Palaeontological Impact Assessment for the proposed construction and operation of the Hendrina North 132kV powerline to Hendrina Power Station, Mpumalanga Province, South Africa

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Desktop Study (Phase 1)

For

Beyond Heritage

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Expertise of Specialist

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25 years PIA studies and over 300 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Beyond Heritage, Modimolle, 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 connection and powerlines for the ENERTRAG Hendrina North Wind Energy Facilities (WEFs). There are two options being considered, the shorter 17km route is the preferred route, and a 20km route is the alternative.

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 routes lie almost entirely on the potentially fossiliferous Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve fossils of the Glossopteris flora. The site visit and walk through showed that the routes are disturbed by current and earlier agriculture, existing roads and other infrastructure. The site visit showed that there were no fossils on the land surface and there were no rocky outcrops that could preserve fossils. 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 or drilling activities have commenced. Any impact would only occur during the Construction Phase. **As far as the palaeontology is concerned, the impact will be low to insignificant; there is no preferred route and there is no no-go area**.

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1. Background

ENERTRAG South Africa (Pty) Ltd (hereafter referred to as "ESA"), has appointed SiVEST SA (Pty) Ltd (hereafter referred to as "SiVEST") to undertake the required BA Process for the proposed construction and operation of a 132kV overhead power line to connect the proposed Hendrina North Wind Energy Facility ("WEF") (14/2/16/3/3/2/2130)1 to the Hendrina Power Station. The proposed project aims to feed the electricity generated by the proposed Hendrina North WEF into the national grid. The WEF will form part of the Renewable Energy Independent Power Producer Programme (REIPPP) (in line with the Integrated Resource Plan (IRP) – renewable wind energy).

The proposed project is located approximately 15km west of Hendrina, within the Steve Tshwete Local Municipality, in the Nkangala District Municipality, Mpumalanga Province. The Hendrina Power Station is located approximately 17km northwest of Hendrina, near Pullens Hope (Figure 1). The proposed powerline (up to and including 132kV) to Hendrina Power Station will be ~20km long depending on the exact route. A 500m corridor is proposed (250m from the centre lines). The proposed project (including site area and powerline corridors) will be located on the following properties / farm portions:

Portion No.	Farm No.	Farm Name
12	153	Driefontein
37	153	Driefontein
2	153	Driefontein
17	153	Driefontein
14	151	Roodepoort
13	151	Roodepoort
2	151	Roodepoort
18	151	Roodepoort
1	151	Roodepoort
8	154	Boschmanskop
3	185	Haartebeestkuil
4	185	Haartebeestkuil
1	25	Broodsneyerplaats
0	162	Hendrina Power Station
0	186	Gloria
11	162	Hendrina Power Station
1	158	Aberdeen

1.1 Grid Infrastructure Connection Components

The Project entails the development of electricity transmission and distribution infrastructure required to connect the proposed Hendrina North WEF to the National Grid via the existing Eskom substation, located at the Hendrina Power Station.

The Applicant intends to develop the Project under a self-build agreement with Eskom. Once construction is complete, it is anticipated that the Grid Infrastructure, and associated Environmental Authorisation, will be transferred to the Grid Operator (Eskom). Eskom will be the ultimate owner of the Grid Infrastructure and will be responsible for the operation, maintenance and decommissioning (if applicable) thereof.

The Project will make use of the Hendrina North WEF2 Project laydown areas and construction camps (subject to a separate application for EA)
The proposed grid connection infrastructure will include the following components:

A Onsite Substation
▪ Onsite substation consisting of 33/132kV yard (to be owned by the applicant) and a 132kV switching station yard (to be owned by Eskom) (footprint up to 3ha). The substation will consist of:

- feeder bays, transformers, switching station electrical equipment (bus bars, metering equipment, switchgear, etc.), control building, workshop, telecommunication infrastructure, and access roads.
- The substation will include an area with a subterranean earthing mat onto which a concrete plinth will be constructed.

