Palaeontological Impact Assessment for the proposed Temo Coal road, rail link and pipeline construction west of Lephalale, Limpopo Province:

Site visit

For

Digby Wells Environmental
Project: NAM5335

30 June 2019

Prof Marion Bamford and Mr Rick Tolchard
Palaeobotanist; and Vertebrate palaeontologist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford

Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf

Experience: 30 years research; 22 years PIA studies

Field assistant: Mr Frederick Tolchard

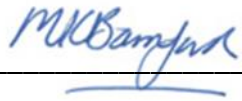
Qualifications: BA; BSc (Honours) Palaeontology (Wits, 2017)

Experience: 3 years research; 3 years PIA training

Declaration of Independence

This report has been compiled by Professor Marion Bamford, with the assistance of Mr Frederick Tolchard, of the University of the Witwatersrand, sub-contracted by Digby Wells Environmental, Johannesburg, South Africa. The views expressed in this report are entirely those of the authors and no other interest was displayed during the decision-making process for the Project.

Specialist: Prof Marion Bamford



Signature

Executive Summary

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 site visit Palaeontological Impact Assessment (PIA) was completed for the proposed construction of ancillary infrastructure associated with their approved coal mining operation, the Temo Coal Mine ("Temo Mine"), near Lephalale in the Limpopo Province ("the Project"). The proposed ancillary infrastructure includes a road diversion, rail loop and water pipeline, which includes three alternative layout designs.

The proposed sites lie on the Quaternary Kalahari Sands that are west of the coal deposits of the Ellisras Basin. The site visit CONFIRMS the conclusion and recommendation of the earlier report (Hardwick, April 2019; SAHRIS case ID:13696) that there is no chance of finding fossils in the proposed routes for the project because these are on Kalahari sands, gravels, calcrete and ferricrete. The potentially fossiliferous rocks were recorded in borehole cores by Brandl (1996)

The older underlying Karoo-aged and potentially fossiliferous deposits are known from borehole material ONLY and occur more than 4m below ground. The uppermost formation, the Clarens Formation, is composed of aeolian sands and is devoid of fossils in this region (Brandl, 1996). It is concluded that there is no chance of finding fossils in the Quaternary alluvium and that as far as the palaeontology is concerned the excavation for foundations for the project may proceed.

Table of Contents

1. Background

A desktop Palaeontological Impact Assessment (PIA) was completed by Hardwick and assessed by Bamford (Hardwick, April 2019) and recommended that no site was visit was necessary. However, SAHRA has requested a site visit for the palaeontology (Case ID:13696).

Temo Coal Mining (Pty) Ltd are proposing to construct a new railway loop to deliver the coal from the mine to the existing Boikarabelo railway link, a water pipeline from the Lephalale water treatment facility to the mine, and the D175 road is proposed to be diverted away from the mining area. The proposed bulk water pipe line will be 64.5 km in length, the road will be diverted 2.8 km away from its current position, and the railway loop will be 22.25 km in length. The proposed activities will be constructed over various farms and mostly along theD175 and D1675 roads.

A palaeontological site visit (or Phase 2) was carried out on 19-21 June and is reported here.

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**
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 i
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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section**
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	Section 8 Appendix 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	Section 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 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: DETAILED MAP OF THE PROPOSED ROAD, RAIL AND PIPELINE ROUTES FOR THE TEMO COAL PROJECT.

Blue = pipeline option 1; purple = pipeline option 2; red = rail loop; yellow = road deviations.

Map supplied by Digby Wells.

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:

- 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;
- Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
- 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

- 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 rocks of this region are known as the Limpopo Belt which is a broad zone of gneisses between the Zimbabwe Craton and the Kaapvaal Craton. The rocks have undergone low to medium grade metamorphism and range in age from about 2600 to 1880 Ma (Simpson et al., 2013). Unconformably overlying these ancient rocks are sediments of the Ellisras Basin which are contemporaneous with the Main Karoo Basin (Johnson et al., 2006). These sediments are further divided into formations (Table 3) and are known from borehole core only (Siepker, 1986 in Brandl, 1996) and have been described as "with the exception of a few arenaceous units, the Karoo Supergroup is very poorly exposed" (Johnson et al., 2006, p 487).

