Palaeontological Impact Assessment for the proposed Eskom-Transnet Freight Rail Project west of Lephalale, And southwards to Thabazimbi, Limpopo and Northwest Provinces

Desktop study

For

Landscape Dynamics

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Expertise of Specialist

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Declaration of Independence

This report has been compiled by Professor Marion Bamford, sub-contracted by Landscape Dynamics, Pretoria and Cape Town, 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

Eskom Holdings SOC Limited: Limpopo Operating Unit, is applying for Environmental Authorisation for the proposed Eskom Transnet Freight Rail Project. The project runs south and west of Medupi Power Station near Lephalale to just north of Thabazimbi in the Limpopo Province. The project includes the construction of four traction substations at Lephalale, Diepspruit, Matlabas and Marakele. In order to comply with 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 palaeontological impact assessment has been done and is reported here.

The proposed routes and sites for the Theunispan-Lephalale-Medupi section (north section) and the Lephalale, Diepspruit, Matlabas and Marakele Traction substations lie on rocks of the Waterberg Group. More specifically, the northern section, includingDiepspruit, are on sandstones of the Sandriviersberg and Mogalakwena Formations (Kransberg Subgroup), the Matlabas Traction substation is on sandstones of the Skilpadkop and Setlaole Formations (Matlabas Subgroup), and the Marakele Traction substation is on sandstones of the Alma Formation (Nylstroom Subgroup).

The formations of the Waterberg Group listed here are not fossiliferous because they are older than the evolution of body fossils and are too coarse-grained, as far as recorded to date, to preserve microbial trace fossils. Microbial trace fossils such as “biological soil crusts” have only been reported from the fine-grained sandstones of Makgabeng Formation which is about 75km east of Lephalale.

It is concluded that there is no chance of finding fossils in the medium to coarse-grained sandstones of the majority of the formations of the Waterberg Group and that, as far as the palaeontology is concerned, the excavation for foundations for the project pylons, access roads and buildings may proceed. There are no preferred routes or sites.

Table of Contents

1. Background

Landscape Dynamics Environmental Consultants was appointed by Eskom Holdings SOC Limited: Limpopo Operating Unit, to apply for Environmental Authorisation for the proposed Eskom Transnet Freight Rail Project. The project runs south and west of Medupi Power Station near Lephalale to just north of Thabazimbi in the Limpopo Province (Figure 1).

The project entails the construction of

- 4 x 132kV Traction Substations (Lephalale, Diepspruit, Matlabas and Marekele)
- 4x communication towers
- ±7km 132kV line from Medupi to proposed Lephalale Traction Sub
- ±26km 132kV line from Lephalale Traction Sub to existing Theunispan Sub
- ±15km 132kV line from Theunispan Sub to Theunispan T-off
- 3 x 132kV line bays at Theunispan Sub
- Loop in-out the 132kV traction stations as follows:

o Lephalale Traction – 2 x 40 m 132kV lines from the new Medupi Theunispan line
o Diepspruit Traction – 2 x 1 km 132kV lines from the existing Medupi Thabazimbi line
o Matlabas Traction – 2 x 1 km 132kV lines from the existing Medupi Thabazimbi line
o Marekele Traction – 2 x 2.5 km 132kV Lines from the existing Medupi Thabazimbi line

A Palaeontological Impact Assessment was requested for the Eskom-Transnet project. To comply with 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 as parts of the project fall in moderately sensitive areas as far as the palaeontology is concerned. The descriptive part of this report (geology, palaeontological and palaeosensitivity) is divided into six sections for the different routes and Traction substations – see Figure 1 – and the overall results are summarised in Section 3ii.

Descriptive Section numbering from north to south according to Figure 1 are:

1. Medupi – Lephalale – Theunispan Route (google map, geology map, SAHRIS palaeosensitivity map)
2. Lephalale Traction substation and maps as above
3. Diepspruit Traction substation and maps
4. Matlabas Traction substation and maps
5. Marakele Traction substation and maps
6. Thabazimbi – to complete the route (no new structures)

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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialists who prepared the report	Appendix A

aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
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	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	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	N/A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 7
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	N/A
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 if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

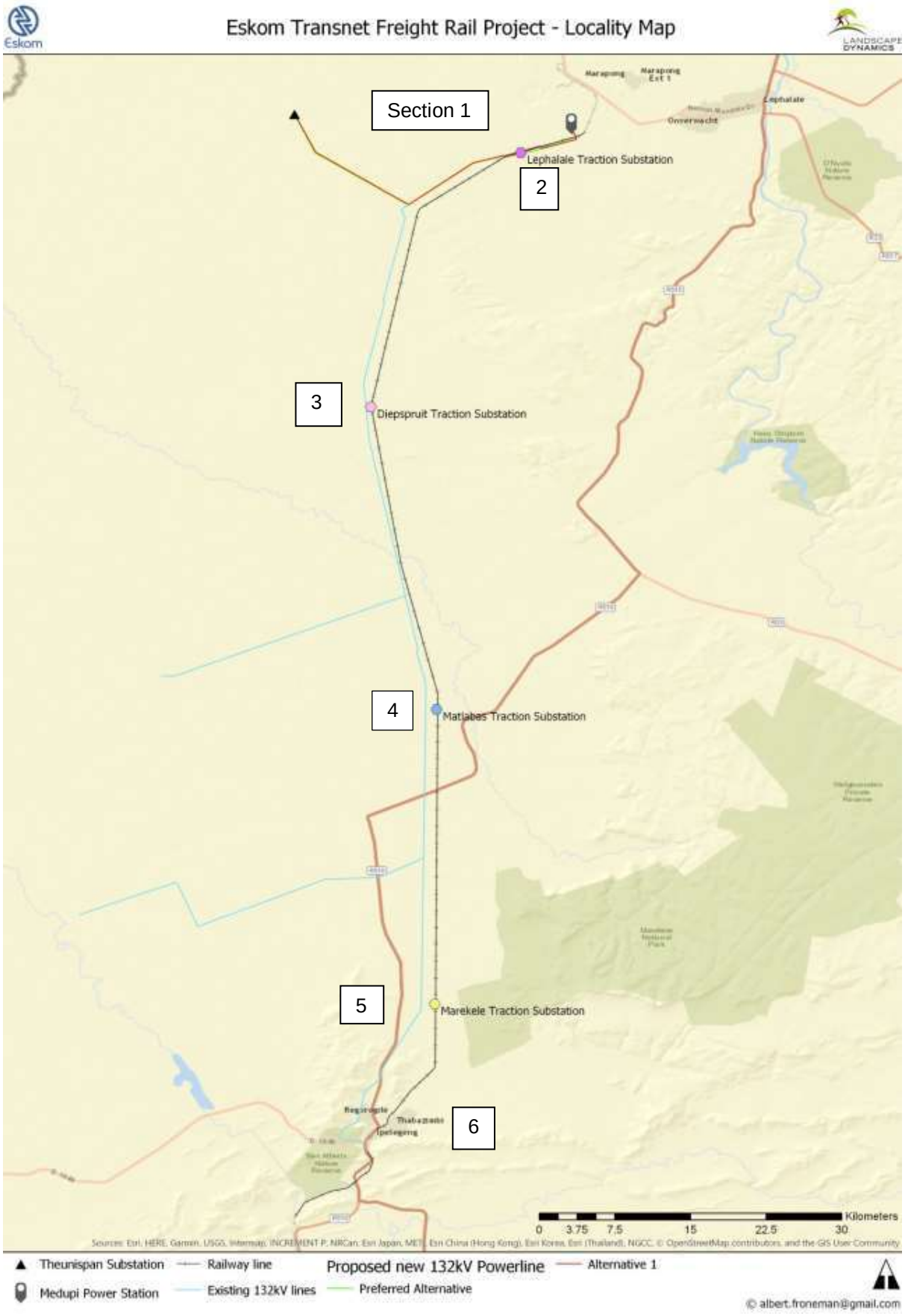

Figure 1: Map of the whole project. Numbers apply to the sections for the palaeontological study.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

