Appendix H-7

PALAEONTOLOGY STUDY

Palaeontological Impact Assessment for the proposed Impumelelo WEF, between Greylingstad and Secunda, Mpumalanga Province

Desktop Study (Phase 1)

For

ASHA Consulting (Pty) Ltd

21 January 2023

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Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf
Experience: 34 years research and lecturing in Palaeontology
26 years PIA studies and over 350 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by ASHA Consulting (Pty) Ltd, Lakeside, 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 WSP for the proposed Impumelelo Wind Energy Facility (WEF) between Greylingstad and Secunda, Mpumalanga Province, and southwest of the Impumelelo Coal Mine. Twenty-six turbines are being considered, together with the relevant infrastructure. The proposed grid connection to the northeast to Zandfontein Substation is the subject of a separate report. The turbines will be placed on Farms Hartbeesfontein 522, Platkop 543 and Mahemsfontein 544.

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 study (Phase 1) Palaeontological Impact Assessment (PIA) was completed for the proposed development, and supplemented with site photographs from the archaeologist.

The proposed WEF lies almost entirely on non-fossiliferous Jurassic dolerite. Only the westernmost turbines and infrastructure lie on or very close to the potentially fossiliferous Vryheid Formation (Ecca Group, Karoo Supergroup) that could preserve fossils of the *Glossopteris* flora. The site visit and walk through by the archaeologist showed that part of WEF site is disturbed by current and earlier agriculture, existing roads and other infrastructure. Secondary grasslands occur in the other parts. The archaeologist did not see fossils on the land surface. 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 moderate negative pre-mitigation and very low post-mitigation; there is no no-go area for the turbines or infrastructure**. The impact will only be during the construction phase.

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Acronyms

Fm – Formation; Ma – million years; NEMA - National Environmental Management Act; PIA Palaeontological Impact Assessment; SAHRIS – South African Heritage Resources information system; WEF – Wind Energy Facility

1. Background

ASHA Consulting (Pty) Ltd was appointed by WSP for ENERTRAG South Africa (Pty) Ltd to assess the potential impacts to heritage resources that might occur through the proposed construction of the Impumelelo Wind Energy Facility (WEF) on a site of some 2800 ha in extent and located between Greylingstad (to the southeast) and Secunda (to the northwest), Mpumalanga (Figures 1-2). The project would have a maximum export capacity of up to 200 MW. An approximate mid-point for the study area is S26° 40' 05" E28° 51' 10". The project is proposed across nine farm portions as shown in Table 1.

The proposed grid connection to the Eskom Zandfontein Substation is the subject of a separate report. This report is for the palaeontological impact of the Impumelelo WEF because there are very highly sensitive rocks in the region.

