Palaeontological Impact Assessment for the proposed South Grid Infrastructure, Hendrina, Mpumalanga Province

Site Visit (Phase 2) Report

For

Cabanga Environmental

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Expertise of Specialist

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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 Cabanga Environmental, 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:
Date: 08 April 2022

Executive Summary

A site visit (phase 2) palaeontological impact assessment was requested for the Hendrina South Grid Infrastructure project (Eskom powerline up to 275 kV), northwest and southwest of Hendrina, Mpumalanga Province.

The proposed routes lie on non-fossiliferous dolerite and on potentially very highly fossiliferous shales of the Vryheid Formation (Ecca Group, Karoo Supergroup) that could have fossil plants of the *Glossopteris* flora above or below the coal seams. A site visit was conducted on 22nd November 2021 to determine if fossils do occur in the project footprint. Much of the area has been or is being cultivated, especially where the soils are sufficiently deep and no rocks occur so most of these sites were not surveyed. Open areas were targeted. No fossils were found and no natural rocky outcrops occurred in the sites for the turbines or other structures, however, it is not known what lies below the soil surface. Therefore, 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 unless fossils are found when excavations for foundations have commenced.

The significance pre-mitigation is low, and post-mitigation is insignificant

Table of Contents

1. Background

Cabanga Environmental has been appointed as the Environmental Assessment Practitioner (EAP) to oversee the applications for Environmental Authorisation for the Hendrina South Grid Infrastructure for the Hendrina South Wind Energy Facility, southwest of Hendrina in Mpumalanga Province (Figure 1).

The Project is being developed in the context of the Department of Mineral Resources and Energy's (DMRE) Integrated Resource Plan, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPP).

ENERTRAG South Africa (Pty) Ltd (ENERTRAG or Developer hereafter) is a subsidiary of the German-based Enertrag AG, a hydrogen and renewable energy developer founded in 1992. Enertrag AG has an established track-record of renewable energy projects around the world, comprising over 100 wind turbines with an installed capacity of over 760MW, and over 500 employees. Current Projects are located in Germany, United Kingdom, France, Poland, Bulgaria and Belarus.

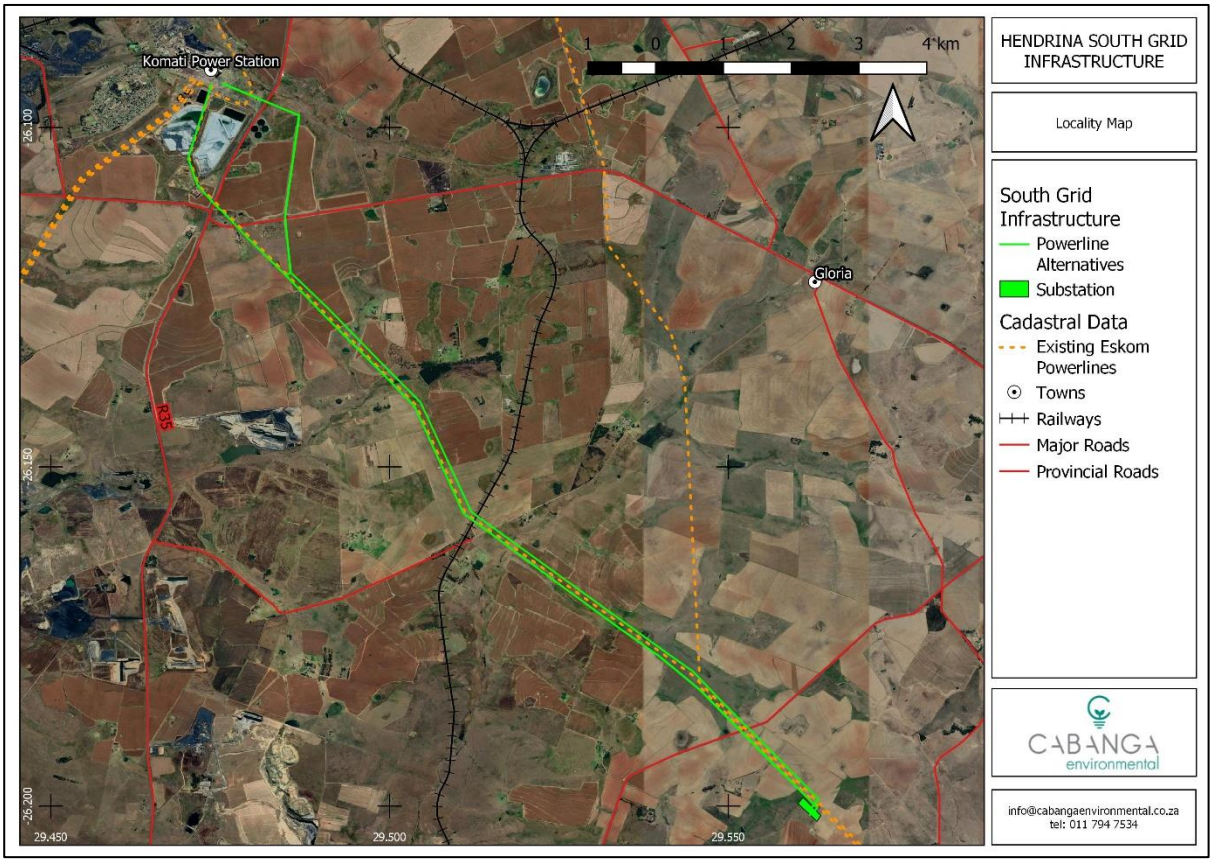

Figure 1: Project Layout Map.

ENERTRAG was established in 2017, with the intention to investigate and develop renewable energy projects in South Africa. The transition from coal-based energy supply to renewables in the Country is inevitable, as coal resources are depleted, coal-based power

stations reach the end of their economic life and in light of international obligations and commitments to reduced emissions. The Project development area is blanketed with numerous coal prospecting and mining rights and applications.

