

**Palaeontological Impact Assessment for the proposed
development of coal mining, Matla Project,
Mpumalanga Province**

Phase 2/Site Report

For

Digby Wells Environmental

24 March 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; 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 Digby Wells, 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 it.

Signature:

Executive Summary

A Phase 2 or site visit Palaeontological Impact Assessment was requested for the proposed development of coal mining and associated activities for the Matla project, south of Emalahleni (Witbank), Mpumalanga¹. 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 completed for the proposed development.

The site visit was undertaken from 12 to 13 March 2019 and aimed to survey a representative area of the existing colliery that will be affected by the proposed new activities. The site visit yielded no fossils at all. The Vryheid Formation (Ecca Group, Karoo Supergroup) contains coals that will be exploited and could potentially also contain plants of the *Glossopteris* flora in the shales between the coal seams. Fossils are not visible in the coal itself and no vertebrates are likely to occur. No fossils were found on the box cut dumps or mining dumps or in river cuttings. Since there is still a small chance that fossils could occur below the surface a Fossil Chance Find Protocol should be added to the EMPr for when excavations and commence.

¹ South African Heritage Resources Information System (SAHRIS) Case ID 11829. Accessible at: <https://sahris.sahra.org.za/cases/exxaro-matla-empr-amendment-and-consolidation>
Interim comment dated 12 October 2018 requiring a Palaeontological Impact Assessment (PIA) is accessible at: <https://sahris.sahra.org.za/node/513317>

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1. Background

A Palaeontological Impact Assessment (Phase 2/site visit “PIA”) was requested by the South African Heritage Resources Agency² (SAHRA) for the proposed additional activities³ for mining at Matla, about 20 km south of Emlaheni for Exxaro Coal Mpumalanga (Pty) Ltd (hereinafter Exxaro). 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 carried out and is reported here.

Project background and description:

In 2017, Digby Wells compiled a Heritage Site Management Plan (HSMP) for a single grave identified within the Exxaro Matla Coal Mine Mining Right Area (MRA) (“Matla”). During this process, Exxaro recognised that a consolidated HRM process had not been completed for Matla or submitted to the relevant Heritage Resource Authorities (HRAs). Exxaro subsequently appointed Digby Wells in 2017 to undertake the HRM process for Matla in compliance with Section 38 of the NHRA. This HRM process included a Notification of Intent to Develop (NID) and Heritage Impact Assessment (HIA) report. As part of this updated report a Palaeontological Impact Assessment is required.

A site visit was undertaken between 12-13 March 2019 by Frederick Tolchard, who is working with Prof Bamford, to visit the site and inspect the areas that will be impacted by the project (see section 3iii) and the results are presented here.

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

² South African Heritage Resources Information System (SAHRIS) Case ID 11829. Accessible at: <https://sahris.sahra.org.za/cases/exxaro-matla-empr-amendment-and-consolidation>
Interim comment dated 12 October 2018 requiring a Palaeontological Impact Assessment (PIA) is accessible at: <https://sahris.sahra.org.za/node/513317>

³ Refer to the Notification of Intent to Develop (NID) and Heritage Impact Assessment (HIA) report submitted to Case ID 11829 for a full description of the proposed activities.

The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section Error! Reference source not found. Error! Reference source not found.
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