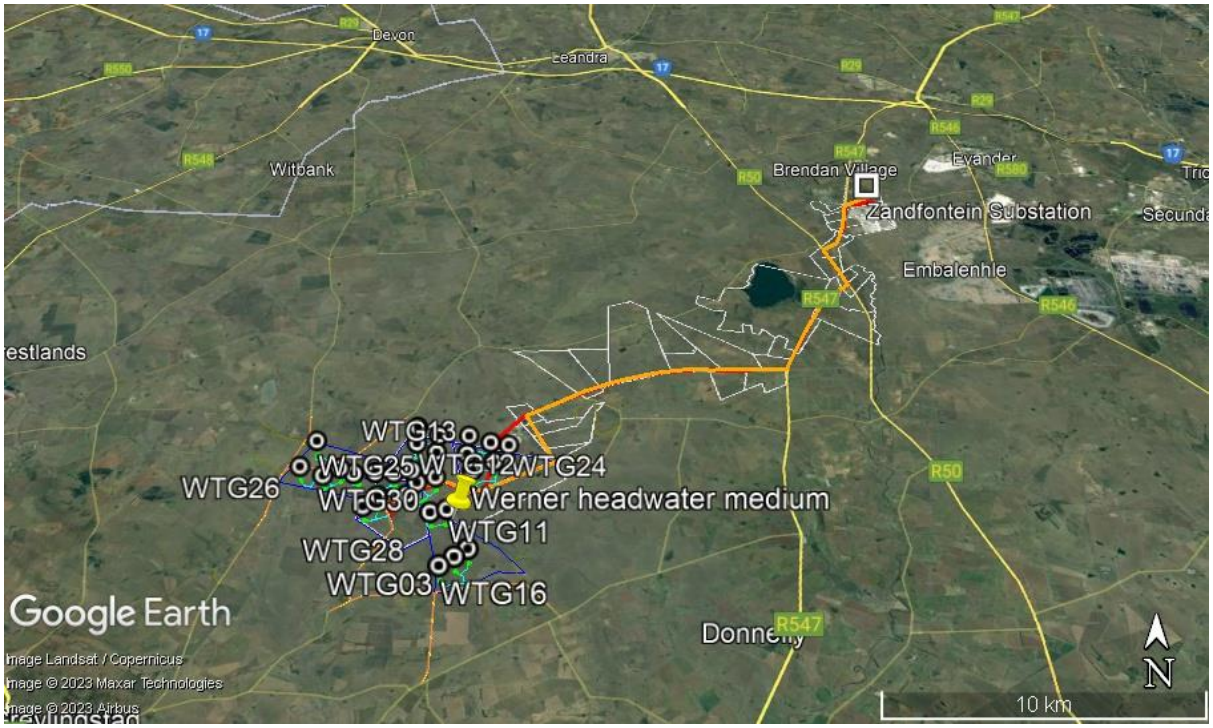

Figure 1: Impumelelo WEF and infrastructure map. Secunda is in the northeast and Greylingstad in the southwest of the map.

