Palaeontological Impact Assessment for the proposed Khetshe Industrial Economic Hub, south of Newcastle, KwaZulu Natal Province

Site Study (Phase 2)

For

EnviroPro

20 June 2020

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

Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 31 years research; 23 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by EnviroPro, 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 development, the Khetshe Mixed Use Development, Madadeni, south of Newcastle, KwaZulu Natal Province. 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), a site visit Palaeontological Impact Assessment (PIA) was conducted on Thursday 18th June 2020 by Prof Marion Bamford and Dr Alisoun House, and is reported herein.

The proposed site lies on the Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve fossil plant impressions of the *Glossopteris* flora. In this area, the Klip River Coalfield, the coalmines all use underground mining methods because the coal seams are far below the surface. The seams are overlain by dolerite and sandstone, and even the finer-grained rocks such as shales, are below the ground. In addition, the area is already highly disturbed from current urban and previous agricultural activities. It is very unlikely that any fossils would occur in the soils overlying the Vryheid formation because soils are weathered and do not preserve fossils.

Survey of the site showed that the area is covered in sandy clay to a depth of at least 1m and is densely vegetated with grasses, and in the wetter depressions the sedges are dominant. There are no rocky or shale outcrops visible and the site has been cultivated in the past. No plant or vertebrate fossils were found. No potentially fossiliferous shales were found. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that once excavations commence, the responsible person on site looks out for fossils, and if fossils are found then a professional palaeontologist be called to assess and collect a representative sample (with an AMAFA permit). No further palaeontological site visits are required unless fossils are found when excavations commence.

Table of Contents

1. Background

The Newcastle Municipality is planning to develop of an area, known as Khetshe (Figure 1), into a mixed use development (residential, retail, industrial complex). The site is in two sections and stretches north-south along the west side of the Madadeni suburbs. The Madedeni Local Municipality lies approximately 20km south-south-west of the town of Newcastle, KwaZulu Natal Province. The site comprises a number of vacant plots and farmlands and is located close to industries, urban facilities and housing.

A Palaeontological Impact Assessment was requested for the Khetshe 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 site visit was conducted by Prof Marion Bamford and Dr Alisoun House on Thursday 18th June 2020 (after national lockdown for the Covid-19 epidemic travel restrictions had been eased). The desktop study and site visit observations for the Palaeontological Impact Assessment (PIA) for the proposed development are presented 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	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 7, 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 7, 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 Khetshe Mixed Use development, south of Newcastle. Map supplied by EnviroPro.

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 (*applicable to this assessment*); equipment comprised a handheld GPS, camera and notebook.
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

