APPENDIX

F-4 PALAEONTOLOGY

Palaeontological Impact Assessment for the proposed Grid Connection for the Mukondeleli Wind Energy Facility, south of Secunda, Mpumalanga Province

Desktop Study (Phase 1)

For

WSP Africa

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Expertise of Specialist

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Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by WSP Africa, Bryanston, 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 proposed grid infrastructure (EGI) for the Mukondeleli Wind Energy Facility (WEF) to be located south of Secunda, Mpumalanga Province. This report is for the Mukondeleli EGI only and the WEF for Mukondeleli is the subject of a separate report.

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

The proposed grid route and substation lies predominantly on non-fossiliferous Jurassic dolerite. Only the northern part of the Grid Connection lies on potentially fossiliferous sediments of the Vryheid Formation (Ecca Group, Karoo Supergroup). This section of the route is along urban areas, and established or abandoned farmland. Given that soils do not preserve fossils and they overlie the shales, and that the area has been disturbed greatly by dolerite intrusions, it is unlikely that there are any fossils in the surface that would be excavated for pole foundations. 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, environmental officer or other designated responsible person once excavations for poles or foundations have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

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1. Background

1. Project Description: Mukondeleli Wind Energy Facility Grid Connection up to 132KV

1.1. Site location

The proposed Mukondeleli Wind Energy Facility (WEF) (The Project) will have a project area of approximately 3600ha, with an overhead Grid Connection of up to 132kKV. Within this project area the extent of the buildable area will be determined subject to finalizatison based on technical and environmental evaluations and considerations.

The project is subject to a Basic Assessment process in terms of the 2014 NEMA EIA Regulations, as amended.

The project is located in the Govan Mbeki Municipality, near the town of Secunda, in the Mpumalanga Province of South Africa. The Mukondeleli grid connection up to 132 KV project area covers 11 farm portions. The details of the properties associated with the proposed Mukondeleli WEF, including the 21-digit Surveyor General (SG) codes for the cadastral land parcels are outlined in the table below:

Table 1-1: Property details associated with the proposed project

Portion Number	Farm Number	Farm Names	21 Digit Surveyor General Code of each cadastral land parcel
2	317	van Tondershoek	T0IS00000000031700002
8	291	Bosjesspruit	T0IS00000000029100008
9	291	Bosjesspruit	T0IS00000000029100009
10	291	Bosjesspruit	T0IS00000000029100010
12	317	van Tondershoek	T0IS00000000031700012
5	285	Twistdraai	T0IS0000 00000285 00005
6	285	Twistdraai	T0IS0000 00000285 00006
3	285	Twistdraai	T0IS0000 00000285 00003
3	318	Brandspruit	T0IS0000 00000318 00003
0	318	Brandspruit	T0IS00000000031800000
4	291	Bojesspruit	T0IS00000000029100004

Figure 1: Google Earth map of the general area to show the Mukondeleli Grid connection route and onsite substations.

