Palaeontological Impact Assessment for the proposed Taylors Halt 132kV powerline and Substation, west of Pietermaritzburg KwaZulu Natal Province

Desktop Study (Phase 1)

For

Setala Environmental (Pty) Ltd

25 February 2022

Prof Marion Bamford
Palaeobotanist
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Checklist of required items in the Heritage report for Electricity Grid Infrastructure

	Requirement	Page / Section
a	An EMPr template	Table i; see also Section 8, Appendix A
b	A confirming statement	Table ii
c	Specialist Declaration of Independence ;	Table iii
d	Confirmation that the environmental sensitivity is low or medium per the sensitivity identified by the screening tool	Palaeontological Sensitivity is low. Sections 3, 4
e	Method for how the mitigation hierarchy was implemented for the theme;	Sections 2, 4
f	Statement on whether identified route is considered to be optimal based on the specialist confirmation of low or medium environmental sensitivity and walkthrough	Desktop study – site has low sensitivity Route and substation are optimal Walkthrough – not required by SAHRA but desktop completed and no fossils are likely to be found

Table i: Generic Environmental Management programme (EMPr) template as required by the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and amended for Substations and Powerlines (Government Gazette No: 42323, March 2019).

GENERIC EMPr TEMPLATE	
Implementation	
Responsible person	Environmental Control Officer (ECO) or other person designated by the Competent Authority (CA)
Method	Check the rocks being excavated for fossil plant impressions or bones. Photographs of typical fossils are included in Appendix A.
Timeframe	When excavations commence
Monitoring	
Responsible person	Environmental Control Officer (ECO) or other person designated by the Competent Authority (CA)
Frequency	Once when the excavations are in progress only.
Evidence of compliance	Photographs of excavated material; written statement

Confirming Statement by Palaeontology Specialist

The confirming statement must be prepared by suitably qualified specialist in the field of heritage resources (archaeology, marine and built environment) and palaeontology, and must contain, as a minimum, the following information:

51	A description of the affected environment in terms of heritage resources and palaeontology, and an indication of existing heritage and palaeontological impacts within the *preliminary corridor* based on the site verification inspection and walk through.	Section 3
52	Identification of heritage resources and palaeontological areas to be avoided within the *preliminary corridor*, including buffers;	Section 6

53	A heritage sensitivity map overlaid with the proposed development footprint (i.e. pylon placement and power line route, as well as supporting infrastructure) based on most recently obtainable and available desktop data, such as the information on the screening tool and the South African Heritage Resources Information System, site verification inspection and walk through (where necessary);	SAHRIS Palaeosensitivity Map – Figure 4.
54	Where required, a written comment or letter of no objection from the South African Heritage Resources Agency and/or applicable provincial heritage authority confirming that there is no unacceptable impact on heritage resources and palaeontology;	EIA – SAHRA Case No:
55	Confirmation that any recommendations as required by the South African Heritage Resources Agency and/or applicable provincial heritage authority have been incorporated and considered;	EIA
56	A description on how the identified environmental sensitivity pertaining to heritage resources and palaeontology has been considered in determining the proposed route;	Section 2
57	A description of the implementation of the mitigation hierarchy in order to determine the proposed route and/or substation location;	Section 4
58	How the inputs of I&APs were considered when determining the *final pre-negotiated route* and/or substation location; and	EIA
59	A statement confirming that: a. impact management actions as contained in the pre-approved Generic EMPr template are sufficient for the avoidance, management and mitigation of impacts and risks; or b. where required, specific impact management outcomes and actions are required and have been provided as part of the site specific EMPr.	a. Section 4; Section EMPr template b. Section 8 Fossil chance Find Protocol; Appendix A
	Specialist Details	Prof Marion Bamford PhD Palaeontology, Wits 1990 P O Box 652, WITS 2050 Johannesburg

APPENDIX D – SPECIALIST DECLARATION

Company Name	Marion Bamford Consulting
Specialist Name	Prof Marion Bamford
Specialist Qualifications	PhD Palaeontology (Wits, 1990)
Specialist Affiliations/Registration	FRSSAf, mASSAf, PSSA (Palaeontological Society of southern Africa), SASQUA, IOP, IAWA
Physical Address	24A Eighth Avenue, Parktown North, 2193

Postal Address	P O Box 652, WITS		
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Telephone	011 717 6690	Fax:	--
Email	Marion.bamford@wits.ac.za ; marionbamford12@gmail.com		

DECLARATION BY THE SPECIALIST

I, __Marion Bamford_____, declare that –

- I act as the independent specialist in this Standard registration process;
- I have performed the work relating to the specialist assessment and/or route or substation location confirmation in an objective manner;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist input and confirming statement relevant to this request for registration, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the proponent all material information in my possession that reasonably has or may have the potential of influencing compliance with the Standards registration process; and
- all the particulars furnished by me in this form are true and correct.

Signature of the Specialist:

_____ _____

Name of Company:

___Marion Bamford Consulting_____

Date:

___25 February 2023_____

Executive Summary

Eskom Holdings SOC LTD is applying for Environmental Authorisation (EA) for the construction of a ± 2,5km overhead line from the Ariadne/Elandskop line to the proposed Taylors Halt substation as well as for the construction of Taylors Halt substation. The project is proposed on Zwaart Kop 4669 FT Portion 0, in the Msunduzi Local Municipality, uMgungundlovu District, near Pietermaritzburg in KwaZulu Natal.

