Palaeontological Impact Assessment for the proposed development of WFA Christian Business School – Gerardsville – on Farm Knopjeslaagte 385 JR, Gauteng Province.

Desktop Study

For

HCAC

22 June 2019

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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 Contracts and Archaeological Consulting, Modimolle, 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 proposed construction of boarding facilities for WFA Christian Business School on a portin of Farm Knopjeslaagte 385 JR, west of Pretoria. 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.

The proposed site lies on the non-fossiliferous syenite dykes (central band) and on dolomites and limestones of the Malmani Subgroup, Transvaal Supergroup. There is a good chance that dolomites underlie the soils and a very small chance that the dolomites preserve stromatolites which are trace fossils. It is the opinion of the palaeontologist that the stromatolites, if present, are of minimal paleontological interest. These are indicated as very highly sensitive on the SAHRIS palaeosensitivity map so a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that as far as the palaeontology is concerned the construction can proceed and no site visit is required unless fossils are uncovered.

Table of Contents

1. Background

WFA Christian Business School proposes to build a Boarding School with associated uses on Portion 66 and Portion 16 of Farm Knopjeslaagte 385 JR, approximately 20 km southeast of Pretoria central and south of Mimosa Avenue, City of Tshwane Metropolitan Municipality, Gauteng Province.

The development entails the establishment of a school that will accommodate approximately 2000 learners and will consist of learning and boarding facilities. The school will be developed on 18.8344 hectares and is to be serviced by a private works package/plant. Grey water harvesting is to be implemented for irrigation purposes.

A Palaeontological Impact Assessment was requested for the project in order 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). The desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is presented here.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (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	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	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	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 development of the WFA Christian Business School on Farm Knopjeslaagte 385JR, about 20km southeast or Pretoria Central. The site is in the blue outline. Map supplied by HCAC.

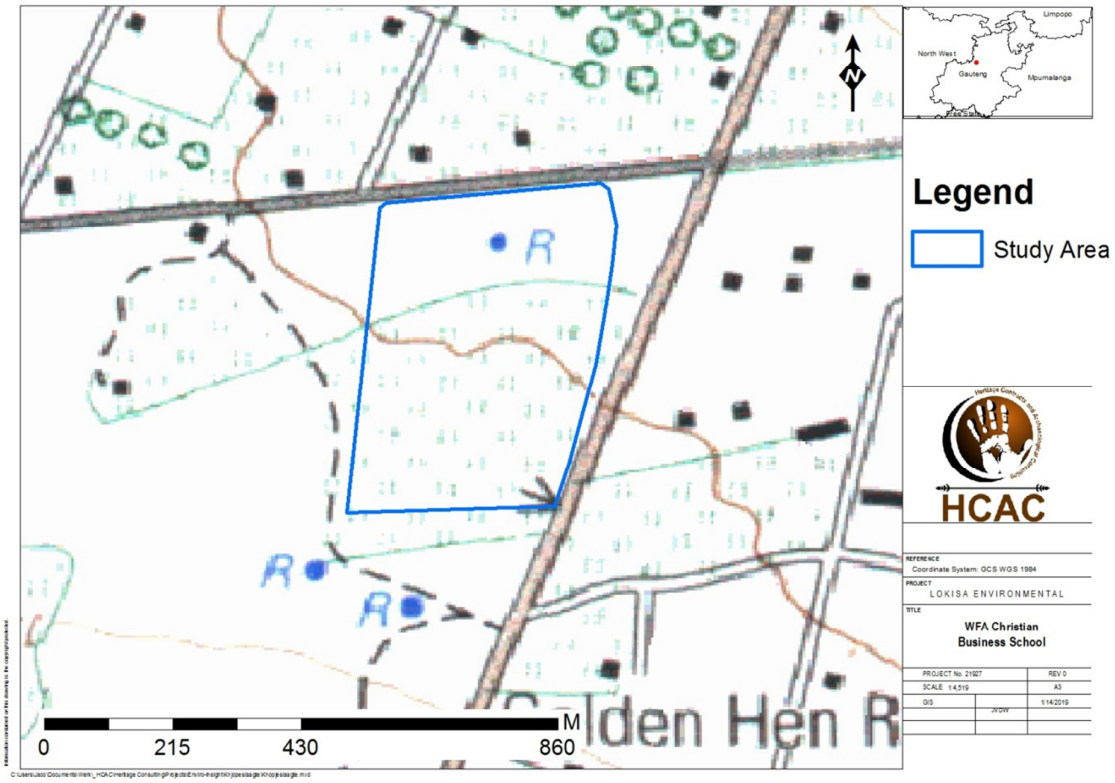

Figure 2: Site map for the proposed WFA Christian Business School in the blue outline.

