Overlying these sandstones are the aeolian sandstones of the Clarens Formation. The sediments were capped by the volcanic outpouring of picritic basalt, known as the Letaba Formation (Lebombo Group).

## ii. Palaeontological context

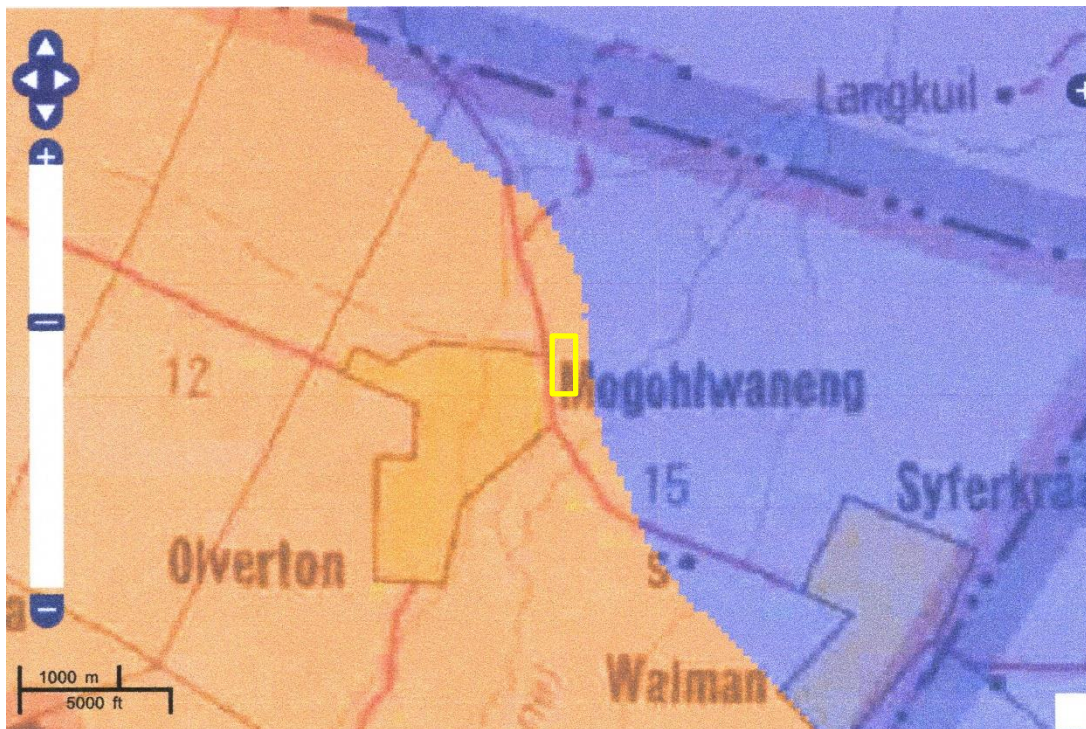


Figure 3: SAHRIS palaeosensitivity map for the site for the proposed route for the Syferkuil section of a 388.40m MV line shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The route for the powerline is on the Clarens Formation (Figures 2-3) and indicated highly sensitive (orange) on the SAHRIS map. The Irrigasie formation is indicated as very highly sensitive (red) while the Letaba Formation has low sensitivity because it is volcanic in origin.

Most of the Clarens Formation is composed of aeolian sands that were deposited in arid conditions but there are rare playa lake deposits that might preserve bones of therapsids, sauropods or early mammals but these are extremely rare. In the Main Karoo Basin around the town of Clarens and in the foothills of the Drakensberg where there are extensive exposures of Clarens Formation sandstones, only a few pieces of silicified wood,

*Podocarpoxylon* sp. (Bamford, 1999, 2004) and *Equisetum* (Plumstead, 1969; Anderson and Anderson, 1985) have been recorded. Vertebrates from the Clarens Formation are the Eumetoposaurus *Massospondylus*, *Lycorhinus*, *Ngwevu*, *Notochampsia*, and *Erythrotherium*, an early mammal (Smith et al., 2020). Trace fossils, foot prints and invertebrate burrows, may also be present.