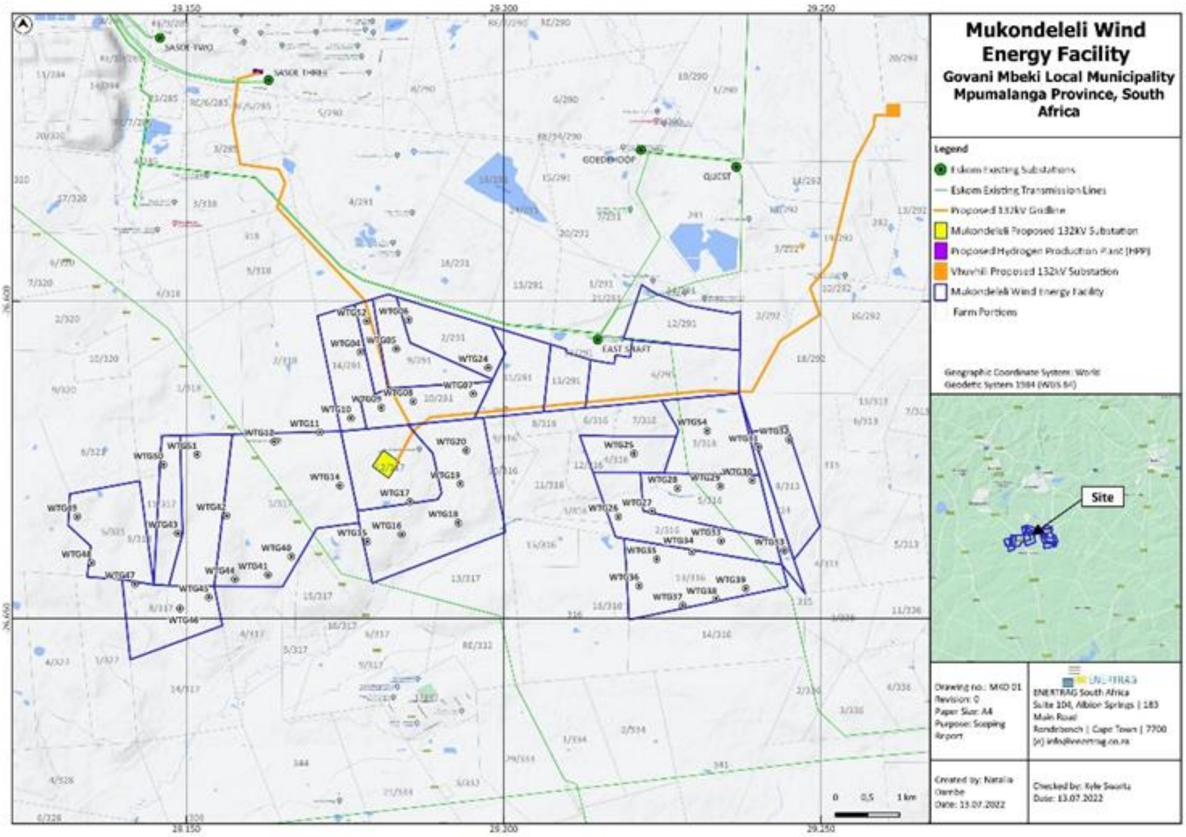

Figure 2: Google Earth Map of the proposed grid connection for the Mukondeleli WEF, with the route shown by the orange line.

1.2. Summary of the key technical details for the project

The proposed development also comprises a 132 kV overhead power line (either single circuit or double circuit) and a step-down substation to feed the electricity generated by the project into a step down substation located on the Sasol Secunda facility which is between 5 and 10 km from the on-site SS. The 132 kV power line and step-down substation at Sasol is subject to a separate Basic Application to be undertaken by the applicant. The key technical details for the Project is tabulated below.

Table 1-2: Key technical details

Component	Description / Dimensions
Site coordinates (centre point)	Transmission Line – Alternative 1 and Alternative 2: Lat 26°35'48.54"S; Long 29°10'31.07"E
Affected farm portion/s	Bosjesspruit 291 (Portions 4, 8, 9 and 10) Van Tondershoek 317 (Portions 2 and 12) Twistdraai 285 (Portions 3, 5, and 6) Brandspruit 291 (Portions 0 and 3)
Capacity	Up to 132KV (either single circuit or double circuit)
Proposed technology	Components of the transmission line typically includes: Transmission structures, conductors, substations, and transformers

Height of the on-site Substation	Approximately 7 – 10 m Up to 22 m (including lighting)
Grid connection and proximity	Connection to step-down substation (to be built at Sasol Secunda facility) Approximately 10km
Battery Energy Storage System (BESS) at Sasol Substation	The BESS and substation will have a combined footprint of up to 4 ha. The BESS storage capacity will be up to 300MW/1 200 megawatt-hour (MWh) with up to four hours of storage

1.3. Components of A Typical Transmission Line System

The main components of a typical electrical transmission system include the following:

Transmission Structures

Transmission structures are the most visible components of the power transmission system. Their function is to inter alia, keep the high-voltage conductors separated from their surroundings and from each other. Some structure designs reflect the specific function of the structure, while others have come about as a result of technological progress.

Conductors

Conductors carry the power through and from the grid. Generally, several conductors per phase are strung from structure to structure. The number of conductors per phase depends on the performance of the line, typically, more than one conductor per phase is used when the operating voltage exceeds 132kV. Conductors are constructed primarily of aluminium, aluminium-alloy, steel or other types of materials as appropriate.