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

The proposed site lies to the north of the Johannesburg dome, ancient basement rocks of granite and gneiss, and rocks of the Transvaal Supergroup are exposed in generally west – east trending bands in this part of the Transvaal Basin. The Transvaal Supergroup comprises late Archean to early Proterozoic rocks that were laid down in the huge inter-cratonic sag basin (Eriksson et al., 2012) that experienced a sequence of regressions and transgressions of the "sea". The Bushveld Complex has intruded into this sequence of rocks and in places the Karoo Supergroup unconformably overlies the Transvaal Supergroup.

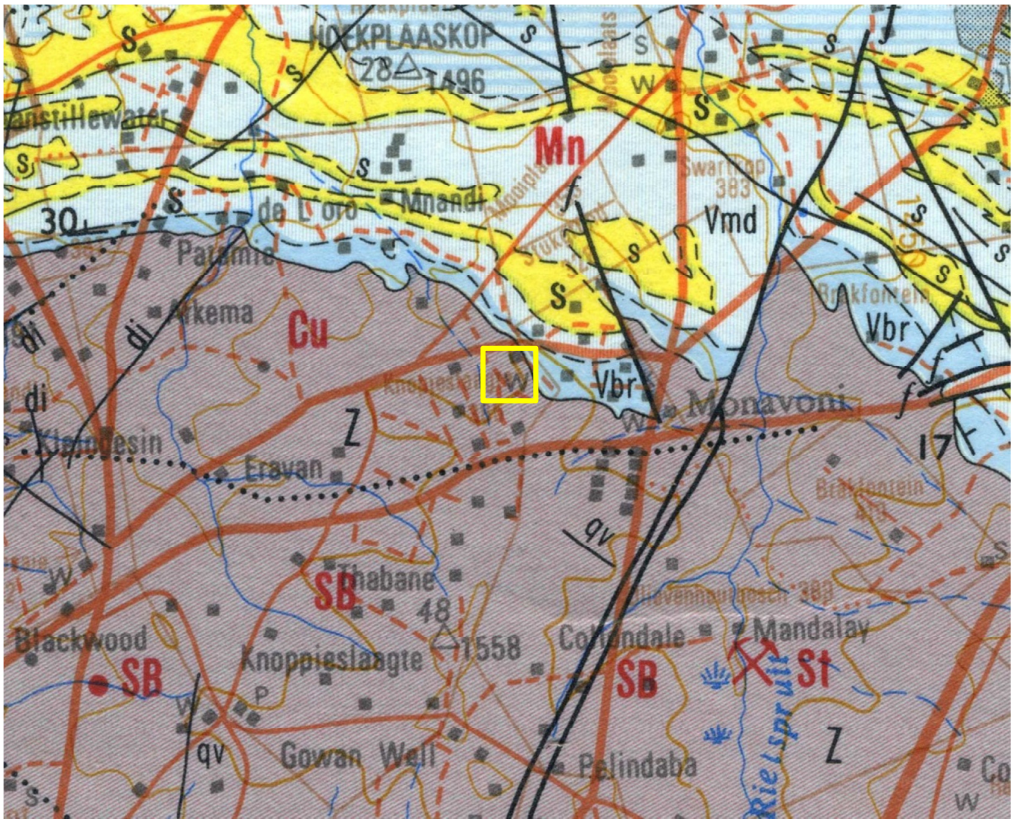

Figure 3: Geological map of the area around the proposed site on Farm Knopjeslaagte 385 JR, southeast of Pretoria. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map, Pretoria 2528 1978.

Table 2: Explanation of symbols for the geological map and approximate ages (Barker et al., 2006; Erikssen et al., 2006, 2012). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
S	Syenite dyke	Syenite	
Vmd	Malmani Subgroup, Chuniespoort Group, Transvaal SG	Dolomite, limestone	Ca 2550-2450 Ma
Vbr	Black Reef Fm, Transvaal SG	Quartzite, conglomerate, shale, basalt	2642-2550 Ma
SB	Basement granite	Granites and gneisses	>3300 Ma

The lowermost rocks of the Transvaal Supergroup occur in this area with the basal Black Reef Formation composed of quartz arenites, conglomerate, shale and basalt. This is a very widespread but thin layer unconformably overlying much older rocks and filling in the depressions of the older rocks. It can vary between from a few meters to 30m in thickness (Eriksson et al., 2006). The black Reef sediments were deposited in the inter-cratonic sag basin as incised valley fill, braided fluvial sediments, transgressive shallow marine and braid delta environmental settings. After a base-level fall and tectonic tilting the Malmani Subgroup was deposited in a shallow marine environment as carbonate platforms. Five formations are recognised in the Malmani Subgroup: from the base upwards are the Oaktree, Monte Cristo, Lyttleton, Eccles and Frisco Formations, distinguished by the relative proportions of dolomite and limestone (Eriksson et al., 2006, 2012).