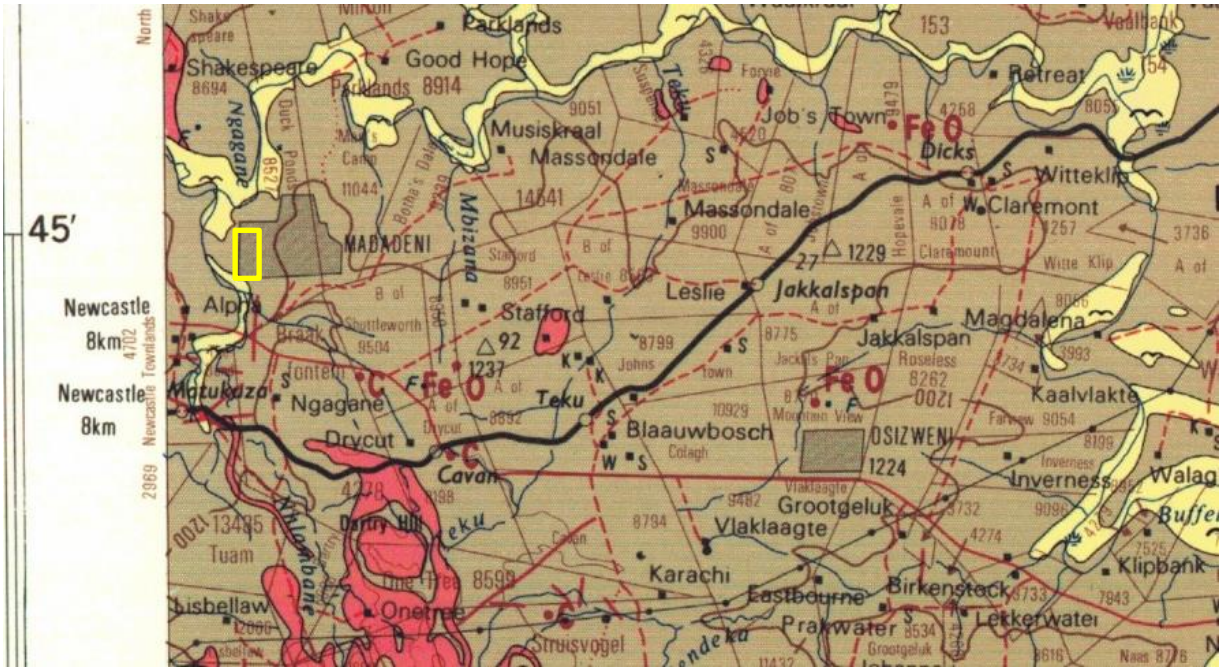


Figure 2: Geological map of the area around Madadeni. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2730 Vryheid.

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
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 25 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm, Ecca Group, Karoo Supergroup	Shales, sandstone, coal	Early Permian, Middle Ecca

The site is in the eastern margin of the Main Karoo Basin and the rocks represent the lower part of the sequence, namely the basal Vryheid Formation and Volksrust Formation of the Ecca Group (Early Permian age). There are numerous volcanic intrusions associated with the younger Drakensburg, the Jurassic dolerite dykes.

The Karoo Basin formed a large inland sea that collected the meltwater from the Carboniferous ice sheets. The glacial deposits are known as the Dwyka Group and comprise tillites, diamictites and various mudstones. Deepwater to shallow water shales of the

Pietermaritzburg Formation are exposed along the eastern margin. As the Gondwana continent moved northwards, away from its earlier position over the South Pole, waters from the southern Cape Fold Mountains continued to fill the inland sea, and vegetation covered the shores, deltas and floodplains. Some of the deltas and flooded areas accumulated peats that were buried by more sediments, and over time with increased pressure and temperatures, were altered into coal lenses and coal shales. The coal-rich Vryheid Formation is overlain by the Volksrust Formation that does not have coal seams in the southeastern basin (Plumstead, 1969; Snyman, 1998; Cairncross, 2001; Johnson et al, 2006). In this eastern part of the basin are the overlying Normandien (Estcourt) Formation and the Late Permian Emakwezini Formation (Bordy and Prevec, 2008) that have minor coal seams.

The Klip River Coalfield which includes Newcastle in the northern part, is considered to be the most important coalfield in South Arica although it has only two economic coal seams and nine types of dolerite sills (Snyman, 1998). Coal mining in this coalfield is all underground because the uppermost coal seam is 100m or more below the ground surface. Overlying the coals, from the top downwards are dolerites, sandstones and shales (ibid).

ii. Palaeontological context

The site lies on the shales and sandstones of the Vryheid Formation (Ecca Group, Karoo Supergroup; Figure 2). The coal seams are far below the land surface, however the coal itself is of no palaeontological interest because the plant matter has been altered beyond recognition. Impressions of fossil plants of the coal flora, namely *Glossopteris* leaves, seeds and reproductive structures, lycopods, sphenophytes, ferns, and early gymnosperms (Plumstead, 1969; Anderson and Anderson, 1985), are sometimes found in the fine-grained shales, but very rarely in the sandstones as they are too coarse to preserve much detail.

Dolerite dykes are composed of intrusive volcanic material and do not preserve fossils. Furthermore, they usually destroy any fossils in their near vicinity in the host rocks. According to the cores described in Snyman (1998, Fig 21) the uppermost potentially fossil-bearing fine-grained shales are between 10 to 40m below the surface.