Figure 2 presents the regional geology within which the pipeline will be situated. Abbreviations of the rock types are explained in Table 2. In this table, SG refers to Supergroup, Fm refers to Formation and Ma refers to 'million years'.

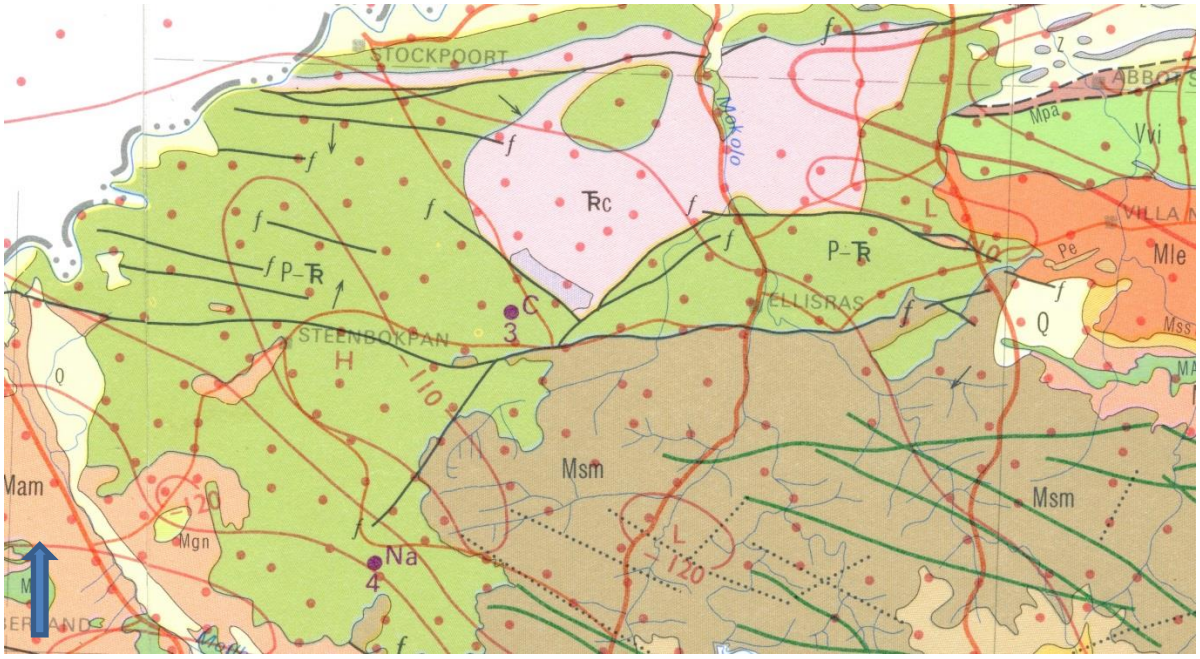


FIGURE 2: GEOLOGICAL MAP OF THE AREA BETWEEN STEENBOKPAN AND LEPHALALE (OLD NAME ELLISRUS). THE PROPOSED ROUTES FOR THE RAIL, ROAD AND PIPELINES FOR TEMO COAL. MAP ENLARGED FROM THE GEOLOGICAL SURVEY 1: 250 000 MAP ELLISRUS 1984.

TABLE 2: EXPLANATION OF SYMBOLS FOR THE GEOLOGICAL MAP AND APPROXIMATE AGES (BARKER ET AL., 2006; JOHNSON ET AL., 2006; SIMPSON ET AL., 2013).

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Sand, alluvium, calcrete	
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Tr-C	Tarkastad Subgroup, Beaufort Group	Shale, sandstone, mudstone, coal	Early Triassic 252 – 230 Ma
P-Tr	Permian Triassic	Shale, mudstone, sandstone, conglomerate, coal	Ca 290-230 Ma
C-Pd	Dwyka Group	Tillite, sandstone, mudstone, shale	Upper Carboniferous, Early Permian 295-290 Ma
Mv	Vaalwater, Formation, Kransberg Subgroup, Waterberg Group	Feldspathic sandstone, shale	2600 – 1880 Ma
Mc	Cleremont Fm, Kransberg Subgroup, Waterberg Group	Sandstone	2600 – 1880 Ma