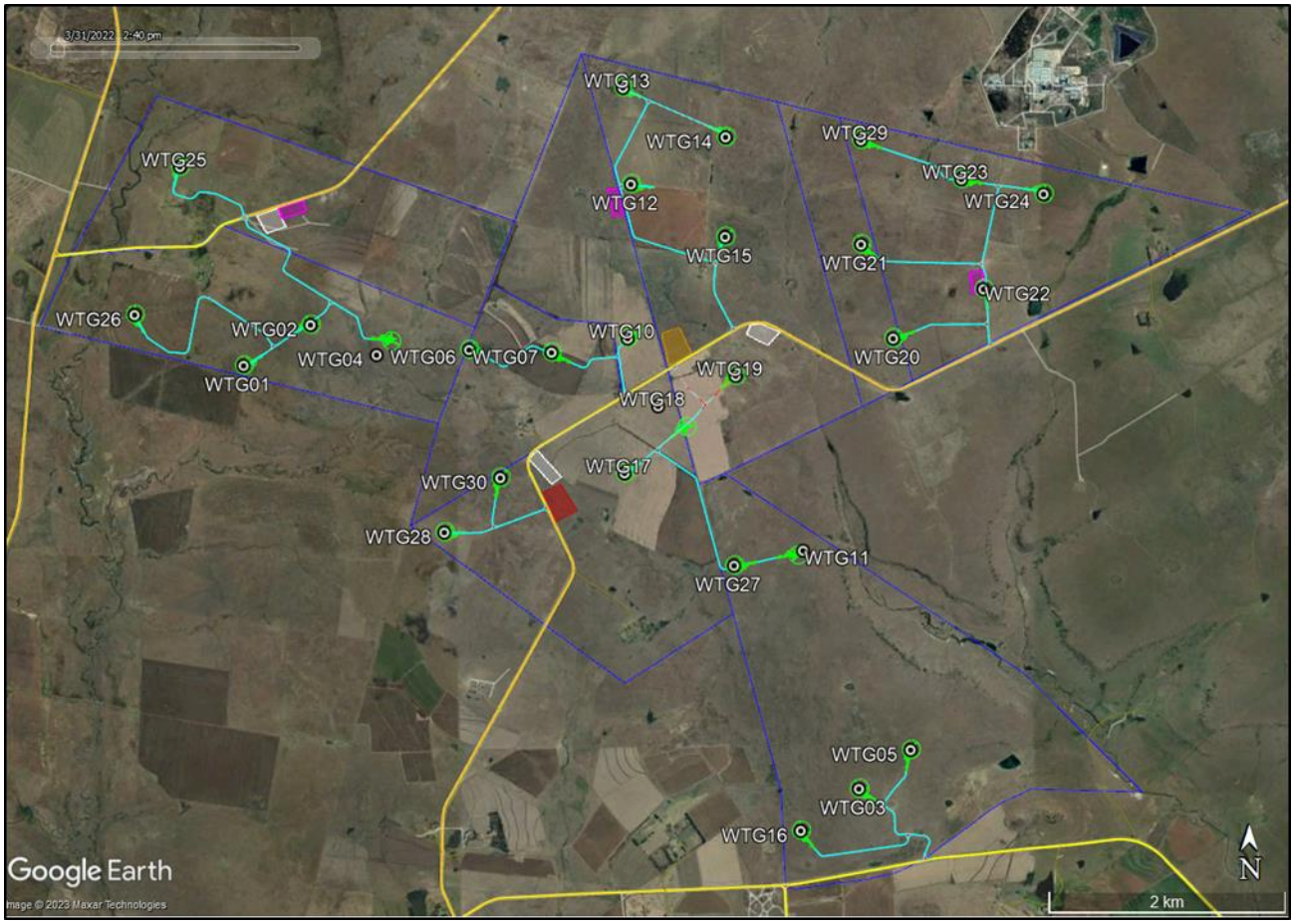

Figure 2: Aerial map to show the proposed layout of the wind turbines (WTG--) for the Impumelelo WEF plus the infrastructure. Black and white dots = turbines, orange square = Alternative 1 substation and BESS (within this area), red square = Alternative 2 substation and BESS (within this area), pink rectangles = three laydown areas, white rectangles = three construction camps.

Table 1: List of farm portions affected by the proposed project.

Portion Number	Farm Number	Farm Name
6	522	Hartbeesfontein
25	522	Hartbeesfontein
2	543	Platkop
4	543	Platkop
5	543	Platkop
9	543	Platkop
7	544	Mahemsfontein
8	544	Mahemsfontein
Remainder	544	Mahemsfontein

Table 2: Details of the proposed project

Facility Name	Impumelelo Wind Energy Facility
Applicant	Impumelelo Wind (Pty) Ltd (Registration Number: 2022/601923/07
Municipalities	The project is located in the Dipaleseng local Municipality of the Gert Sibande District Municipality
Affected Farms	Portions 6 & 25 of the Farm 522 Hartbeesfontein; Portions 2, 4, 5 and 9 of the Farm 543 Platkop; Portions 0, 7 and 8 of the Farm 544 Mahemsfontein
Extent	2800 ha
Buildable area	Approximately 680 ha, subject to finalization based on technical and environmental requirements
Capacity	Up to 200MW
Number of turbines	28
Turbine hub height:	Up to 200m
Rotor Diameter:	Up to 200m
Foundation	Approximately 25m^2 diameter x 3m deep – 500 – 650m^3 concrete. Excavation approximately 1000m^2, in sandy soils due to access requirements and safe slop stability requirements.
Operations and Maintenance (O&M) building footprint:	Located in close proximity to the substation. Septic tanks with portable toilets Typical areas include: - Operations building – 20m x 10m = 200m^2 - Workshop – 15m x 10m = 150m^2 Stores - 15m x 10m = 150m^2
Construction camp laydown (x3):	Typical area 100m x 50m = 5000m^2. Sewage: Septic tanks and portable toilets
Temporary laydown or staging area (x3):	Typical area 220m x 100m = 22000m^2. Laydown area could increase to 30000m^2 for concrete towers, should they be required.
Batching plant (temporary):	Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo.
Internal Roads:	Width of internal road – Between 5m and 6m. Length of internal road – Approximately 60km. Where required for turning circle/bypass areas, access or internal roads may be up to 20m to allow for larger component transport.
Cables:	The medium voltage collector system will comprise of cables up to and including 33kV that run underground, except where a technical assessment suggest that overhead lines are required, within the facility connecting the turbines to the onsite substation.
Independent Power Producer (IPP) site substation and battery energy storage system (BESS):	Total footprint will be up to 6.5ha in extent (5ha for the BESS and 1.5ha for the IPP portion of the substation). The substation will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control building, telecommunication infrastructure, access roads, and other substation components as required. The associated BESS storage capacity will be up to 200MW/800MWh with up to four hours of storage. It is proposed that Lithium Battery Technologies, such as Lithium Iron Phosphate, Lithium Nickel Manganese Cobalt oxides or