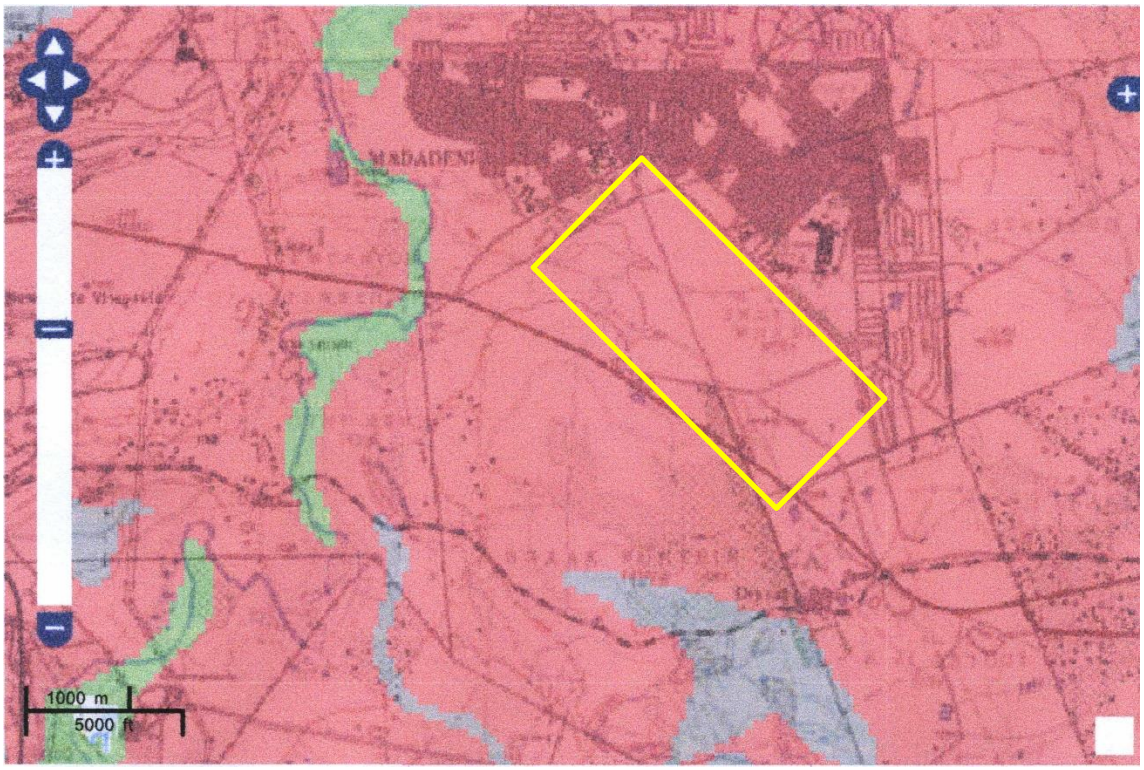


Figure 3: SAHRIS palaeosensitivity map for the site for the proposed Khetshe Mixed Use development shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as very highly sensitive (red) so a site visit is necessary. The proposed project involves the construction of factories and warehouses that would need foundations and amenities such as electricity, clean water and sewage pipes which would penetrate no deeper that several meters below ground.

iii. Site visit results and observations

On Thursday 18th June the site was visited and accessed on foot where possible. Some sections had been fenced off, or were occupied by informal settlements or light industries so these were not accessed. The wetlands were not traversed because they were flooded from the recent unseasonal rain but the rest of the land was surveyed and the observations are presented in Table 3. GPS points refer to the pins in the map in Figure 4, and site photographs in Figures 5 - 16. Representative parts of the whole area were surveyed and just some of them are listed and photographed.

Figure 4: Google Earth map of the Khetshe Mixed Use site with the GPS points marked as Pal 1, etc., (Refer to Table 3).

Table 3: Observations from site visit to Khetshe, Madadeni, on 18th June 2020.

Site, GPS location	Observations	Figure
Pal 1 27° 25’ 42.29”S 30° 02’ 25.87”E	Rolling topography with major roads traversing it, and two streams. General view of the area from the northeast corner southwards, and view eastwards to the power station. Land surface covered with grasses	5, 6, 7
Pal 2 27° 47’ 33.08”S 30° 03’ 03.68”E	Grasses and ridges from previous farming activities. No rocks and no fossils	8,
Pal 3 27° 47’ 15.59”S 30° 03’ 09.90”E	Grasslands with termitaria showing the fine-grained soils derived from shales of the Vryheid Formation	9, 10
Pal 4 27° 46’ 58.83”S 30° 02’ 48.16”E	Eucalyptus trees, termitaria and grasslands. Close up of rocks from a trench show the coarse-grained and highly weathered rocks about 2m below the surface. No fossils occur in such material	11, 12, 13
Pal 5 27° 45’ 56.53”S	Separate NW section of the project is highly disturbed with diggings down to 3m, many now filled with building rubble.	14, 15, 16

30° 01’ 25.13”E	The highly oxidised red soils are covered with about 20-40cm of laterite which is from extreme wet-dry conditions and accumulation of iron minerals. No fossils in the lateriate or the soils below.	