Symbol	Group/Formation	Lithology	Approximate Age
Msm	Sandriviersberg and Mogalakwena Fms, Kransberg Subgroup, Waterberg Group	Sandstone, conglomerate	2600 – 1880 Ma

Table 3 and Figure 3 present a summary of the local stratigraphy. Letters from the 1:250 000 Ellisrus map have been included in the Formation column and apply to Figure 3. Farms that will be impacted are: Draai Om 595 (244RE = new number on Sahris map), Verloren Valley 451 (276), Snelpan 546 (245), Duikerpan 486 (249RE), Nieuwholland 488 (247RE), Kleinpan 557 (269RE) and Houwhoek 277, and alongside existing roads.

TABLE 3: LOCAL STRATIGRAPHY OF THE ELLISRAS BASIN FROM BRANDL (1996) BASED ON BOREHOLES

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
Letaba Fm	Basaltic lava	125m thick (boreholes) south of Zoetfontein Fault and northeast of Grootgeluk mine only
Clarens Fm	Massive sandstone, aeolian	130m thick. Forms hills and ridges
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

Formation	Lithology	Notes
Waterkloof Fm K1 (Dwyka)	Diamictite, mudstone, conglomerate	Borehole: deeply weathered
Diabase intrusions	Diabase	Post Karoo, probably Jurassic

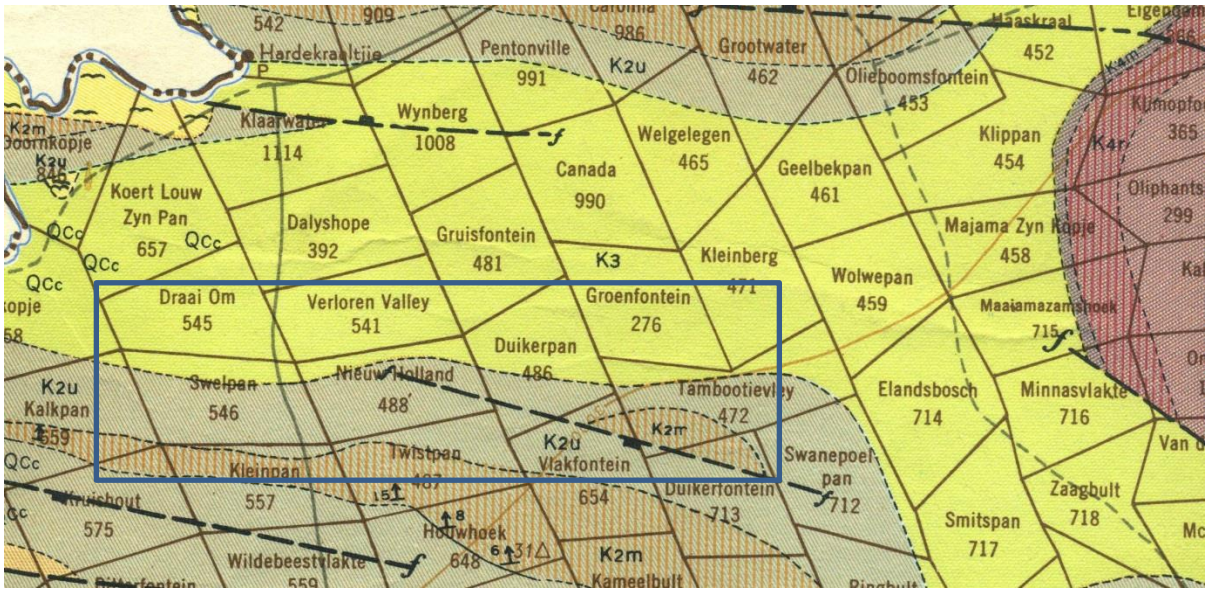


FIGURE 3 : 1:250 000 ELLISRUS GEOLOGICAL MAP WITH THE FARM NAMES INDICATED.

ii. Palaeontological context

The Waterberg Group rocks in this region, namely the Vaalwater, Mokalakwena and Sandriver Formations are too old to preserve body fossils and not the correct type to preserve microfossils such as have been found in the older Makgabeng Formation (Simpson *et al.*, 2013).

