Palaeontological Impact Assessment for the Newcastle Coal Mine Project, KwaZulu Natal Province

Site Visit Report (Phase 2)

For

Cabanga Environmental

10 December 2022

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Expertise of Specialist

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Experience: 33 years research; 25 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Cabanga Environmental, Randpark Ridge, 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 Newcastle Coal Project. The Holder has completed prospecting and now wants to apply for a Mining Right. Surface activities will be limited to the Eastern Section with possible future underground mining in the west. The site is west of the town of Newcastle and includes portions of the Farms Waterfall 3335 HS and Craig 2989 HS, as well as others. Just these two farms in the easternmost part of the project area were visited and surveyed for fossils.

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 (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on non-fossiliferous Jurassic dolerite and potentially very highly sensitive rocks of the Vryheid Formation (Ecca Group, Karoo Supergroup) which is the target for the coal mine. The site visit and walk through by palaeontologists confirmed that there are no fossil plants of the *Glossopteris* flora present on the surface. One outcrop of shale has preserved trace fossils (Stop 7: S27°45'35.17973" E29°50'8.29158" (see Table 3) Photos in Fig 12) but these are not of particular significance. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, developer, environmental officer or other designated responsible person once excavations, drilling or mining activities have commenced. Since the impact will be low to moderate, as far as the palaeontology is concerned, the project should be authorised provided that any fossils found are rescued and that AMAFA is notified.

Table of Contents

1. Background

Cabanga Environmental has been appointed to continue with an EIA for what is known as the Newcastle Coal Project. The Holder of the Prospecting Right is now in the process of applying for a Mining Right. Surface activities will be limited to the Eastern Section with possible future underground mining in the west. Newcastle Colliery (Figures 1-2) will be west of the town of Newcastle and includes 9 land parcels with 18 land parcels around the periphery. Details are provided in Figure 2.

Since the surface activities, such as access, parking, offices, equipment, services and adits, will be in the eastern sector, two farms were the focus of this impact assessment. Portion 1 of Farm Craig 2989 HS and the easternmost part of Farm Waterfall 3335 HS were accessible with permission from the landowners.

A Palaeontological Impact Assessment was requested for the Newcastle Coal project. 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 and walkthrough (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6).

	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	date of this report
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	Site investigation: December 2022 (no seasonal relevance)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
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	Section 8 – chance find protocol to ensure fossils are not impacted
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;	Figure 2
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 6 and 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	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	Landowners Darryl Brown and Moshin Ahmeen were consulted. EAP will undertake further consultations
p	A summary and copies of any comments that were received during any consultation process	Public Participation will be undertaken by the EAP

