

**Palaeontological Impact Assessment for the Proposed
Prospecting Rights Application on Rietvlei 150 HU,
~20km east of Vryheid,
KwaZulu-Natal Province**

Phase 2 Study

For

Digby Wells on behalf of Information Decision Systems

27 August 2019

Prof Marion Bamford

Palaeobotanist

P Bag 652, WITS 2050

Johannesburg, South Africa

Marion.bamford@wits.ac.za

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 Digby Wells, Johannesburg, 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 (PIA) was requested for the proposed Prospecting Rights Applications for farm Rietvlei 150 HU, about 20km east of Vryheid, KwaZulu-Natal Province. A site visit was conducted on 27 August, the outcomes presented here.

To comply with the minimum requirements of South African Heritage Resources Agency (SAHRA) Palaeo-Sensitivity Map (PSM), as well as Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a Phase 2 PIA was completed for the proposed application.

The proposed site lies on the shales, mudstones, sandstones and coals of the Vryheid Formation, lower Ecca Group, Karoo Supergroup. No fossils were observed in the outcrops of shales and coarse sandstones or shales or in the dumps of shales from the previous mining activities. Around Vryheid and Hlobane, the uppermost coal seam is about 100m below the surface, overlain by dolerite, sandstone, mudstone / siltstone and a few metres of modern soils. Therefore, until excavations and mining commence it is unlikely that any fossils would be observed. Since fossil plants of the *Glossopteris* flora will be associated with the shales close to the coal seams a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological site visits are required until fossils are found by the geologist or responsible person.

Table of Contents

Expertise of Specialist.....	1
Declaration of Independence.....	1
1. Background.....	4
2. Methods and Terms of Reference	4
3. Geology and Palaeontology.....	6
i. Project Location and Geological Context.....	6
ii. Palaeontological context	7
iii. Observations from the Site Visit.....	8
4. Impact Assessment.....	12
5. Assumptions and Uncertainties	14
6. Recommendation.....	14
7. References.....	15
8. Fossil Chance Find Protocol.....	16

List of Figures

Figure 1: Topographic map of the proposed Prospecting Rights Application area on Farm Rietvlei 150 HU, KwaZulu Natal, with the sections shown by the green colour.	4
Figure 2: Geological map of the area around the farm Rietvlei 150 HU, east of Vryheid. The location of the proposed project is indicated within the yellow rectangle. Map enlarged from the Geological Survey 1: 250 000 map 2730 Vryheid.	6
Figure 3: SAHRIS PSM for the site for the proposed prospecting rights application of Farm Rietvlei 150 HU 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.	8
Figure 4: Observations A through F	10
Figure 5: Observations G through I.....	11
Figure 6: Selection of fossil plant impressions of the Glossopteris flora	19

1. Background

A Phase 2 Palaeontological Impact Assessment (PIA) was requested for the proposed Prospecting Rights Application for the Farm Rietvlei 150 HU, approximately 20 km east of Vryheid, KwaZulu-Natal Province. This site lies in the Vryheid coalfield indicated as very highly sensitive on the SAHRIS Palaeo-Sensitivity Map (PSM).

To comply with the minimum requirements of South African Heritage Resources Agency (SAHRA) PSM, as well as Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a Phase 2 PIA was completed for the proposed application, comprising a site visit on 27 August 2019.