The northern part of the project, the more or less west-east route between Theunispan and Medupi, lies along a geological border. To the north is the Ellisrus Basin that is the same age as the Main Karoo Basin, Late Carboniferous to Early Jurassic, (ca 300 – 180 million years old) and contains important coal deposits that are exploited for the coal-fired power plants of Medupi and Matimba. To the south is the main Waterberg Basin that preserves much older rocks of the Waterberg Group that are Palaeozoic in age, (ca 2060 – 1800 million years old; Simpson et al., 2013). The powerline, north to south section, traverses the Waterberg Basin to Thabazimbi which is on its southern margin and adjacent to the even older Transvaal Basin.

The Waterberg Group has been divided into three subgroups and ten formations; the latter do not occur in all three part of the basin, namely the south-southeast and central area, the north-northeast and central area and the Nylstroom Basin (Barker et al., 2006; fig 10 and table 2); see Table 2 in this report.

Widespread alluvium and sands of the Kalahari Group occur throughout the whole region and these are much younger than the rocks below. Intrusive rocks, diabase, are scattered throughout the Waterberg Basin. As diabase is not fossiliferous it will not be discussed further.

<u>Palaeontological Section 1 – Medupi-Lephalale-Theunispan Route</u>

Figure 2: Detailed map for Palaeontology Section 1 (see Fig 1) of the proposed road, rail and pipeline routes for the Medupi - Lephalale – Theunispan section of the Eskom – Transnet Freight Rail Project. Colours of lines as indicated in the legend included in the map. Map supplied by Landscape Dynamics.

Table 2: Explanation of symbols for the geological maps (Figures 3 below) and approximate ages (Barker et al., 2006; Johnson et al., 2006; Simpson et al., 2013). SG = Supergroup; Fm = Formation; Ma = million years.

Formation	**Lithology**	**Notes**
Quaternary	Calcrete, ferricrete, terrace gravel, soil, unconsolidated red sand, alluvium and scree	Late Middle Pleistocene
Tertiary deposits	Gravel and sand, sometimes calcified	Occur close to rivers
K4d Letaba Fm	Basaltic lava	125m thick (boreholes) south of Zoetfontein Fault and northeast of Grootgeluk mine only
K4r Clarens Fm	Massive sandstone, aeolian	130m thick. Forms hills and ridges
K4l Lisbon Fm (Elliot)	Red massive mudstone, siltstone, silty sandstone, calcareous concretions	100-110m thick. Exposures only in bed of Limpopo river, Lisbon 19 LQ
Greenwich Fm K4m (Molteno)	Sandstone, minor conglomerates	Borehole: narrow band
Eendragtpan Fm K3 (Beaufort)	Variegated mudstones	110m (central) to 40m thick (north); fine-grained, no plant material (p 34)

Grootgeluk Fm K2U (upper Ecca)	Mudstone, carbonaceous shale, coal	10-110m thick; *Glossopteris* leaves common, pollen
Goedgedacht Fm K2M (middle Ecca)	Sandstones, siltstones, coaly mudstones, very thin coal layers	Only in north and northwestern part of basin
Swartrant Fm K2L (lower Ecca)	Sandstone, siltstone	3 zones, each with *Stigmaria* roots
Wellington Fm K1 (Dwyka)	Mudstone, siltstone and sandstone lenses	Pollen (MacRae, 1991) C-P boundary
Waterkloof Fm K1 (Dwyka)	Diamictite, mudstone, conglomerate	Borehole: deeply weathered
Diabase intrusions	diabase	Post Karoo, probably Jurassic
W (orange)	Waterberg Group; Sandrivierberg and Mogalakwena Fms, Kransberg Subgroup.	Conglomerate, grit, quartzitic sandstone

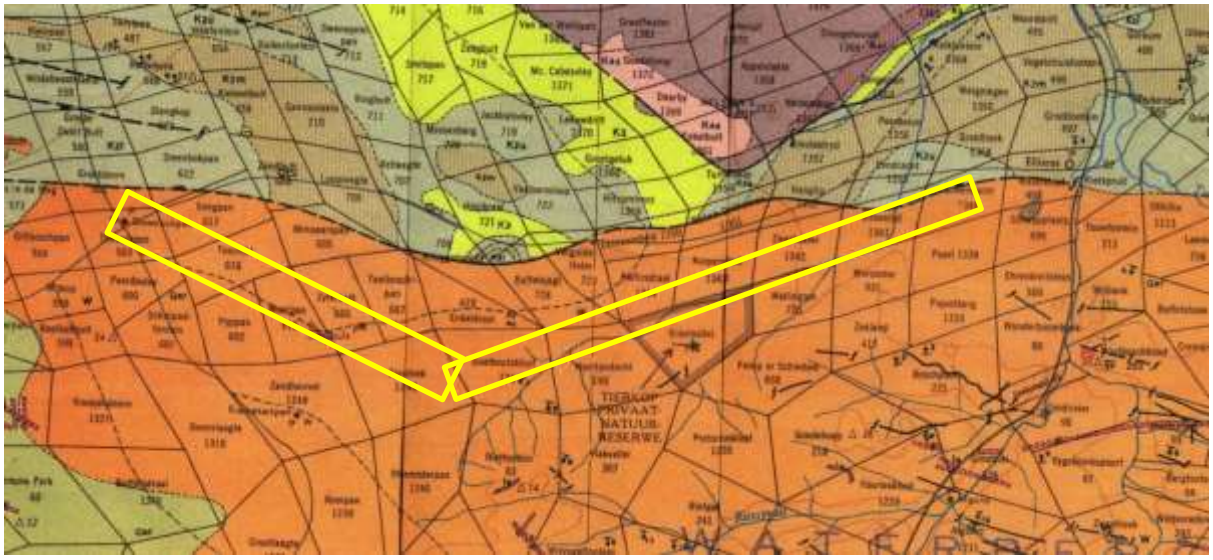

Figure 3: Geological map of the area between Theunispan and Lephalale (old name Ellisrus). The proposed routes are for the rail, road and powerlines for the Eskom-Transnet project. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map Ellisrus 2326, 1984.