Substations

The very high voltages used for power transmission are converted at substations to lower voltages for further distribution and consumer use. Substations vary in size and configuration but may cover several hectares; they are cleared of vegetation and typically surfaced with gravel. They are fenced, and are normally reached by a permanent access road. In general, substations include a variety of indoor and outdoor electrical equipment such as switchgear, transformers, control and protection panels and batteries, and usually include other components such as control buildings, fencing, lighting etc.

For the substation to perform it needs sophisticated protection equipment to detect faults and abnormal conditions that may occur on the network. Action may consist for example, of automatically tripping a transmission line to cater for abnormal conditions such as lightning strikes, fires or trees falling on transmission lines. This action is necessary for safety reasons in the event of an accident or to maintain electricity supply and limit the disruption caused.

1.4. Project Infrastructure

The proposed project entails the construction of 1 x up to 132kV transmission line from the Alternative 1 substation (preferred substation) to the private offtaker substation.

The proposed project will comprise the following key components:
- Construction of 1 x up to 132kV transmission line (either single or double circuit) between the Mukondeleli WEF substation (Alternative 1 preferred substation) to the private offtaker substation. The powerline will have a 250m assessment corridor to allow for micro-siting.
- Establishment of the substation (with a footprint of approximately 2 ha) at the preferred Mukondeleli substation area.
- Establishment of a BESS at the Sasol substation which will have a combined footprint of up to 4 ha. The BESS storage capacity will be up to 300MW/1 200 megawatt-hour (MWh) with up to four hours of storage.
- Standard substation electrical equipment, i.e., transformers, busbars, office area, operation and control room, workshop, and storage area, feeder bays, transformers, busbars, stringer strain beams, insulators, isolators, conductors, circuit breakers, lightning arrestors, relays, capacitor banks, batteries, wave trappers, switchyard, metering and indication instruments, equipment for carrier current, surge protection and outgoing feeders, as may be needed.
- The control building, telecommunication infrastructure, oil dam(s) etc,
- All the access road infrastructure to and within the substation
- Associated infrastructure including but not limited to lighting, fencing, and buildings required for operation (ablutions, office, workshop and control room, security fencing and gating, parking area and storerooms).

1.4.1. Components of the Transmission Line

A brief overview of the physical/technical requirements of the project is as follows:
- 1 x up to 132kV transmission line (either single or double circuit) between the Alternative 1 substation (preferred Mukondeleli WEF substation) and private offtaker substation
- Straight line distance between Alternative 1 substation (preferred Mukondeleli WEF substation) and private offtaker substation is approximately 7.78 km.
- The assessment corridor for 1x up to 132kVA transmission line is 250 m.
- The maximum height for an up to 132kV powerline structure is 40m.
- Minimum conductor clearance is between 8.1 and 12.6m.
- Span length between pylon structures is typically up to 250m apart, depending on complexity and slope of terrain.

The design of 132kV structure is currently unknown, the following options will be used to determine preferred design:
  - Intermediate self-supporting monopole
  - Inline or angle-strain self-supporting monopole
  - Suspension self-supporting monopole
  - Triple pole structure
  - Steel lattice structure

The up to 132 kV structures will have a concrete foundation and the sizes may vary depending on design type up to 80m^2 (10m by 8m), with depths reaching up to 3.5m typically in a rectangular 'pad' shape. The actual number of structures required will vary according to the final route alignment determined.

1.4.2. Clearance Requirements for Transmission Lines

For safety reasons, transmission lines require certain minimum clearance distances. These are as follows:

— The minimum vertical clearance distance between the ground and the transmission line is 6.7m.
— The minimum vertical clearance to any fixed structure that does not form part of the transmission line is 9.4m - 11m.
— The minimum distance between a 132kV transmission line and an existing road is 60m – 120m (depending on the type of road).
— Any farming activity can be practiced under the conductors provided that safe working clearances and building restrictions are adhered to.
— Minimum servitude to other parallel lines.