B 132kV powerline
▪ Up to 132kV powerline connecting the on-site substation at Hendrina North WEF to the Hendrina Power Station. Power line towers being considered for this development include self-supporting suspension monopole structures for relatively straight sections of the line and angle strain towers where the route alignment bends to a significant degree. Maximum tower height is expected to be approximately 25m.

Technical details associated with proposed powerlines	
Powerline capacity:	132kV powerlines (single circuit or double circuit)
Powerline corridor length	Approx. 17-20km (To be confirmed prior to construction)
Powerline corridors width	500m (250m on either side of centre line)
Powerline servitude	32m per 132kV powerline
Powerline pylons:	Monopole or Lattice pylons, or a combination of both where required
Powerline pylon height:	Maximum 40m height

1.2 Grid Connection BA Alternatives

The proposed grid connection infrastructure proposals include two (2) power line route alignment alternatives within a 500m wide and a 33/132kV onsite substation (**Figure 2**). These alternatives will be considered and assessed as part of the BA process and will be amended or refined to avoid identified environmental sensitivities.

The two alternative grid connection solutions (within a 500m wide corridor) will include:

▪ Grid Connection Alternative 1 (Preferred): The proposed powerline will be approximately 17km and will connect to the Hendrina North WEF to the Hendrina Power Station. This alternative is shorter and spans over existing road and farm boundaries. This is the landowners preferred routing. The preferred pylon and powerline will be 132 kV Intermediate Self-Supporting single circuit or double circuit Monopole.

▪ Grid Connection Alternative 2:
The proposed powerline will be approximately 20km and will connect to the Hendrina North WEF to the Hendrina Power Station. This alternative follows an existing a dirt road until it meets the Eskom HENDRINA-ABINA 132kV powerline. It then follows the Eskom powerline

The proposed substation will be located on Portion 3 of Hartebeestkuil 185IS. This site was identified as the only alternative due to the substation location needing to be centrally located, its location outside of identified wetlands and critical biodiversity areas, on undeveloped land (not within agriculture land as per land owner request).

1.3 No-Go Alternative
The 'no-go' alternative is the option of not undertaking the proposed grid connection infrastructure project. Hence, if the 'no-go' option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