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

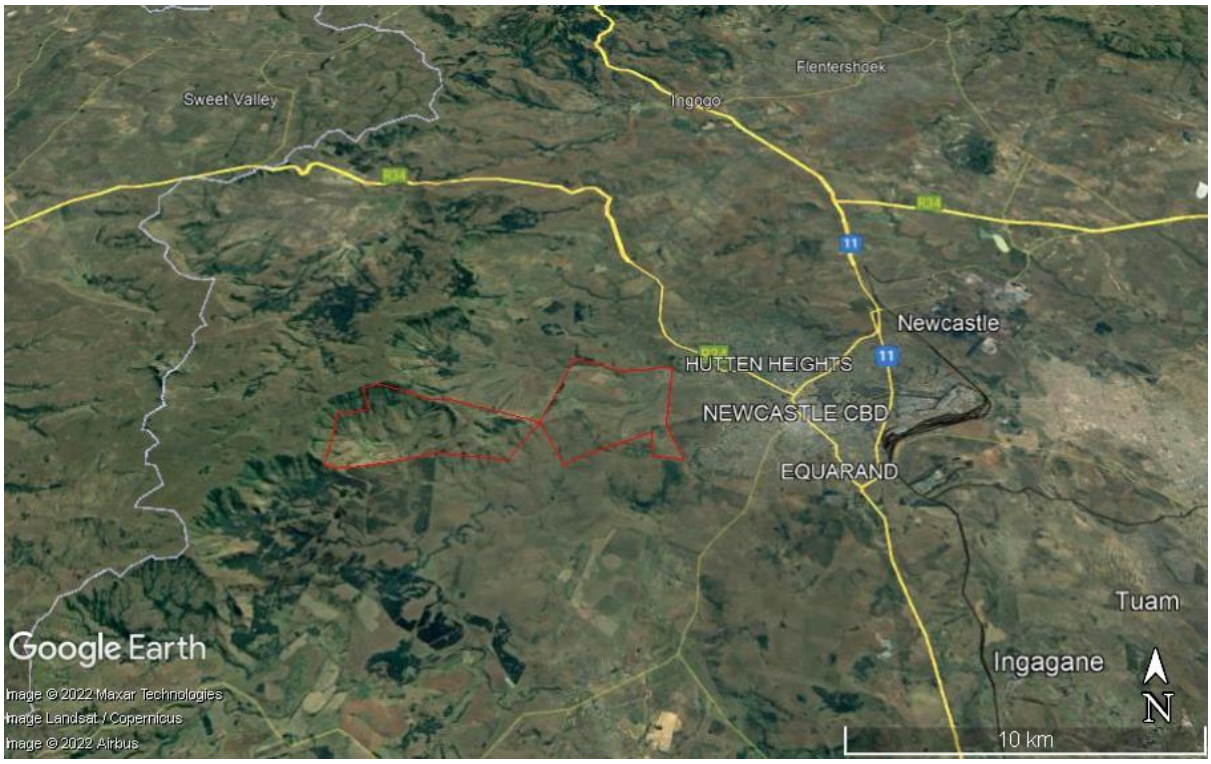
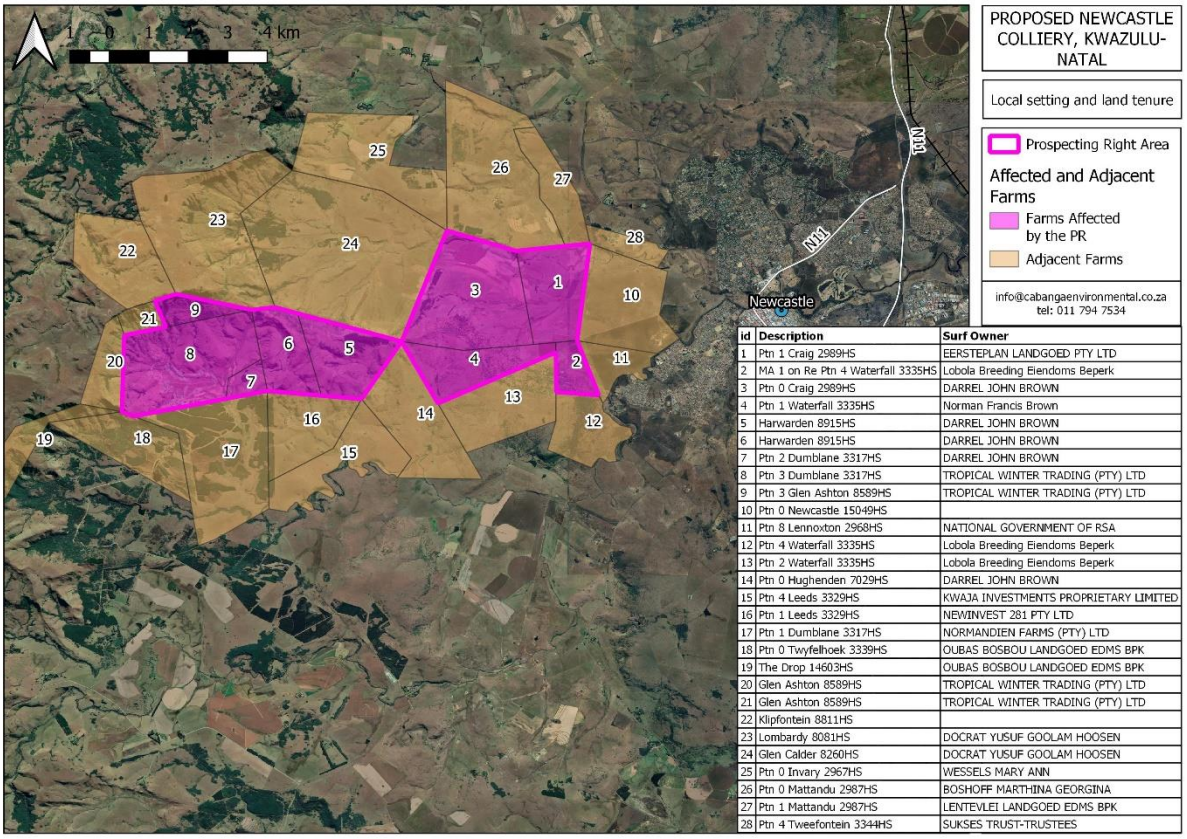


Figure 1: Google Earth map of the proposed development (thin red outline) showing the relevant land marks.