Location

The proposed Project covers the following farms (Plan 2):

- Powerline - Eskom Grid South (up to 275kV) – 16km;
  - On the subproject site
    - o Dunbar 189 IS (Portion 1, 3, 5, 6 and 7)
  - Off the subproject site
    - o Dunbar 189 IS Portion 4
    - o Wilmansrust 47 IS (Portion 1 and 3)
    - o Bultfontein 187 IS (Portion 2, 3, 4, and 10)
    - o Geluk 26 IS (Portion 7 and 26)
    - o Broodsneyersplaats 25 IS (Portion 7 and 11)
    - o Komati Power Station 56 IS Remaining extent
  - In Buffer
    - o Bultfontein 187 IS (Portion 6 and 14)
    - o Wilmansrust IS 47 Portion 9

A Palaeontological Impact Assessment is required for the Project because it lies partly on very highly sensitive rocks according to the SAHRIS palaeosensitivity map. 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 and survey (Phase 2) Palaeontological Impact Assessment (PIA) was completed for the proposed project and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 2
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	Section 2
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 6

d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A for fossils
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 6
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;	Sections 1, 6
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 6
k	Any mitigation measures for inclusion in the EMPr	Section 6; Annexure 1, 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	Sectioned 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 6
o	A description of any consultation process that was undertaken during the course of carrying out the study	Public Participation Process undertaken as part of the EIA executed by the EAP
p	A summary and copies if any comments that were received during any consultation process	Public Participation Process undertaken as part of the EIA executed by the the EAP
q	Any other information requested by the competent authority.	None requested at this time

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; accessed in November 2021 and May 2022.
2. Site visits by a qualified palaeontologist to very highly sensitive sites only to locate any fossils and assess their importance (as reported herein, and collect or rescue fossils if required);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*as indicated in sections 4 and Annexure 1 below*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a just a representative sample collected and housed in a recognised repository.

3. Geology and Palaeontology

i. Project location and geological context

The site lies in the northern part of the main Karoo Basin. The Karoo sediments unconformably overlie the rocks of the Transvaal Supergroup sequence. Exposed in this region are the non-fossiliferous rhyolite of the Selons River Formation and the granites of the Lebowa Granite Suite.

The Karoo Supergroup rocks cover a very large proportion of South Africa. They are 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. 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 (Johnson et al., 2006).

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 the Free State, Mpumalanga 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.

Intruding through the Karoo sediments are numerous dolerite dykes associated with the massive basalt outpouring of the Jurassic aged Drakensberg Group. Such volcanic rocks do not preserve fossils.

Much younger sediments of Quaternary age have been deposited as alluvium and soils along the rivers and streams.