	Vanadium Redox flow technologies will be considered as the preferred battery technology however the specific technology will only be determined following EPC procurement. The main components of the BESS include the batteries, power conversion system and transformer that will all be stored in various rows of containers.
Site access	R547 and R23
Height of substation fencing	Up to 3 m high Galvanised steel

Table 3: 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 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
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

	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 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
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 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 northeastern part of the main Karoo Basin where the basal sediments are exposed (Figure 3). To the southwest is a large exposure of the Klipriviersberg Group volcanic rocks. They do not preserve fossils and are not in the project footprint.

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).

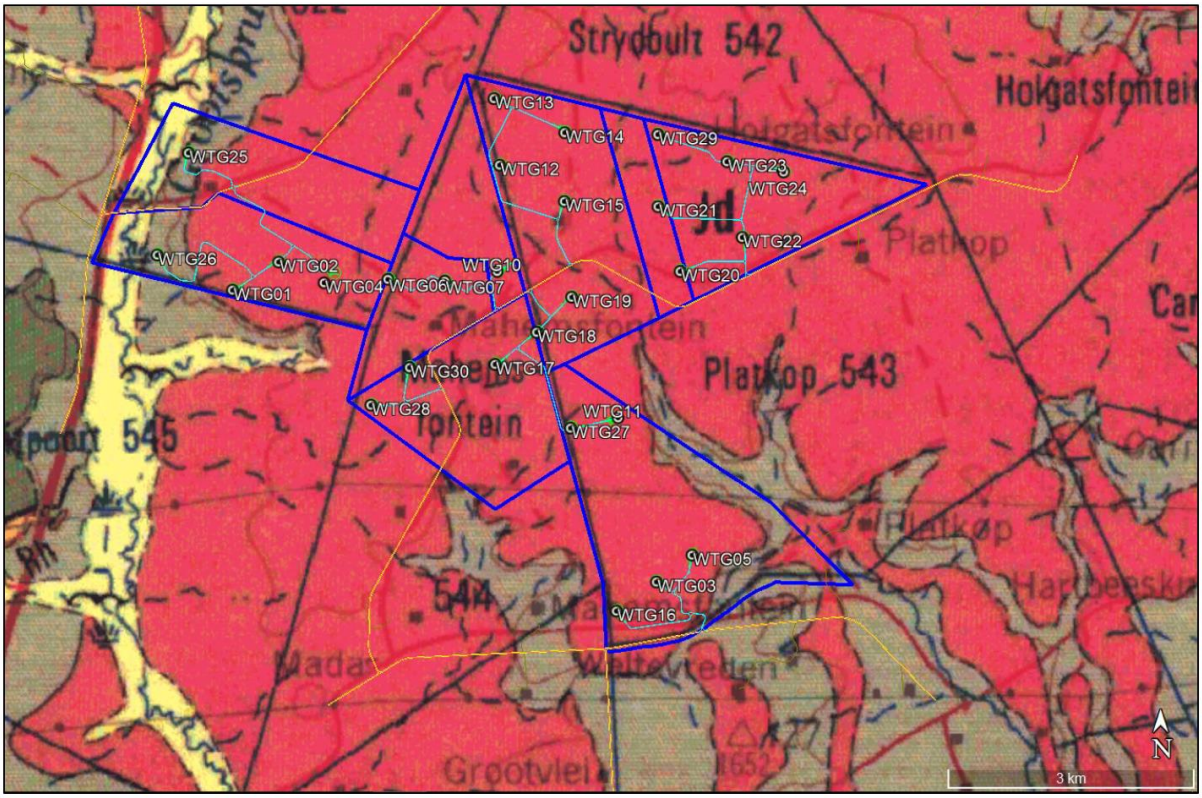

Figure 3: Geological map of the area around the proposed Impumelelo WEF with the farm boundaries outlined in blue. Abbreviations of the rock types are explained in Table 4. Map enlarged from the Geological Survey 1: 250 000 map 2628 East Rand.