id	Description	Surf Owner
1	Ptn 1 Craig 2989HS	EERSTEPLAN LANDGOED PTY LTD
2	MA 1 on Re Ptn 4 Waterfall 3335HS	Lobola Breeding Eiendoms Beperk
3	Ptn 0 Craig 2989HS	DARREL JOHN BROWN
4	Ptn 1 Waterfall 3335HS	Norman Francis Brown
5	Harwarden 8915HS	DARREL JOHN BROWN
6	Harwarden 8915HS	DARREL JOHN BROWN
7	Ptn 2 Dumblane 3317HS	DARREL JOHN BROWN
8	Ptn 3 Dumblane 3317HS	TROPICAL WINTER TRADING (PTY) LTD
9	Ptn 3 Glen Ashton 8589HS	TROPICAL WINTER TRADING (PTY) LTD
10	Ptn 0 Newcastle 15049HS	
11	Ptn 8 Lennoxton 2968HS	NATIONAL GOVERNMENT OF RSA
12	Ptn 4 Waterfall 3335HS	Lobola Breeding Eiendoms Beperk
13	Ptn 2 Waterfall 3335HS	Lobola Breeding Eiendoms Beperk
14	Ptn 0 Hughenden 7029HS	DARREL JOHN BROWN
15	Ptn 4 Leeds 3329HS	KWAJA INVESTMENTS PROPRIETARY LIMITED
16	Ptn 1 Leeds 3329HS	NEWINVEST 281 PTY LTD
17	Ptn 1 Dumblane 3317HS	NORMANDIEN FARMS (PTY) LTD
18	Ptn 0 Twyfelhoek 3339HS	OUBAS BOSBOU LANDGOED EDMS BPK
19	The Drop 14603HS	OUBAS BOSBOU LANDGOED EDMS BPK
20	Glen Ashton 8589HS	TROPICAL WINTER TRADING (PTY) LTD
21	Glen Ashton 8589HS	TROPICAL WINTER TRADING (PTY) LTD
22	Klipfontein 8811HS	
23	Lombardy 8081HS	DOCRAT YUSUF GOOLAM HOOSEN
24	Glen Calder 8260HS	DOCRAT YUSUF GOOLAM HOOSEN
25	Ptn 0 Invary 2967HS	WESSELS MARY ANN
26	Ptn 0 Mattandu 2987HS	BOSHOFF MARTHINA GEORGINA
27	Ptn 1 Mattandu 2987HS	LENTEVLEI LANDGOED EDMS BPK
28	Ptn 4 Tweefontein 3344HS	SUKSES TRUST-TRUSTEES

Figure 2: Annotated Google Earth map for the Newcastle Coal Project. Surface activities will be in the east on sites 1, 2, 3 and 4 so these areas require a walk through.

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, as is the case here;
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 site lies in the northeastern part of the Karoo basin where the lower Karoo Supergroup strata are exposed (Figure 3). Along the rivers and streams much young reworked sands and alluvium overly the older strata.

The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It 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 was 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 fine-grained sediments in the large inland sea. These are the oldest rocks in the 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. This group has been divided into two formations with Elandsvlei Formation occurring throughout the basin and the upper Mbizane Formation occurring only in the Free State and KwaZulu Natal (Johnson et al., 2006).