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 route lies on the potentially fossiliferous Volksrust Formation (Ecca Group, Karoo Supergroup and non-fossiliferous Jurassic dolerite although is unlikely that any fossils of any importance would occur in the deep water shales. One example of a marine bivalve has been recorded as well as rare trace fossil. 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 for pole or substation foundations have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

Table of Contents

1. Background

Eskom Holdings SOC LTD (the applicant) appointed Setala Environmental as the independent environmental assessment practitioner (EAP) to apply for Environmental Authorisation (EA) for the construction of a ± 2,5km overhead line from the Ariadne/Elandskop line to the proposed Taylors Halt substation as well as for the construction of Taylors Halt substation.

An application for authorisation of the project is submitted to the National Department of Forestry, Fisheries and the Environment (DFFE), in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the Environmental Impact Assessment (EIA) Regulations of 2014, as amended.

The proposed project has certain activities that are listed in terms of Sections 24(2) and 24(d) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) (as amended) and will require Environmental Authorisation for the construction thereof.

Project Location
The project is proposed on Zwaart Kop 4669 FT Portion 0, in the Msunduzi Local Municipality, uMgungundlovu District, near Pietermaritzburg in KwaZulu Natal Province. LPI Code N0FT00000000466900000. (The final power line route alignment is to be confirmed). The project area is indicated in Figures 1-2.

Scope of Work
The proposed construction of a ± 2,5km 132kV powerline is initiated by Eskom to ensure the reliability and quality of supply of the network. Edendale 132/22kV, Elandskop 88/11kV and Mpophomeni 88/11kV transformers are currently loaded above 95% of their nameplate ratings. With the expected load growth, these transformers will exceed their nameplate rating. Also, Edendale NBEM, Edendale NBEC, Vulindlela NB57 and Mpophomeni NB54 are overloaded.

Taylors Halt 132/22kV substation will de-load the two transformers at Edendale and Mpophomeni as it will split the four networks (Edendale NBEM, Edendale NBEC, Vulindlela NB57 and Mpophomeni NB54).

1) Taylors Halt 132/22kV Substation
   A 132/22kV substation called Taylors Halt SS will be established complete with earthworks, drainage, access road, fencing and gates, earthmat and foundations. In addition, 132/22kV transformers and 2 x 132kV line bays to loop in and out of Ariadne/Elandskop 132kV line will be installed.
2) Ariadne/Elandskop Taylors Halt 132kV line (loop in & out)
   A 2,5km 132kV power line will T-off from Ariadne/Elandskop 132kV line and Loop in Loop Out to Taylors Halt 132kV/22kV Substation on double circuit structures.

The current Application for Authorisation is for the construction of the following:

- Construct a ± 2,5km overhead 132kV line outside an urban area from the T-off with the 132kV Ariadne/Elandskop line to the proposed Taylor Halt substation.
- Construct 132/22kV Taylors Halt Substation.

A Palaeontological Impact Assessment was requested for the ESKOM Taylors Halt 132kV powerline and substation 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 **Error! Bookmark not defined.**
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	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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	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