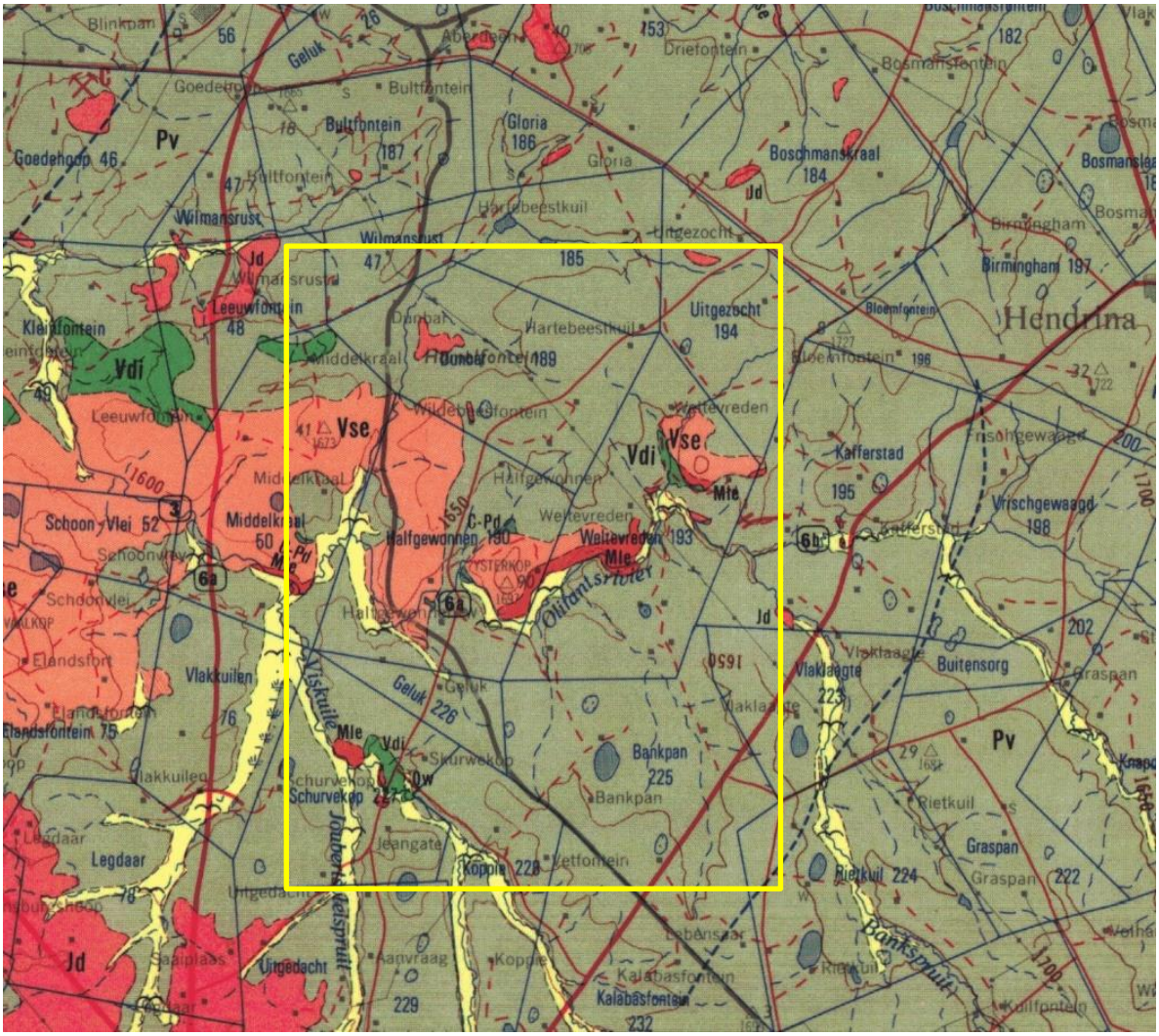

Figure 2: Geological map of the area around to the west of Hendrina for the ENERTRAG project footprint. The location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

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

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary sand	Aeolian sand, with gravelly areas (triangles)	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shales, sandstone, coal seams	Early Permian, ca 280 Ma
Vse	Selons River Fm, Pretoria Group, Transvaal SG	Porphyritic rhyolite with interbedded sandstone	Neoproterozoic
Mle	Lebowa Granite Suite, Bushveld Igneous Complex	granite	

ii. Palaeontological context

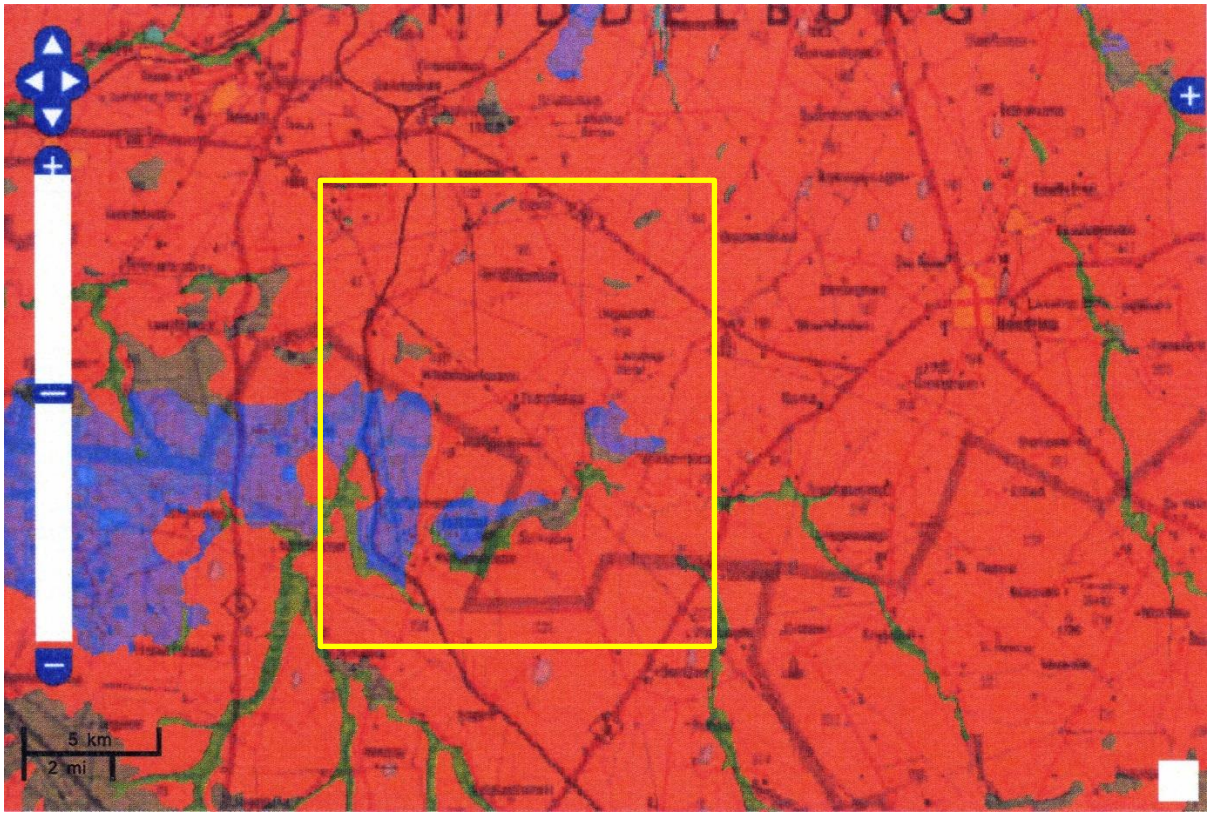

Figure 3: SAHRIS palaeosensitivity map for the site for the proposed Project shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for development is in the Vryheid Formation. The fossils preserved in this stratum are

plants only and vertebrates are unknown. The plants are those of the *Glossopteris* flora comprising *Glossopteris* leaves, fructifications, wood and roots, and other plants such as lycopods, sphenophytes, ferns and early gymnosperms. Although the Vryheid formation shales and sandstones are potentially fossiliferous, fossils are sporadic and their occurrence is unpredictable. Fossils do not occur in the coal seams as this organic material has been greatly altered by heat and compression to form coal. Soils are weathered products of sediments and so not contain any recognisable fossil material.

Hendrina is on the border between the Ermelo Coal Field (formerly the Eastern Transvaal Coal field) to the east, and the Witbank Coal Field to the west (Snyman, 1998; fig 14). Drill core logging from the Witbank Coal Field shows that the uppermost shales and siltstones (the lithology that might preserve fossils) are 5-8m below the surface because they are covered by soils. There is no chance, therefore, of finding shales as rocky outcrops, or fossils in the upper 5m of soils.

iii. Site visit preparation and observations

Since part of the project footprint is dolerite, there is no need to visit those sections because they do not preserve fossils. Much of the rest of the area is on cultivated land with deep soils and so fossils are unlikely to be in the soils. Some of these areas were checked to confirm this observation based on previous work in the Mpumalanga coalfields. The target for the site visit, therefore, was the open and undisturbed areas. Table 3 shows the preliminary assessment and the targeted sites, with reasoning. A site visit and survey of the project area was completed on 22nd November 2021 by Rick Tolchard and his observations and GPS points are also in Table 3. Photographs taken by Tolchard are in Figures 6-8.