1.4.3. Proposed Associated Infrastructure

The proposed transmission integration project will require the following with respect to the permanent infrastructure:

— Where the transmission line crosses a fence between neighbouring landowners and there is no suitable gate in place, a suitable gate will be erected in consultation with the landowner. These gates are necessary in order to ensure access to the line for maintenance and repair purposes.
— Existing road infrastructure will be used as far as possible to provide access for construction vehicles during the construction of the line. Thereafter, the roads are used for inspection and maintenance purposes. Where appropriate roads may be upgraded to access transmission lines and substations. Where no roads exist, access roads may be created for maintenance and inspection purposes.
— Fibre Optic cable could be strung on the earth cable if required for telecommunication
— Associated infrastructure including but not limited to lighting, fencing, and buildings required for operation (ablutions, office, workshop and control room, security fencing and gating, parking area and storerooms).

1.4.4. Proposed Eskom Substations

Two alternative substation locations have been proposed for the Mukondeleli WEF (Preferred Alternative and Alternative 1). It must be indicated that both substation alternatives are planned to be constructed on approximately 10 ha. Based on the plan, an IPP substation and an Eskom substation will be constructed for each of the alternatives. The substations will be constructed next to each other on area of 2ha each. Electricity generated from the Mukondeleli WEF will be distributed through the IPP substation to the Eskom substation, from the Eskom substation electricity will be distributed by the proposed up to 132kV grid connection transmission line into the ECSS before being distributed to the national grid via a up to 400kV grid connection transmission line through Mukondeleli Power station.

The substation will consist of a high voltage substation yard to allow for multiple up to 132kV feeder bays and transformers, control building telecommunication, and other substation components as required. Supporting infrastructure such as Control room, parking, oil spillage containment dam, fence, and other infrastructure will be constructed as part of the Eskom section substation see **Error! Reference source not found. Error! Reference source not found.** below for example of substation.

A Palaeontological Impact Assessment was requested for the Mukondeleli Grid 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 desktop 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	Page i.
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	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	Relevant section in report
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	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	N/A
p	A summary and copies of any comments that were received during any consultation process	N/A
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

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 (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

The project lies in the central part of the main Karoo Basin where large exposures of non-fossiliferous Jurassic dolerite have intruded through the Vryheid Formation. Along the main water courses much younger, Quaternary, sands and alluvium overlie the much older Karoo rocks.

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.