Table 4: 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, sand alluvium	Quaternary, ca 1.0 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
Rk	Klipriviersberg Group, Ventersdorp SG	Mafic lava, amygdaloidal lava, tuff	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

The palaeontological sensitivity of the WEF sites under consideration are presented in Figures 4-5. The sites are mostly on non-fossiliferous dolerite. Only WTG 25, 26, 1 and 2 are on or close to the Vryheid Formation (Figure 4) that is considered very highly sensitive for palaeontology so a site visit is required by SAHRA.

Dolerite is an igneous rock so does not preserve fossils and any fossils in close vicinity to the dolerite are usually destroyed by the intrusion. The fossils preserved in the Vryheid Formation 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 altered greatly by heat and compression to form coal. Soils are weathered products of sediments and do not contain any recognisable fossil material.

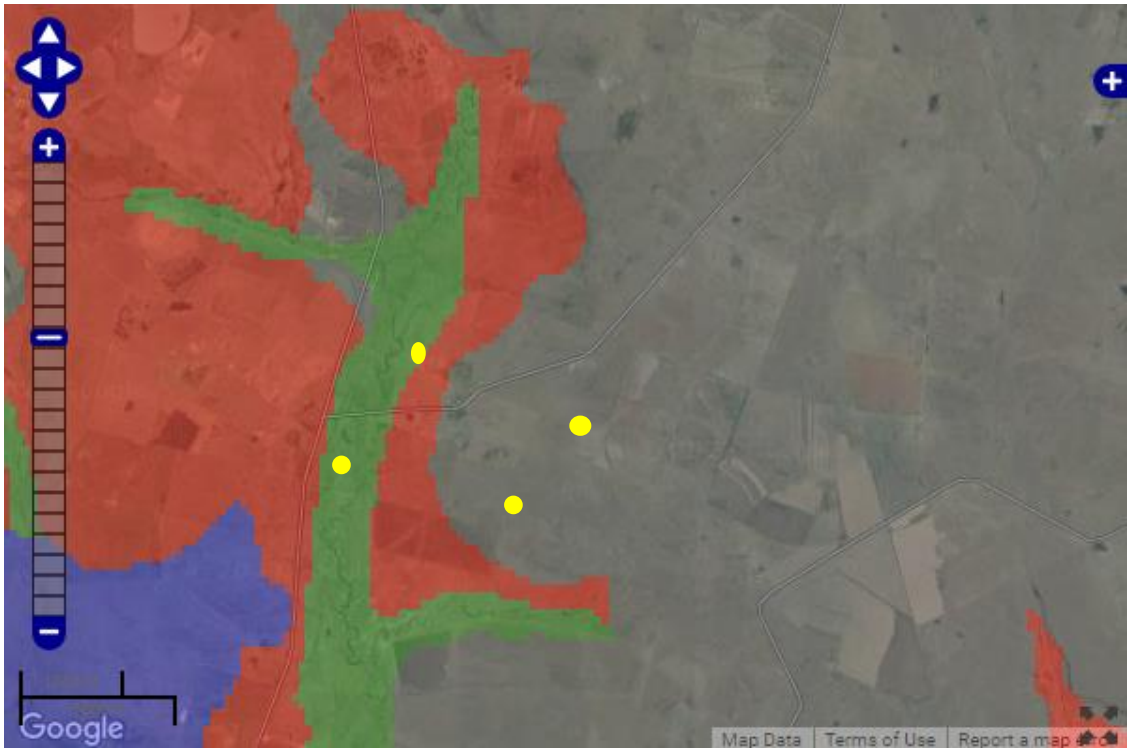

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed western sector of the Impumelelo WEFs. Only WTG 25, 26, 1, 2 are on or close to the Vryheid Fm. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