Table 3: Sites, geology, observations and site visit observations and relevant site photographs as indicated.

WTG No	Land use	Geology Fm	Observations
4	Powerline Eskom Grid South		
SS	farmland	Vryheid	Abandoned field but previously ploughed; no rocks and no fossils
Line SE to NW to Komati	Farmland, roads	Dolerite & Vryheid	Same route as for the North Grid

General observations

The footprint for the Project is generally on farmland that has been cultivated for many years. Fields are either recently ploughed or lying fallow but they have all been cleared of any rocks so there are no rocky outcrops of shales or sandstone that could have fossils preserved in them. Some fields have cattle grazing on them. A few fields, termed 'open' in Table 3, do not appear to have been cultivated so they were targeted, however, they too

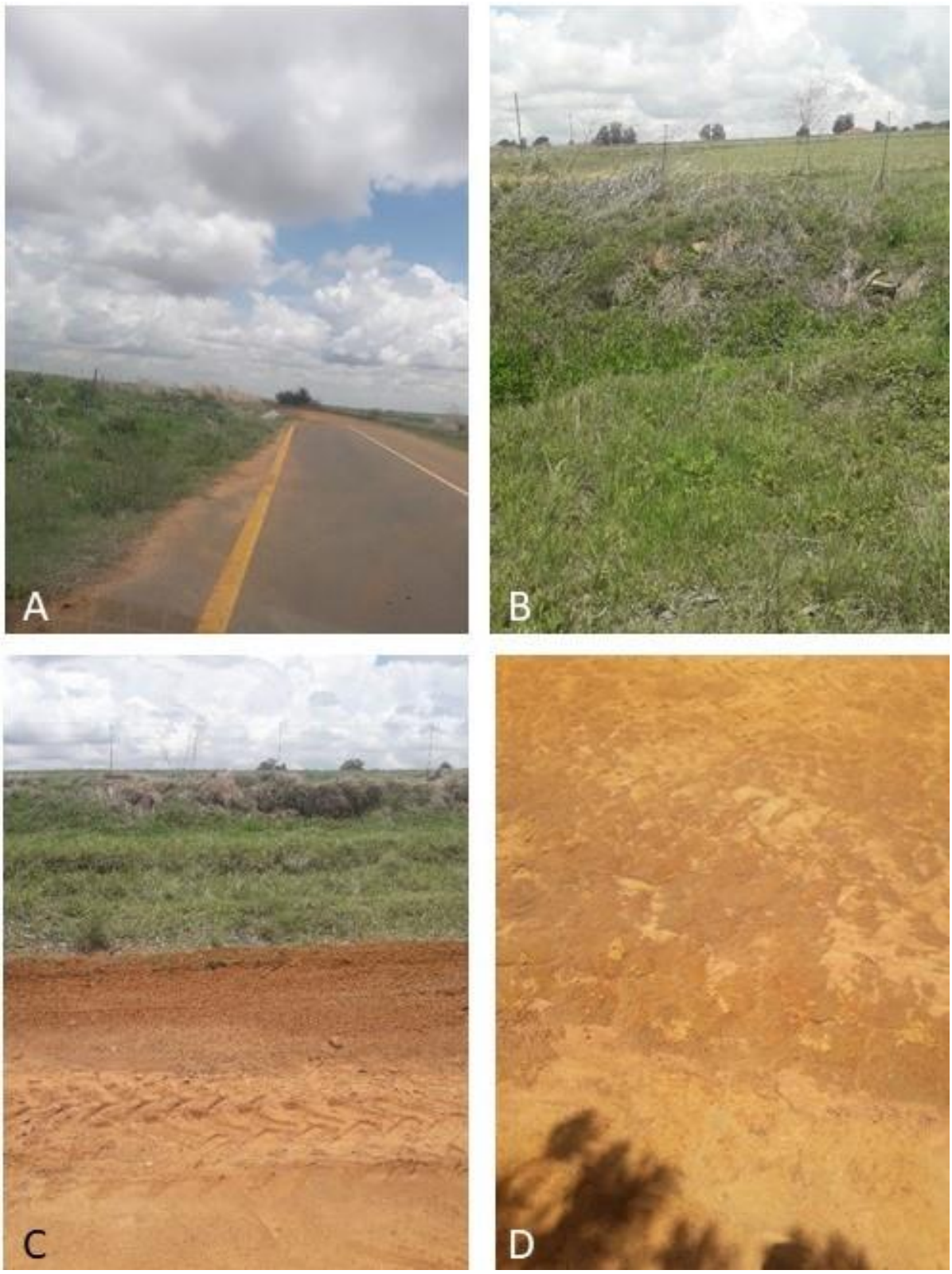

Figure 4: Site visit photographs for the Project. A – Stop 1 along the southern stretch of the road down the centre of the North sector, note flat topography typical of the whole area, and cultivated fields to the west and east. B – more open area but still no rocky outcrops. C – exposure of deep, sandy soil along the edge of a field. D – close-up of the soils showing lack of rocks and rocky outcrops.