Figure 5: View from the north-eastern corner of the land looking southwards. Note dense cover of grasses and generally flat topography in this part of the project area.

Figure 6: Dense cover of grasses and flat cover indicate that the land has been ploughed in the past.

Figure 7: Closer view of grasses and sedges in deep soils.

Figure 8: Grassland with no rocky outcrops.

Figure 9: Termitarium in the sandy surface soils.

Figure 10: Termitarium broken open (not by us) to show fine-grained dark grey shales of the Vryheid Formation below.

Figure 11: Eucalyptus trees, sandy soils and grassland in the background.

Figure 12: Pile of rocks and soils from a trench about 2 m deep.

Figure 13: Rocks from figure 12. Note coarse-grain and micaceous flecks. No fossils

Figure 14: Diggings showing red soils below with a capping of hard laterite.

Figure 15: Highly oxidised soils in the cut profile (and infill of building refuse).

Figure 16: Close up of the pesolitic laterite. No fossils would be preserved in such modified soils from Quaternary weathering.

4. Impact assessment

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

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.
	L	Localised - Within the site boundary.

Criteria for ranking the SPATIAL SCALE of impacts	**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	Dolerite does not preserve fossils; only shales from the Vryheid Fm might preserve fossils and these are more than 10m below the surface 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 only the possible fossils within the area would be fossil plants from the *Glossopteris* 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 surface soils or dolerite, but possibly in the shales below 10m. Therefore, a Fossil Chance Find protocol should be added to the eventual EMPr.

From the walk through survey of the site, the land has a gently rolling topography with at least two streams cutting through. There are no rocky outcrops of shales that might preserve fossils, and no fossils or rocks in the soils. Based on the nature of the project, surface activities are unlikely to impact upon the fossil heritage because the potentially fossiliferous Vryheid Formation shales are more than 10m below the surface. Soils are weathered to highly weathered (laterite capping) and so do not preserve fossils. No fossils occur on or near the surface, but might occur below ground. This would not be determined until the excavations for foundations and amenities have commenced. The area is already disturbed from previous agricultural and urban activities. Since there is an extremely small chance that fossils from the Vryheid 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 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 only the shales of the Vryheid Formation contain fossil plant material BUT these are well below the ground. The site visit and walk-through survey confirmed that there are no fossils on or near the surface. From published core data (Snyman, 1998), the shales begin between 10 and 80m below the ground surface. Until excavations have begun it will not be possible to be certain.

6. Recommendation

Based on the site visit and survey, as well as the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the soils or dolomites that cover the Vryheid Formation shales. There is a small chance that fossils may occur in the shales below the ground but it will be impossible to tell until the excavations have commenced and fresh rock is exposed. Therefore, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once excavations have commenced and putative fossils are found (verified by the photographs sent to the palaeontologist), then they should be rescued and the palaeontologist called to collect a representative sample with an AMAFA permit.

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.

Bordy, E.M., Prevec, R. 2008. Sedimentology, palaeontology and palaeo-environments of the Middle (?) to Upper Permian Emakwezini Formation (Karoo Supergroup, South Africa). South African Journal of Geology 111, 429-458.

Cairncross, B. 2001. An overview of the Permian (Karoo) coal deposits of southern Africa. African Earth Sciences 33, 529–562.