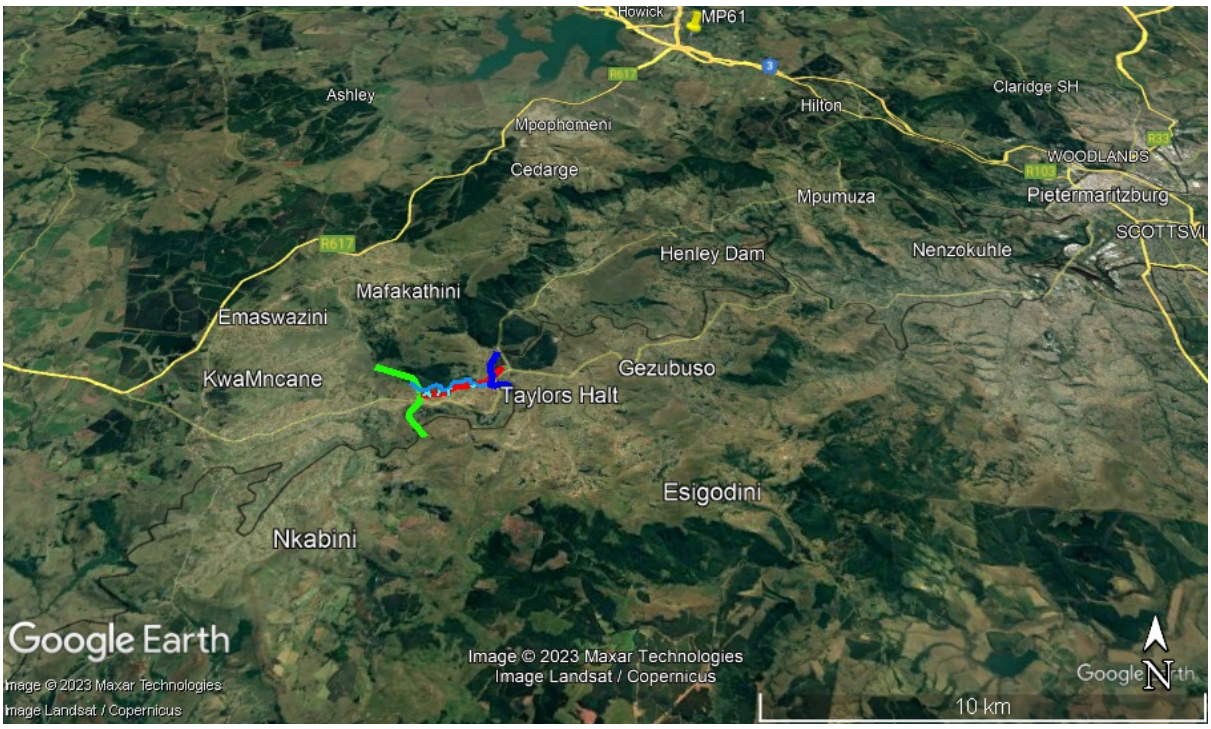

Figure 1: Google Earth map of the general area to show the relative land marks and nearby towns. The Taylors Halt project is shown by the coloured numbered lines.

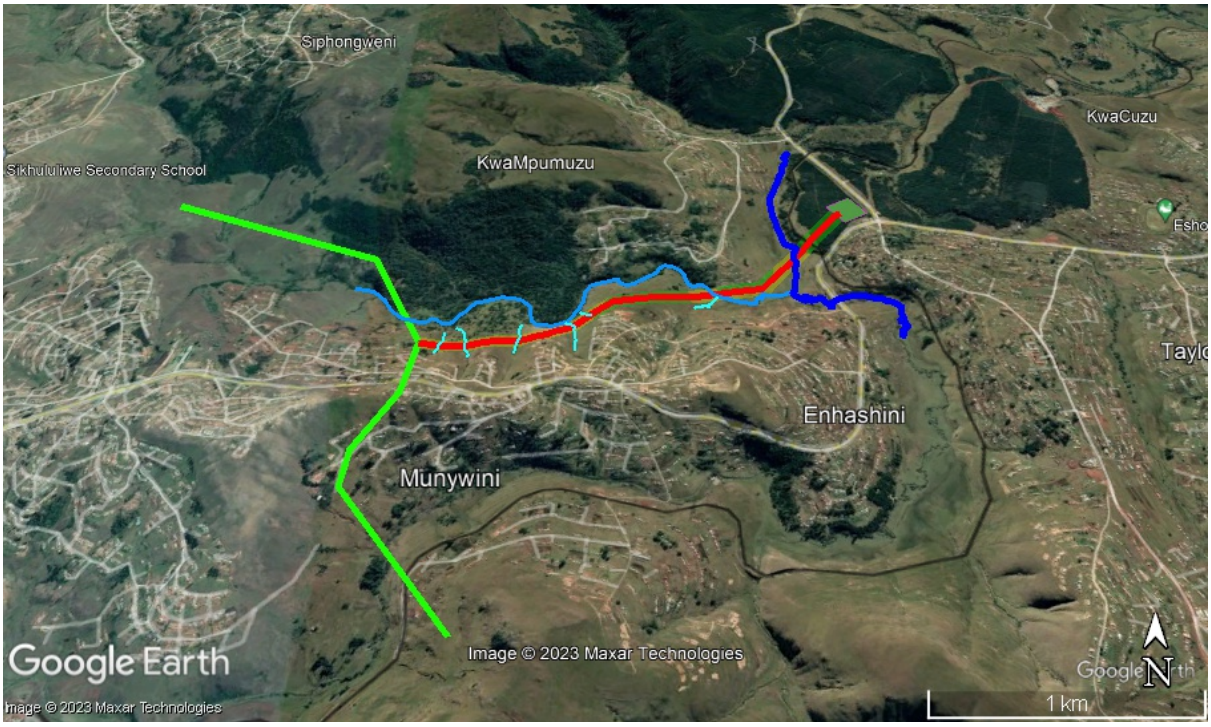

Figure 2: Google Earth Map of the proposed Taylors Halt 132kV powerline and substation. Green line – Ariadne-Elandskop powerline ; red line – proposed Taylors Halt power line; thick blue line –Msunduze River ; thin blue line – tributary into Msunduze River; short turquoise lines – drainage lines; green square – new Taylors Halt Substation