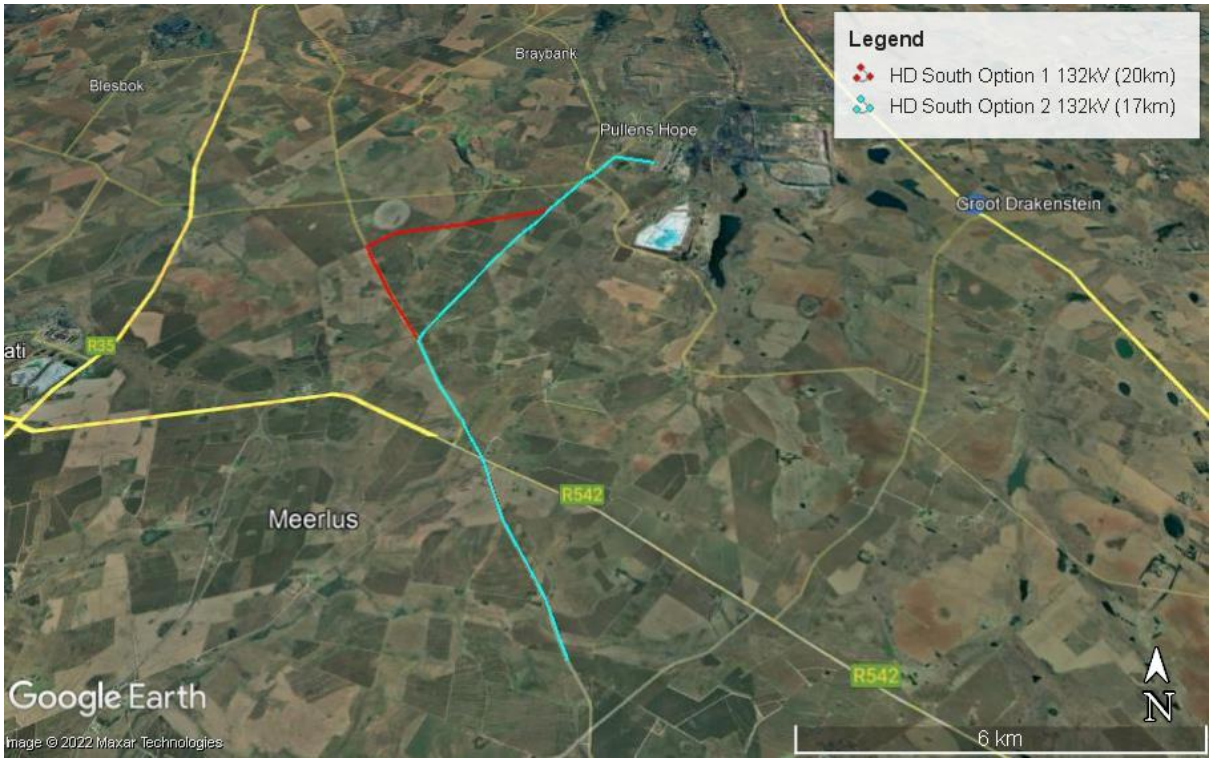

Figure 1: Hendrina North Grid route and infrastructure map. Blue line is the preferred route and red line is the alternate route. Hendrina is to the south,

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.

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 3
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix 3
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	Yes
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	Spring
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	None
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figures 2-4
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 1
l	Any conditions for inclusion in the environmental authorisation	Appendix 1
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix 1
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

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

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 include 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 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).

Figure 2: Geological map of the area around the Hendrina Substation and proposed power lines. Blue line is the preferred route and yellow line the alternate route. 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 (Eriksson et al., 2006. Johnson et al., 2006; McCarthy et al., 2006; Robb et al., 2006; van der Westhuizen 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

Symbol	Group/Formation	Lithology	Approximate Age
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