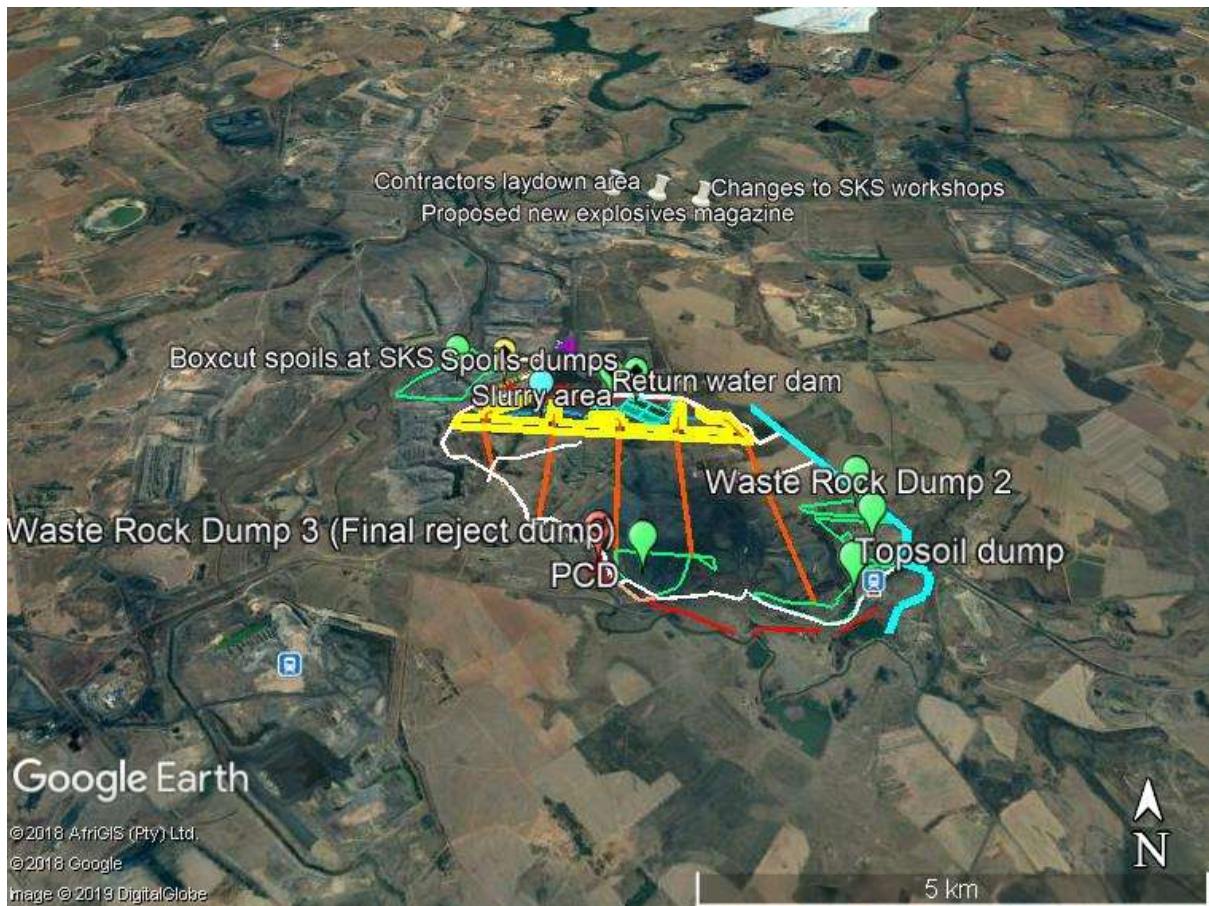


Figure 1: Google Earth map of the proposed area to be developed for the Matla project. Map supplied by Digby Wells.

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*);
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 location of the project lies on the north eastern margin of the Main Karoo Basin and includes only the Vryheid Formation, Ecca Group (Karoo Supergroup). Ecca Group shales, sandstones, mudrock and coals were deposited around the large inland sea that receded over time and are overlain by the Beaufort deposits that were the result of a shrinking sea and shift from lacustrine to braided stream settings.

Jurassic dolerite is common to the south of the region but these are intrusive and of volcanic origin. The dykes cross-cut the Karoo strata and also tend to destroy any fossils that might have been in their vicinity. As the dykes are non-fossiliferous they will not be discussed further.