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

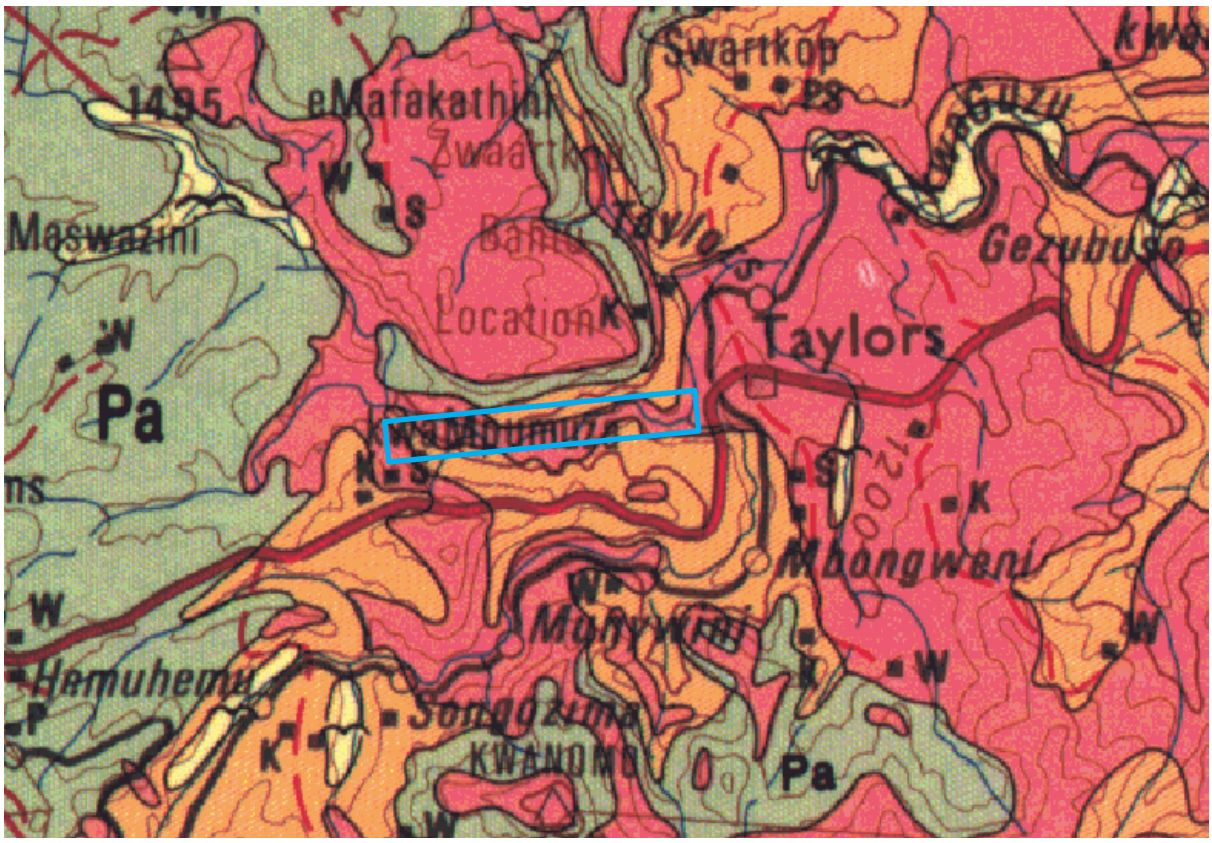

Figure 3: Geological map of the area around the Taylors Halt power line. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock

types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2930 Durban.

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

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic dolerite	Dolerite	Jurassic Ca 183 Ma
Pa	Adelaide Subgroup, Beaufort Group, Karoo Supergroup	Sandstone, shale	Late Permian
Pvo	Volksrust Fm, Ecca Group, Karoo SG	Dark-grey shales, mudstones	Middle Permian

The project lies in the south eastern part of the main Karoo Basin (Figure 3). The Karoo Supergroup rocks cover a very large proportion of South Africa and extend from the northeast (east of Pretoria) to the southwest and across to almost the KwaZulu Natal south coast. It is bounded along the southern margin by the Cape Fold Belt and along the northern margin by the much older Transvaal Supergroup rocks. Representing some 120 million years (300 – 183Ma), the Karoo Supergroup rocks have preserved a diversity of fossil plants, insects, vertebrates and invertebrates.

During the Carboniferous Period South Africa was part of the huge continental landmass known as Gondwanaland and it was positioned over the South Pole. As a result, there were several ice sheets that formed and melted, and covered most of South Africa (Visser, 1986, 1989; Isbell et al., 2012). Gradual melting of the ice as the continental mass moved northwards and the earth warmed, formed fine-grained sediments in the large inland sea. These are the oldest rocks in the system and are exposed around the outer part of the ancient Karoo Basin, and are known as the Dwyka Group (Johnson et al., 2006).

Overlying the Dwyka Group rocks are rocks of the **Ecca Group** that are Early Permian in age. There are eleven formations recognised in this group but they do not all extend throughout the Karoo Basin. In the Free State 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.

Overlying the Ecca Group are the rocks of the **Beaufort Group** that has been divided into the lower Adelaide Subgroup for the Upper Permian strata, and the Tarkastad Subgroup for the Early to Middle Triassic strata. As with the older Karoo sediments, the formations vary across the Karoo Basin. In this part of the basin three formations are recognised in the Adelaide Subgroup, the basal Koonap Formation, Middleton Formation and thick upper Balfour Formation. Without a distinct lithology or fossils it is not possible to recognise the formations within the Adelaide Subgroup, as is the case in the southwestern 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 powerline route is mostly on Jurassic dolerite (grey) and the Volksrust Formation (orange).