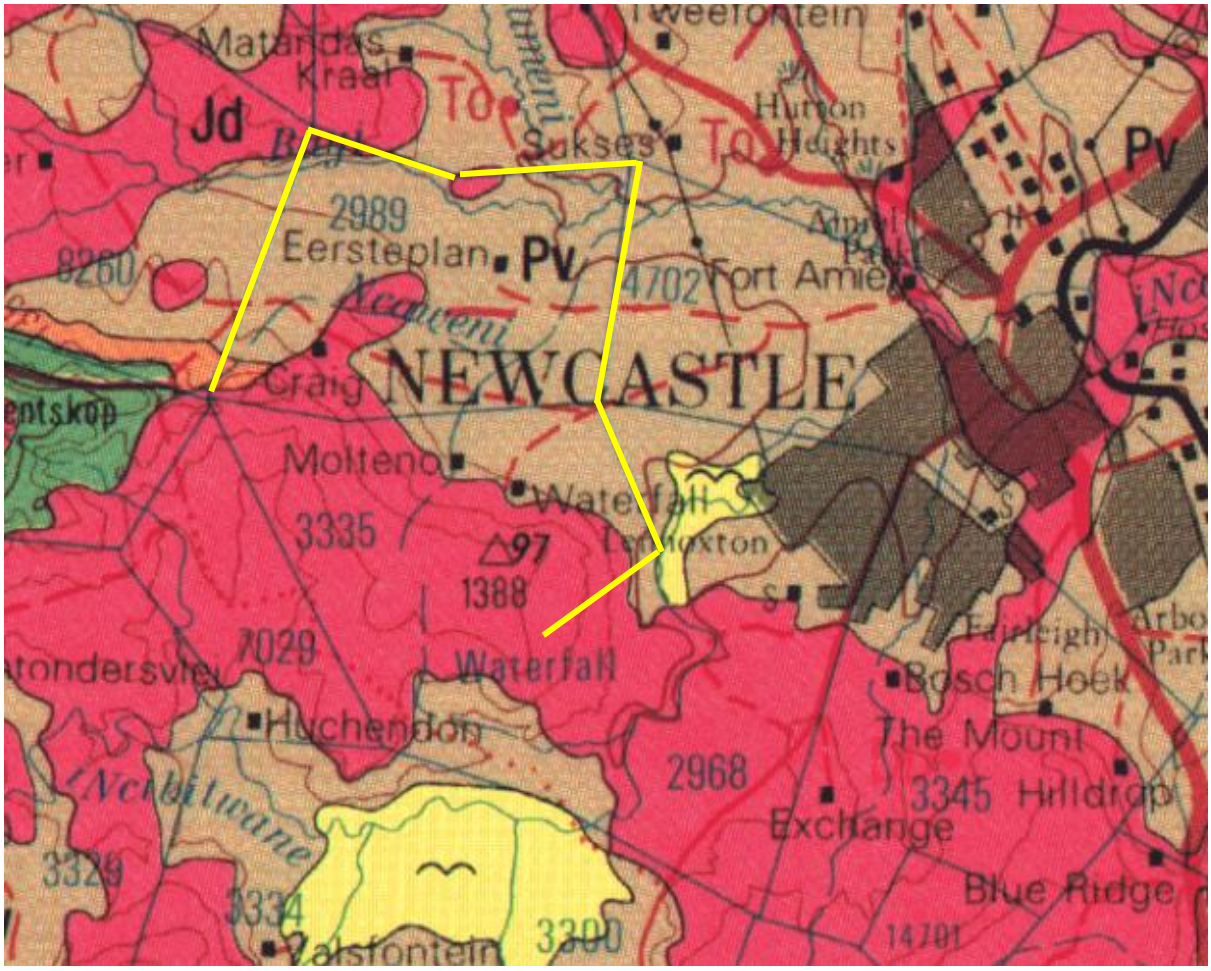


Figure 3: Geological map of the area west of Newcastle, and Farms Craig 2989 HS and Waterfall 3335 HS. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2728 Frankfort.

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

Symbol	Group/Formation	Lithology	Approximate Age
Qc	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, Ca 183 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shales, mudstone, sandstone, coal seams	Early Permian Ca 290-270 Ma

Overlying the Dwyka Group rocks are rocks of the Ecca 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 Mpumalanga, 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.

Large exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site where surface disturbance is likely to be concentrated is in the Vryheid Formation.

The Vryheid Formation lies on the uneven topography of pre-Karoo or Dwyka Group rocks in the northern and northwestern margins, but lies directly on the Pietermaritzburg Formation in the central and eastern part. The lithofacies show a number of upward-coarsening cycles, some very thick, and they are essentially deltaic in origin. There are also delta-front deposits, evidence of delta switching, and fluvial deposits with associated meandering rivers, braided streams, back swamps or interfluves and abandoned channels (Cadle et al., 1993; Cairncross, 1990; 2001; Johnson et al., 2006). Coal seams originated where peat swamps developed on broad abandoned alluvial plains, and less commonly in the backswamps or interfluves. Most of the economically important coal seams occur in the fluvial successions (ibid). In the east (Mpumalanga and northern KwaZulu Natal), the Vryheid formation can be subdivided into a lower fluvial-dominated deltaic interval, a middle fluvial interval, and an upper fluvial-dominated deltaic interval again (Taverner-Smith et al., 1988).

The Vryheid Formation preserves the distinctive Gondwanan flora, the *Glossopteris* flora. As the climate warmed up and the huge continent drifted polewards the land was rapidly colonised by luxuriant vegetation, in some parts. Peats formed in waterlogged environments and over time were buried, preserved and altered by heat and pressure to eventually form the coal seams typical of this formation and abundant in Mpumalanga and KwaZulu Natal coalfields. Coals themselves do not preserve the original plant structures, but plant impressions or compressions can be preserved in the lenses between the coals or in fine grained sediments. The flora is composed of the dominant *Glossopteris* plants (leaves, seeds, reproductive structures, roots and wood). Other plants are lycopods, sphenophytes, ferns, cordaitaleans and other early gymnosperms. Vertebrates are not found with the fossil plants because they require a different set of conditions for preservations. Plants require rapid burial in a reducing and anoxic environment, while bones can be preserved in oxidizing environments (Cowan, 1995).

The Jurassic dolerite does not preserve fossils because it is an intrusive volcanic rock. The very young Quaternary sands along the stream are also very unlikely to preserve fossils as they have been moved by the river floods and fossils would have been destroyed, if present in the first place.

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed mining right on Farms Craig and Waterfall for the Newcastle Project 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.