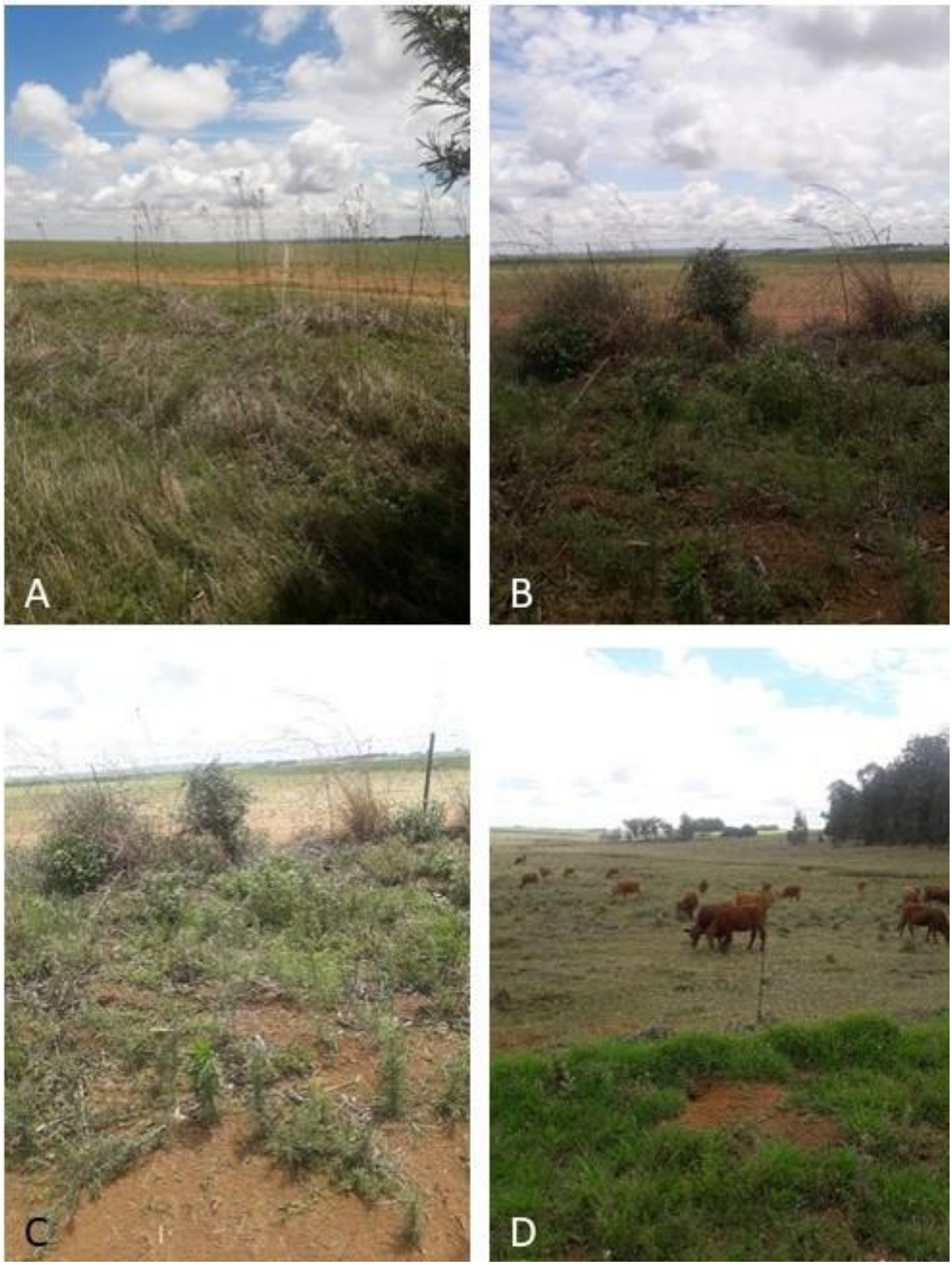

Figure 5: Site visit photographs for the Project. A – Stop 5 near the western area of the site – fallow and cultivated fields. D – ground surface with no rocks. E – some fields have grazing cattle. No fossils.