Based on numerous borehole cores the stratigraphy of the Ellisras Basin has been determined and the coal deposits assessed (Brandl, 1996; Snyman, 1998). Coal seams occur in the Grootgeluk Fm and are mined extensively in the area to the north and northwest of Lephalale. Some *Stigmaria* roots have been recorded from the Swartrand Formation and leaf impressions of *Glossopteris* from the Grootgeluk Formation (Brandl, 1996; Johnston *et al*., 2006). The overlying Clarens Formation is predominantly composed of Aeolian sand and, apart from a few non-diagnostic root traces in core material, does not contain any fossils (Brandl, 1996).

The proposed rail, water pipeline and road routes in the western and northwestern section of the project are on fresh ground whereas the central and eastern sections are along existing roads that have already impacted on the geology. The site visit survey included all

route but focused on the western section. Furthermore, the palaeontological sensitivity of the area under consideration is presented in Figure 4 and indicates that the western section is very highly sensitive.

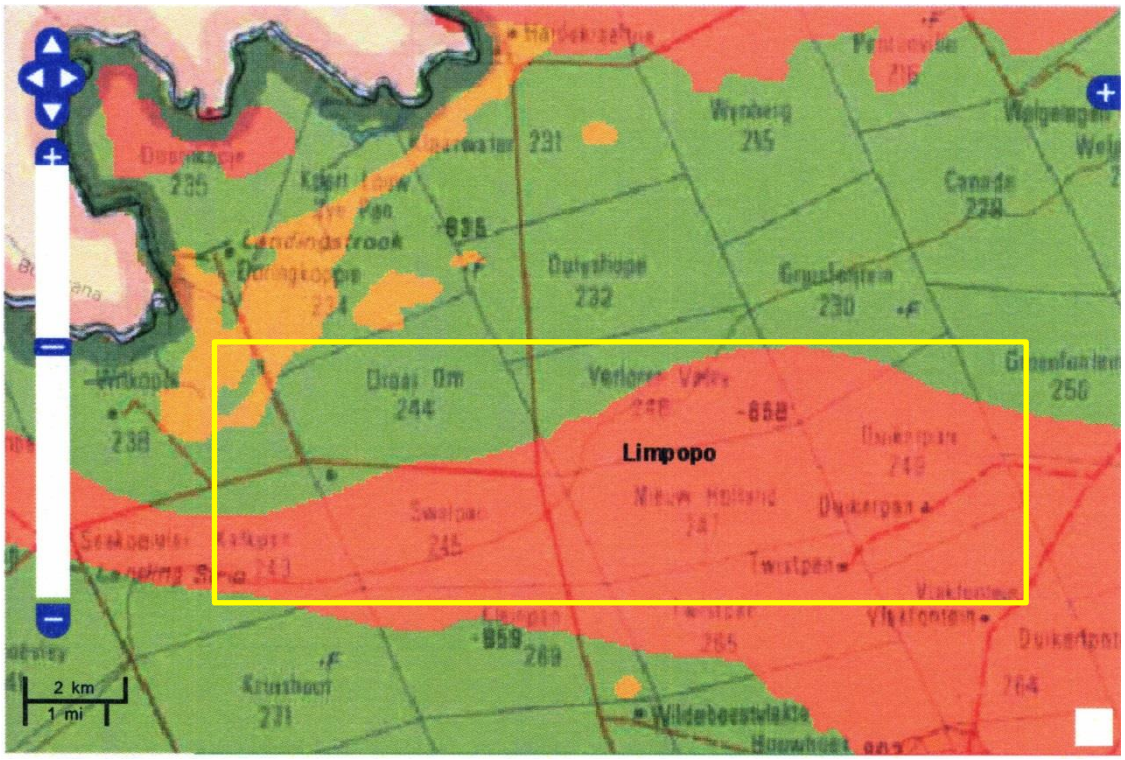


FIGURE 4: SAHRIS PALAEOSENSITIVITY MAP FOR THE REGION. THE PROPOSED RAIL, ROAD AND PIPELINE ROUTES ARE WITHIN THE YELLOW RECTANGULAR OUTLINE.

Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

iii. Results of site visit.

