

**Palaeontological Impact Assessment for the proposed
coalmine on Ogies South Portion 1/5,
Mpumalanga Province**

Site Visit Report (Phase 2)

For

Greater Emalahleni Youth Co operative

15 October 2021

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford

Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf

Experience: 32 years research; 24 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Greater Emalahleni Youth Co operative. 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:

A handwritten signature in blue ink, appearing to read 'MKBamford', with a horizontal line underneath.

Executive Summary

The Applicant proposes to develop a coal mine on Ogies South Portions 1 and 5, just south of the town of Ogies, Mpumalanga Province. The final proposed mining area will be 3.5 ha.

A Phase 2 Palaeontological Impact Assessment was requested for this project because the site is on very highly sensitive rocks according to the SAHRIS Palaeosensitivity map (SAHRIS Case ID: 15878_2). To comply with regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit and report for the Palaeontological Impact Assessment (PIA) were completed for the proposed project.

No fossils of any kind were seen during the site visit. The peri-urban area is highly disturbed with rubbish dumps and old building foundations. Soils and some vegetation cover the area but there are no rocky outcrops.

The proposed site lies on shales and sandstones of the Vryheid Formation (Ecca Group, Karoo Supergroup) that are potentially fossiliferous. Potential fossils would be impressions of the *Glossopteris* flora (*Glossopteris* leaves, lycopods, sphenophytes, ferns and early gymnosperms). Although no fossils were seen during the site visit, a Fossil Chance Find Protocol should be added to the EMP. Based on this information it is recommended that no further palaeontological site visit is required. If fossils are found once excavations for mining, foundations and infrastructure commences then they should be rescued and a palaeontologist called to collect a representative sample. As far as the palaeontology is concerned, the project may proceed.

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1. Background

Ndlenhle Mining and Consultants (Pty) Ltd was appointed by the Greater Emalahleni Community Forum to undertake an environmental assessment for the proposed coal mine on the farm Kleinzuikerboschplaat 5 IS, in the eMalahleni Local Municipality of Mpumanga Province. The mine will be 5 hectares extent including the access/haul road, mobile office, ablution facilities as well as a mobile washing and screening plant.

An EMP report has been submitted as well as a letter to SAHRA requesting comments due to discovering a number of graves. The proposed mining area has since been reduced to 2.5 ha so that the graveyard can be left intact.

In addition, SAHRA (CaseID: 15878_2) has requested a Phase 2 (site visit) Palaeontological Impact Assessment because the project site lies on rocks of the Vryheid Formation and is indicated as very highly sensitive on the SAHRIS Palaeosensitivity map (Figures 2,3).

The site visit was done by Rick Tolchard on Wednesday 13th October 2021 with the assistance of Christopher Magagula. In order to comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a site visit (or phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed project and is 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
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 4
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3iii
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	None
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;	No palaeontological sensitivities identified
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	Section 8
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
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	Section 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A – consultation done by EAP
p	A summary and copies if any comments that were received during any consultation process	N/A – consultation done by EAP
q	Any other information requested by the competent authority.	Section 8