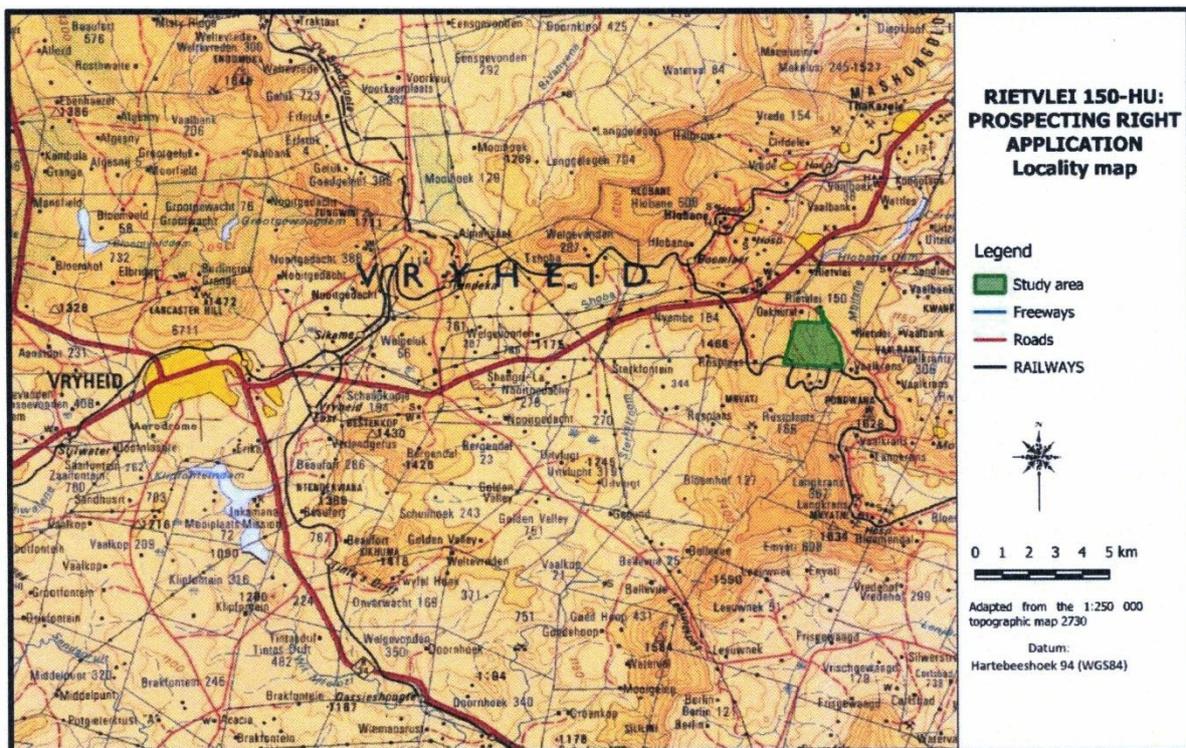


FIGURE 1: TOPOGRAPHIC MAP OF THE PROPOSED PROSPECTING RIGHTS APPLICATION AREA ON FARM RIETVLEI 150 HU, KWAZULU NATAL, WITH THE SECTIONS SHOWN BY THE GREEN COLOUR.

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;

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*).

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 specialists who prepared the report	Appendix B
a ii	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
c ii	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	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
n ii	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

A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:		Relevant section in report
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

3. Geology and Palaeontology

i. Project Location and Geological Context

The site, Farm Rietvlei 150 HU, lies in the Vryheid coalfield and south of the Hlobane Colliery. This is in the north eastern part of the main Karoo Basin. Mudstones, siltstones, sandstones and coal seams have filled in the uneven topography of the basin during the Permian and Triassic periods. Jurassic dolerite dykes have cut through these sediments, mostly to the south and west of this area, and are associated with the Drakensberg basalt outpourings. To the east of the site are several small exposures of the slightly older Dwyka Group tillites, diamictites, sandstones and mudstones, also of the Karoo Supergroup.