ii. Palaeontological context

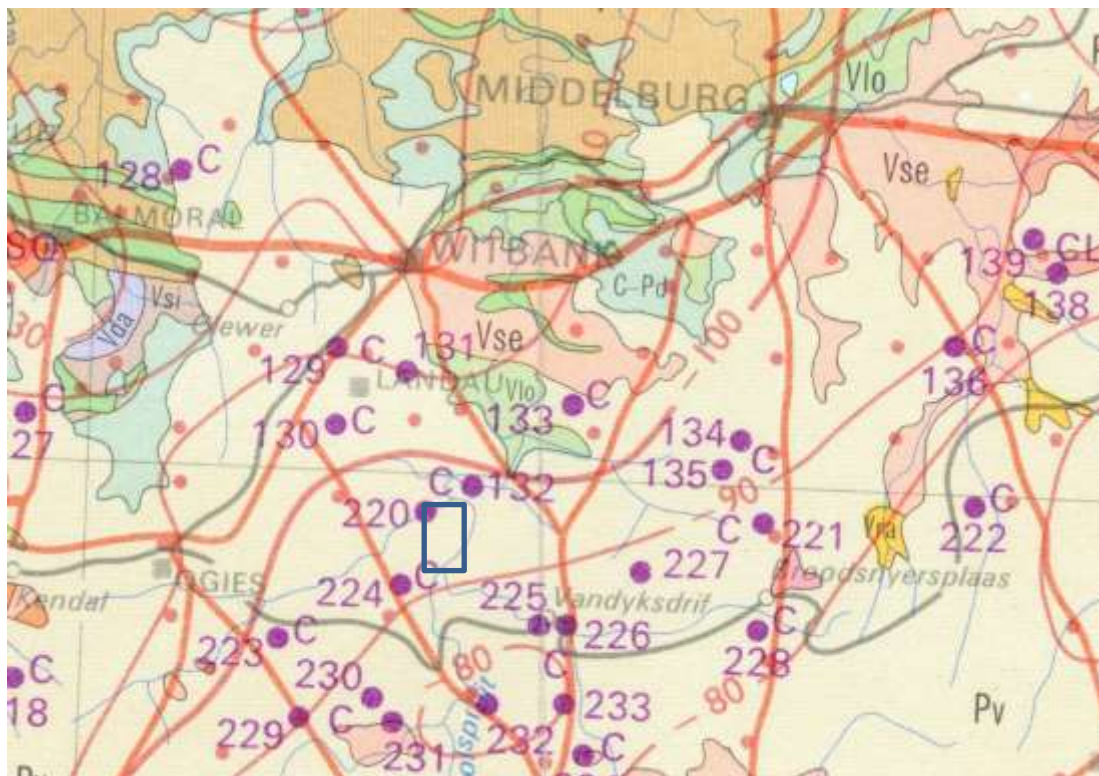


Figure 2: Geological map of the area south of Emalaheni (Witbank), Mpumalanga. The location of the proposed project is indicated within the blue rectangle. Pale pink represents the Vryheid Formation (Pv). Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

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

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pvo	Volksrust Fm, Ecca Group, Karoo SG.	shale	Middle Permian, Upper Ecca
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shales, sandstone, coal	Early Permian, Middle Ecca

The Witbank Coalfield has numerous coal mines and in general they exploit the coal seams 1-5 (base to top) and drill cores indicate the depth and relative thickness of the coal seams. In the Kriel area the uppermost seam, no 5, is 30m below the land surface and in the Ogies area it is 45m below surface (Snyman, 1998) so it is unlikely that any coal or associated fossiliferous shale lenses would be visible in farmlands but could be exposed in river cuttings, active collieries or box cuts.