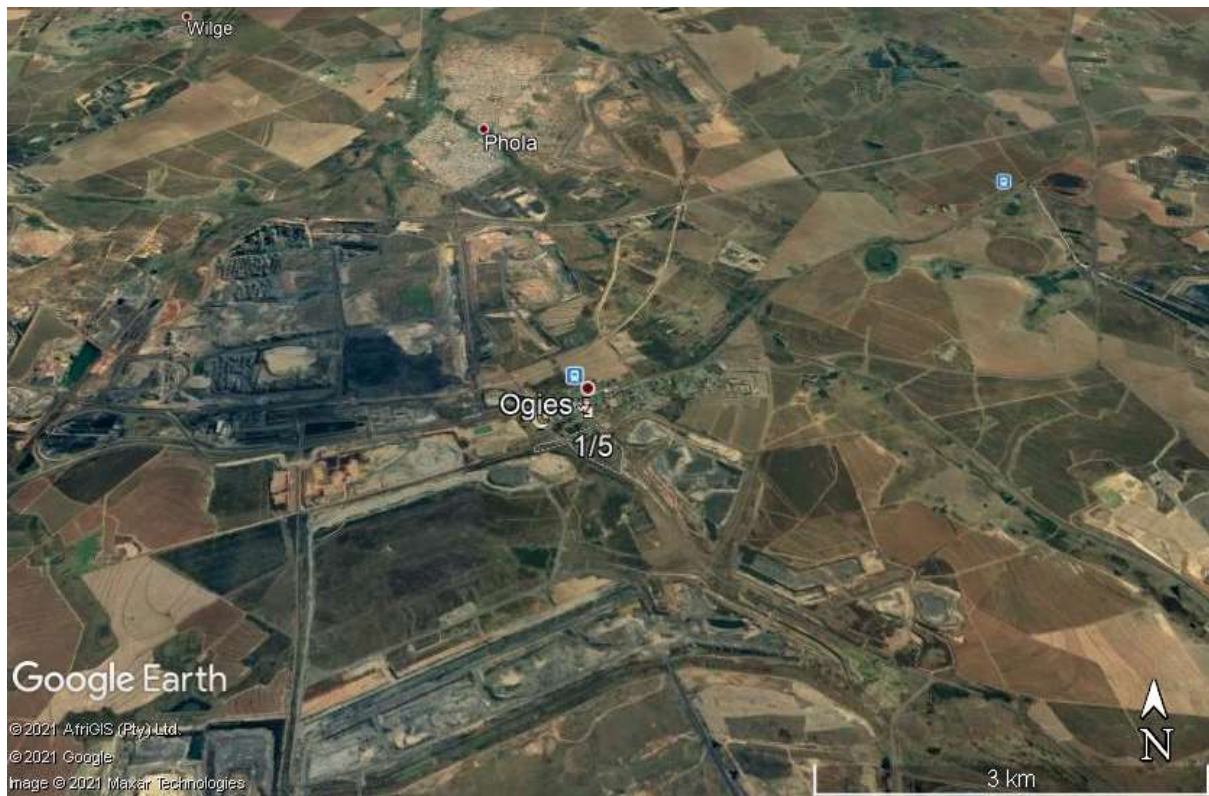


Figure 1: Google Earth map showing the proposed mining area on Farm Ogies South Ptn 1/5 relative to the town of Ogies.



Figure 2: Google Earth map with the outline of the area of interest (thin white lines)

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*).