Figure 5 presents the inspection sites along the survey route. Table 4 provides the GPS coordinates and descriptions of the inspection points. Figure 6 to Figure 16 below include photographs taken at select inspection points. All these photographs were taken by F. Tolchard between June 20 and 21, 2019.

FIGURE 5: GOOGLE EARTH MAP OF PROPOSED ROUTES WITH NUMBERS INDICATED FOR THE SURVEY STOPS AND PHOTOGRAPHS.

TABLE 4: GPS POINTS FOR THE PALAEONTOLOGOCAL SURVEY

Point No; Description	GPS coordinates	Description of rocks, soils, vegetation
No 1 East start near airport/landing strip	23° 43’ 01.54” S 27° 41 54.84” E	Area disturbed, thick cover of sands and patches of trees and bushland
No 2 northeast loop	24° 41’ 05.76” S 27° 42’ 19.10” E	Area disturbed, thick cover of sands and patches of trees and bushland
No 3 NE junction	23° 40’ 52.89” E 27° 40’ 56.51” E	Area disturbed, thick cover of sands and patches of trees and bushland
No 4 going west	23° 41’ 43. 93” S 27° 37’ 44.00” E	Area disturbed, thick cover of sands and patches of trees and bushland

Point No; Description	GPS coordinates	Description of rocks, soils, vegetation
No 5 Track loops north along the dump/ slimes dam	23° 41′ 08.82″ S 27° 36′ 56.97″ E	Area very disturbed, thick cover of sands and patches of trees and bushland
No 6	23° 42′ 26.93″ S 27° 30′ 30.91″ E	Area disturbed, thick cover of sands and patches of trees and bushland
No 7	23° 42′ 36.51″ S 27° 25′ 45.58″ E	Deep Kalahari sands covered with grasses; shrubs and trees in the background. No rocky outcrops and no vertebrate or plant fossils. (Figure 6)
No 8 junction	23° 41′ 12.20″ S 27° 21′ 07.57″ E	Between points 7 and 8. Deep Kalahari sands covered with thick grasses, slight slope but no rocky exposures (Figure 7). East of Point 8. Sandy soil with fragments of calcrete. No fossils (Figure 8).
No 9 going west loop	23° 36′ 18.95″ S 27° 18′ 42.31″ E	Between points 8 and 9 was the only example of shale that could preserve plant impressions but the sediment was completely barren, Figure 9. Point 9 with sandy soils and some pieces of calcrete. No fossils. (Figure 10).
No 10 westwards	23° 35′ 41.81″ S 27° 13′ 30.43″ E	Between stops 9 and 10 there is a clump of large boulders of sandstone but with no bedding planes and no fossils (Figure 12). Between points 9 and 10 the vegetation is very thick on deep Kalahari sands. The topography is flat and there are and no rocky outcrops (Figure 13). At Point no 10 the vegetation is thick on deep Kalahari sands and no outcrops (Figure 14).
No 11 heading south to junction	23° 40′ 18.27″ S 27° 14′ 44.21″ E	Point no 11 has deep Kalahari sands and thick vegetation, flat topography and no rocky outcrops (Figure 15).
No 12 southernmost loop and head back to point 8	23° 42′ 37.17″ S 27° 16′ 22.62″ E	Vegetation and soils before stop no 12, noted deep Kalahari sands, thick covering of grasses, shrubs and trees and no outcrop (Figure 16).

FIGURE 6: POINT NO 7. DEEP KALAHARI SANDS COVERED WITH GRASSES; SHRUBS AND TREES IN THE BACKGROUND. NO ROCKY OUTCROPS AND NO VERTEBRATE OR PLANT FOSSILS.

FIGURE 7: BETWEEN POINTS 7 AND 8. DEEP KALAHARI SANDS COVERED WITH THICK GRASSES, SLIGHT SLOPE BUT NO ROCKY EXPOSURES.

FIGURE 8: EAST OF POINT 8. SANDY SOIL WITH FRAGMENTS OF CALCRETE. NO FOSSILS

FIGURE 9: BETWEEN POINTS 8 AND 9 SHOWING THE ONLY EXAMPLE OF SHALE THAT COULD PRESERVE PLANT IMPRESSIONS BUT THE SEDIMENT WAS COMPLETELY BARREN.