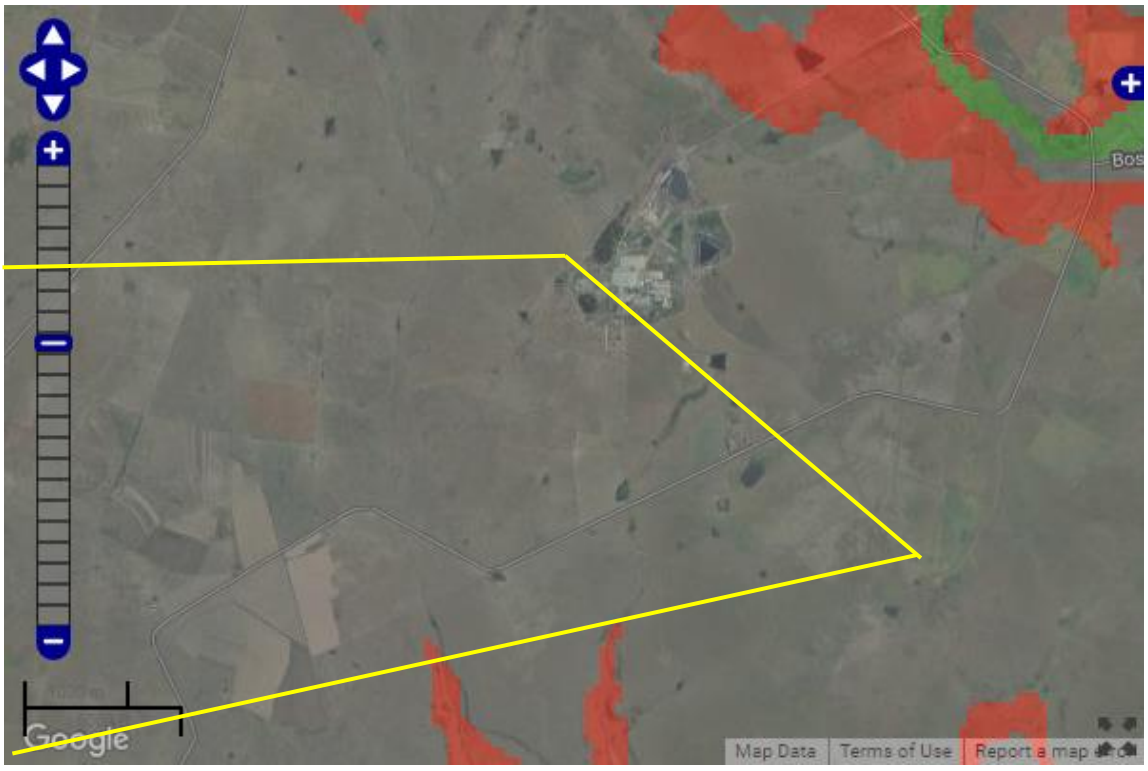

Figure 5: SAHRIS palaeosensitivity map for the central and eastern sector WEFs for Impumelelo placed within the yellow outline. Colours as for Fig. 4.

iii. Site visit preparation and observations

Part of the area was surveyed by the archaeologist for archaeology and some of his photographs are included here. The doleritic area and the shales were all covered by soils that have been ploughed for agriculture. Some lands are also lying fallow and they are covered by deep soils and secondary grassland (Figures 6-7; photographs taken by Jaco van der Walt). No rocky outcrops of shales were reported from the visited area.

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

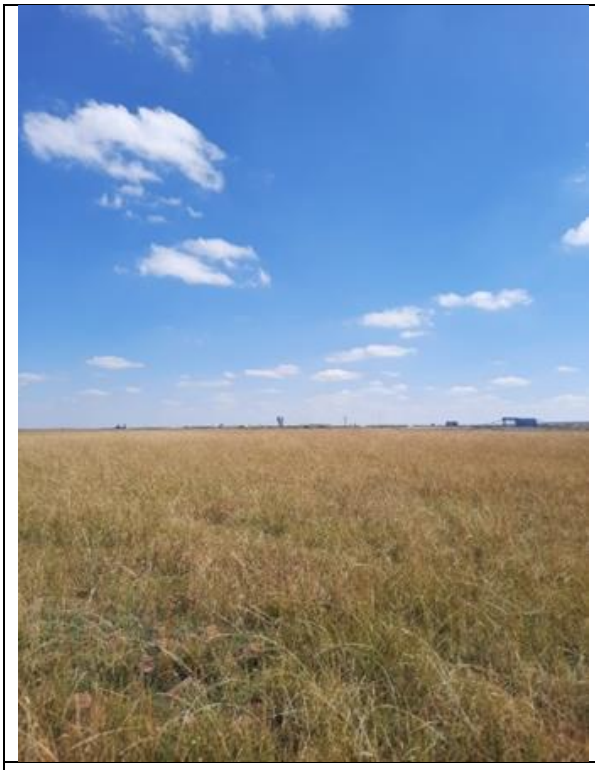

Figure 6A – general view of undulating lands covered with deep soils and secondary grassland.