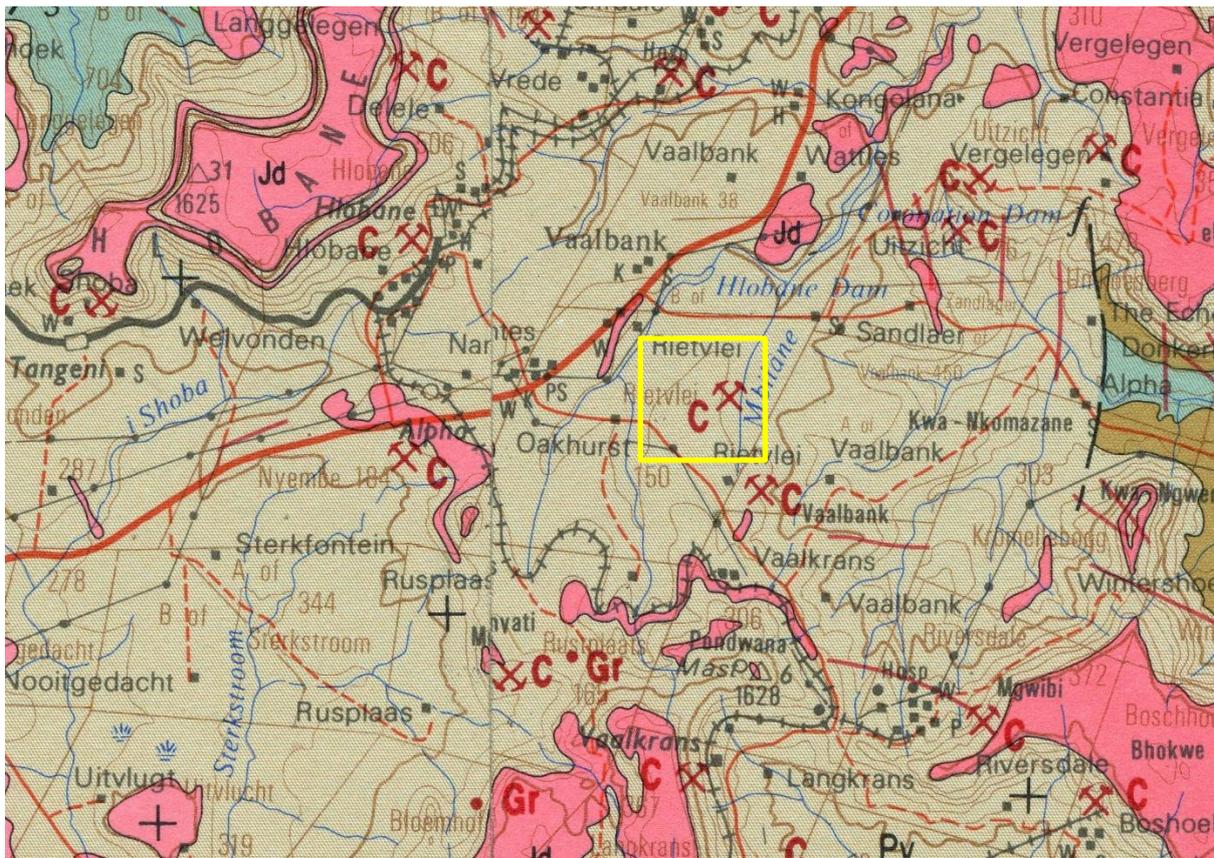


FIGURE 2: GEOLOGICAL MAP OF THE AREA AROUND THE FARM RIETVLEI 150 HU, EAST OF VRYHEID. THE LOCATION OF THE PROPOSED PROJECT IS INDICATED WITHIN THE YELLOW RECTANGLE. MAP ENLARGED FROM THE GEOLOGICAL SURVEY 1: 250 000 MAP 2730 VRYHEID.

TABLE 2: EXPLANATION OF SYMBOLS FOR THE GEOLOGICAL MAP AND APPROXIMATE AGES (BUCHANAN, 2006. JOHNSON ET AL.). SG = SUPERGROUP; FM = FORMATION; MA = MILLION YEARS; GREY SHADING = FORMATIONS IMPACTED BY THE PROJECT.