Geology and Palaeontology Section 1

All the routes lie on rocks of the upper Waterberg Group, namely the Sandriviersberg and Mogalakwena Formations, Kransberg Subgroup. They comprise a variety of sandstones (Barker et al., 2006). The Sandriviersberg Formation has medium to coarse-grained arenite, granule-rich arenite and granule rudite. It coarsens progressively towards the northeast where it grades into the Mogalakwena Formation that has well developed trough and planar cross-bedded sublitharenites or litharenites. These two formations were deposited by large braided rivers flowing from highlands in the north-northeast towards a distant sea in the

southwest. The rocks are between 2060 and 1800 million years old (Simpson et al., 2013) and so are too old for body fossils. No microbial trace fossils have been recorded to date from these formations but they have been reported from slightly older formations, namely the Makgabeng Formation, which could explain the SAHRIS classification of moderately sensitive (Figure 4; green). The Makgabeng Formation, however, has finer-grained sediments (Barker et al., 2006) that are better suited to the preservation of microbial structures.

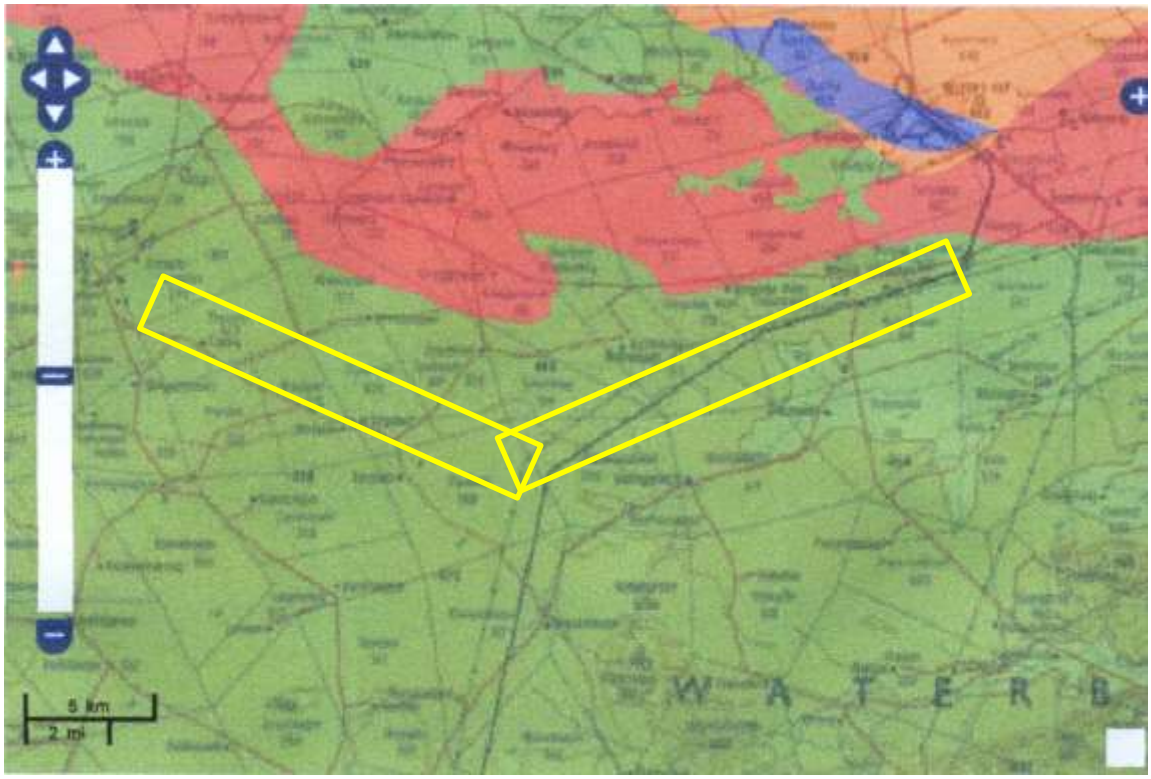

Figure 4: SAHRIS palaeosensitivity map for the area between Theunispan and Lephalale. The proposed routes for the rail, road and powerlines for the Eskom-Transnet project are within the yellow rectangles. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Palaeontological Section 2 – Lephalale Traction substation

The geology and palaeontology are the same as for Section 1: the site (Figure 5) lies on rocks of the Waterberg Group, Sandriviersberg and Mokalakwena Formations (Figure 6) that are medium to coarse-grained sandstones and most unlikely to preserve any fossils as they are too old for body fossils, and too coarse-grained to preserved microbial structure, although the site is indicated as moderately sensitive in the SAHRIS palaeosensitivity map (Figure 7).

Figure 5: Detailed map for Palaeontology Section 2 (see Fig 1) of the proposed road, rail and pipeline routes for Lephalale Traction substation for the Eskom – Transnet Freight Rail Project. Colours of lines as indicated in the legend included in the map. Map supplied by Landscape Dynamics.

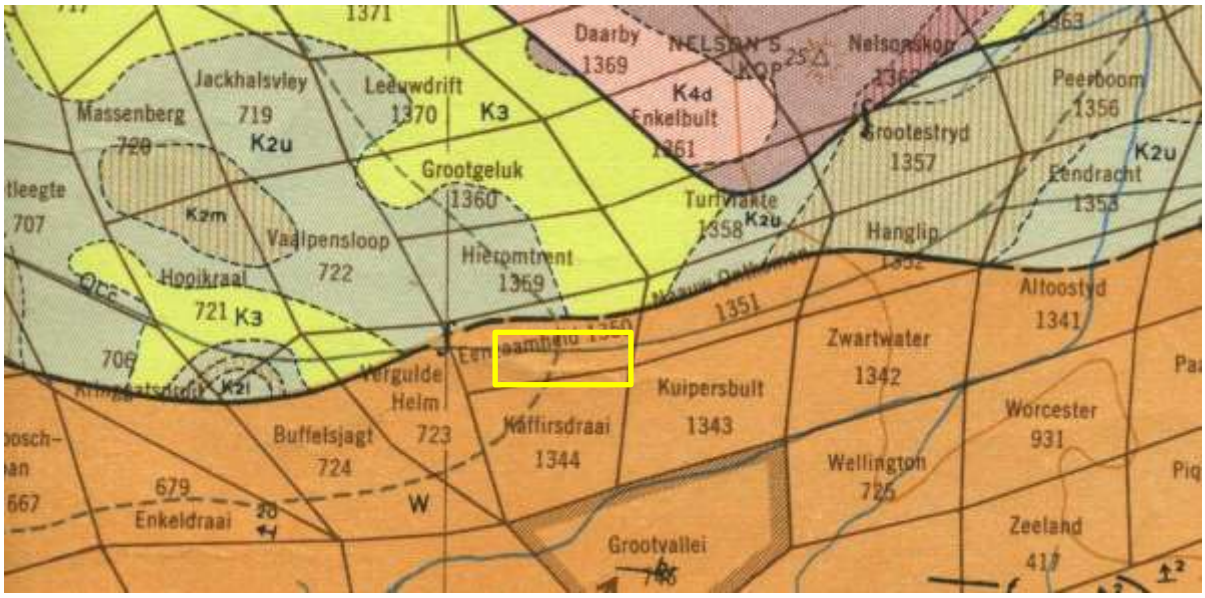

Figure 6: Geological map of the area around Lephalale for the proposed routes for the Traction substation (yellow rectangle) for the Eskom-Transnet project. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map Ellisrus 2326, 1984.