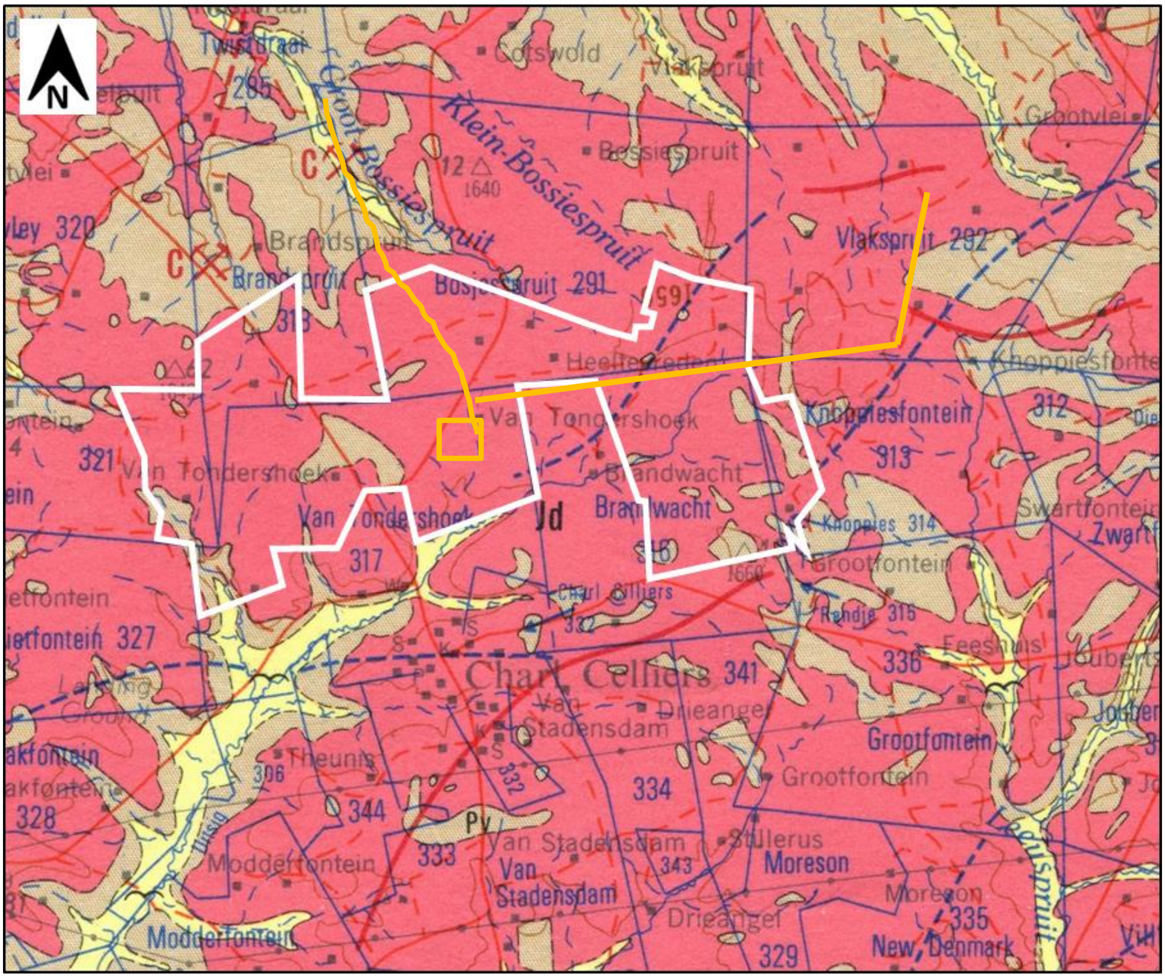

Figure 3: Geological map of the area around the Mukondeleli WEF indicated within the white polygon. The grid route is the orange line. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. 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
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 183 Ma
Pv	Vryheid Fm, Ecca Group, Karoo SG	Shale, mudstone, coal, sandstone	Middle Permian ca 266 – 260 Ma

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 (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 central and eastern part are the following formations, from base upwards: Pietermaritzburg, Vryheid and Volksrust Formations. 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 are the rocks of the Beaufort Group that has been divided into two subgroups. As with the older Karoo sediments, the formations vary across the Karoo Basin. Overlying the Beaufort Group are the three formations of the Stormberg Group. They are absent from this part of the basin. 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 for development mainly is in the Jurassic dolerite but there are a few outcrops of 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).
Since dolerite is an igneous (volcanic) rock, it does not preserve any fossils. In fact, the dolerite usually destroys any fossils in its near vicinity that were present in the sediments through which it has intruded.