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shales, sandstone, coal	Early Permian, Middle Ecca
Pp	Pietermaritzburg Fm, Ecca Group, Karoo SG	Grey shales	Early Permian, Early Ecca
C-Pd	Dwyka Group, Karoo SG	Diamictites, tillites, mudstones, sandstones	Late Carboniferous to Early Permian
Vdi	Diabase		

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for prospecting is in the Vryheid Formation. In KwaZulu-Natal there are up to 13 coal seams, but because of the uneven basal topography, pinching out of seams against basal highs, and complex depositional environment (deep water, swamps, deltas, backswamps and floodplains) of the ancient Karoo sea and margins. Although coal is formed from the extreme compression and heat alteration of peats and peats are formed from buried accumulations of plant material growing in swampy environments, coal itself does not contain any recognisable fossil plant material. The shales and mudstones associated with the coals, however, are likely to preserve impressions of plants from the *Glossopteris* flora, for example *Glossopteris* leaves, reproductive structures, lycopods, sphenophytes, ferns, cordaitaleans and early gymnosperms.

A few terrestrial vertebrates had evolved by the early Permian but bones are very seldom preserved together with fossil plants because they require different conditions for preservation. No fossils vertebrates are likely to occur in the Vryheid Formation.

Geotechnical cores have been drilled throughout the coalfields and for the Hlobane area, in the Vryheid region, uppermost coal seam is about 120m below the surface soils (Snyman, 1998, p. 179). The overlying rocks comprise dolerite, sandstone and shales. Dolerite does not preserve fossils and often destroys any fossils that were in the immediate vicinity. These dykes and sills are associated with the Drakensberg outpouring of basalts during the early Jurassic. Underlying shales may preserve impressions of leaves of the *Glossopteris* flora.