iii. Site visit observations

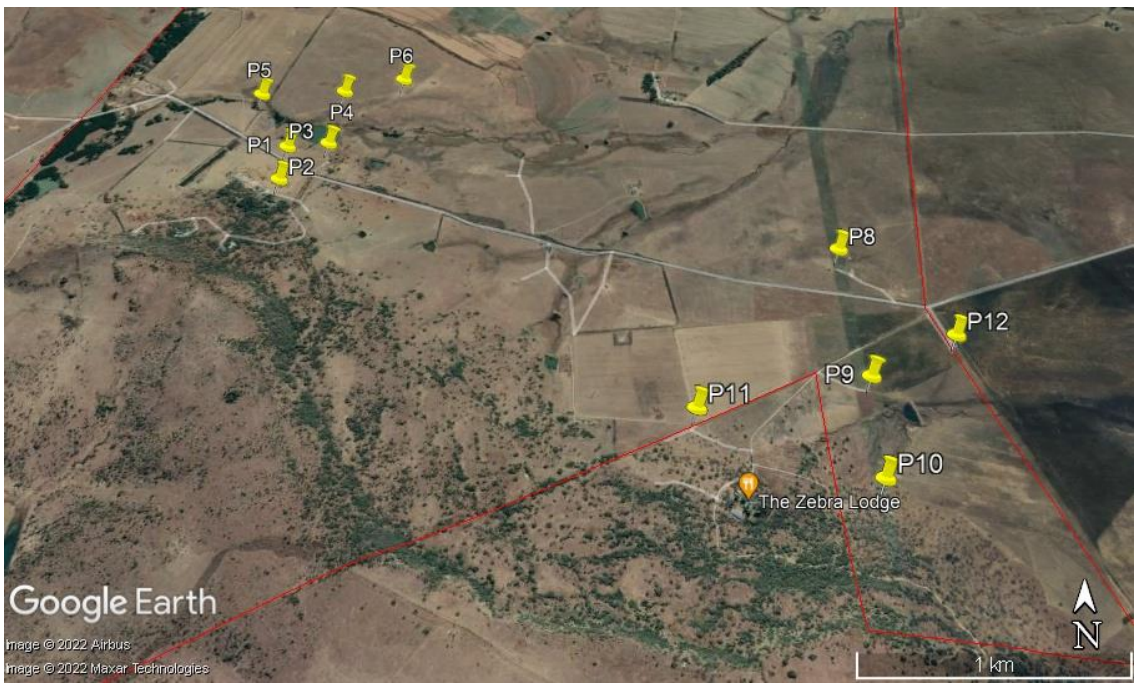


Figure 5: Google Earth map for the site stops and observations (refer to Table 3).

Table 3: Site observations, GPS points and relevant figures.

GPS	Observations	Figures
Stop 1 S27°45'7.02841" E29°51'18.17956"	Area in front of the farm buildings showing bare sandy soils, buildings, grass and alien vegetation. The day was cloudy and overcast with impending rain so rather dark for good photography. No rocky outcrops and no fossils.	6A-C
Stop 2 S27°45'14.21289" E29°51'18.04075"	Close to the entrance to the Thorn Hill Country Estate outbuildings. Same as for stop 1.	6D
Stop 3 S27°45'5.94302" E29°51'25.2975"	Near the fenced-off area of enclosures. Very disturbed from livestock. Grass, trees, weeds but no rocky outcrops.	7A-D
Stop 4 S27°44'54.46556" E29°51'26.6608"	Fields with evidence of cattle. Grassland with distant trees. No rocky outcrops and no fossils.	8A-D
Stop 5 S27°44'55.07947" E29°51'24.74681"	Fields with evidence of cattle. Grassland with distant trees. No rocky outcrops and no fossils.	8C-D
Stop 6 S27°44'51.7803" E29°51'37.47577"	Enclosed paddocks for cattle. Deep soils with grassland cover. Alien trees.	9A-D
Stop 7 S27°45'35.17973" E29°50'8.29158"	What appeared to be a borrow pit in the hillside for the dam wall but now re-vegetated shows outcrops of grey shale. All the exposures are very weathered and no fossil plant impressions were found in spite of careful searching. One spot seems to have trace fossils or is just fossilised plant debris.	10 – 11 12A-D
Stop 8 S27°45'28.5451" E29°52'55.0011"	Disturbed area near an abandoned waterhole. Grassland with no rocky outcrops.	13A-B
Stop 9 S27°45'48.6151" E29°57'55.3229"	Disturbed grassland. No rocky outcrops. Only rocks are displaced dolerite cobbles.	13C-D
Stop 10 S27°46'04.9031" E29°50'8.29158"	Disturbed grassland.	14A
Stop 11 S27°45'53.9171" E29°57'27.8754"	Disturbed grassland, previously ploughed. No rocky outcrops.	14B
Stop 12 S27°45'41.4200" E29°53'10.1819"	Disturbed grassland, previously ploughed. No rocky outcrops. No fossils, only occasional dolerite blocks or cobbles.	14C-D