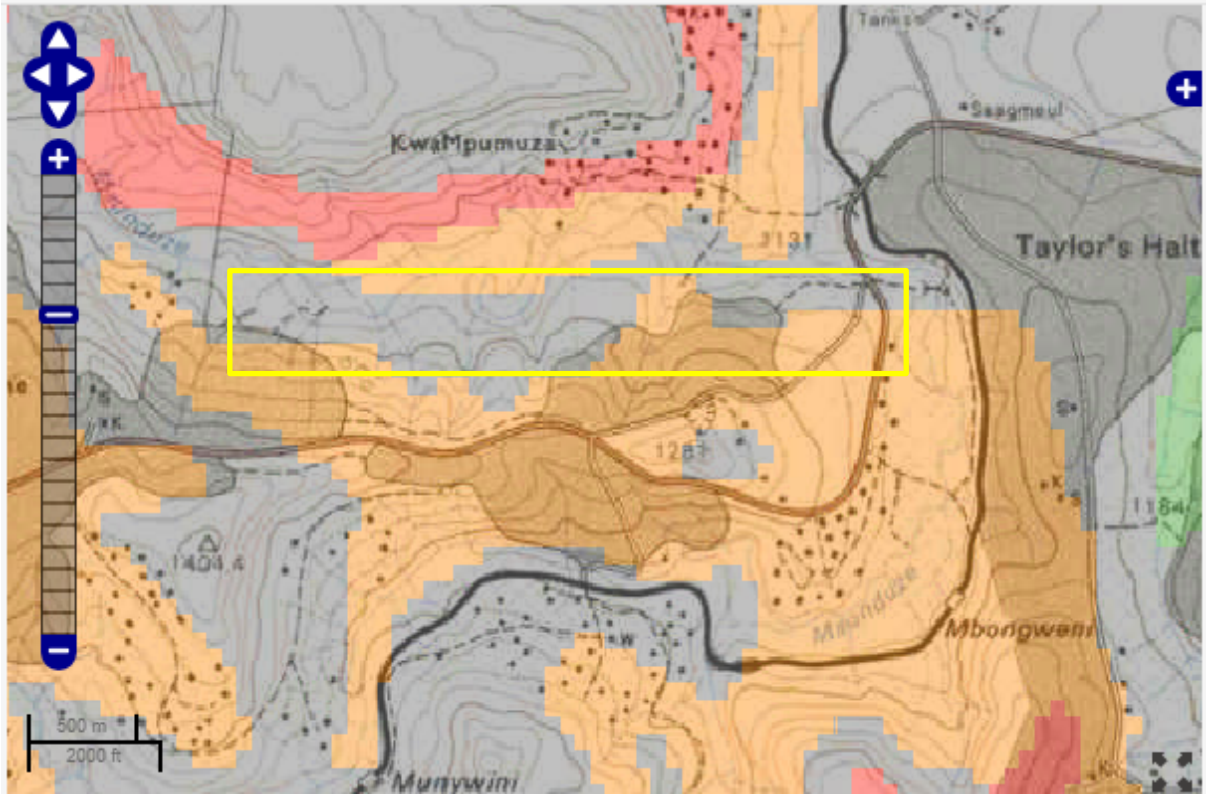

Figure 3: SAHRIS palaeosensitivity map for the site for the proposed route for the Taylors Halt 132kV powerline and new substation shown within the yellow rectangle (note the wide corridor is assessed here to accommodate alternatives. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The Volksrust Formation is the upper part of the Ecca Group (and lower Beaufort according to Smith et al., 2020) and is predominantly argillaceous and the grey to black silty shale with thin, usually bioturbated siltstone or sandstone lenses and beds that occur mostly in the upper and lower boundaries. The very thick and fine-grained sediments represent an open shelf environment where muds were deposited from suspension with (Johnson et al., 2006) in a deep water environment. It is not known if this was an inland sea or open marine setting but the discovery of the marine bivalve, *Megadesmus*, (albeit

one instance) about 25km west southwest of Newcastle in Volksrust Formation shales, points to a marine influence for at least part of the sequence (Cairncross et al., 2005).

The Adelaide Subgroup is part of the eastern foredeep basin and was deposited in the overfilled or non-marine phase (Catuneanu et al., 2005) and so comprises terrestrial deposits. There are numerous fining-upward cycles, abundant red mudrocks and sedimentary structures that indicate deposition under fluvial conditions (Johnson et al., 2006). Some of the lower strata probably represent a subaerial upper delta-plain environment and the generally finer grained materials are typical of meandering rather than braided rivers. Channel deposits are indicated by sandstones while overbank deposits are indicated by the mudstones (Johnson et al., 2006).

Jurassic dolerite is an intrusive volcanic material and so does not preserve fossils, in fact it often destroys any nearby fossils that were present in the sediments through which it intrudes. These dykes were emplaced at about the same time as the massive outpourings of basalt that formed the Drakensberg Mountains.

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.
	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local

Criteria for ranking the SPATIAL SCALE of impacts	**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	Dolerites do not preserve fossils; so far there are no records from the Volksrust Fm dark-grey shales 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.
SPATIAL SCALE	**L**	Since the only possible fossils within the area would be trace fossils in coastal margin settings or marine bivalves, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the loose soils and sands that cover the area or in river valley. Rare trace fossils occur in some settings but this area is not part of the palaeo-coastline of the Volksrust Fm. Nonetheless, a Fossil Chance Find Protocol should be added to the eventual EMPr.

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 wrong type to contain fossils. Furthermore, the material to be excavated is river sand and alluvium and this does not preserve fossils (Briggs, 2016; Cowan, 1995). Since there is an extremely small chance that fossils from the Volksrust Formation 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 do not contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils and any transported fossils would be on minimal scientific value.