3. Geology and Palaeontology

i. Project location and geological context

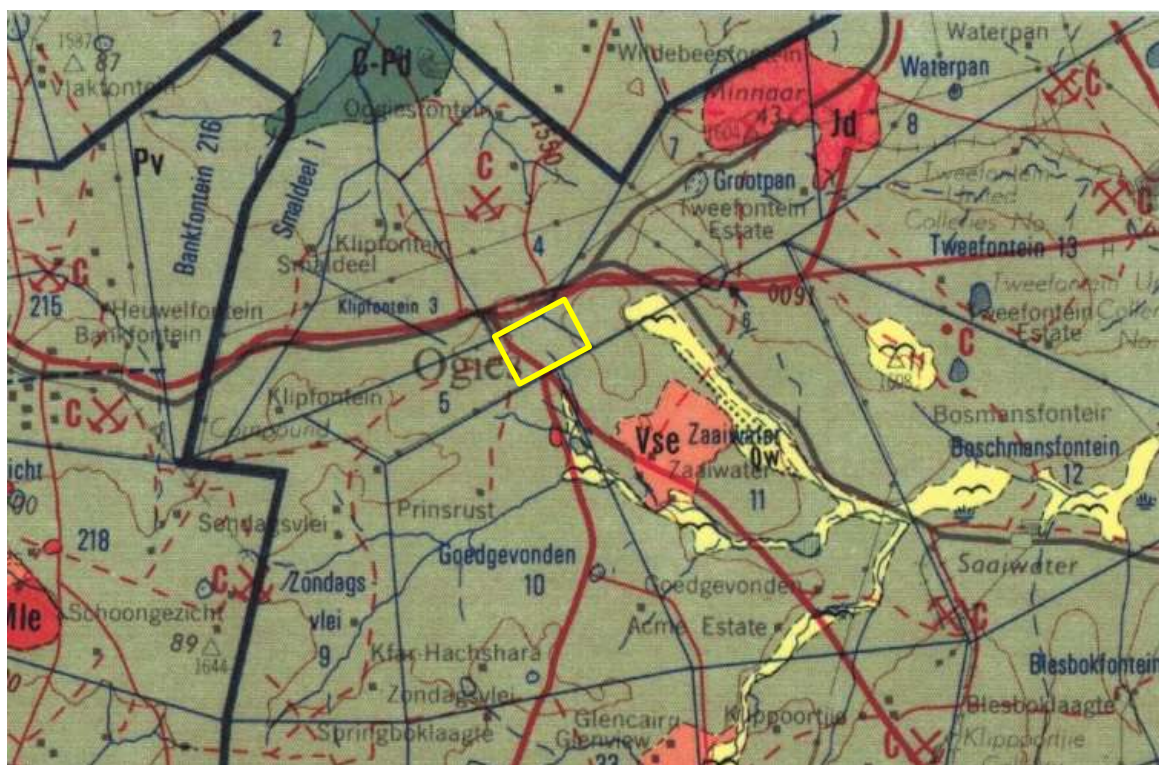


Figure 3: Geological map of the area around Ogies with the mining area on Ogies South 1/2 shown within the yellow outline. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

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

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary sands and soils	Partly consolidated fine-grained sediments with silcrete nodules	Last 2.5 Ma
Pv	Vryheid Fm, Eccca Group, Karoo SG	Shales, sandstone, coal	Early Permian, Middle Eccca <269 - 266 Ma
C-Pd	Dwyka Group, Karoo SG	Diamictites, shales	Late Carboniferous – Early Permian, ca 290-280 Ma
Vse	Selons River Fm, Rooiberg Group, Transvaal SG	Porphyritic rhyolite with interbedded mudstone and sandstone	Ca 2056 Ma

The site lies in the north eastern sector of the Karoo Basin with Karoo Supergroup rocks intruded by dolerite dykes and unconformably overlain by much younger alluvium and soils of probable Quaternary age (Figure 3). The Karoo Supergroup rocks unconformably overlie the much older rocks of the Transvaal Supergroup in the Transvaal Basin and some of them are exposed to the south of the town (Figure 3).

The Main Karoo Basin and Karoo Supergroup rocks cover a very large proportion of South Africa. The Karoo Basin is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

During the Carboniferous period South Africa was part of the huge continental landmass known as Gondwanaland and it positioned over the South Pole. As a result, there were several ice sheets that formed and melted, and covered most of South Africa (Visser, 1986, 1989; Isbell et al., 2012). Gradual melting of the ice as the continental mass moved northwards and the earth warmed, formed sedimentary deposits in the large inland sea. These are the oldest rocks in the Karoo system, and are exposed around the outer part of the ancient Karoo Basin and are known as the Dwyka Group. They comprise tillites, diamictites, mudstones, siltstones and sandstones that were deposited as the basin filled (Johnson et al., 2006).

Overlying the Dwyka Group rocks are rocks of the Eccca Group that are Early Permian in age. There are eleven formations recognised in this group but they do not all extend throughout the Karoo Basin. In the Free State and KwaZulu Natal, from the base upwards are the Pietermaritzburg Formation, **Vryheid Formation** and the Volksrust Formation. All of these sediments have varying proportions of sandstones, mudstones, shales and siltstones and represent shallow to deep water settings, deltas, rivers, streams and overbank depositional environments.

Overlying the Ecca Group rocks are the Beaufort Group Rocks that are late Permian and early Triassic in age. They are not exposed in this region.

Intruding through all these sediments are dolerite dykes (but not in this section) that formed during the Jurassic Drakensberg basaltic eruptions. Unconformably overlying the older rocks are the considerably younger Quaternary or Kalahari sands. As the continent dried out during the Late Quaternary period windblown sands from the Kalahari Basin were redeposited farther to the east, and together with fluvially borne sands from the major rivers such as the Vaal River, the sands covered some of the lower lying areas (Partridge et al., 2006). Soils cover most of the area and these are much younger than the rocks below.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The Permian Vryheid Formation sediments could have preserved fossil plants of the *Glossopteris* Flora, including leaf impressions and fructifications of *Glossopteris*, and other extinct groups like the cordaitaleans, some lycopods, sphenophytes, wood and ferns, as well as early gymnosperms. Fossil plants have been recorded from other regions but they are sporadic and their distribution is hard to predict. Coal seams 1-6 are found in this region but although coal is formed from the alteration by temperature and pressure of peats that are an accumulation of plant matter, no plants are recognised within the coal itself. Fossil plants can be found in the fine-grained shale lenses between the coal seams.