Figure 6B – central part with some outcrops of dolerite. Note generally flat topography and no rocky outcrops of shales, only non-fossiliferous dolerite

Figure 7A – flat field with young crop. No rocky outcrops.

Figure 7B – field lying fallow, generally flat with no rocky outcrops.

Figure 7C – in the westernmost section ploughed field with mature mealie crop. No outcrops of shales.

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 are relevant to each turbine foundation, BESS, laydown area and other infrastructure.

WSP is investigating the sites for turbines on farms Hartbeesfontein 522, Platkop 543 and Mahemsfontein 544 for the proposed Impumelelo WEF.

Assessment of Impacts and Mitigation
The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

Following the mitigation sequence/hierarchy of five levels:

a) Avoid/prevent significant impact
b) Minimise
c) Rehabilitate/restore
d) Off-set
e) No-go,

mitigation in the form of removing any important fossils (steps a and b) will reduce realty the impact of this project on the palaeontological heritage.

The key objectives of the risk assessment are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Ranked criteria listed in Table 5a and the scores for the palaeontological impact are given in Table 5b.

Table 5a: Impact Assessment and Scoring according to WSP protocols.

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

Table 5b: Impact Assessment score and significance for Palaeontology for the Impumelelo WEF project.

Project: Impumelelo WEF area		
Criteria (from table above)	Scores	
	Pre-mitigation	Post-mitigation
Impact Magnitude (M)	2	1
Impact Extent (E)	1	1
Impact Reversibility (R)	3	1
Impact Duration (D)	5	2
Probability of Occurrence (P)	3	1
Significance (M+E+R+D) x P	(2+1+3+5) x 3 = 36	(1+1+1+2) x 1 = 5

Significance Rating	Moderate	Very Low
Negative / Positive	Negative	Positive

Mitigation
The impact on the palaeontological heritage can be reduced greatly by a palaeontologist conducting a pre-construction site visit when the final layout is known to look for fossils and removing any scientifically important fossils with the relevant SAHRA permit. (See Section 8 and Appendix A).

Positive/Negative Impact
The discovery and removal of fossils as a direct result of this project has a positive impact because prior to this the particular fossils or fossil deposit were unknown to science.

Alternatives
None provided to date.

Additional Environmental Impacts
As far as the palaeontology is concerned, there are no additional impacts because the fossils are inert and inactive.

Cumulative Impacts
As far as the palaeontology is concerned, there are no cumulative impacts because each site is unique and may or may not have fossils. Fossil bones may be scattered over the landscape but their distribution is erratic and unpredictable. If a bone-bed or plant outcrop occurs this would an aerially small concentration of fossils and very unlikely to extend beyond tens of metres. Therefore, projects on adjacent land parcels are unlikely to add any impact on this project.

No-Go areas
There are no-go areas because the fossils, if present, can be removed ad curated in a recognised institution such as a museum or university that has the facilities to store and research the fossil material.

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 2). During the operational and decommissioning phases no new ground will be excavated so there will be no impact.

Impact on the Palaeontology
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 only some of the rocks are the correct age and type to contain fossils, namely the plants of the *Glossopteris* flora in the Vryheid Formation. Only WTG-25, 26, 1 and 2 are on or close to the Vryheid Formation and the rest are on non-fossiliferous dolerite. There is an extremely small chance that fossils from beneath soils in the Vryheid Formation may be disturbed. 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 very 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 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 soils 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 contractor, 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 site and there is no no-go area.

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/mining commence.
2. When excavations begin the rocks and discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (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 8). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the 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.