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 deep-water, dark-grey shales of the Volksrust Formation. There is a very small chance that trace fossils may occur in the shales 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 pole or substation foundations 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, so as far as the palaeontology is concerned, the amendment to the project should be authorised.

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 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.

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

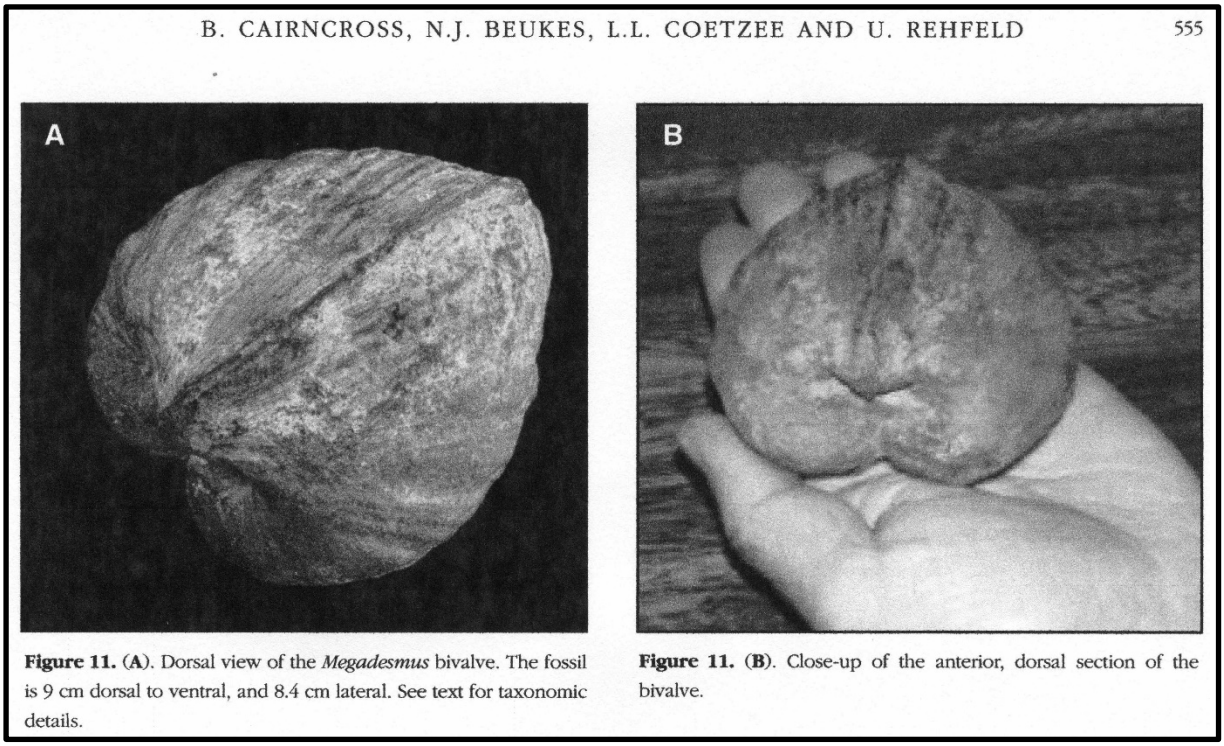

Figure 5: Photographs of the marine bivalve *Megadesmus* from the Volksrust Formation (from Cairncross et al., 2005).

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD January 2023

Present employment: Professor; Director of the Evolutionary Studies Institute.

Member Management Committee of the NRF/DSI Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa
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Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) **Academic qualifications**
Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) **Professional qualifications**
Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) **Membership of professional bodies/associations**
Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

v) **Supervision of Higher Degrees**

All at Wits University

Degree	Graduated/completed	Current
Honours	13	0
Masters	13	3
PhD	13	7
Postdoctoral fellows	14	4

vi) **Undergraduate teaching**
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year

Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12 - 20 students per year.

vii) **Editing and reviewing**
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals

viii) **Palaeontological Impact Assessments**
25 years' experience in PIA site and desktop projects

- Selected from recent projects only – list not complete:
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2022 for AHSA
- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage
- Hendrina North and South WEFs & SEFs 2022 for Cabanga
- Dealesville-Springhaas SEFs 2022 for GIBB Environmental
- Vhuvhili and Mukondelei SEFs 2022 for CSIR
- Chemwes & Stilfontein SEFs 2022 for CTS Heritage
- Equestria Exts housing 2022 for Beyond Heritage
- Zeerust Salene boreholes 2022 for Prescali
- Tsakane Sewer upgrade 2022 for Tsimba
- Transnet MPP inland and coastal 2022 for ENVASS
- Ruighoek PRA 2022 for SLR Consulting (Africa)
- Namli MRA Steinkopf 2022 for Beyond Heritage

ix) **Research Output**
Publications by M K Bamford up to January 2022 peer-reviewed journals or scholarly books: over 170 articles published; 5 submitted/in press; 14 book chapters.
Scopus h-index = 30; Google Scholar h-index = 39; -i10-index = 116 based on 6568 citations.
Conferences: numerous presentations at local and international conferences.