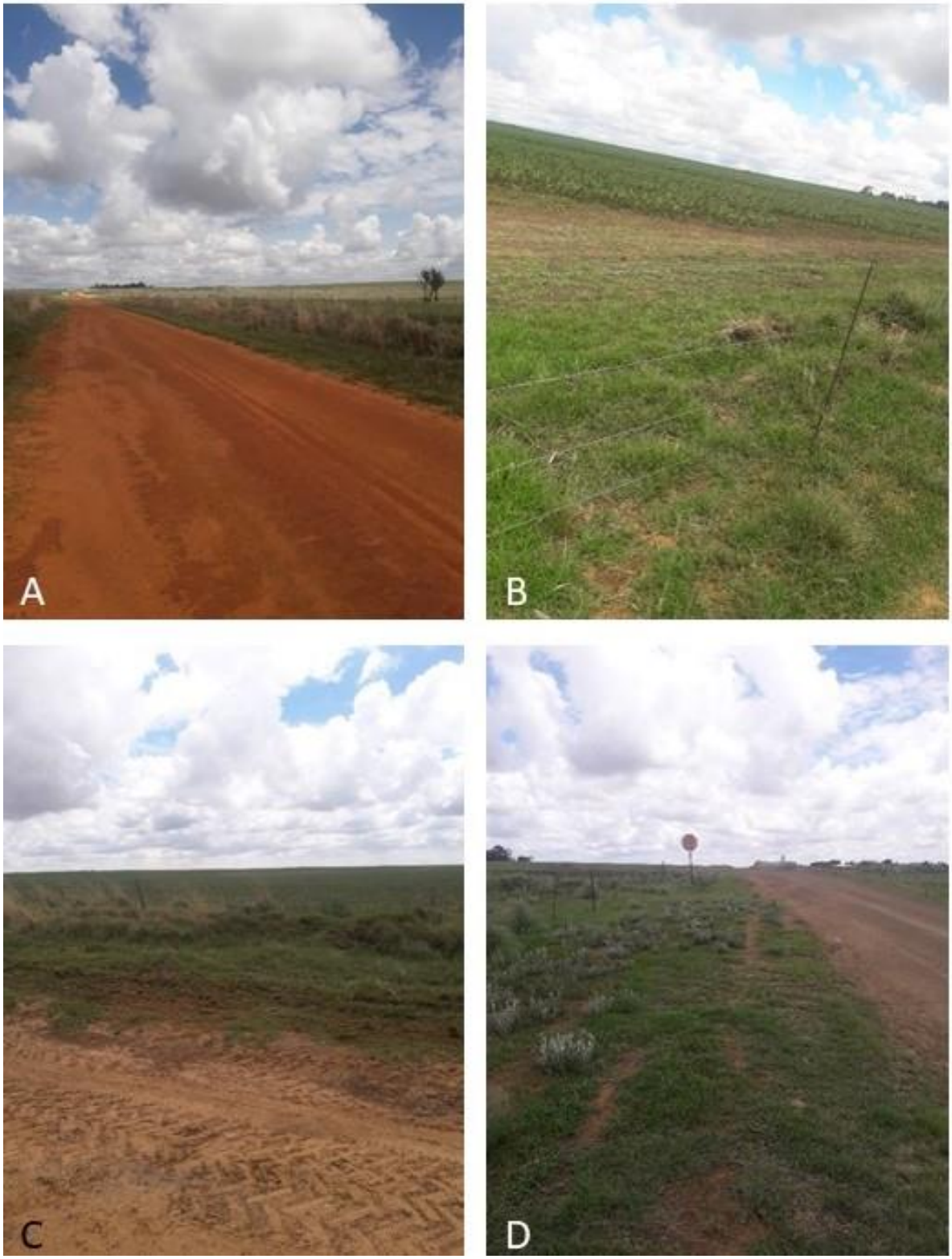

Figure 6: Site visit photographs for the Project. South area. A – sandy roads, flat topography and farmlands. C – D flat lands lying fallow near the western and southern area of the site.

had deep soils and no rocky outcrops. The season was early summer so the grass was green but still short and visibility was excellent.

Many turbines have been placed (proposed) on or close to farm roads or tracks, termed 'tracks' in Table 3 The ground here is compacted and there are no rocky outcrops.

The above figures, 4-6, are presentative examples of the topography and land surface.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in **Error! Reference source not found.**. Other energy facilities in the region, namely the Forzando PV Facility and the Halfgewonnen Solar PVs Dreamworks Haven, have no impact whatsoever on the palaeontology of this project. It is only the project footprint / ground surface that is relevant to each project.

ENERTRAG is investigating four (4) Projects in the Hendrina area: Hendrina North Wind Energy Facility (WEF), Hendrina North Grid Infrastructure, Hendrina South WEF and Hendrina South Grid Infrastructure. Each Project will be subject to a separate application for Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) and will be subject to a Scoping and EIA Process.

Therefore, the impact assessment presented in this Report for the South Grid Infrastructure Project, must consider the cumulative nature of impacts as well as the potential impact(s) of individual projects and project components

Table 4A: Impact Assessment categories

	Weight	Description
Probability	1	Unlikely: Impact Could occur in extreme events. Less than 15% chance of the impact ever occurring.
	2	Possible: possibility of impact occurring is very low due to design or historic experience. Between 16% and 30% chance of the impact occurring.
	3	Probable There is a distinct possibility of the impact occurring at least once during the project lifespan. 31% to 60% chance of the impact occurring.
	4	Highly Probable: The impact is expected to occur. Between 61% and 85 % chance of the impact occurring.
	5	Definite: There are sound scientific reasons to expect that the impact will occur and cannot be prevented.
Duration	1	Short term: Less than 1 year
	2	Short to medium term: 2 - 3 years
	3	Medium term - 3 to 10 years
	4	Long term: 11-20 years
	5	Permanent: in excess of 20 years
Scale / Extent	1	Isolated: Limited footprint within the site will be affected (less than 50% of the site)
	2	Site Specific: The Entire Site will be affected
	3	Local: Will affect the site and surrounding areas
	4	Regional: Will affect the entire region / catchment / province

	5	National: Will affect the country, and possibly beyond the borders of the country
Magnitude/ Severity (Negative)	1	Slight: Little effect, negligible disturbance / benefit
	2	Slight to Moderate: Effects are observable but natural process continue without significant alteration
	3	Moderate: The effects of the impact change ecosystem processes / social dynamics and results in these processes being permanently altered, but functioning.
	4	Moderate - High: The effects of the impact permanently alter natural / social processes to the point where function is limited
	5	High: The aspect is affected to such an extent that its functioning is compromised and this effect is irreversible
Sensitivity of the Aspect	1	Not sensitive: The affected aspect is not sensitive to change or of particular significance to people (No irreplaceable loss of resource)
	2	Somewhat sensitive: The affected aspect is of not of significant value but is sensitive to change
	3	Sensitive: The affected aspect is of moderate value and is slightly resilient to change
	4	Very Sensitive: The affected aspect is of significant value and only slightly resilient to change
	5	Irreplaceable: The affected aspect is of significant value and extremely sensitive to change. Direct irreplaceable loss of significant resource
Consequence	4 to 19	Insignificant
	20 to 39	Low
	40 to 59	Moderate
	60 to 79	High
	80 to 100	Significant

Likelihood																		
5	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
4	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80
3	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
2	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Consequence																

Table 4B: Assessment table for the South Grid Infrastructure project

Project	Probability	Duration	Extent	Severity	Sensitivity	Likelihood	Consequence
CONSTRUCTION PHASE							
S-line Pre-mit.	2	5	1	2	3	22	low
S-line post-mit	1	1	1	1	1	1	insignificant
OPERATIONAL PHASE							
S-line pre-mit	1	1	1	1	1	1	n/a