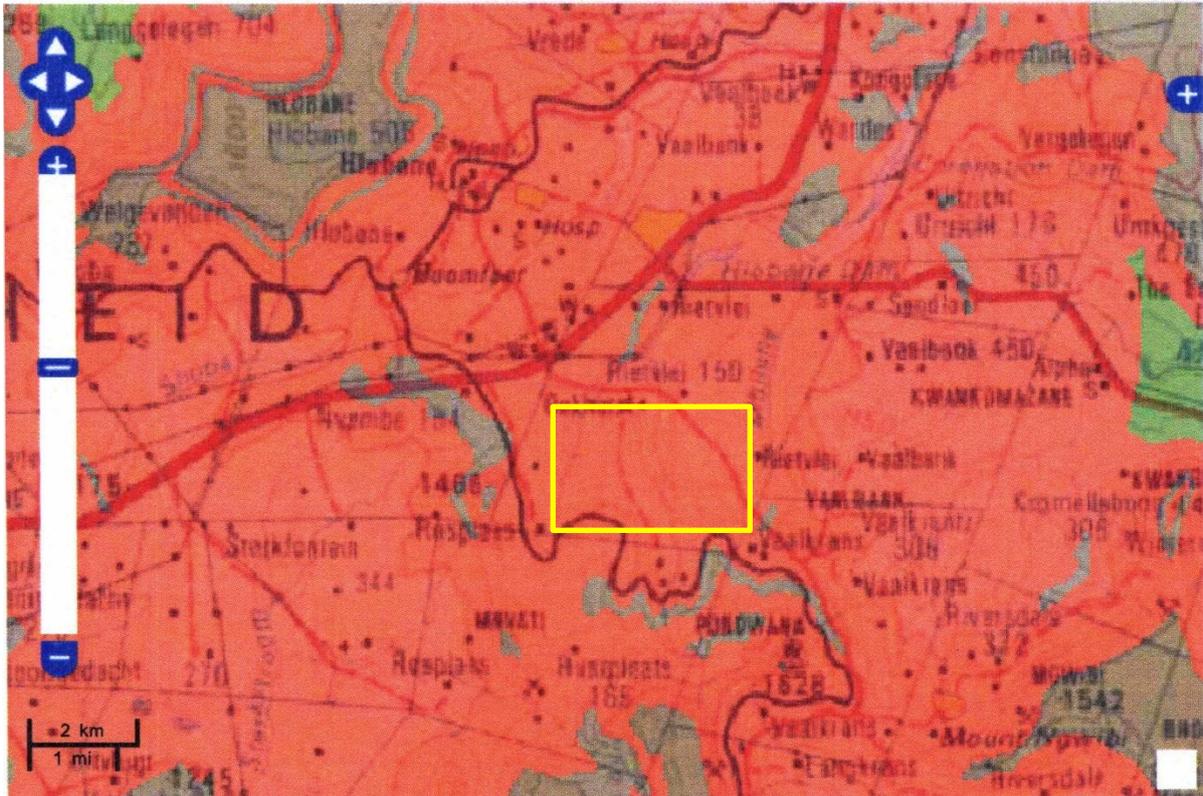


FIGURE 3: SAHRIS PSM FOR THE SITE FOR THE PROPOSED PROSPECTING RIGHTS APPLICATION OF FARM RIETVLEI 150 HU SHOWN WITHIN THE YELLOW RECTANGLE. BACKGROUND COLOURS INDICATE THE FOLLOWING DEGREES OF SENSITIVITY: RED = VERY HIGHLY SENSITIVE; ORANGE/YELLOW = HIGH; GREEN = MODERATE; BLUE = LOW; GREY = INSIGNIFICANT/ZERO.

From the SAHRIS PSM above, the area is indicated as very highly sensitive (red) requiring site visit. The observations from the site visit on 27 August 2019 are presented below.

iii. Observations from the Site Visit

Rick Tolchard and Alisoun House completed the PIA field investigation on 27 August 2019. They were assisted by Mr Njabulo Simelane as the on-site representative of the Project. The observations from the site visit are summarised in Table 3 below.

TABLE 3: OBSERVATIONS AT EACH SITE WITH GPS COORDINATES

Location	Observations	Image
Point 1 27° 45' 12"S 31° 01' 22"E	Grassland with some sandstone outcrops along stream, Eucalyptus and wattle in the background. No fossils recorded.	B
Point 2 27° 45' 11"S 31° 01' 20"E	Large boulders of very coarse sandstone. No fossil impressions.	E & F

Location	Observations	Image
Point 3 27° 45' 10"S 31° 01' 15"E	Opencast mining dump; no fossils were present in the shales and sandstones.	D & G
Point 4 27° 45' 03"S 31° 01' 44"E	Shales exposed, with capping of coarse sandstone; no fossils.	A
Point 5 27° 45' 35"S 31° 02' 06"E	Entrance to abandoned underground mine, with dolerite and sandstone boulders nearby, as well as dump; no fossils.	C & I
	Dump near abandoned mine entrance showing shales and sandstones with no fossils.	H



FIGURE 4: OBSERVATIONS A THROUGH F



FIGURE 5: OBSERVATIONS G THROUGH I

4. Impact Assessment

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

TABLE 4: 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

PART A: DEFINITION AND CRITERIA		
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	H	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 5: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	H	-
	M	-
	L	Fossils of the <i>Glossopteris</i> flora are expected in the Vryheid Fm but none was observed in the widespread covering of modern soils. The impact would be very unlikely in the soils. Fossils may occur 100 m below the surface
	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, 10+m below the surface soils, the spatial scale will be localised within the site boundary.
	M	-
	H	-

PART B: ASSESSMENT		
PROBABILITY	H	-
	M	It is extremely unlikely that any fossils would be found in the dolerite and soils but could be in the shales and mudstones associated with the coal seams. Therefore, a fossil chance find protocol should be added to the eventual EMPr.
	L	-

Based on the nature of the soils and thick capping of dolerite and sandstone (Snyman, 1998) overlying the coal reserves, there are no fossils visible in the surface because they do not occur in the soils or dolerite. Fossil plant impressions are likely to occur in the shales and mudstones associated with the coal seams BUT their occurrence is sporadic and unpredictable. Only once excavations and mining activities commence would there be a chance of finding fossils. Since there is a chance that fossils from the Vryheid Formation may be disturbed once excavations and mining commence, a Fossil Chance Find Protocol has been added to this report (Section 8; Appendix A). Taking account of the defined criteria, the potential impact to fossil heritage resources is low to moderate.