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

ii. Palaeontological context

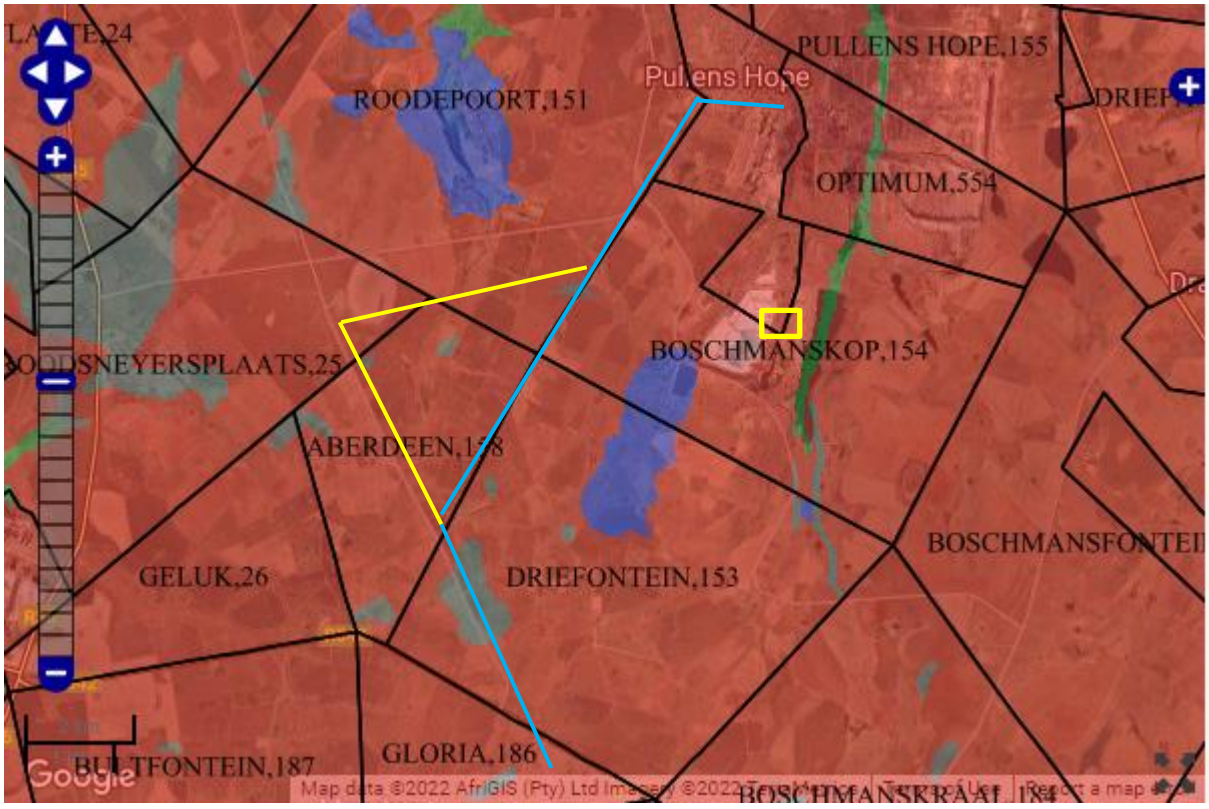

Figure 3: SAHRIS palaeosensitivity map for the site for the proposed northern routes for the Hendrina North Grid Connection. The preferred route is shown by the blue line and

the alternative by the yellow line. 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 grid routes under consideration are presented in Figure 4. The routes mostly are along the Vryheid Formation that is considered very highly sensitive for palaeontology (Figures 3-4) so a site visit is required by SAHRA.

The palaeontological sensitivity of the area under consideration is presented in Figures 3-4. 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.

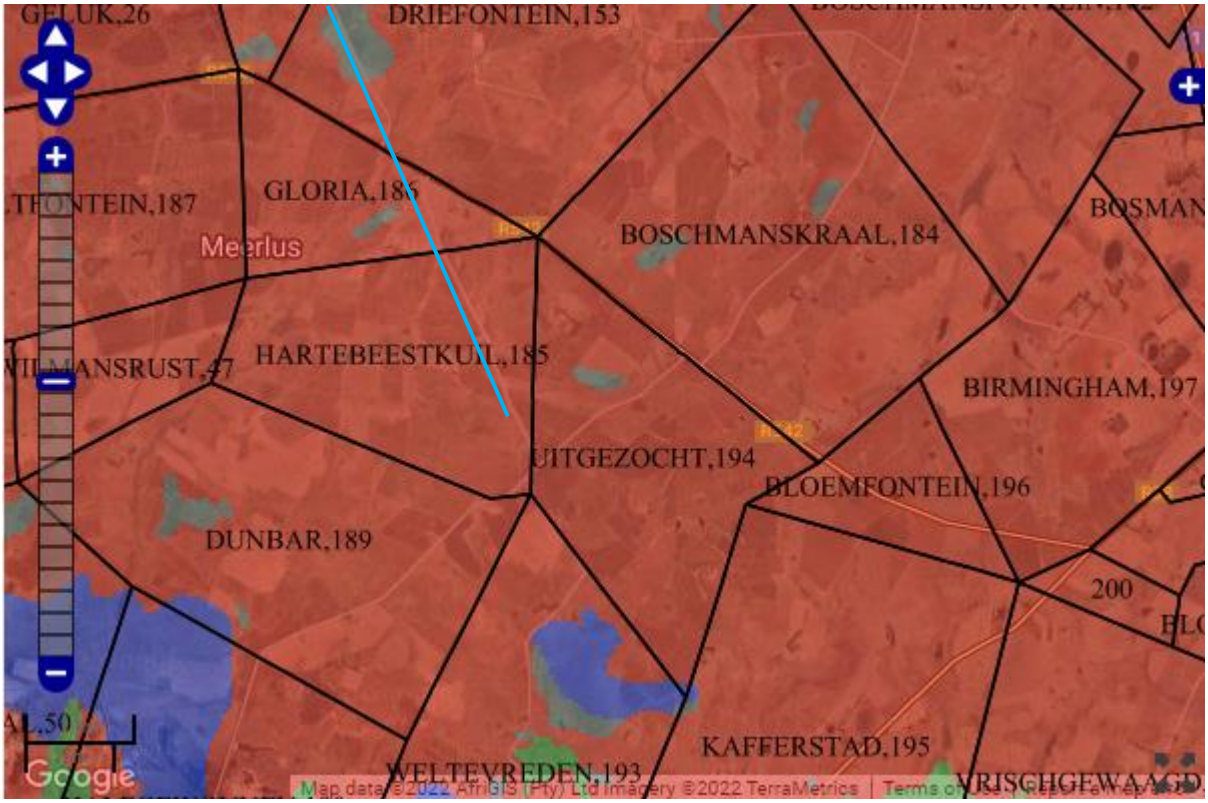

Figure 4: SAHRIS map for the southern route. Colours as in figure 3.