S-line post-mit	1	1	1	1	1	1	n/a
DECOMMISSIONNG PHASE							
S-line pre-mit	1	1	1	1	1	1	n/a
S-line post-mit	1	1	1	1	1	1	n/a
ALTERNATIVES							
S-line pre-mit	2	5	1	2	3	22	low
S-line post-mit	1	1	1	1	1	1	insignificant
CUMMULATIVE IMPACT OF PHASES							
S-line Pre-mit	2	5	1	2	3	22	low
S-line Post-mit	1	1	1	1	1	1	insignificant
CUMULATIVE IMPACT OF ALL FOUR PROJECTS							
TOTAL pre-mit	2	5	1	2	3	22	**low**
TOTAL post-mit	1	1	1	1	1	1	**insignificant**

Based on the nature of the Project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the correct age and type to contain fossils, namely the plants of the *Glossopteris* flora in the Vryheid Formation. Although NO FOSSILS were found during the site visit surveys, there is an extremely small chance that fossils from beneath soils in the Vryheid Formation may be disturbed if excavations for foundations are deeper than about 5m. Therefore, a Fossil Chance Find Protocol has been added to this report (Annexure 1). Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

Alternatives – turbines could be moved a few metres in any direction (for other reasons) but this will make no difference to the palaeontological impact.

Only the **construction phase** could have any impact on the palaeontology because this is when the ground will be excavated and any fossils, if present, would be removed (Annexure 1). During the operational and decommissioning phases no new ground will be excavated so her will be no impact

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and only some do contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils. It is not known if there are fossils below the ground surface.

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 loose soils and sands of the Quaternary. There is a very small chance that fossils may occur in the shales and siltstones of the early Permian Vryheid Formation, but only more than 5m below the surface, therefore, a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found once excavations have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample (Annexure 1).

Site visit summary: No fossils are present in the surface soils. No fossils are likely to occur in the top 5m of soils, but may occur in shales below that depth.
Mitigation: if fossils are found once deep excavations have commenced then the Fossil-Chance Find Procedure (Annexure 1, Appendix A) must be followed. If there are no fossils then no further action is required.

7. References

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Annexure 1 – ENERTRAG Fossil Chance Find Procedure

Contents

- **INTRODUCTION**

Cultural heritage can represent irreplaceable sources of life and inspiration and should be safeguarded. Although there are always cultural heritage studies conducted in the Project and its area of influence, there is always potential for new discoveries to be made, especially during excavation activities. Finds can include fossils, archaeological, paleontological or sacred sites as well as more modern graves. This section will deal with fossils only.

Palaeontological Heritage resources are protected in terms of the Heritage Resources Act (Act No 25 OF 1999). The Act usually sets out the overarching administrative processes for protecting and preserving fossils and management by the Developer. Successful implementation requires everyone being alert to the possibility of finds, applying the specified measures and immediately notifying the Site Supervisor, Environmental Officer, Environmental Control Officer (ECO) who should in turn inform relevant Authorities as appropriate.

- **OBJECTIVES**

This Procedure aims to protect and preserve any palaeontological heritage discovery from potential adverse impacts associated with the construction and operation activities of the proposed Project.

- **RESPONSIBILITIES**

  - **Developer**

Developer shall:

- Ensure correct implementation of the fossil chance find procedure upon any chance finds or suspected discoveries.

  - **Contractor**

The Contractor shall:

- Oversee and provide resources for the implementation of this procedure;
- Co-ordinate the chance find with the Palaeontologist / other Heritage Specialist.
- Inform relevant Authorities as appropriate in case of find; and
- Obtain any necessary permits if required

- **TRAINING**

Awareness training should be conducted by the EPC Environmental Officer (EO) for all Employees. The training should include, as a minimum, the following:

- Identifying potential features of palaeontological heritage significance;
- Procedures for dealing with fossil resources discovered on site;
- Applicable Legislation pertaining to the protection of palaeontological resources; and
- The importance of protecting heritage resources.

Photographs of similar fossils (plants, vertebrates, invertebrates of trace fossils) must be provided to the EPC to assist in recognizing the fossils plants in the shales, mudstones or dolomies. This information will be built into the EMPr's training and awareness plan and procedures

- **PROCEDURE**

  - **Palaeontological Discoveries during Works**

Any palaeontological discoveries during works should be reported to the immediate Supervisor, EO and/ECO and treated as an incident. Following the incident and within two hours the Contractor EO will notify Developer in writing. Work at the affected area should cease immediately, the area should be demarcated until further instructions by relevant Specialist and /or relevant Authorities. The EPC Contractor or other person discovering a potentially significant site or fossil should initiate the following actions:

Stop Work

- Inform the immediate Supervisor, EO, ECO and Developer;
- Stop work in the immediate area and take digital photographs to record the find; and
- Install temporary site protection measures (e.g. delineate a 'no-go' area using warning tape, stakes and signage / deploy workers and give instructions to prevent access or further disturbance) and take all reasonable steps to avoid any further disturbance or damage from excavation, vibration, plant or machinery.

Reporting

- Inform all relevant Employees of the chance find and whether access to work area or along the right-of-way is being restricted;

-
- EPC EO to consult with a Palaeontologist Specialist, providing photographic records for a preliminary assessment.
- The specialist shall be responsible for evaluating whether the chance find needs to be classified as a significant fossil find, or deposition site that needs to be preserved, or an isolated and out of primary context occurrence or feature;
- The specialist will be required to highlight the way forward
- EPC will notify the relevant Authorities
- Should any fossils need to be removed from the site a SAHRA permit must be obtained by the palaeontologist.
- Annual reports must be submitted to SAHRA as required by the relevant permits.