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 plant, insect, invertebrate and vertebrate material. The soils do not preserve fossils, however there may be fossil plant impressions 10 or more metre below the surface, and this will only be revealed, if present at all, once excavations and mining commence.

6. Recommendation

Based on survey and observations during the site visit, it is clear that there are no fossils present in the soils. There is very small chance that fossils may occur in the shales and mudstones associated with the coal seams. In this area the soils are about 5 m deep but there is a thick capping of dolerite, so there is a chance that fossils occur well below this depth. Their occurrence in the Vryheid Formation (Ecca Group) is sporadic and unpredictable. A Fossil Find Protocol should be added to the EMPr: if fossils are found once mining has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

7. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrumus of South African megaflooras, 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. Fossil Chance Find Protocol

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

1. The following procedure is only required if fossils are seen on the surface or below the surface when excavations/mining commence.
2. When excavations begin the rocks and must be given a cursory inspection by the geologist on site, environmental officer or designated person. Any fossiliferous material (plants, insects, bone, coal) 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 examples see Figure 12). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then the site inspections by the palaeontologist will not be necessary.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – lists of possible fossils and photographs

Plant group – Vryheid Fm	Genus and Species
Sphenophytes (horsetails)	<i>Sphenophyllum speciosum</i>
	<i>Raniganjia kilburnensis</i>
	<i>Phyllothea australis</i>
	<i>Phyllothea lawleyensis</i>
	<i>Phyllothea wetensis</i>
	<i>Schizoneura gondwanensis</i>
Ferns	<i>Sphenopteris lobifolia</i>
Glossopterids	<i>Plumsteadia natalensis</i>
	<i>Plumsteadia gibbosa</i>
	<i>Estcourtia vandijksii</i>
	<i>Estcourtia bergvillensis</i>
	<i>Rigbya arberioides</i>
	<i>Lidgettonia africana</i>
	<i>Lidgettonia mooiriverensis</i>
	<i>Lidgettonia inhluzanensis</i>
	<i>Lidgettonia lidgettonioides</i>
	<i>Lidgettonia elegans</i>
	<i>Glossopteris symmetrifolia</i>
	<i>Glossopteris loskopensis</i>
	Ottokariaceae
	Lidgettoniaceae
Incertae sedis	<i>Noeggerathiopsis hislopi</i>

Plant group – Vryheid Fm	Genus and Species
	<i>Pagiophyllum vandijkii</i>
	<i>Taeniopteris estcourtiana</i>
	<i>Benlightfootia mooiensis</i>



FIGURE 6: SELECTION OF FOSSIL PLANT IMPRESSIONS OF THE GLOSSOPTERIS FLORA

Appendix B – Details of Specialist

Curriculum Vitae - 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
- Klipootjie 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

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)

Mr Frederick Tolchard

Brief Curriculum Vitae – June 2019

Academic training

BA Archaeology – University of the Witwatersrand, graduated 2015

BSc (Honours) Palaeontology – University of the Witwatersrand, 2017 with distinction

MSc Palaeontology – University of the Witwatersrand, 2018 – 2019.

Field Experience

Honours Fieldtrip – Karoo biostratigraphy – April 2017

Research fieldwork – Elliot Formation with Prof Choiniere – April 2018, November 2018;
April 2019

PIA fieldwork projects

2018 May – Williston area – SARAO project, Digby Wells

2018 September – Lichtenburg PVs – CTS Heritage

2018 November – Nomalanga farming – Digby Wells

2019 January – Thubelisha coal – Digby Wells

2019 March – Matla coal – Digby Wells

2019 March – Musina-Machado SEZ – Digby Wells

2019 June – Temo coal – Digby Wells