FIGURE 10: POINT 9 WITH SANDY SOILS AND SOME PIECES OF CALCRETE. NO FOSSILS.

FIGURE 11: FINE-GRAINED SANDSTONE WEST OF POINT 9. NO FOSSILS

FIGURE 12: BETWEEN STOPS 9 AND 10. LARGE BOULDER OF SANDSTONE WITH NO BEDDING AND NO FOSSILS.

FIGURE 13: BETWEEN POINTS 9 AND 10. THICK VEGETATION ON DEEP KALAHARI SANDS, FLAT TOPOGRAPHY AND NO ROCKY OUTCROPS

FIGURE 14: POINT NO 10. THICK VEGETATION ON DEEP KALAHARI SANDS AND NO OUTCROPS.

FIGURE 15: POINT NO 11. DEEP KALAHARI SANDS AND THICK VEGETATION. FLAT TOPOGRAPHY AND NO ROCKY OUTCROPS.

FIGURE 16: VEGETATION AND SOILS BEFORE STOP NO 12. NOTE DEEP KALAHARI SANDS, THICK COVERING OF GRASSES, SHRUBS AND TREES AND NO OUTCROP.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 5. Table 6 presents the results of the impact assessment.

TABLE 5: 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 6: IMPACT ASSESSMENT

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-
	L	No fossils occur in the Kalahari alluvium so the impact will be low zero
	L+	-
	M+	-
	H+	-

PART B: Assessment		
DURATION	L	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	L	Since only the surface (estimated maximum depth to 4m) sands, gravel, calcrete and ferricrete will be excavated for road and rail foundations and pipeline there will be NO impact on the potential fossils associated with the coals which occur to the east and well below surface. No Beaufort vertebrate fossils were found. The spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	H	-
	M	-
	L	There is no chance of finding fossils in the Quaternary alluvium

Based on the nature of the project, ONLY surface activities are planned for the proposed rail loop to Boikarabelo station, water pipelines and road deviations. Fossils do not occur in this level. The site visit and survey along the proposed routes CONFIRMED the presence of Kalahari sand and alluvium, and no fossiliferous rocks. Permian fossil plants from the Grootgeluk Formation (K2U, upper Ecca) and the Eendragtpan Formation (K3, Beaufort) were not found in the project footprint. Vertebrate fossils from the Beaufort were not found. 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. This was confirmed by a site visit by the palaeontologist on 19-21 June 2019.

The SAHRIS palaeosensitivity map indicates that much of the western section of the project is very highly sensitive (red) but no fossils were found. It should be noted that the mapped geology for the Ellisras Basin is based on borehole cores (Brandl, 1986; Johnson et al., 2006) and NOT on surface mapping.

6. Recommendation

Based on the first report and CONFIRMED by the site visit there are no fossils in the proposed routes for the rail loop, water pipelines and road deviations for the Temo Coal project. There is no preferred route as far as the palaeontology is concerned. It is the opinion of the palaeontologist that this project may proceed.

7. References

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

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.

Brandl, G., 1996. The geology of the Messina area. Explanation sheet 2230, Geological Survey of South Africa. 35pp.

Hardwick, S. April 2019. Environmental Authorisation for the Temo Mine proposed Rail, Road and Pipeline Development, Limpopo Province: Heritage Impact Assessment.

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

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

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 specialists

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)

Mr Frederick Tolchard
Brief Curriculum Vitae – June 2019

Academic training

BA Archaeology – University of the Witwatersrand, graduated 2015
BSc (Honours) Palaeontology – University of the Witwatersrand, 2017 with distinction
MSc Palaeontology – University of the Witwatersrand, 2018 – 2019.

Field Experience

Honours Fieldtrip – Karoo biostratigraphy – April 2017
Research fieldwork – Elliot Formation with Prof Choiniere – April 2018, November 2018; April 2019

PIA fieldwork projects

2018 May – Williston area – SARAO project, Digby Wells
2018 September – Lichtenburg PVs – CTS Heritage
2018 November – Nomalanga farming – Digby Wells
2019 January – Thubelisha coal – Digby Wells
2019 March – Matla coal – Digby Wells
2019 March – Musina-Machado SEZ – Digby Wells