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.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations for foundation and amenities 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 fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 17-18). 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/AMAFA 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 Vryheid Formation

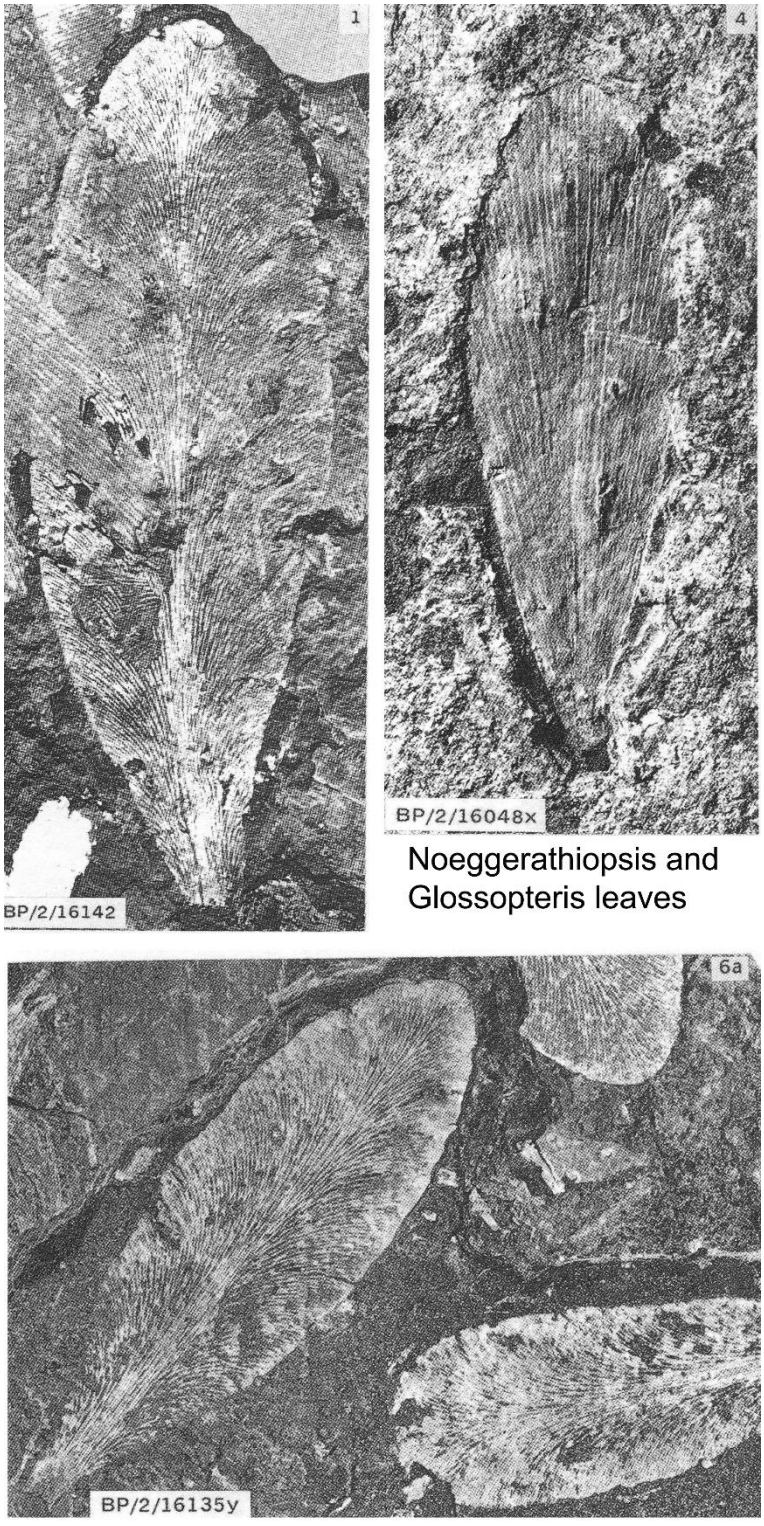
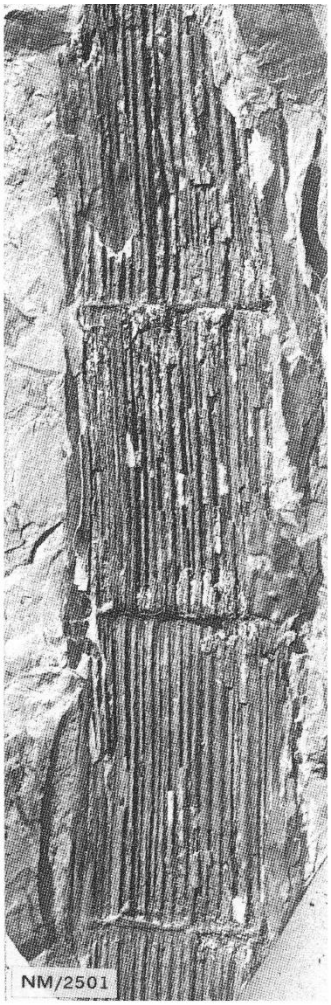
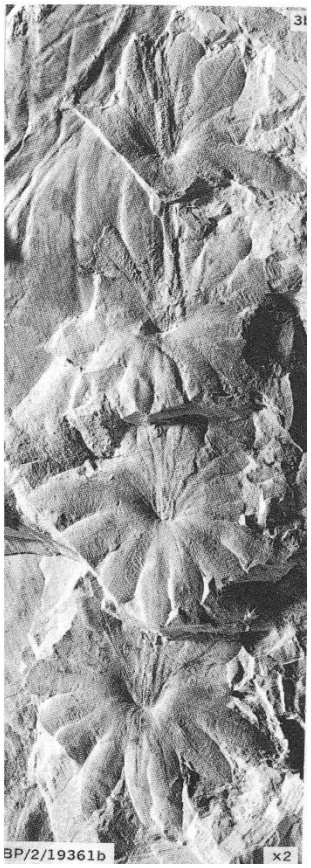