11. APPENDIX C - Legislation

Standard for the Development and Expansion of Power Lines and Substations within Identified Geographical Areas (CSIR, June 2022)*

*Full reference citation: Department of Forestry, Fisheries and the Environment, 2022. Standard for the Development and Expansion of Power Lines and Substations within Identified Geographical Areas Revision 2. Prepared by the CSIR and SANBI for the Strategic Environmental Assessment for the Expansion of Electricity Grid Infrastructure Corridors in South Africa.

1.1 Context of the Standard

The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) promotes the integrated environmental management of activities that may have a significant impact (positive or negative) on the environment. Section 24(1) of the NEMA states that "*in order to give effect to the general objectives of integrated environmental management laid down in this Chapter, the potential consequences for or impacts on the environment of listed activities or specified activities must be considered, investigated, assessed and reported on to the competent authority or Minister responsible for Mineral Resources, as the case may be, except in respect of those activities that may commence without having to obtain environmental authorisation in terms of this Act.*".
Section 24(2)(c) - (e) provides the ability of the Minister, or MEC in concurrence with the Minister to identify activities and geographical areas within which activities may be excluded from the requirement to obtain environmental authorisation and section 24(2)(d) provides the additional ability to link such exclusions with compliance with prescribed norms or standards.

This Standard, entitled "Standard for the Development and Expansion of Power lines and Substations within Identified Geographical Areas" (the Standard) has been adopted in terms of section 24(10)(a) of NEMA to allow for the exclusion, in terms of section 24(2)(d) of NEMA, of activities which relate to the development and expansion of electricity transmission and distribution infrastructure as identified in Listing Notices 1 and 2 of the Environmental Impact Assessment (EIA) Regulations, promulgated under section 24(5) of NEMA as well as any listed or specified activities necessary for the realisation of such infrastructure which includes substations, as described in the scope of this Standard.

This Standard has been developed based on two Strategic Environmental Assessment (SEA) processes undertaken for the development of Electricity Grid Infrastructure (EGI) in South Africa as listed below:

- SEA completed in 2016 for the identification and assessment of five (5) EGI Corridors; and

- SEA initiated in 2017 and completed in 2019 for the identification and assessment of two (2) expanded EGI Corridors.

The SEA processes identified geographical areas which are of strategic importance for the rollout of electricity transmission and distribution infrastructure in terms of Strategic Integrated Project 10: Electricity Transmission and Distribution for all. These geographical areas consist of seven strategic transmission corridors for the development of transmission and distribution infrastructure (Figure 1) that have been pre-assessed for environmental sensitivities.

- 2016 EGI SEA:
- Central Corridor;
- Eastern Corridor;
- International Corridor;
- Northern Corridor; and
- Western Corridor.
- 2019 Expanded EGI SEA:
- Expanded Eastern Corridor; and
- Expanded Western Corridor.

The study areas of the SEAs (i.e. the corridors) were investigated by specialists through desktop geographic information system (GIS) analysis. These strategic transmission corridors have been gazetted as identified geographical areas in Government Notice No. 113 published under Government *Gazette* No. 41445 of 16 February 2018 and Government Notice No. 1637 published under Government *Gazette* No. 45690 of 24 December 2021.

The Final SEA Reports for the 2016 EGI SEA and 2019 EGI Expansion SEA can be accessed at: https://gasnetwork.csir.co.za/ and https://egis.environment.gov.za/

1.4 Exclusions

This Standard and exclusions do not apply in the following instances:
Where any part of the infrastructure occurs on an area for which the environmental sensitivity for a relevant environmental theme is identified as being very high or high by the screening tool and confirmed to be such by the EAP or the relevant specialist for the identified environmental theme;
Where the site verification for a specific theme identifies that the low or medium sensitivity rating of the screening tool is in fact high or very high; or
Where the greater part of the proposed infrastructure fall outside of any strategic transmission corridor.

Where this Standard* does not apply, either the requirements of the EIA Regulations, or the requirements of Government Notice No. 113 in Government *Gazette* No. 41445 of 16 February 2018, read with the NEMA EIA Regulations, where relevant, will apply to the relevant environmental theme for which the very high or high sensitivity has been identified, in respect of the portion of the development which occurs on the area where the environmental sensitivity is confirmed to be very high or high, or to the entire

development where the greater part of the infrastructure falls outside of the strategic transmission corridor.

1.5 Applicability of the Generic Environmental Management Programme

As part of the 2016 EGI SEA, a Generic Environmental Management Programme (EMPr) was compiled for the development and expansion of: (a) overhead electricity transmission and distribution infrastructure; and (b) substation infrastructure for the transmission and distribution of electricity. The two Generic EMPrs were gazetted for implementation in Government Notice No. 435 published under Government *Gazette* No. 42323 of 22 March 2019. The Generic EMPrs apply within South Africa as a whole, and need to be applied for the development of all overhead and substation electricity transmission and distribution infrastructure (as contained in the EIA Regulations Listing Notices 1 – 3 published in Government Notices R9827, R9838, R9849 and R98510). These Generic EMPrs consist of the following:

- Part A - Includes definitions, acronyms, roles and responsibilities and documentation and reporting requirements.
- Part B – Section 1: Pre-Approved Generic Template that must be completed by the contractor prior to commencement of construction. This section does not need to be submitted to the competent authority.
- Part B – Section 2: Provision of preliminary infrastructure layout and a declaration that the applicant/holder of the environmental authorisation will comply with the pre-approved Generic EMPr template contained in Part B: Section 1 and understands that the impact management outcomes and impact management actions are legally binding.
- Part C – Site Specific Sensitivities and Attributes: If any specific environmental sensitivities or attributes are present on the site which require site specific impact management outcomes and actions that are not included in the pre-approved generic EMPr (Part B – Section 1), these specific impact management outcomes and actions must be included in Part C and must be submitted to the competent authority for approval.