The *Glossopteris* flora fossils are of interest to palaeobotanists but in general they are widely scattered and difficult to locate. This flora is well known but there is always a very small chance that some new taxa may be discovered (Plumstead, 1969; Anderson and Anderson, 1985).

Quaternary sands seldom preserve fossils as they are either aeolian in origin or from recent fluvial activity, in other words they are not in primary context. Fossil pans, spring mounds or stabilised sand dunes may preserve fossils but these features are not indicated on the Google Earth map that shows the land has having been modified by agricultural practices.

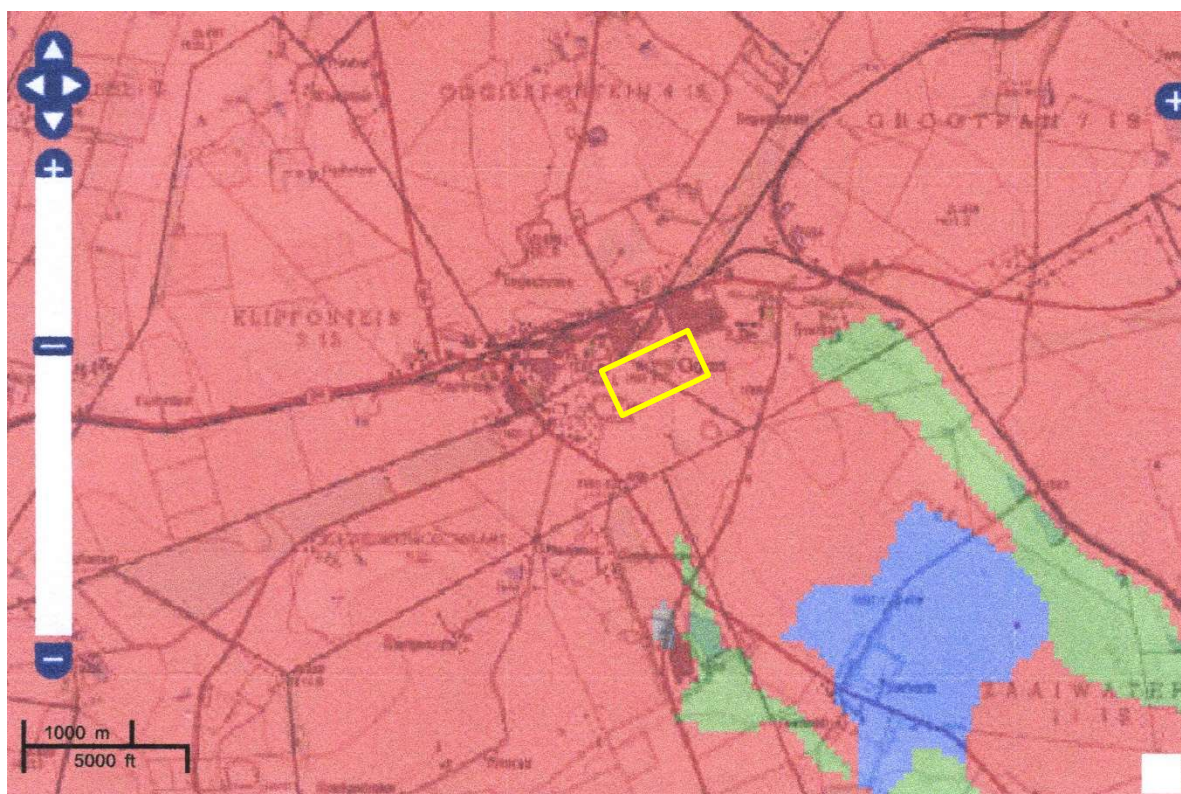


Figure 4: SAHRIS palaeosensitivity map for the site for the Ogies South 1/2 mining area shown within the yellow outline Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

In this Witbank coalfield of Mpumalanga, coal seams 1-5 (from base to top) are present at various levels below the ground surface. Seams 2 and 4 are the thickest seams (Snyman, 1998, based on core material) and the uppermost seam, No 5, is between 12 and 45m below the surface. In all areas, the uppermost seam is overlain by soils, shales and sandstones of varying thicknesses.