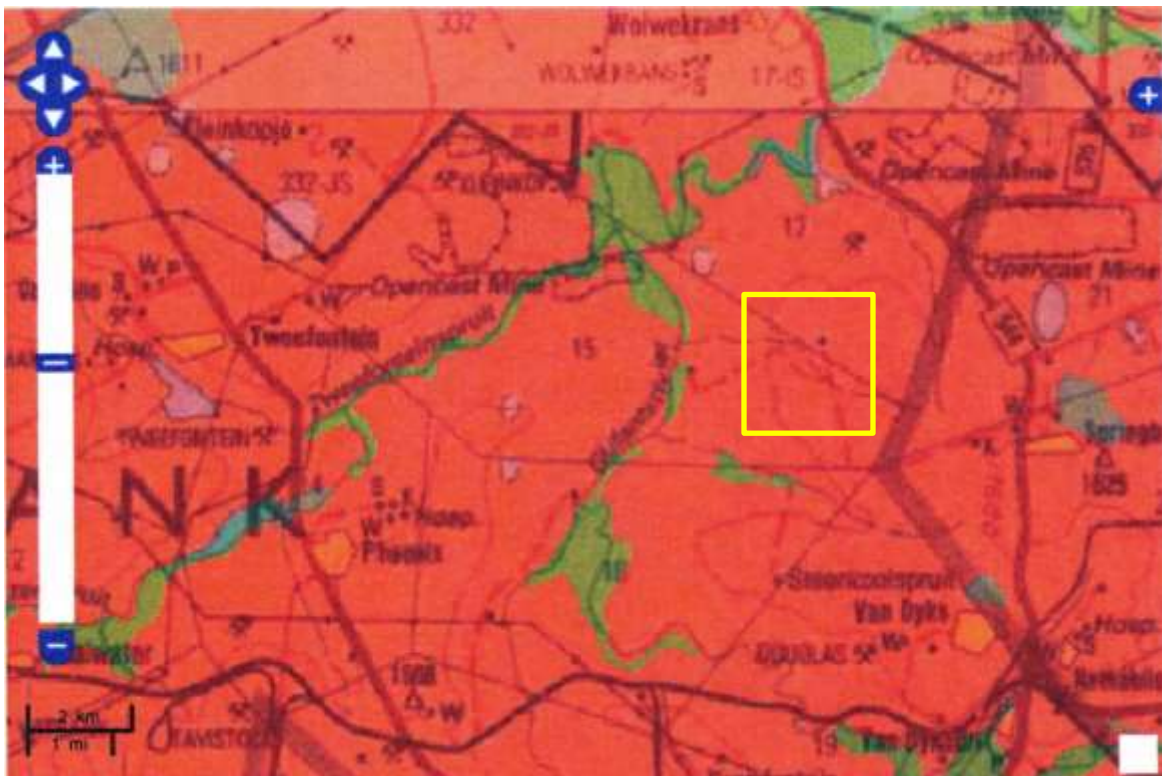


Figure 3: SAHRIS palaeosensitivity map for the Matla project, Mpumalanga. The site surveyed is within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The palaeontological sensitivity of the area under consideration is presented in Figures 3.

iii. Site Visit

The Matla colliery was visited on 12-13 March 2019, focussing on the sites where sediments were visible, in other words the box cuts and colliery dumps and along the access roads.

Table 3: List of sites visited with the latitude and longitude provided, observations and related figure for photographs of the site.

Site designation	GPS coords	Comment
Box cut 1	S 26°13.050' E 29°04.641' 1586m	Fig 4: general view of the terrain, soil surface and weathered shales. No coal seams or potentially fossiliferous shales have yet been exposed.
Box cut 2	S 26°12.993° E 29°04.590' 1597m	Fig 5: preliminary excavations show the deep surface soils and black shales below but do fossils were seen.
Dump 1	S 26°15.843' E 29°07.433' 1593m	Figs 6-7: Some of the dump material has been removed but what remains comprises extraneous clasts and black shales with vague markings but these are not fossil plants.



Figure 4: Photographs of Box Cut 1. A – general view of the terrain. B – surface soil visible between the vegetation and lines marking next trench to be excavated. C – mixed calcrete and exposed grey-black shales. D – weathered shales and no fossils preserved.



Figure 5: Box Cut 2. A – edge of the box cut revealing black shales. B – erosion showing the deep surface soils. C – weathered box cut section with shales used as road fill. D – shales from the box cut with no fossils preserved.



Figure 6: Dump site 1. A – section of coal dump that has been partially cleared and reveals surface below. B – extraneous clast in the dump material with boot as scale. C – section of material in the dump. D – white markings in the shale but these are not fossils.