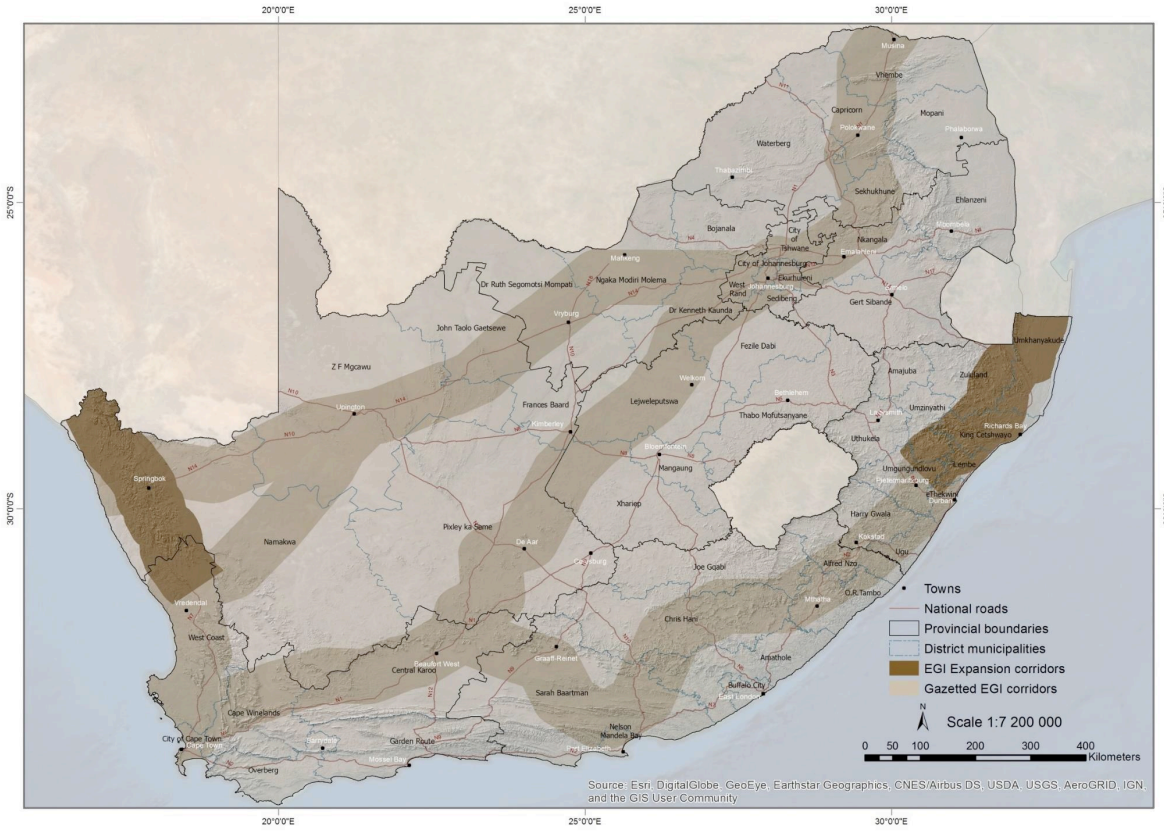

Figure 1: Electricity Grid Infrastructure (EGI) corridors based on Strategic Environmental Assessment processes (SEA areas (from Standard Document p 8)

SAHRA legislation and Minimum Standards

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 (phase 1) or site visit and walk-through (Phase 2) Palaeontological Impact Assessment (PIA), must be completed for the proposed development and is reported as part of the EIA process. The report must comply with the SAHRA Minimum Standards (Table 1 below).

The most reliable resource to determine the sensitivity of a site for palaeontology is the SAHRIS Palaeosensitivity Map that is based on the 1:250 000 Geological maps of South Africa together with the various Palaeosensitivy Reports for each province. These can be found at https://sahris.sahra.org.za/map/palaeo

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:
ai	Details of the specialist who prepared the report,
aii	The expertise of that person to compile a specialist report including a curriculum vitae
b	A declaration that the person is independent in a form as may be specified by the competent authority
c	An indication of the scope of, and the purpose for which, the report was prepared
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
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment
e	A description of the methodology adopted in preparing the report or carrying out the specialised process
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure
g	An identification of any areas to be avoided, including buffers
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;
i	A description of any assumptions made and any uncertainties or gaps in knowledge;
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
k	Any mitigation measures for inclusion in the EMPr
l	Any conditions for inclusion in the environmental authorisation
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised
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
o	A description of any consultation process that was undertaken during the course of carrying out the study
p	A summary and copies of any comments that were received during any consultation process
q	Any other information requested by the competent authority.
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.