Appendix A – Examples of fossils from the Vryheid Formation

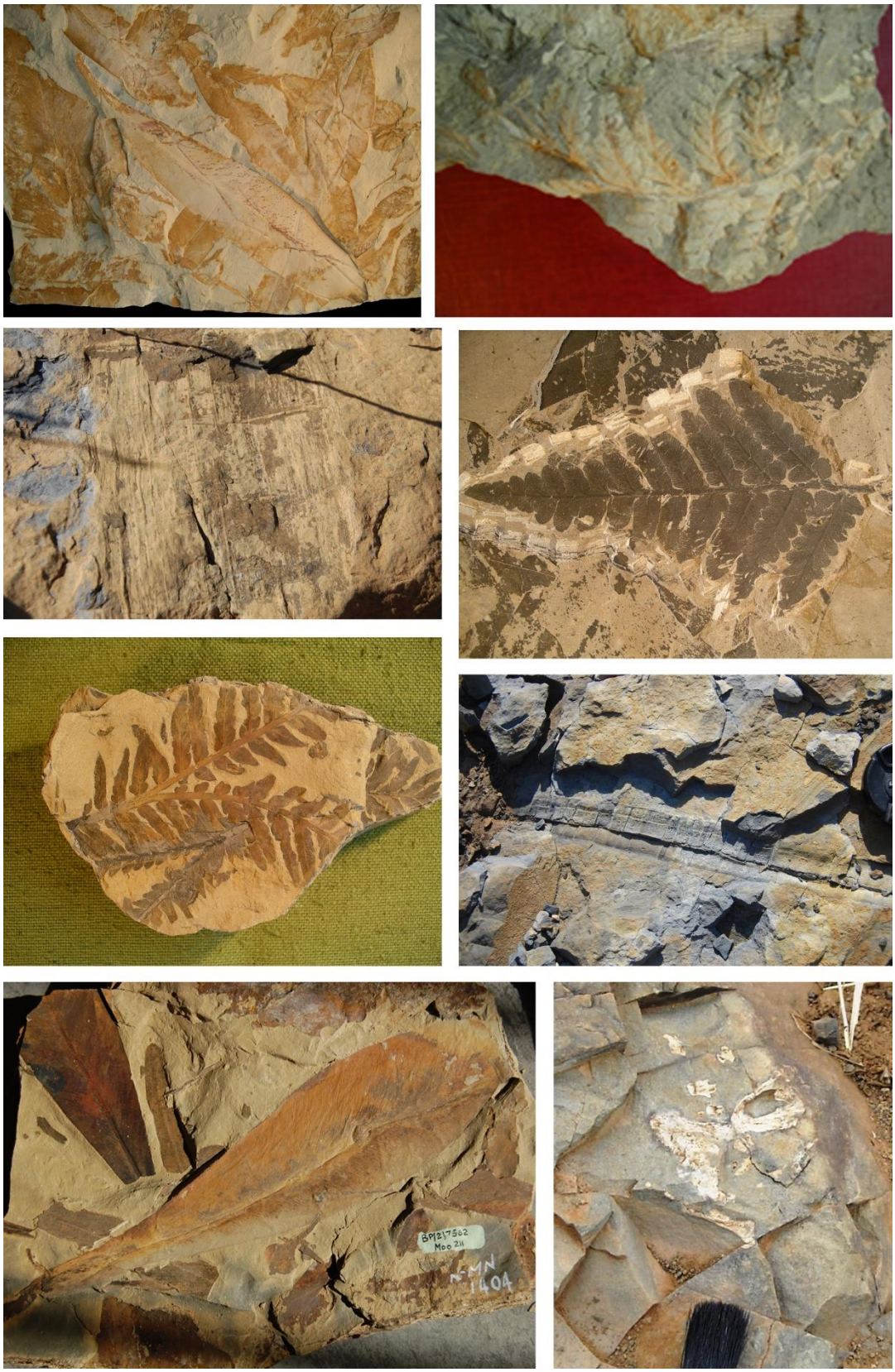

Figure 8: Photographs of fossil plants that could occur below ground in shales.

9. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 2023

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	13	3
PhD	13	6
Postdoctoral fellows	15	4

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 January 2023 peer-reviewed journals or scholarly books: over 170 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 30; Google scholar h-index = 39; -i10-index = 116
Conferences: numerous presentations at local and international conferences.