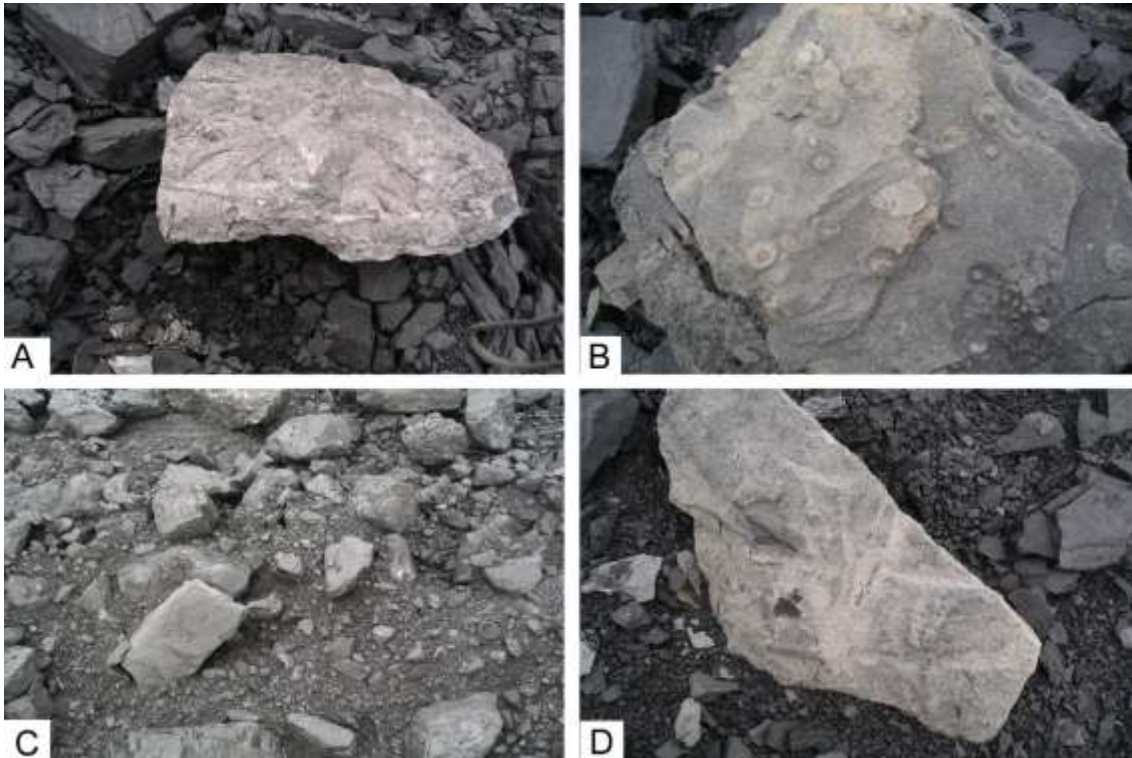


Figure 7: Dump site 1 continued. A – more white markings on the shale but these are not fossil plants or bones. B – weathering of minerals included in the shales. C – weathered shales. D – blocks of shale with markings but not fossils.

4. Impact assessment

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

TABLE 4A: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.

Criteria for ranking the DURATION of impacts	L	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	H	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 4B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	H	-
	M	The Vryheid Fm siltstones and shales could contain impressions of plants of the <i>Glossopteris</i> flora. The impact would be moderate
	L	..
	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	There is a moderate chance of fossils occurring BUT none was found during the survey. There is a small chance that once excavations begin fossils will be exposed from below the surface or associated with the shale lenses between the coal seams, so a Chance Find Protocol should be added to the EMPr.
	L	-

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 preserve fossils, however none was found by the palaeontologist who surveyed the area. Since there is a small chance that fossils from the Vryheid Formation may be found below the surface and therefore will be disturbed, a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria and results of the survey, the potential impact to fossil heritage resources is extremely low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and do contain fossil plants of the early Permian *Glossopteris* flora.

From the survey we are certain that there are no surface exposures of fossils because there are deep soils. They may occur below ground but from the coal dump and box cuts there were NO fossils exposed. If they are present then they are extremely rare and sporadic.

6. Recommendation

Based on experience and the lack of any fossils recorded from the area, it is unlikely that many fossils would be preserved in the site. There is very small chance that fossils may occur below the surface so a Chance Find Protocol should be added to the EMPr: if fossils are found once excavations have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample with the relevant SAHRA permit.

7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrumus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

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 infrastructure or mining begin.

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone) should be put aside in a suitably protected place. This way the mining activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 8, 9). 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 or 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 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 fossils from the Vryheid Formation