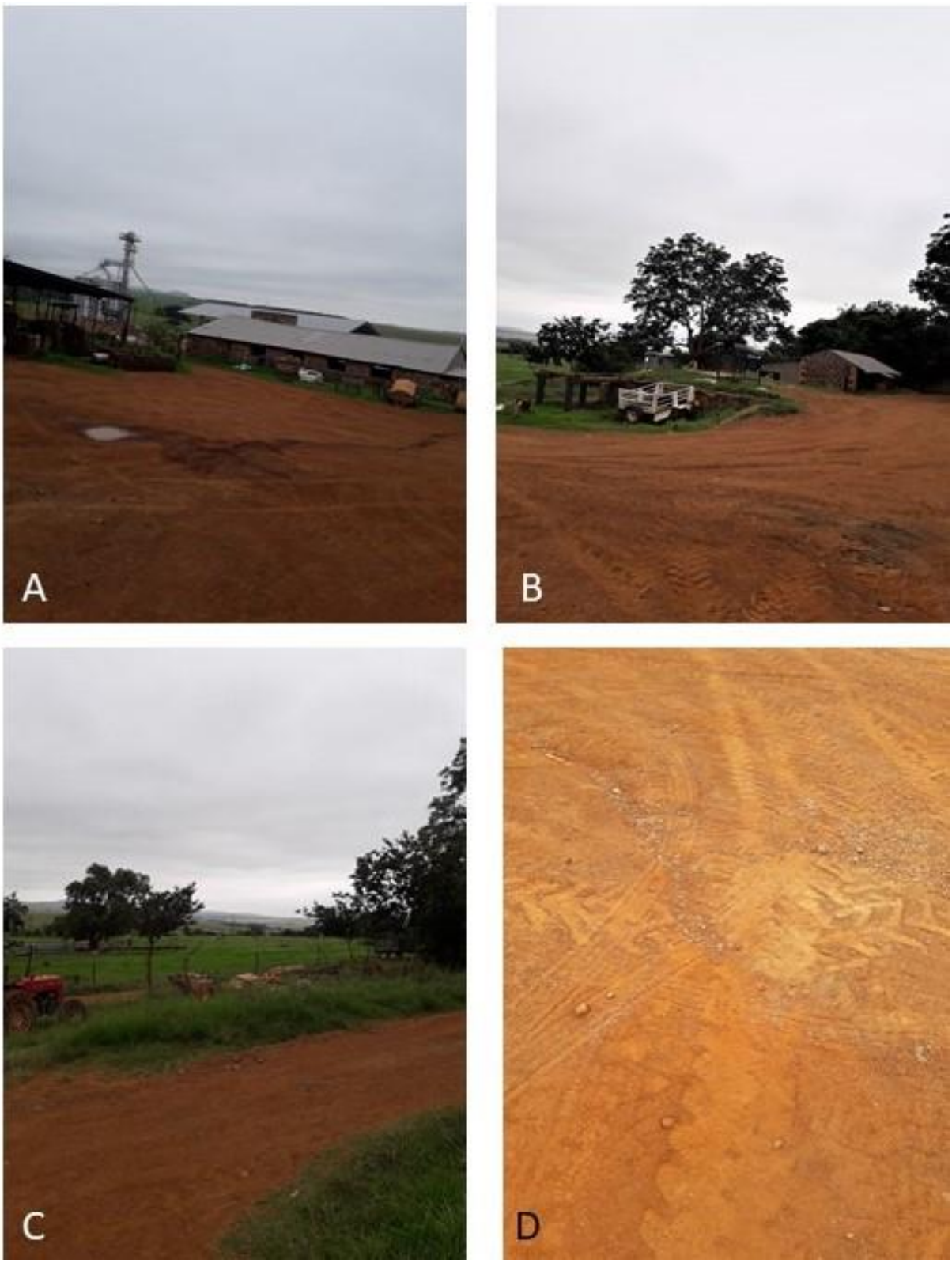


Figure 6: Site photographs for Newcastle Coal project. See Table 3 for details.