General Mitigation / Treatment Strategies

- Fossils are to be left in place for recording by the specialist. It is important they are not disturbed or moved as their context is as important as the fossil; if materials are to be collected they should be excavated in an appropriate manner, wrapped in protective material and placed in bags and labelled by the Specialist and forwarded to the Authorities in a manner that ensures the integrity of the 'chain of custody';
- Project personnel are not permitted to take or keep fossils as personal possessions as that is a criminal offence;
- Any damage, accidental or otherwise, should be investigated by the EPC Contractor detailing corrective actions, with digital images, maps and plans showing any locations that are no-go, limited access or present risks of further chance finds;
- Stakeholder engagement may be needed with affected communities to determine the correct mitigation actions. Site treatment scenarios may include:
    - Preservation in place through avoidance or re-routing or specialized construction techniques, and/or
    - Rescue excavations to remove, record and relocate in advance of further construction work if avoidance is not possible.
- If the chance find is an isolated fossil occurrence, the Site Supervisor should approve the removal of site protection measures and activity can resume only with consultation and approval of the local Authorities;
- While required treatment is ongoing, EPC Contractor should coordinate with the relevant Employees keeping them informed as to status and schedule of investigations / actions, and informing them when activities may resume;

- **MONITORING**

Monitoring should be conducted as required to assess control success, to gauge the effectiveness of prevention plans. The Contractor should monitor their activities to prevent the damaging of palaeontological resources. Monitoring for palaeontological resources should be integrated into EO and ECO monitoring Programme.

Appendix A: Photographs of Vryheid Formation fossils

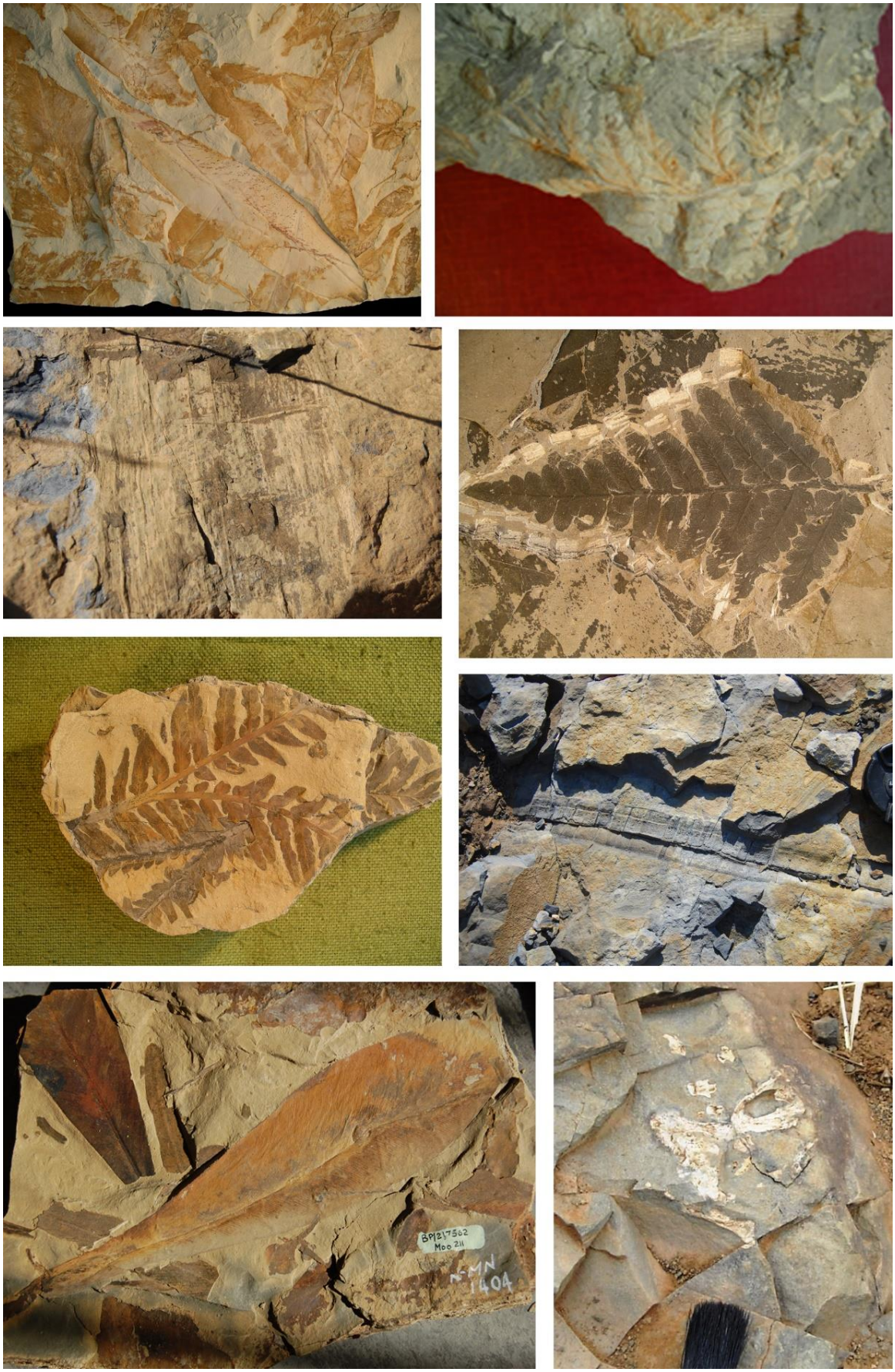

Figure 7: *Glossopteris* flora from the Vryheid Formation. These are leaf impressions. Note, bottom right figure is an example of Permian fossil bones but very rarely found in this area.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
July 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-
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	2
Masters	10	5
PhD	11	4
Postdoctoral fellows	10	4

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

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

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 July 2021 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 29; Google scholar h index = 36;
Conferences: numerous presentations at local and international conferences.

Mr Frederick Tolchard
Brief Curriculum Vitae – October 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, 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