Figure 7: SAHRIS palaeosensitivity map for the area around Lephalale and the proposed Traction substation within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Palaeontological Section 3 – Diepspruit Traction Substation.

The geology and palaeontology are the same as for Section 1: the Diepspruit site (Figure 8) lies on rocks of the Waterberg Group, Sandriviersberg and Mokalakwena Formations (Figure 9) that are medium to coarse-grained sandstones and most unlikely to preserve any fossils as they are too old for body fossils, and too coarse-grained to preserved microbial structure, although the site is indicated as moderately sensitive in the SAHRIS palaeosensitivity map (Figure 10).

Figure 8: Detailed map for Palaeontology Section 3 (see Fig 1) of the proposed road, rail and pipeline routes for Lephalale Traction substation for the Eskom – Transnet Freight Rail Project. Colours of lines as indicated in the legend included in the map. Map supplied by Landscape Dynamics.

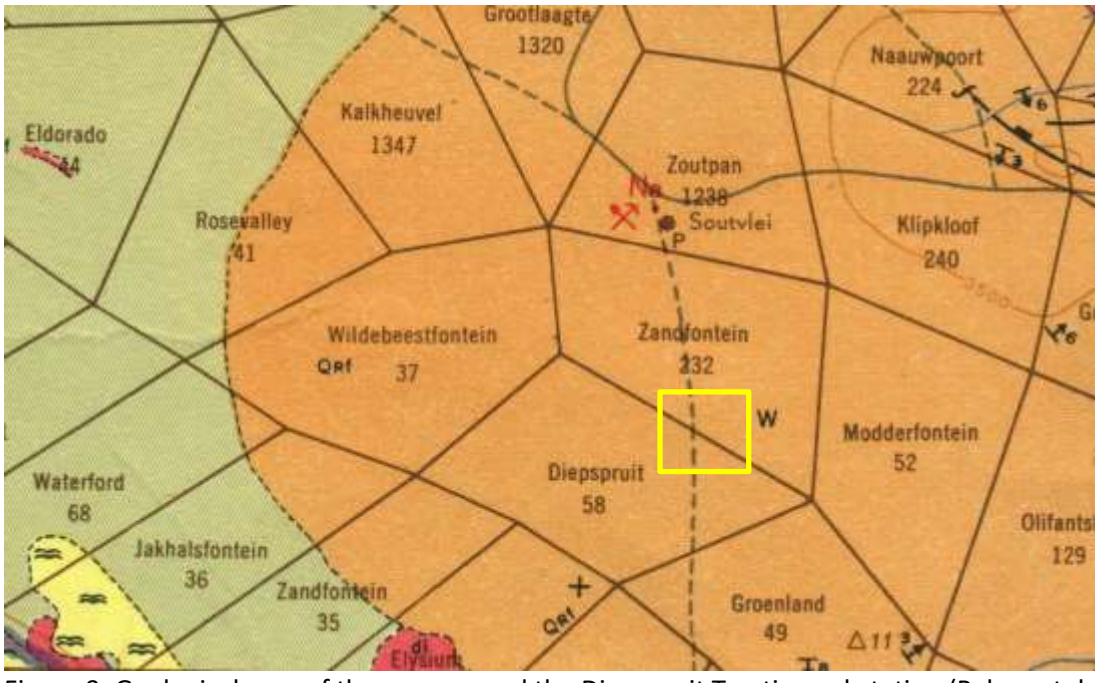

Figure 9: Geological map of the area around the Diepspruit Traction substation (Palaeontology Section 3) (yellow rectangle) for the Eskom-Transnet project. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map Ellisrus 2326, 1984.

Figure 10: SAHRIS palaeosensitivity map for the area around Diepspruit Traction substation within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Palaeontology Section 4 – Matlabas Traction substation

The geology and palaeontology are similar to Section 1: the Matlabas site (Figure 11) also lies on rocks of the Waterberg Group, but on the Langloof Formation (old name and probably equivalent to the Skilpadkop and Setlaole Formations) of the Matlabas Subgroup (Figure 12) that are thickly bedded immature lithic arenites and pebble rudites (Barker et al., 2006) and most unlikely to preserve any fossils as they are too old for body fossils, and too coarse-grained to preserved microbial structure, although the site is indicated as moderately sensitive in the SAHRIS palaeosensitivity map (Figure 13).

The Skilpadkop Formation was deposited in a braided river which formed a narrow braidplan to the north of the Murchison Fault. The Setloale Formation is made up of granule-rich arenites and rudites with lesser tuffs and tuffaceus mudstone. It has been interpreted as a proximal fluvial facies that was deposited on a narrow braid-plain (Barker et al., 2006).