The syenite dykes are much younger than the Transvaal Supergroup rocks and are part of the Pilansberg dyke swarm that took place between 1450 – 1200 Ma (Verwoerd, 2006).

ii. Palaeontological context

Basement granites and gneisses and the syenite dykes are igneous in origin and too old to preserve fossils so they will not be considered any further.

Black Reef Formation quartz arenites and shales were deposited in medium to low energy marine settings and are too old for body fossils. Dolomites of the Malmani Subgroup, however, sometimes preserve stromatolites. Stromatolites are trace fossils of ancient algal colonies that laid down successive layers of materials such as calcium carbonate, calcium sulphate, magnesium carbonate and magnesium sulphate in flat or dome-like structures. Only very rarely are the algal cells preserved and they would only be visible in thin sections under a petrographic microscope.

The palaeontological sensitivity of the area under consideration is presented in Figure 4, where the grey colour (no fossils) represents the basement granites and gneisses and the syenite dykes. Malmani Subgroup dolomites are shown as very highly sensitive (red). The site for development is in the Malmani Subgroup. From the google Earth imagery the site has been disturbed by previous agricultural activities and is covered by soils. Soils do not preserve fossils. There might be dolomite below the surface but not all dolomites have stromatolites.

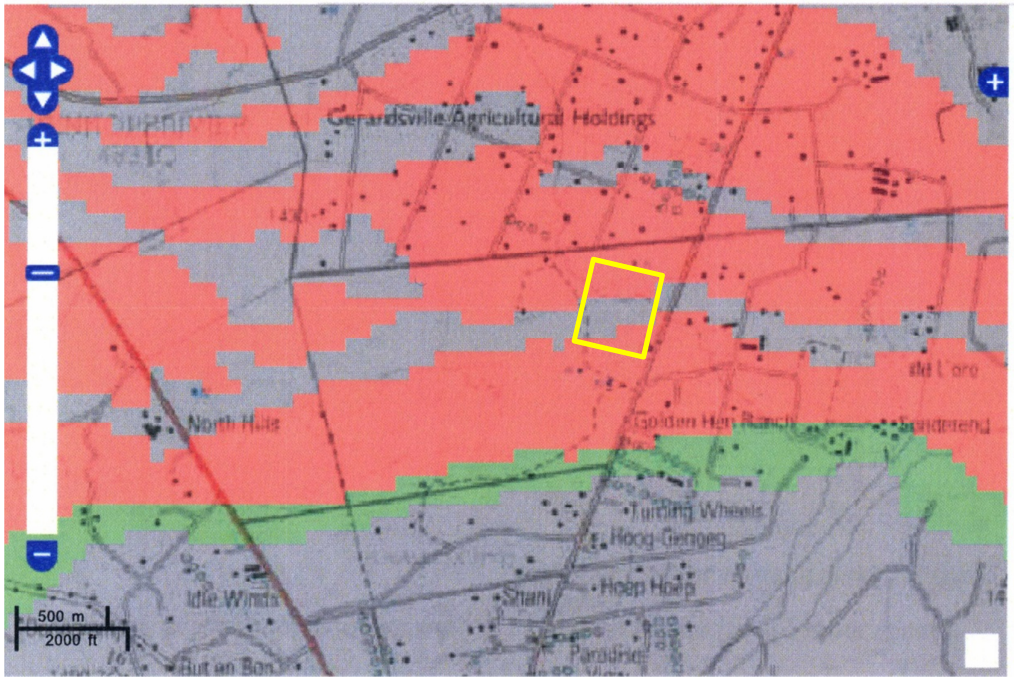

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed WFA Christian Business School buildings, on Farm Knopjeslaagte 66 shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

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	This is likely to be Malmani dolerite below the soils but it is unknown if there are stromatolites in this dolomite. 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 trace fossils such as stromatolites, 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 stromatolites, even if present, but they have been reported from other outcrops, so a Fossil Chance Find protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities will not impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are either much too old to contain fossils or could contain trace fossils such as stromatolites, but none has been recoded from this site. They have been recorded from other outcrops of Malmani dolomites in South Africa. Most palaeontologists and geologists do not consider stromatolites to be of any great significance and so do not collect them. Since there is an extremely small chance that fossil algae may be preserved in stromatolites, if present, 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 not contain fossil plant, insect, invertebrate and vertebrate material. Only if stromatolites are present in the dolomites and only if they contain the fossil algal cells would they be of palaeontological importance. It is unknown if there are

limestones present in this area or if there are dolomites with stromatolites. The surface soils and the ancient igneous rocks would not preserve fossils.