Figure 17: Photographs of fossil leaf impressions of the *Glossopteris* flora.

Fern: Asterotheca sp.





Sphenophytes: whorls of leaves on a striated stem

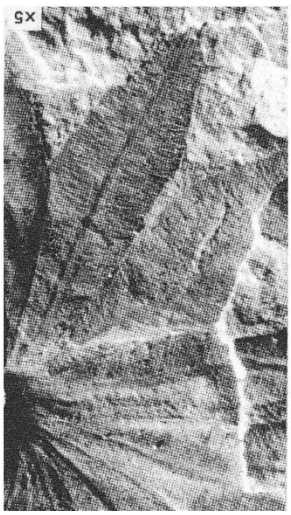


Figure 18: Photographs of leaf impressions of other plant groups in the *Glossopteris* flora.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
April 2020

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	9	2
Masters	9	5
PhD	11	5
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 –
Journal of African Earth Sciences: 2020 -

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
- Geelkop PV project – 2020 – for CapeAprac
-

xi) Research Output

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 140 articles published; 5 submitted/in press; 8 book chapters.
Scopus h-index = 27; Google scholar h-index = 32; -i10-index = 80
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)

Short CV for Dr Alisoun House PhD
June 2020

Current position – Postdoctoral Fellow, Evolutionary Studies Institute, University of the Witwatersrand
Email: Alisoun.house@wits.ac.za

Education
BSc – 1984 – Botany major; University of the Witwatersrand
BSc Honours – 1985 – Botany; University of the Witwatersrand
MSc – 1989 – Botany and Palynology
PhD – 2012- 2015 – Palynology; University of the Witwatersrand

Selected Publications
House, A., Balkwill, K., 2013. FIB-SEM: An Additional Technique for Investigating Internal Structure of Pollen Walls. Microscopy and Microanalysis 19, 1535–1541. doi:10.1017/S1431927613013263

House, A., Balkwill, K., 2016. Labyrinths, columns and cavities: new internal features of pollen grain walls in the Acanthaceae detected by FIB–SEM. Journal of Plant Research 129, 225–240. DOI 10.1007/s10265-015-0777-9

House, A.V., Bamford, M.K. 2019. Investigating the utilisation of woody plant species at an Early Iron Age site in KwaZulu-Natal, South Africa by means of identifying archaeological charcoal. Archaeological and Anthropological Sciences 11, 6737-6750. https://doi.org/10.1007/s12520-019-00939-9

House, A., Bamford, M.K., Chikumbirike, J., (submitted end April 2020). Charcoal from Holocene deposits at Wonderwerk Cave, South Africa: A source of palaeoclimate information. Special issue on WW, in African Archaeological Review

Palaeontological Impact Assessment Experience:
May 2018 – SARAO Williston and Carnarvon for Digby Wells
August 2019 – Idlanga Coal MR, Rietvlei, Vryheid area for Digby Wells
September 2019 – Schmidtsdrift PR for Thaya Environmental Specialists
September 2019 – Estcourt Hospital for HCAC
October 2019 – Dersley outflow for Digby Wells
June 2020 – Frankfort-Winfield 88kV line for 1World Consultants