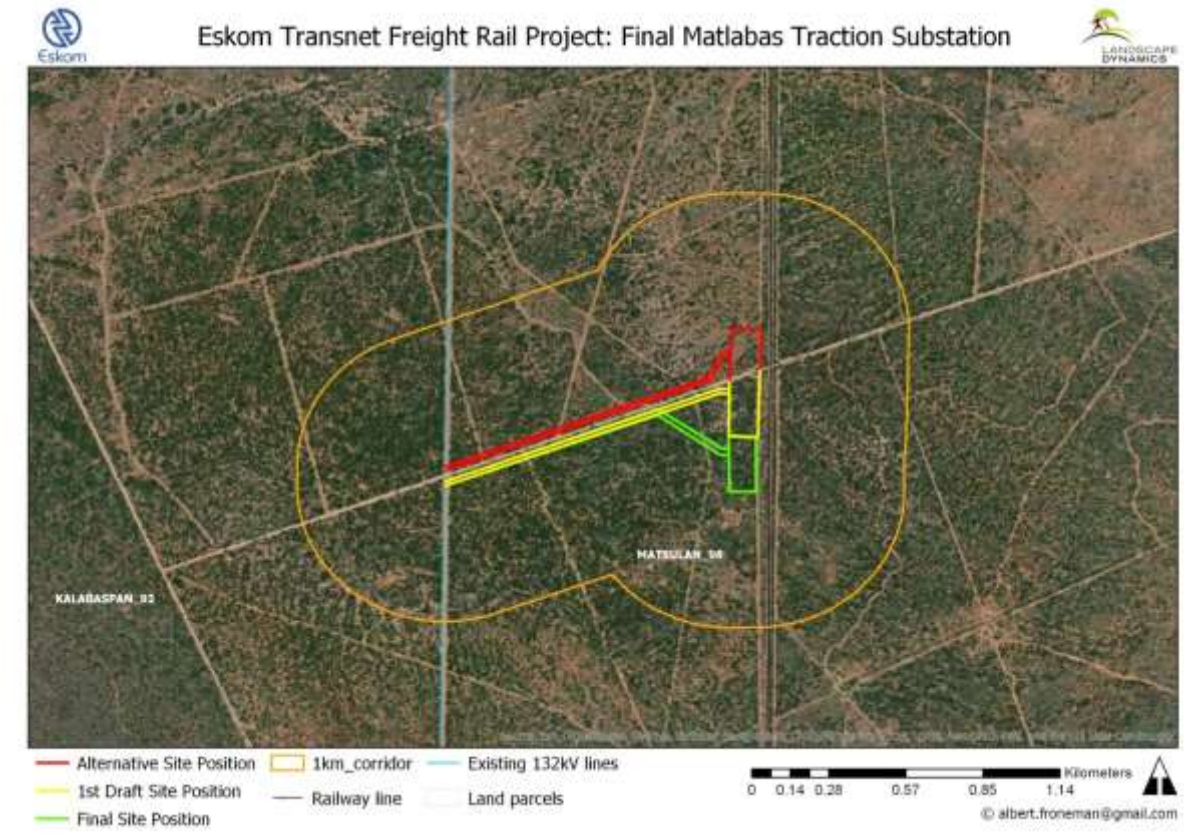

Figure 11: Detailed map for Palaeontology Section 4 (see Fig 1) of the proposed Matlabas Traction substation for the Eskom – Transnet Freight Rail Project. Colours of lines as indicated in the legend included in the map. Map supplied by Landscape Dynamics.

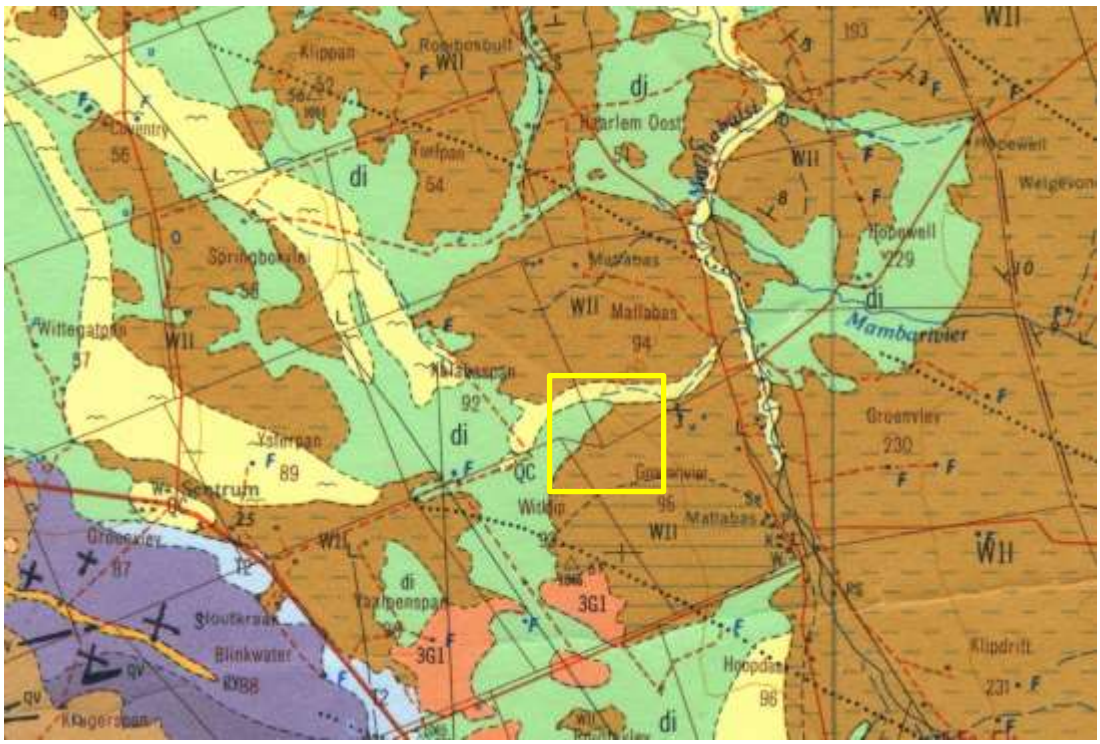

Figure 12: Geological map of the area around the proposed Matlabas Traction substation (yellow rectangle) for the Eskom-Transnet project. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map Thabazimbi 2426, 1984.

Table 3: Explanation of symbols for the geological maps (for Figures 12 and 15) and approximate ages (Barker et al., 2006; Johnson et al., 2006; Simpson et al., 2013). SG = Supergroup; Fm = Formation; Ma = million years.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Sand, alluvium, calcrete	
di	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Mv	Vaalwater, Formation, Kransberg Subgroup, Waterberg Group	Feldspathic sandstone, shale	2060 – 1880 Ma
Mc	Cleremont Fm, Kransberg Subgroup, Waterberg Group	Sandstone	2060 – 1880 Ma
Msm	Sandriviersberg and Mogalakwena Fms, Kransberg Subgroup, Waterberg Group	Sandstone, conglomerate	2060 – 1880 Ma
W1l	Langkloof Fm, poss Skilpadkop and Setlaole Fm, Matlabas Subgroup, Waterberg Group	Siltstones, shales, sandstone, grit	2060 – 1880 Ma
W1a	Alma Fm, Nylstroom Subgroup, Waterberg Group	Feldspathic greywacke, sandstone, grit, conglomerate, arkose, siltstone	2060 – 1880 Ma
T2	Dolomite series, Transvaal SG (poss Malamani subgroup)	Dolomites, chert	
3G1	Main granite, Bushveld complex	granite	

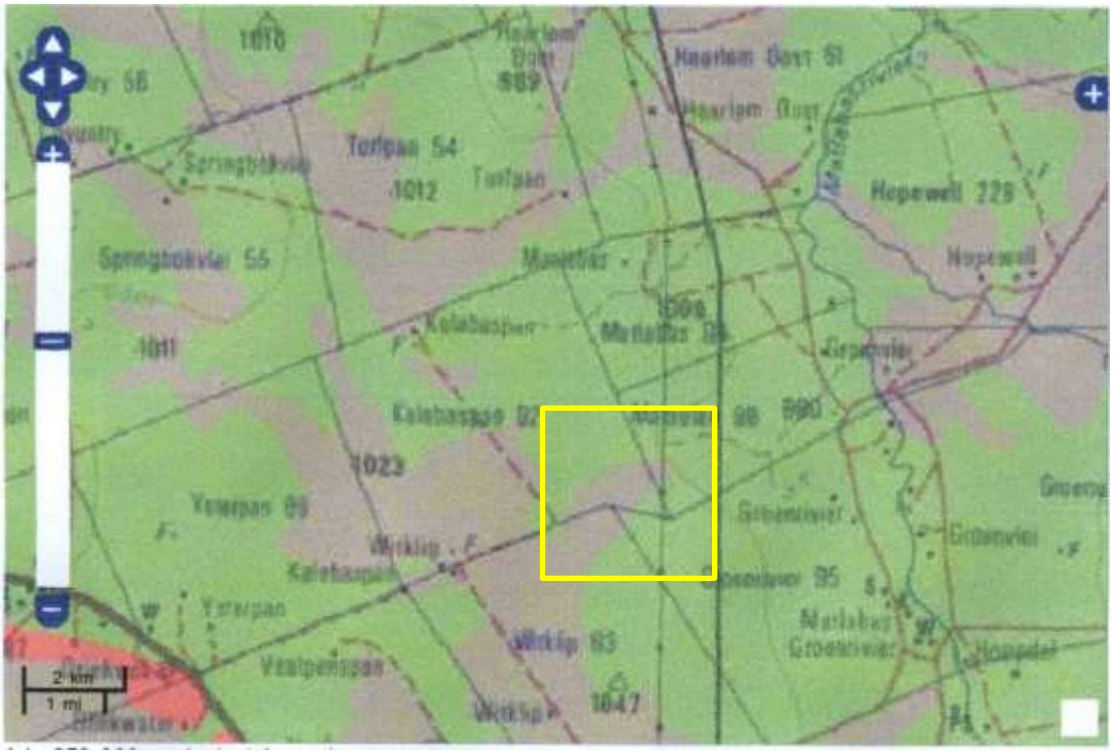

Figure 13: SAHRIS palaeosensitivity map for the area around the proposed Matlabas Traction substation (within the yellow rectangle). Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Palaeontology Section 5 – Marekele Traction Substation