From the SAHRIS map (Figure 4), the area is indicated as very highly sensitive (red) for the Vryheid Formation. Therefore, a site visit and survey is required. This was completed.

iii. Site visit survey and observations

A site visit was completed on 13th October 2021 by Rick Tolchard and the survey observations are given below. Photographs were taken by him and are shown in Figures 5 - 7. The season is spring but seasonality has no effect on the fossils because they are dead. No fossils were found during the site visit walk through.

Table 3: GPS coordinates for some of the survey stops on Ogies South Ptn 1/5, observations and relevant photographs. Refer to the Google map in Figure 4 for the stops (Pal 1-7). Photographs taken by Rick Tolchard.

Stop Pal-	Stop GPS co-ord	Survey observations	Figure
1	S26°03'38.48645" E29°03'25.40184" 1610m	Southernmost corner looking northwards across the mining area. Note many signs of disturbance. Soils exposed so good visibility. No rocky outcrops and no fossils seen	5A, B
2	S26°03'25.72565" E29°03'20.18279" 1616m	Bare soils and old building foundations	5C,D
3	S26°03'27.16288" E29°03'14.89827" 1620m	Rare rocks and pebbles but appear to be transported. Typical soils and disturbance	6A, B
4	S26°03'26.85691" E29°03'17.22687" 1617m	Bare soils and patches of invasive vegetation No rocks and no fossils	6C, D
5	S26°03'27.87787" E29°03'20.23500" 1615m	Disturbed vegetation and pebbles and rubbish	7A, B
6	S26°03'28.38783" E29°03'20.92268" 1617m	View looking southwest over the proposed mining area.	7C,D
7	S26°03'23.40" E29°02'53.39" 1610m	Same disturbed setting with bare ground and vegetation patched.	No photos



Figure 4: Google earth map with the Ogies South Ptn 1/5 site visit observation points as noted, Pal 1-7. Refer to Table 3 for the GPS points and site observations.



Figures 5: Photographs from the site visit to Ogies South Ptn 1/5, southern corner. A–B = Stop Pal 1, note exposed ground covered soil and with no rocky outcrops. C–D = Stop Pal 2. No fossils and no rocky outcrops seen.



Figure 6: Photographs from the site visit to Ogies South Ptn 1/5. A-B = Pal 3. C-D = Pal 4. Very disturbed, flat topography and no rocky outcrops or fossils were seen.



Figure 7: Photographs from the site visit to Ogies South Ptn 1/5. A-B = Pal 5. C-D = Pal 6. Disturbed area and no rocky outcrops or fossils seen.

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	-
	L	Soils and sands of the Quaternary do not preserve fossils; the Vryheid Fm might preserve fossil plants; so far there are no records of fossils in this region 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 the only 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. The site visit confirmed that there were no fossils in the soils or in the ploughed fields.
	M	-
	H	-
PROBABILITY	H	-
	M	-

PART B: ASSESSMENT		
	L	It is extremely unlikely that any fossils would be found in the loose soils and sand that will be excavated, but there might be Vryheid Fm plants underneath the soils. Therefore, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the proposed Solar Facility area. The geological structures suggest that the rocks are the correct age and type to contain fossils, i.e. fossil plant impressions of the *Glossopteris* flora, but the rocks are covered by soils, sandy soils and vegetation. The site visit confirmed that there were no rocky outcrops and no fossils in the sandy soils. Since there is a small chance that fossils from the below ground 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 dolerites, sandstones, shales and sands are typical for the country and some could contain fossil plant, insect, invertebrate and vertebrate material. The soils and sands of the Quaternary period would not preserve fossils. The site visit confirmed that there were no fossils in the sandy soils that are overlying the Vryheid Formation. It is not known if there are fossils below ground but the shales and mudstones that might have leaf impressions of the *Glossopteris* flora are an average more than 5m below the soil surface in the Ogies area (Snyman, 1998, Fig 15).

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 alluvium, sands and soils of the Quaternary. There is a very small chance that fossil plants of the *Glossopteris* flora may occur in the adjacent and underground shales of the Vryheid Formation. The site visit showed that there are NO FOSSILS visible on the surface. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found once drilling and mining or excavations for foundations and infrastructure have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. As far as the palaeontology is concerned, the project may proceed.

7. References

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

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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.

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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.

Visser, J.N.J., 1986. Lateral lithofacies relationship in the glaciogenic Dwyka Formation in the western and central parts of the Karoo Basin. *Transactions of the Geological Society of South Africa* 89, 373-383.