iii. Site visit preparation and observations

Most of the routes are along existing powerline routes, farm borders and farm roads. The rest of the routes lie in recently or previously ploughed fields that would not have fossils because any stones have been removed before ploughing. Rocky outcrops, therefore were targeted as there might be impressions of fossil plant in the shales of the Vryheid Formation. The routes are already very disturbed from roads, ploughed lands, a railway line and what appears to be underground water pipelines as there were several access points.

The topography is almost flat with a few undulating areas so it was easy to see quite far in the search for rocky outcrops.

The routes were walked along (or driven along when roads were present and the buffer zone was scanned visually. The site visit and survey of the project routes were completed on 08 September 2022, commencing from the south along the overlapping route. Photographs are provided in Figures 5-7. NO FOSSILS were seen on the land surface and no rocky outcrops were found.

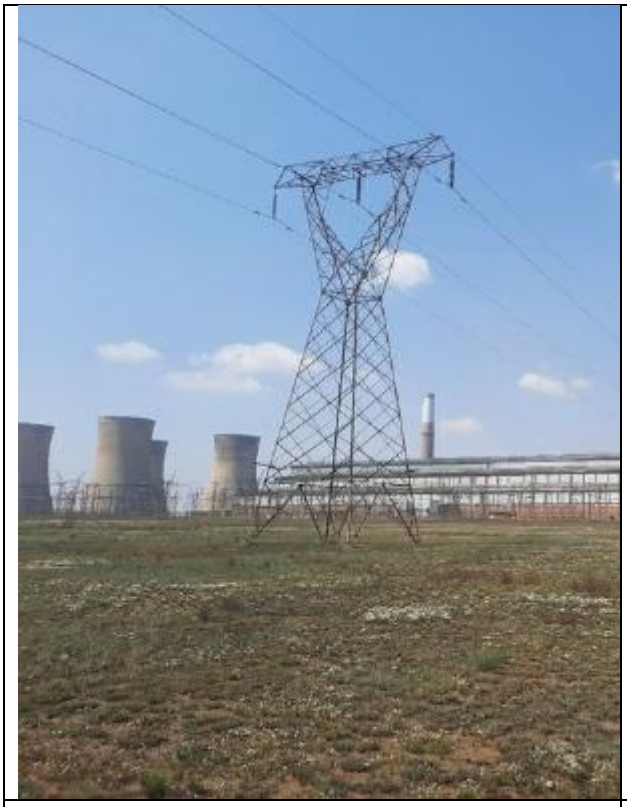

Figure 5A – powerlines from Hendrina power station.

Figure 5B – farm road in southern part of the powerline route. Note generally flat topography and no rocky outcrops

Figure 6A – gravel road between fields

Figure 6B – tar road between fields

Figure 6C – ploughed field on right and field lying fallow on the left. No rocks and no fossils

Figure 6D – gravel road with exotic trees along the left side.