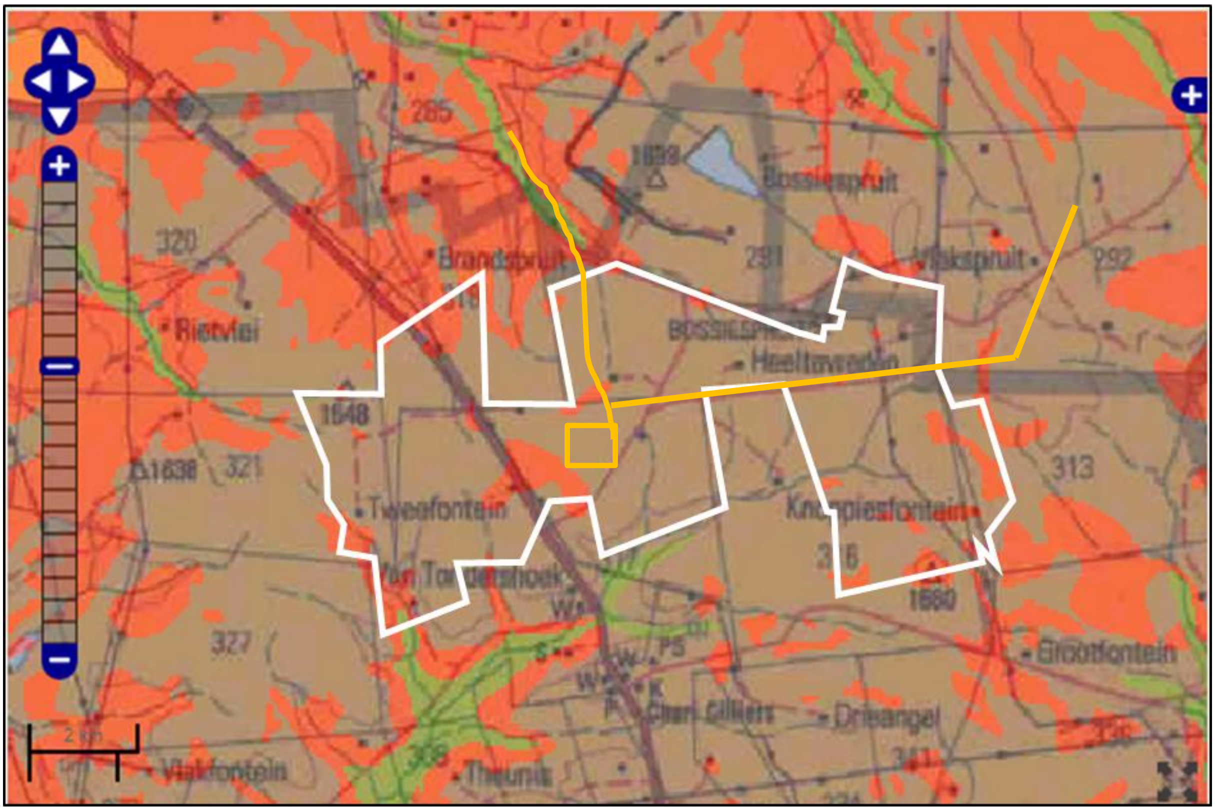

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed Mukondeleli Grid (orange) for the WEF (within the white polygon). Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the grid route is indicated as being on sensitive rocks of the Vryheid Formation (red) only for the northern section close to Secunda. The rest is on zero sensitive rocks (grey) for the dolerite, including the offtaker substation.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

Table 3a: 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 3b: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	H	-
	M	-
	L	Dolerite (intrusive volcanic rock)does not preserve fossils; so far there are no records from the Vryheid Fm of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	L+	-
	M+	-
	H+	-
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.

PART B: Assessment		
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be fossil plants in the Vryheid Fm shales or mudstones, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	-
	M	Fossils do not occur in dolerite. It is unlikely that any fossils would be found in the loose soils and sands that cover the area but they possibly occur below ground in the Vryheid Fm, therefore, a Fossil Chance Find Protocol should be added to the eventual EMPr.
	L	-

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are mostly the wrong kind to contain fossils (dolerite and covering soils. Since there is a small chance that fossils may occur below ground in the Vryheid Formation and 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 dolomites, sandstones, shales and sands are typical for the country and only some contain fossil plant, insect, invertebrate and vertebrate material. The dolerite and the overlying soils and sands of the Quaternary period would not preserve fossils. It is not known if the project excavations will reach the shales below ground, or if the shales have any fossil plants preserved in them. There are no coal mines in the project footprint so it is unlikely that any coal seams of economic value are present. It is known that dolerite destroys any fossils in its vicinity as the hot lava bakes the adjacent sediments through which it intrudes.

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 dolerite or in the overlying soils and sands of the Quaternary. There is a very small chance that fossils may occur below in the shales of the early Permian 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 for foundations and amenities have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. Since the impact on the palaeontology would be low, as far as the palaeontological heritage is concerned, the project should be authorised provided that the fossil chance find protocol (Section 8) is followed for the short section of the route, close to Secunda that lies on the Vryheid Formation (see figures 3-4):

7. References

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8. Chance Find Protocol

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

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations 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 (plants, insects, bone or 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 5). 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 contractor/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then 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.