The geology and palaeontology are similar to that for Section 4: the Marekele site (Figure 14) lies on rocks of the Waterberg Group, but on the Alma Formation, Nylstroom Subgroup (Figure 15) that are medium to coarse-grained arkoses to arenites and most unlikely to preserve any fossils as they are too old for body fossils, and too coarse-grained to preserve microbial structures, although the site is indicated as moderately sensitive in the SAHRIS palaeosensitivity map (Figure 16).

The Alma Formation comprises a succession of medium to coarse-grained arkoses, lithic arkoses, feldspathic arenites, subarkoses and litharenites (Barker et al., 2006). They interpret these sediments as having been deposited as a series of alluvial fans, forming a bajada along a scarp caused by an uplifted block on the south side of the Murchison strike-slip fault zone (ibid).

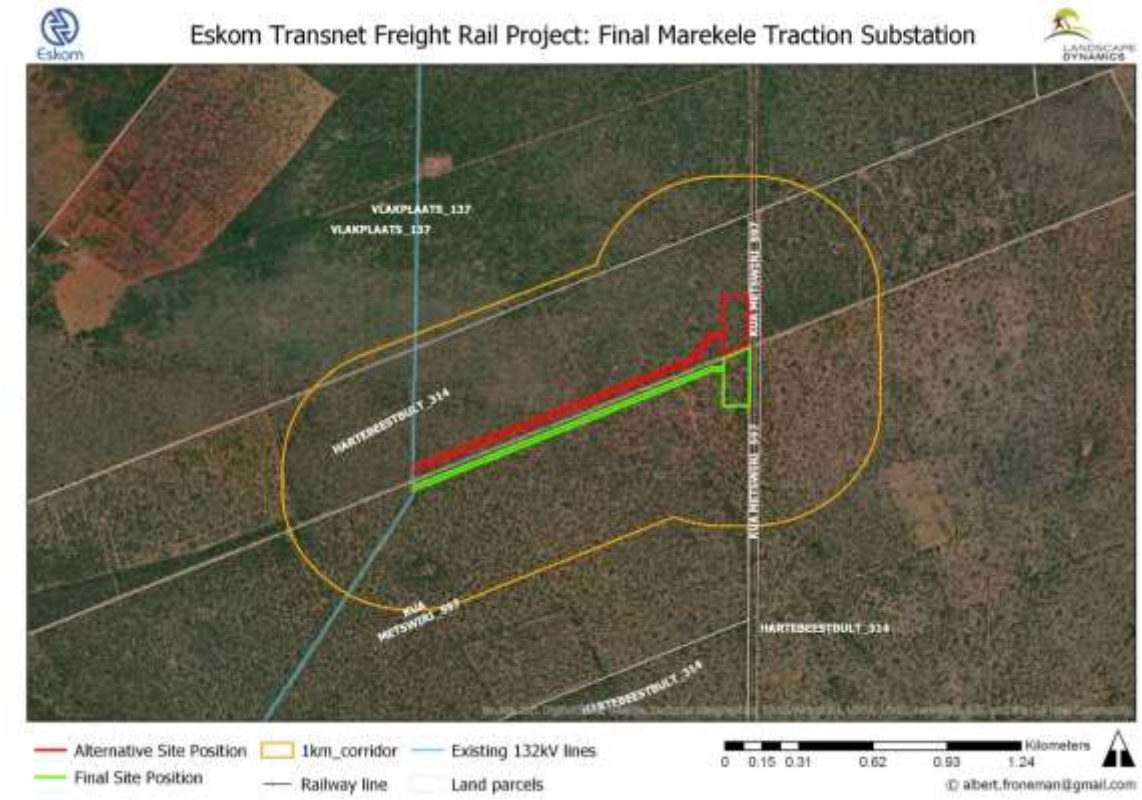

Figure 14: Detailed map for Palaeontology Section 5 (see Fig 1) of the proposed Marekele Traction substation for the Eskom – Transnet Freight Rail Project. Colours of lines as indicated in the legend included in the map. Map supplied by Landscape Dynamics.

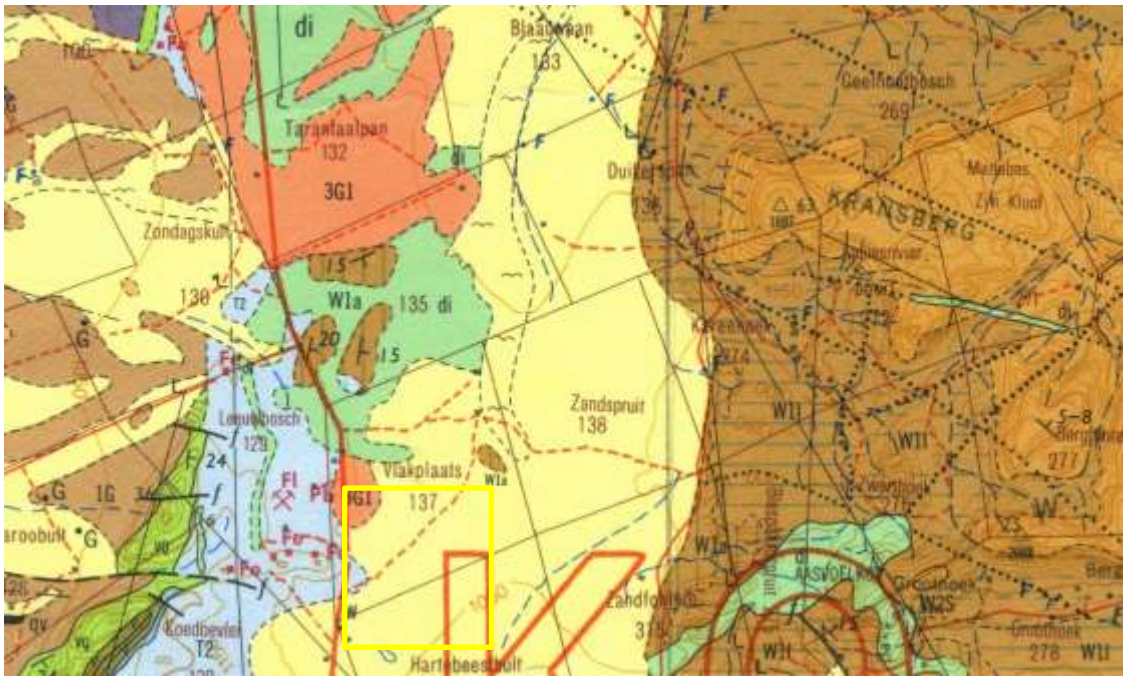

Figure 15: Geological map of the area around Marekele Traction substation (yellow rectangle) for the Eskom-Transnet project. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map Thabazimbi 2426, 1984.