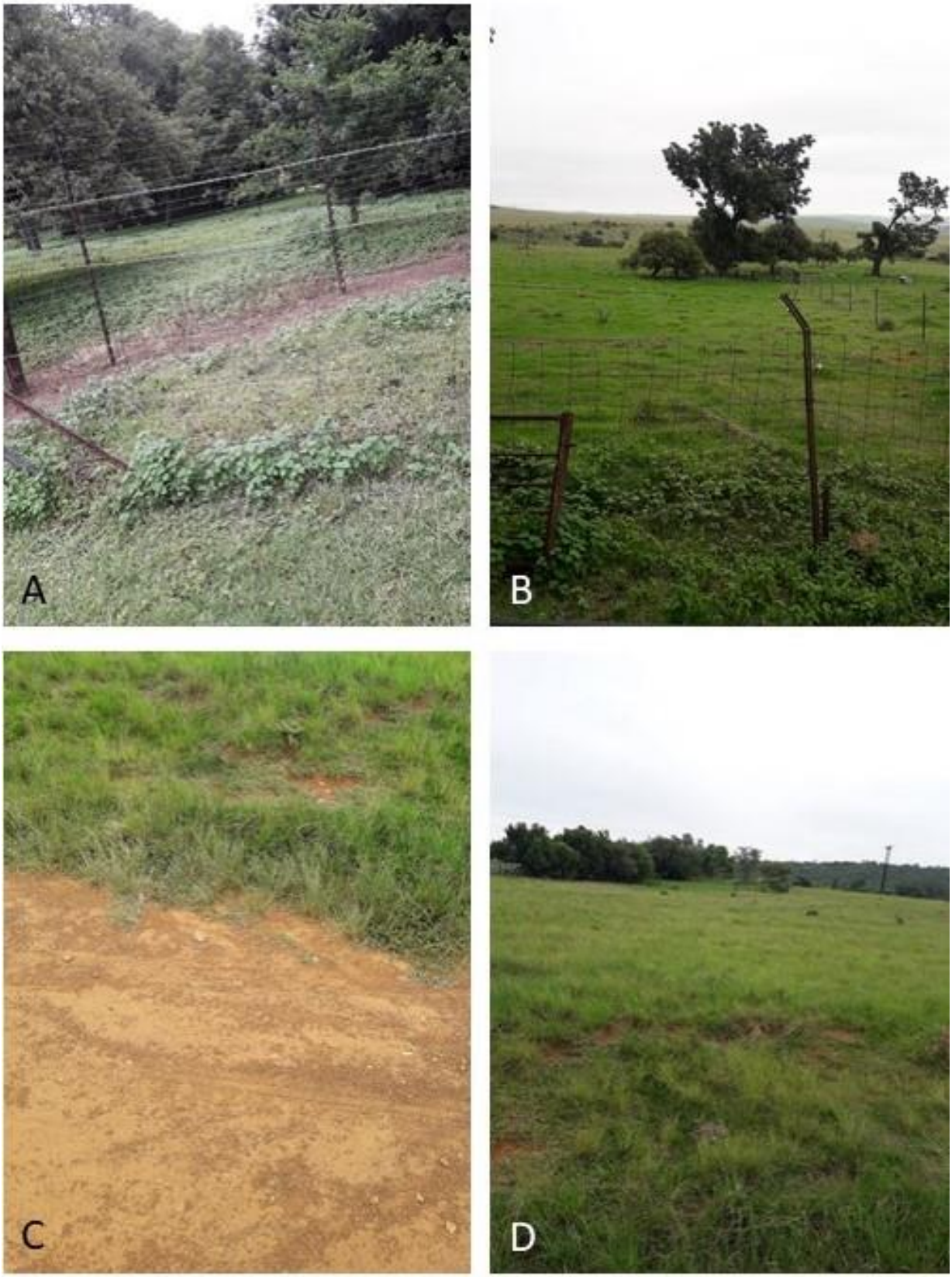


Figure 7: Site photographs for Newcastle Coal project. See Table 3 for details.

Figure 8: Site photographs for Newcastle Coal project. See Table 3 for details.

Figure 9: Site photographs for Newcastle Coal project. See Table 3 for details.

Figure 10: Site photographs for Newcastle Coal project. See Table 3 for details.

Figure 11: Site photographs for Newcastle Coal project. See Table 3 for details.

Figure 12: Site photographs for Newcastle Coal project. See Table 3 for details. A-B are trace fossils or plant debris. C-D are outcrops of flaky very weathered grey shales.

Figure 13: Site photographs for Newcastle Coal project. See Table 3 for details.

Figure 14: Site photographs for Newcastle Coal project. See Table 3 for details.

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.
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 do not preserve plant fossils; so far there are no records from the Vryheid formation of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-
	M+	-

PART B: Assessment		
	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 *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 loose sand that will be developed for infrastructure but it is unknown what lies below the soils. Therefore, a Fossil Chance Find Protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities and open pit mining 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. The site visit and walk through confirmed that there were NO FOSSILS of any significance in the project footprint. Furthermore, the surface material to be excavated is soil in order to get to the coal seams and this does not preserve fossils. Since there is a good chance that fossils from the Vryheid Formation will be disturbed where open cast or underground mining takes place, 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 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 site visit and walk through on 06 December by palaeontologists confirmed that there are no fossils on the surface, except for one possible example of trace fossils or plant debris fossils. Outcrops of shales are very rare but it is not known what lies below the surface. The sands of the Quaternary period would not preserve fossils.

6. Recommendation

Based on the fossil record but confirmed by the site visit and walk through there are no fossils of any significance such as those of recognisable *Glossopteris* floral elements even though fossils have been recorded from rocks of a similar age and type in South Africa. It

is extremely unlikely that any fossils would be preserved in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur in below the ground surface in the shales of the Vryheid Formation so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations and drilling have commenced for the surface infrastructure for the new colliery, then they should be rescued and AMAFA notified so that a palaeontologist can be called to assess and collect a representative sample.

7. References

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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/excavations/mining commence.
2. When excavations begin the rocks and discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, fossils of plants, insects, bone or coalified material) 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 15). This information will be built into the EMPr'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 an AMAFA or SAHRA permit must be obtained. Annual reports must be submitted to AMAFA and 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 AMAFA and 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.