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

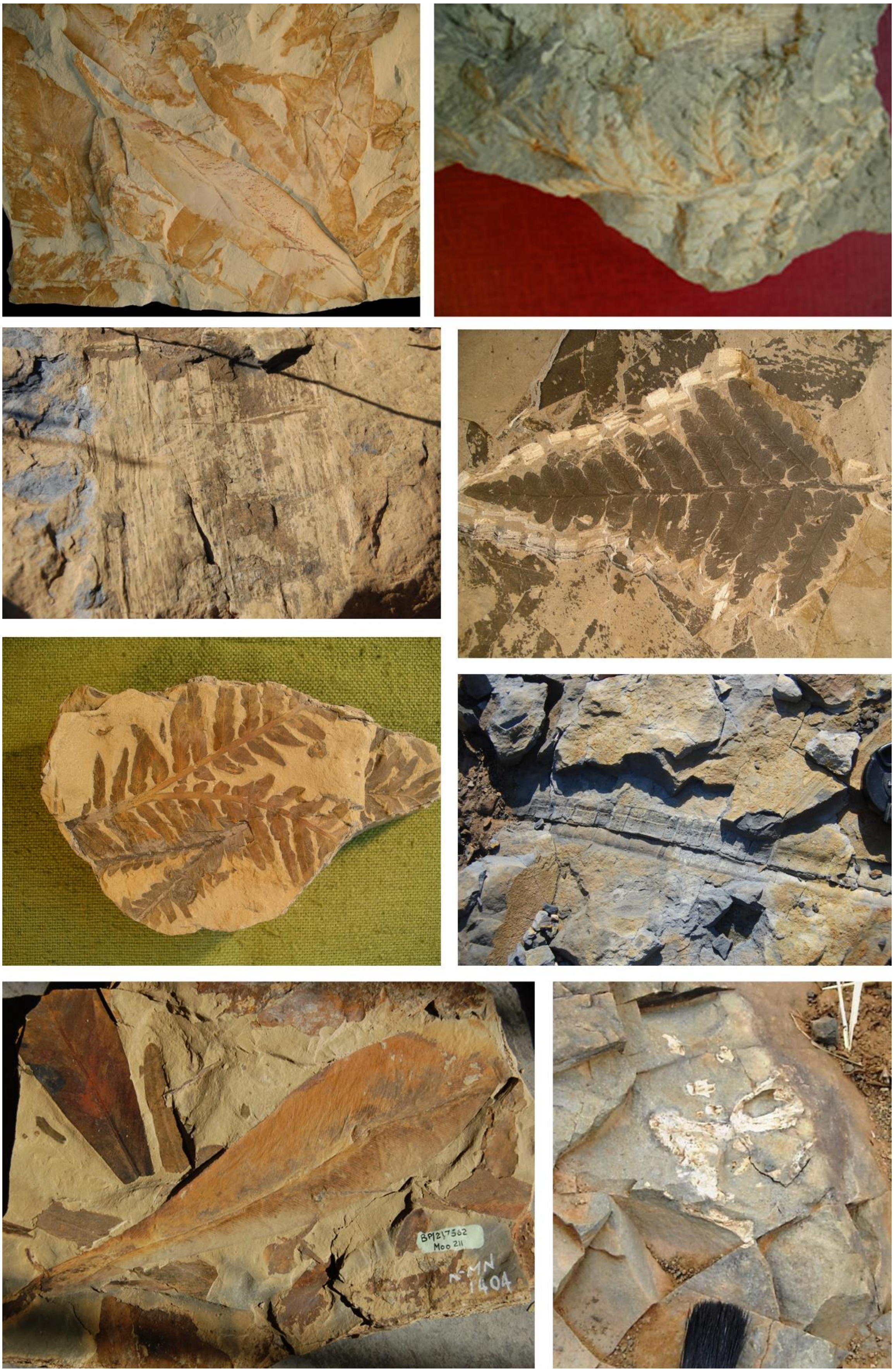

Figure 5: Photographs of fossil plants of the *Glossopteris* flora as seen in the field.

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD July 2022

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.
NRF Rating: C-2 (1999-2004); B-3 (2005-2015); B-2 (2016-2020); B-1 (2021-2026)

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	13	0
Masters	11	3
PhD	11	6
Postdoctoral fellows	15	1

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 45 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 Open Science UK: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals
Reviewing of funding applications for NRF, PAST, NWO, SIDA, National Geographic, Leakey Foundation

x) Palaeontological Impact Assessments

Selected from the past five years 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

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 = 35; -i10-index = 92
Conferences: numerous presentations at local and international conferences.