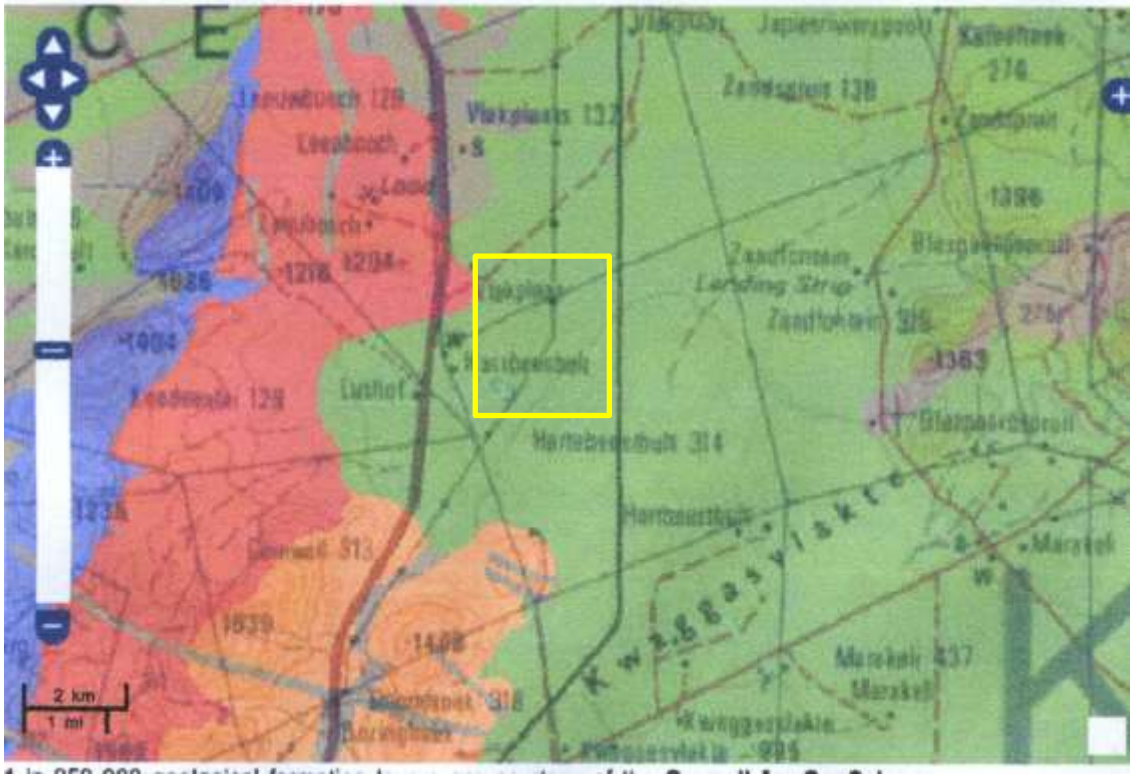

Figure 16: SAHRIS palaeosensitivity map for the area around Marekele Traction substation within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

Palaeontology Section 6 – End of route – Thabazimbi

No new structures are planned for this section as there is an existing powerline. The geology of the area is the same as for the sections north of the town of Thabazimbi, namely the Waterberg Group. The other rocks in the region are shales, hornfels and quartzites of the Timeball Hill Formation (lower Pretoria Group) and Malmani Subgroup dolomites and cherts (Chuniespoort Group), both of the Transvaal Supergroup, and the Black Reef Formation. There are also intrusive rocks of the Bushveld Complex in this area. Only the Malmani Subgroup is potentially fossiliferous (stromatolites/trace fossils) as these rocks are ancient, but no new development is planned in this project.

Figure 17: Google Earth map for the entire route (see Fig 1) of the proposed road, rail and pipeline routes for the Lephalale to Thabazimbi Eskom – Transnet Freight Rail Project shown in purple. Map supplied by Landscape Dynamics.

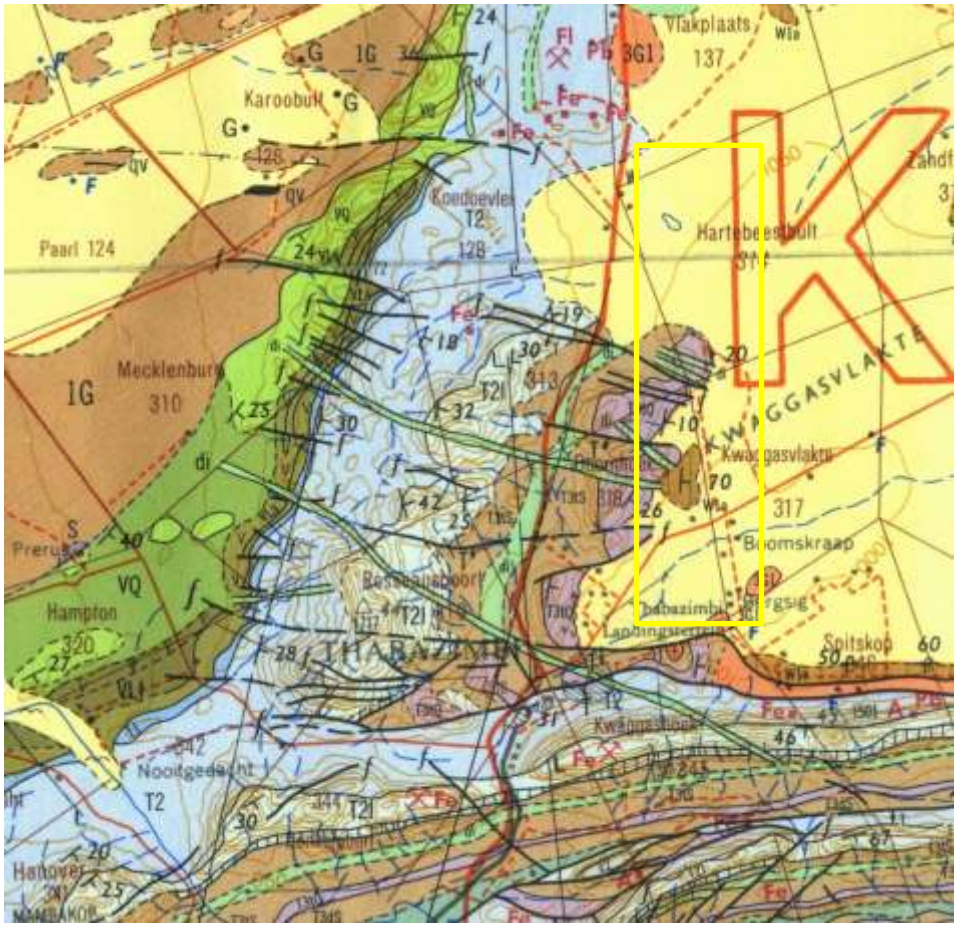

Figure 18: Geological map of the area north of Thabazimbi for the existing routes for the Eskom-Transnet project. The route is on Kalahari sands and alluvium (yellow). Map enlarged from the Geological Survey 1: 250 000 map Thabazimbi 2426, 1974.