The older Irrigasie Formation has a narrow coal zone at the base (Johnson et al., 2006) and so is expected to have an associated *Glossopteris* flora with *Glossopteris* leaves, lycopods, sphenophytes, ferns and early gymnosperms.

The Letaba Formation is composed of picritic (olivine-rich) lavas that intruded through the Karoo sequence. Since it is volcanic (igneous) in origin the Letaba formation does not preserve any fossils.

#### 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 | - |

| <b>PART B: ASSESSMENT</b> |           |   |
|---------------------------|-----------|---|
|                           | <b>L</b>  | Soils do not preserve plant fossils; so far there are no records from the Clarens 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.            |
|                           | <b>L+</b> | -   |
|                           | <b>M+</b> | -   |
|                           | <b>H+</b> | -   |
| <b>DURATION</b>           | <b>L</b>  | -   |
|                           | <b>M</b>  | -   |
|                           | <b>H</b>  | Where manifest, the impact will be permanent.   |
| <b>SPATIAL SCALE</b>      | <b>L</b>  | Since the only possible fossils within the area would be fossil plants or vertebrates from the Clarens Fm in the sandstones, the spatial scale will be localised within the site boundary.  |
|                           | <b>M</b>  | -   |
|                           | <b>H</b>  | -   |
| <b>PROBABILITY</b>        | <b>H</b>  | -   |
|                           | <b>M</b>  | -   |
|                           | <b>L</b>  | It is extremely unlikely that any fossils would be found in the loose soils and sand that will be excavated but there might be fossils below ground. 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 development footprint. The geological structures suggest that the rocks are the correct age and type to contain fossils in the Clarens Formation but their occurrence is very rare and sporadic. Furthermore, the material to be excavated for pole foundations is soil, and this does not preserve fossils. Since there is an extremely small chance that fossils from the Clarens Formation 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 very low.

## 5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the lavas, sandstones, shales and sands are typical for the country and only sedimentary rocks might contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils. It is not known if the Clarens Formation in this area has fossils but none has been reported to date.

## 6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying sands and soils of the Quaternary. There is a very small chance that fossils may occur in the sandstones of the late Triassic Clarens Formation so a Fossil Chance Find Protocol should be added to the site monitoring programme. If fossils are found by the environmental officer or other responsible

person once excavations for or construction of the poles have commenced then they should be rescued, photographed, and a palaeontologist contacted 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.

Bamford, M.K., 1999. Permo-Triassic fossil woods from the South African Karoo Basin. *Palaeontologia africana* 35, 25-40.

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

Duncan, A.R., Marsh, J.S., 2006. The Karoo Igneous Province. 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 501-520.

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.

## 8. Chance Find Protocol

### **Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.**

1. The following procedure is only required if fossils are seen on the surface and when drilling/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 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 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 Clarens Formation.**



Figure 4: Partially prepared foot bones of a large eumetoposid from the Stormberg Group.





Figure 5: Silicified wood from the Karoo Basin.

## Appendix B – Details of specialist

### Curriculum vitae (short) - Marion Bamford PhD June 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-  
Telephone : +27 11 717 6690  
Fax : +27 11 717 6694  
Cell : 082 555 6937

E-mail : [marion.bamford@wits.ac.za](mailto:marion.bamford@wits.ac.za) ; [marionbamford12@gmail.com](mailto:marionbamford12@gmail.com)

## ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:

1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.

1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.

1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.

1986-1989: PhD in Palaeobotany. Graduated in June 1990.

## iii) Professional qualifications

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

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

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

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

## iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa

Royal Society of Southern Africa - Fellow: 2006 onwards

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

International Association of Wood Anatomists - First enrolled: January 1991

International Organization of Palaeobotany – 1993+

Botanical Society of South Africa

South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016

SASQUA (South African Society for Quaternary Research) – 1997+

PAGES - 2008 –onwards: South African representative

ROCEEH / WAVE – 2008+

INQUA – PALCOMM – 2011+onwards

## 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
- 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 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)