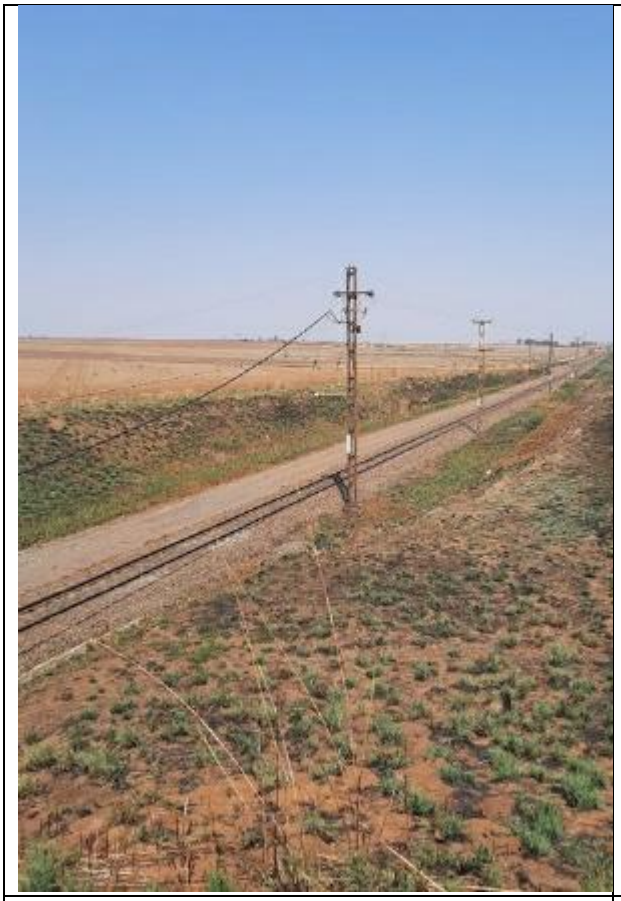

Figure 7A: Railway line close to the southern point where the two routes concur.

Figure 7B – fallow fields on either side of a gravel road in the alternate route.

Figure 7C – powerlines in an ploughed field.

Figure 7D – grass cover in a fallow land.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in **Error! Reference source not found.**. It is only the project footprint / ground surface that is relevant to each route, in particular the pole foundations and substation foundations.

ENERTRAG is investigating two alternatives for the grid connection powerline route to connect the Hendrina North WEF.

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	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	9
4	16	20	24	28	32	36	40	44	48	52	56	60	64	68	7
3	12	15	18	21	24	27	30	33	36	39	42	45	48	51	5
2	8	10	12	14	16	18	20	22	24	26	28	30	32	34	3
1	4	5	6	7	8	9	10	11	12	13	14	15	16	17	1
	4	5	6	7	8	9	10	11	12	13	14	15	16	17	1
	Consequence														

Mitigation for palaeontology is the removal of fossils along the route, either during the site visit, or when excavations for pole foundations commence. This way they will not be damaged but will have a positive impact because fossils that would otherwise be unknown, can then be deposited in a recognised institution for further research.

Table 4B: Assessment table for the Hendrina North Grid Infrastructure project

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

Alt 2 post-mit	1	1	1	1	1	1	insignificant
CUMMULATIVE IMPACT OF PHASES							
CUMULATIVE IMPACT OF THE 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.

Alternative route – is along the same geology and the same type of farmlands as the preferred route, so there is no difference and so no preference as far as the palaeontology is concerned.

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 there will be no impact.

Cumulative Impact – Since the distribution of fossils is sporadic and unpredictable (we only know that some rock formations preserve fossils in some areas), and so each site is independent of the other, there will be no cumulative impact.

No-go areas – no fossils were found along both routes. If fossils are below ground and in the sites to be excavated, they would be removed (mitigation), therefore, there are no no-go areas.

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 overlying soils and sands of the Quaternary period would not preserve fossils.

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 overlying sands and sols of the Quaternary. There is a very small chance that fossils may occur in the below ground 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 infrastructure have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be low, therefore as far as the palaeontology is concerned the project should be authorised. There is no preferred route and there is no no-go area.

7. References

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

Anderson, J.M., Anderson, H.M., Archangelsky, S., Bamford, M., Chandra, S., Dettman, M., Hill, R., McLoughlin, S., Rösler, O. 1999. Patterns of Gondwana plant colonisation and diversification. Journal of African Earth Sciences, 28(1): 145-167.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Snyman, C.P., 1998. Coal. In: Wilson, M.G.C., and Anhaeusser, C.P., (Eds). The Mineral Resources of South Africa: Handbook, Council for Geosciences 16, 136-205.