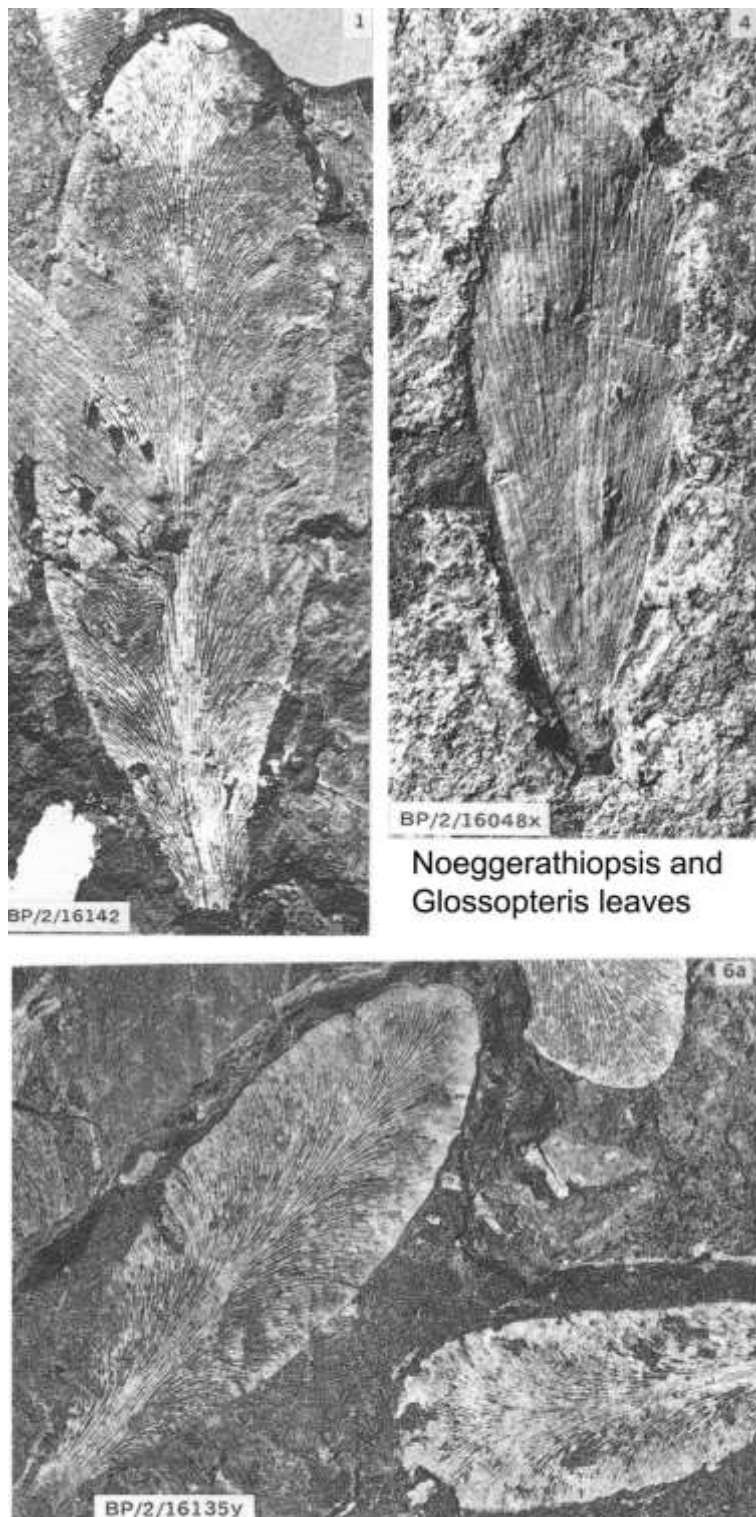
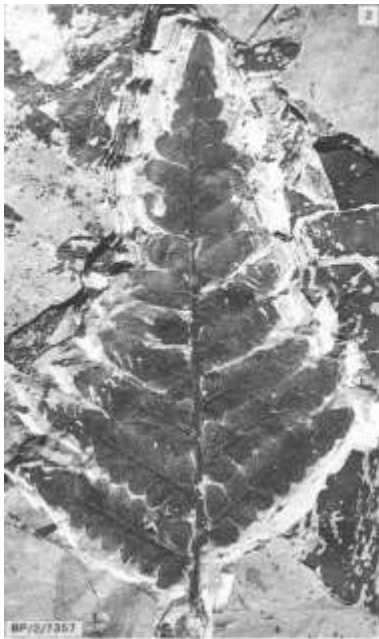


Figure 8: *Glossopteris* and cordaitalean leaves from Ecca sediments



Fern: *Asterotheca* sp.



Sphenophytes: whorls of leaves on a striated stem



Figure 9: other examples from the *Glossopteris* flora – sphenophytes that are known to occur in other Vryheid Formation localities.

Curriculum vitae (short) - Marion Bamford PhD January 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-
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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
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xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 125 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)