9. Appendix A – Examples of fossils from the Vryheid Formation

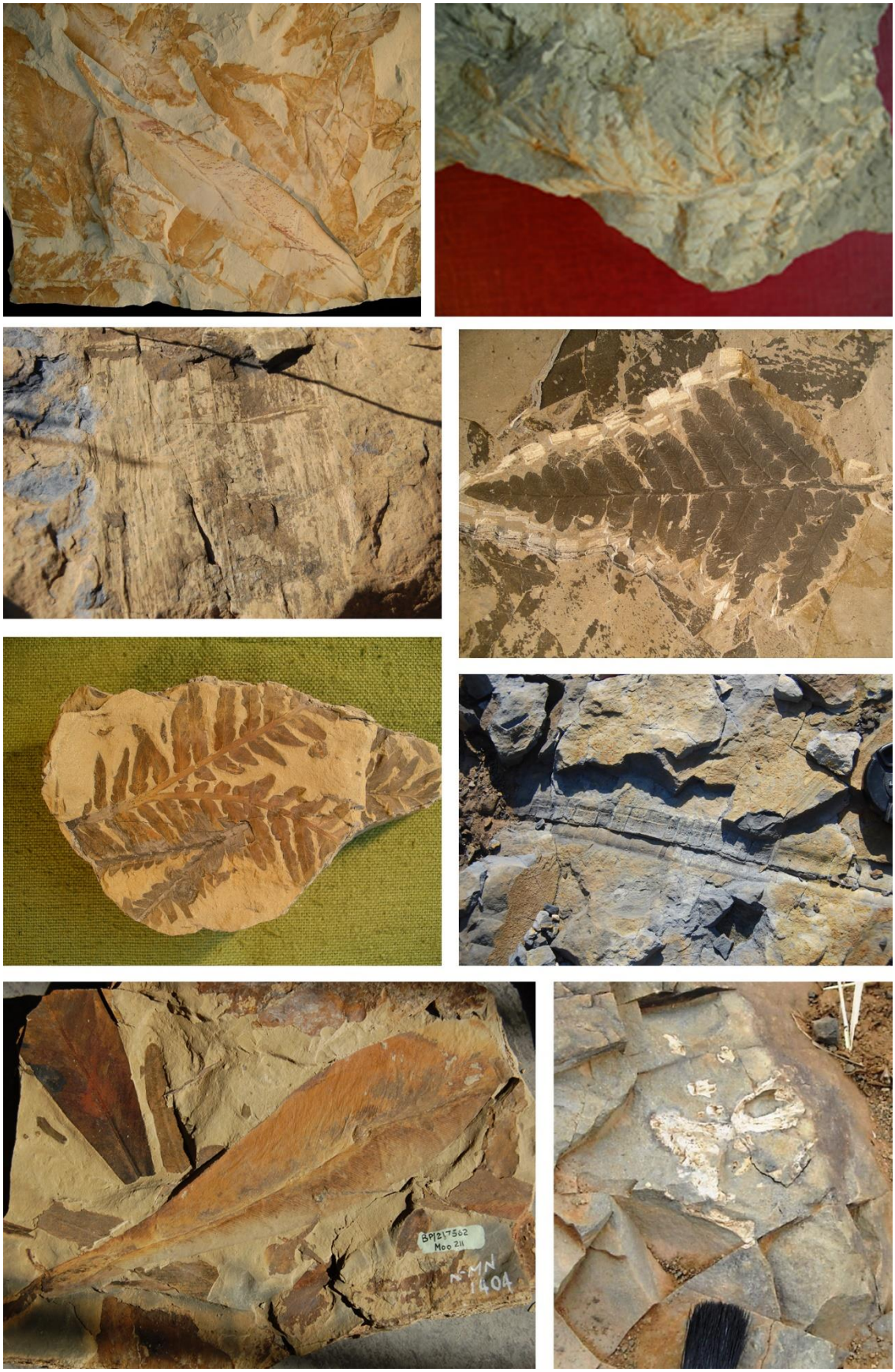

Figure 15: Photographs of fossil plants from the Vryheid formation that would be expected to occur.

10. Appendix B – Details of specialists

Marion Bamford (PhD)

Short CV for PIAs – July 2022

I) **Personal details**

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	11	0
Masters	14	1
PhD	11	6
Postdoctoral fellows	12	2

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 12 - 20 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 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 25 local and international journals

x) **Palaeontological Impact Assessments**

Selected from recent project only – list not complete:

- 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

- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2021 for AHSA

Xi) **Research Output**
Publications by M K Bamford up to July 2022 peer-reviewed journals or scholarly books: over 165 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 30; Google Scholar h-index = 36; -i10-index = 95
Conferences: numerous presentations at local and international conferences.

Mr Frederick Tolchard
Brief Curriculum Vitae – November 2022

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, Nov 2018; April 2019; Sept 2021

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.

Tolchard F., Kammerer C., Butler R.J., Abdala F., Hendrickx C., Benoit J., Choinière J.N. (2021.) A very large new trirachodontid from the Triassic of South Africa and its implications for Gondwanan biostratigraphy. Journal of Vertebrate Paleontology. DOI: 10.1080/02724634.2021.1929265.

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
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 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
2021 October – Ogies South MR – beyondgreen
2021 October – Nooitgedacht Colliery MR – Shangoni
2022 January – Sigma PVs Sasolburg – CTS Heritage
2022 March – Taaibosch Puts PVs – CTS Heritage
2022 March – Modder East Operations – Prime Resources
2022 March – Driefontein mine revised infrastructure – Amber Earth
2022 March – Transnet MPP Access routes, inland and coastal - ENVASS
2022 June – Roodepoort MRA, Rietspruit – Eco-Elementum
2022 July – Highveld Colliery for Eco-Elementum
2022 July – Doornrug and Kleinwater Collieries for Eco-Elementum
2022 November – Kendal Plots, Ogies, for Amber Earth
2022 November – Boschmanspoort, Hendrina for Eco-Elementum