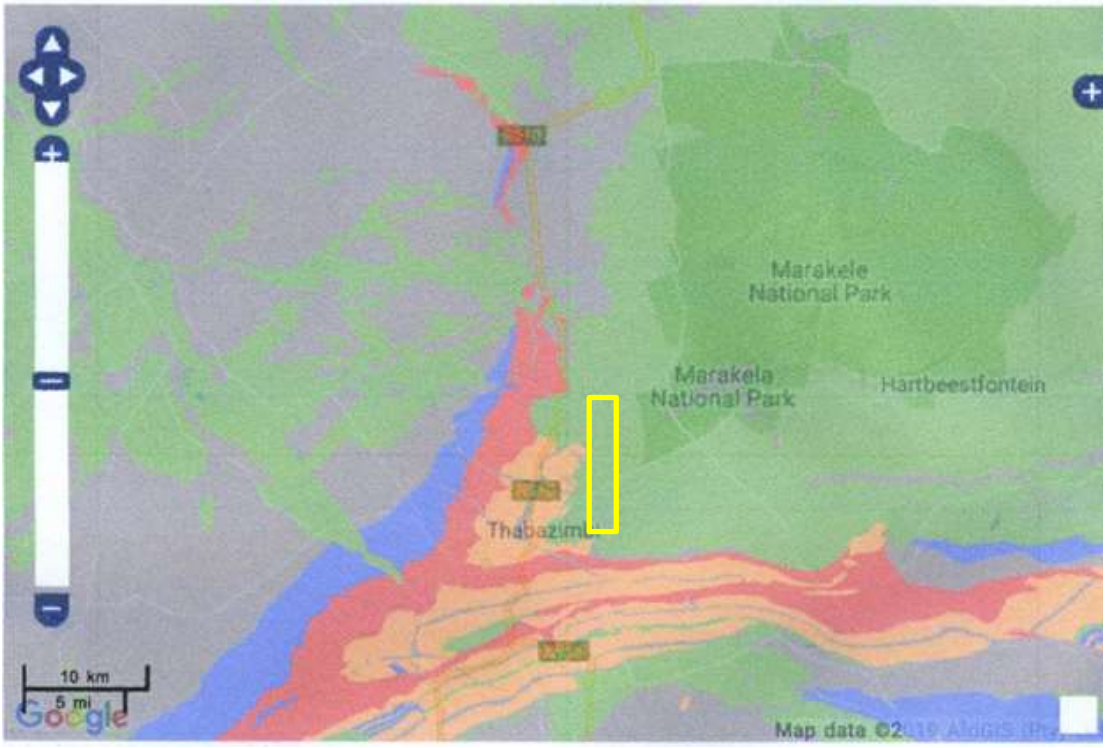

Figure 19: SAHRIS palaeosensitivity map for the area around Thabazimbi and is the last or southernmost section of the Eskom-Transnet Freight and Rail Project (within the yellow rectangle). Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

ii. Summary Palaeontological context

The Waterberg Group rocks in this region, namely the basal Alma Formation (Nylstroom Subgroup) for the Marekale Traction substation, the Skilpadspad Formation (Matlabas Subgroup for the Matlabas Traction substation and the Mokalakwena and Sandriversberg Formations (Kransberg Subgroup) for the Diepspruit and Lephalale Traction substations and the route from Theunispan to Lephalale and Medupi, are too old to preserve body fossils (Plumstead, 1969) and are not the correct type to preserve microfossils such as have been found in the Makgabeng Formation (Simpson et al., 2013). The traces of microbial activity, “biological soils crusts” were found on fine-grained substrates near Ga-Hlako about 75km to the east of Lephalale. Although it is possible that such trace fossils could occur in other formations of the Waterberg Group they seem to be confined to fine-grained sediments (Simpson et al., 2013) and the sediments intersected by the project are medium to coarse-grained. It is highly unlikely that the microbial traces would be visible in the coarser sediments.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 5:

TABLE 5A: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 5B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	No fossils have been recorded from the medium to coarse-grained Waterberg Group. No fossils occur in the Kalahari alluvium so the impact will be low to zero
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	The spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	There is no chance of finding microbial trace fossils in the medium to coarse-grained Waterberg Group sandstones or in the Quaternary sand and alluvium

Based on the nature of the project, ONLY surface activities (excavations for substation buildings and pylons or poles) are planned for the proposed powerline and substations between Theunispan and Lephalale-Medupi or south to Thabazimbi. The sand and coarse sandstone to do not preserve fossils. Taking account of the defined criteria, the potential impact to fossil heritage resources is zero.

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 sands, gravels, calcretes and ferricretes are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. No fossils have been recoded from the medium to coarse-grained sandstones of the Waterberg Group as they are too old for body fossils, and too coarse to preserve microbial trace fossils. Only the fine-grained Makgabeng sediments, some 75km distant from Lephalale, have found to preserve trace fossils.

The SAHRIS palaeosensitivity map indicates that whole route is moderately sensitive (green) but this seems highly unlikely and is possible based on one record of trace fossils from one of the ten formations in the Waterberg Group.

6. Recommendation

Based on the geology and palaeontological record as far as is known, it is extremely unlikely that any fossils occur in the project footprint. There is no preferred route or sites for traction substations, as far as the palaeontology is concerned. It is the opinion of the palaeontologist that this project may proceed.

7. References

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Barker, O B., Brandl, G., Callaghan, C.C., Erikssen, P.G., van der Neut, M., 2006. The Soutspanberg and Waterberg Groups and the Blouberg Formation. 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 301-318.

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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.

Simpson, E.L., Heness, E., Bumby, A., Eriksson, P.G., Eriksson, K.A, Hilbert-Wolf, H.L., Linnevelt, S., Malenda, H.F., Modungwa, T., Okaforba, O.J., 2013. Evidence for 2.0 Ga continental microbial mats in a paleodesert setting. Precambrian Research 327, 36-50.

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.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
June 2019

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.

1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

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

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa – 1984 to present
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	6	1
Masters	8	1
PhD	10	3
Postdoctoral fellows	9	3

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

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

Cretaceous Research: 2014 -

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Amandelbult 2018 for SRK
- 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
- SARAO 2018 for Digby Wells
- Ventersburg B 2018 for NGT
- Hanglip Service Station 2018 for HCAC
-

xi) Research Output

Publications by M K Bamford up to June 2019 peer-reviewed journals or scholarly books: over 130 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 29;
Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)
NRF Rating: B-3 (2010-2015)
NRF Rating: B-3 (2005-2009)
NRF Rating: C-2 (1999-2004)