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 stromatolites of the Malmani Subgroup. If limestones or dolomites are present they can be ignored but if stromatolites are found, photographs should be sent to a professional palaeontologist to determine the importance and scientific value of the trace fossils. If determined to be worth collecting then a SAHRA permit must be obtained by a palaeontologist before collecting material. Therefore a Fossil Chance Find Protocol should be added to the EMPr (Section 8, Appendix A). As far as the palaeontology is concerned the construction can proceed.

Table 1: The frequency of monitoring the implementation of the EMPr

7. References

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. 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 237-260.

Eriksson, P.G., Bartman, R., Catuneanu, O., Mazumder, R., Lenhardt, N., 2012. A case study of microbial mats-related features in coastal epeiric sandstones from the Palaeoproterozoic Pretoria Group, Transvaal Supergroup, Kaapvaal craton, South Africa; the effect of preservation (reflecting sequence stratigraphic models) on the relationship between mat features and inferred palaeoenvironment. Sedimentary Geology 263, 67-75.

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.

Verwoerd, W.J., 2006. The Pilansberg alkaline 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 281-383.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations for roads, infrastructure and buildings 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 (stromatolites) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the stromatolites (for example see Figure 5, 6). 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. 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.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – Examples of fossils

Figure 5: Examples of small stromatolites as seen in the field from the Malmani Subgroup near Lichtenburg.

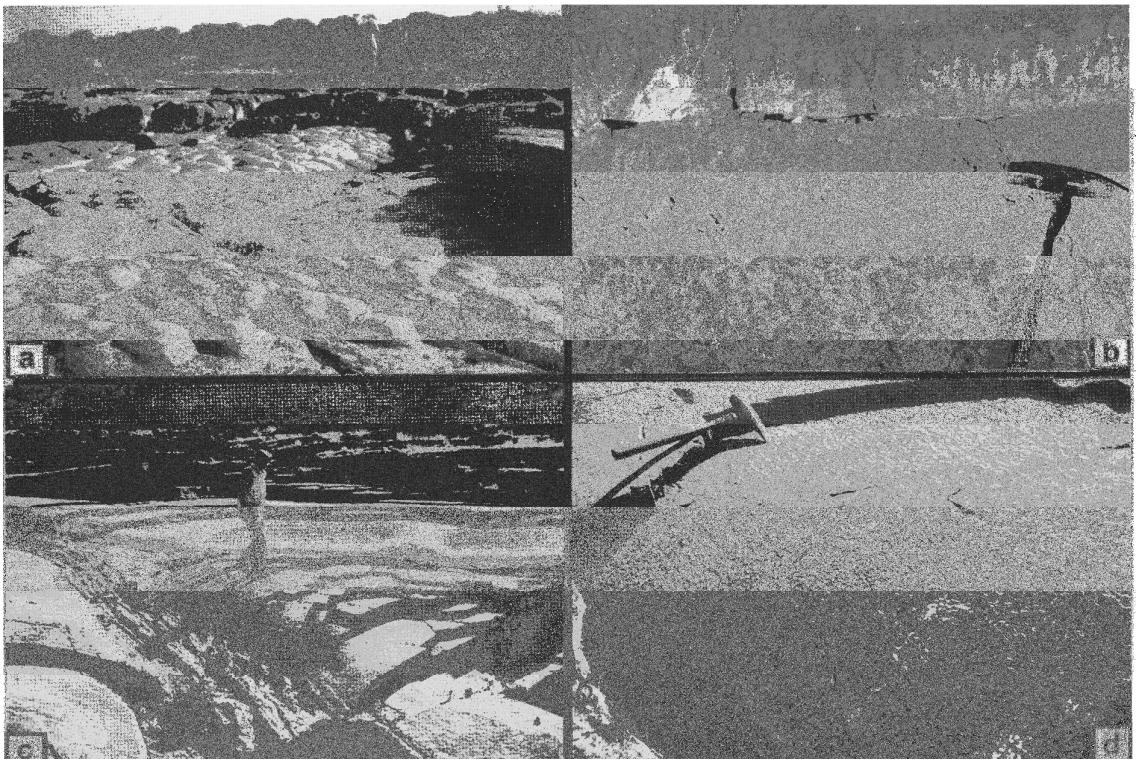

Figure 6: Large domal stromatolites as seen in the field and in side view (b). (Figure from Eriksson et al., 2006).

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
June 2019

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	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
- SARAO 2018 for Digby Wells
- Ventersburg B 2018 for NGT
- Hanglip Service Station 2018 for HCAC

xi) Research Output

Publications by M K Bamford up to June 2019 peer-reviewed journals or scholarly books: over 130 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 30;
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)