Visser, J.N.J., 1989. The Permo-Carboniferous Dwyka Formation of southern Africa: deposition by a predominantly subpolar marine ice sheet. *Palaeogeography, Palaeoclimatology, Palaeoecology* 70, 377-391.

8. Chance Find Protocol

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

1. The following procedure is only required if fossils are seen on the surface and when drilling or mining activities commence.
2. When excavations begin the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone, coal) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 8). 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 excavations where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site, a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – Examples of fossils from the Vryheid Formation (Ecca Group)



Figure 8: Photographs of a selection of plants from the *Glossopteris* flora from the Ecca Vryheid Formation. Bottom right - an example of the appearance fossil bones in the rock.

Appendix B – Details of specialists

Curriculum vitae (short) - Marion Bamford PhD January 2021

I) Personal details

Surname : **Bamford**
First names : **Marion Kathleen**
Present employment : Professor; Director of the Evolutionary Studies Institute.
Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
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ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:

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

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

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

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

iii) Professional qualifications

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

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

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

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

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa

Royal Society of Southern Africa - Fellow: 2006 onwards

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

International Association of Wood Anatomists - First enrolled: January 1991

International Organization of Palaeobotany – 1993+

Botanical Society of South Africa

South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016

SASQUA (South African Society for Quaternary Research) – 1997+
 PAGES - 2008 –onwards: South African representative
 ROCEEH / WAVE – 2008+
 INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	11	0
Masters	10	4
PhD	11	4
Postdoctoral fellows	10	5

viii) Undergraduate teaching

Geology II – Palaeobotany GEOL2008 – average 65 students per year
 Biology III – Palaeobotany APES3029 – average 25 students per year
 Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;
 Micropalaeontology – average 2-8 students per year.

ix) Editing and reviewing

Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
 Guest Editor: Quaternary International: 2005 volume
 Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental

- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for EnviroPro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for EnviroPro

xi) Research Output

Publications by M K Bamford up to June 2021 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 10 book chapters.

Scopus h-index = 29; Google scholar h-index = 35; i10-index = 92

Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)

NRF Rating: B-3 (2010-2015)

NRF Rating: B-3 (2005-2009)

NRF Rating: C-2 (1999-2004)

Mr Frederick Tolchard

Brief Curriculum Vitae – January 2021

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. Graduated 2020 with Distinction

PhD Palaeontology – Wits – 2020 - current

Field Experience

Honours Fieldtrip – Karoo biostratigraphy – April 2017

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

Publications

Tolchard, F., Nesbitt, S.J., Desojo, J.B., Viglietti, P.A., Butler, R.J. and Choiniere, J.N., 2019.

‘Rauisuchian’ material from the lower Elliot Formation of South Africa: Implications for late Triassic biogeography and biostratigraphy. *Journal of African Earth Sciences*, 160, 103610.

Viglietti, P.A., McPhee, B.W., Bordy, E.M., Sciscio, L., Barrett, P.M., Benson, R.B.J., Wills, F., Tolchard, F., Choiniere, J.N., 2020. Biostratigraphy of the Scalenodontoides Assemblage Zone (Stormberg Group, Karoo Supergroup), South Africa. *South African Journal of Geology* 123, 239-248.

PIA fieldwork projects

2018 May – Williston area – SARAQ 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

2019 September – Makapanstad Agripark – Plantago

2020 January – Hendrina, Kwazamakuhle – Kudzala

2020 February – Hartebeestpoort Dam - Prescali

2020 March – Twyfelaar Coal mine – Digby Wells

2020 March – Ceres Borrow Pits – ACO Associates

2020 March – Copper Sunset Sand – Digby Wells

2020 October – Belfast loop and Expansion – Nsovo

2020 October – VLNR lodge Mapungubwe – HCAC

2020 November – Delmore Park BWSS - HCAC

2020 December – Kromdraai commercial – HCAC

2021 January – Welgedacht Siding – Elemental Sustainability

2021 March – Shango Kroonstad – Digby Wells

2021 May – Copper Sunset Viljoensdrif sand mining – Digby Wells

2021 August – New Largo Pit – Golder

2021 August – Khutsong Ext 8 housing, Carletonville, for Afzelia
2021 September – Lichtenburg PV facility – CTS Heritage