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 dolomites. 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 2 – Examples of fossils from the Vryheid Formation

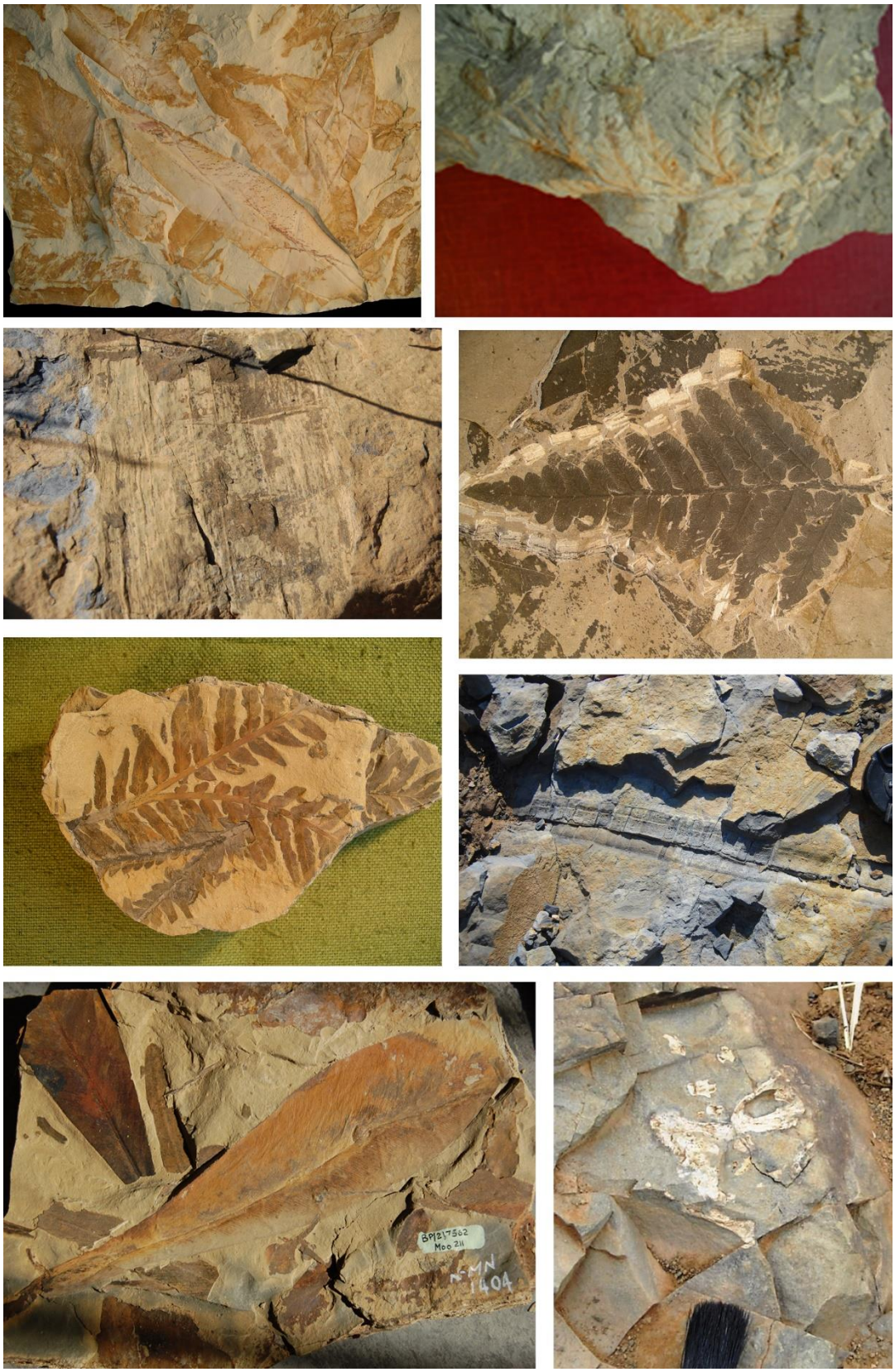

Figure 8: Photographs of fossil plants that could occur below ground in shales.

8. Appendix 3 – 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	2

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.