

**Palaeontological Impact Assessment for the proposed
upgrade of the Bloukrans River Crossing, the Qabango
River crossing and three culverts along Road D489
within the Umtshezi local Municipality of the KwaZulu
Natal Province**

Desktop Study

For

KSEMS

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Expertise of Specialist

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Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by SLR Consulting (Africa), (Pty) Ltd. The views expressed in this report are entirely those of the author and SLR Consulting (Africa) (Pty) Ltd and no other interest was displayed during the decision making process for the project.

Specialist: Prof Marion Bamford.....

Signature:

Executive Summary

The desktop Palaeontological Impact Assessment for the proposed mining project on the farm Commissiekraal, KwaZulu Natal, concludes that there is very little likelihood of any fossils of scientific interest being found during the early stages of the development because the coal seams are underground.

Once mining operations have begun the personnel should look out for fossils in the shales between coal seams. This information will be built into the mine's training and awareness plan and procedures. If any fossil plants are found they should be removed and protected, and a palaeontologist called to assess their significance.

Palaeontological Impact Assessment for the proposed upgrade of the Bloukrans River Crossing, the Qabango River crossing and three culverts along Road D489 within the Umtshezi local Municipality of the KwaZulu Natal Province

Background

As requested a desktop palaeontological impact assessment has been carried out on behalf of your client, the KZN Department of Transport, who proposes to conduct the upgrade of the Bloukrans River Crossing, the Qabango River crossing and three culverts along Road D489 within the Umtshezi local Municipality. These River Crossings are located within road D489 which can be accessed approximately 3.1km and 7.9km from the R102/D483 Junction respectively.

The co-ordinates for the proposed upgrade for the
Bloukrans River Crossings: 28°51'26.52"S & 29°49'12.90"E
Qabango River Crossings: 28°51'18.33"S & 29°50'59.34"E
Km 15.28 Culvert: 28°52'54.25"S & 29°54'47.12"E
Km 16.26 Culvert: 28°53'9.40"S & 29°55'18.54"E
Km 16.76 Culvert: 28°53'17.44"S & 29°55'34.47"E

The National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology.

Methods and Terms of Reference

1. In order to determine the likelihood of fossils occurring in the affected area geological maps, literature, palaeontological databases and published and unpublished records must be consulted.
2. If fossils are likely to occur then a site visit must be made by a qualified palaeontologist to locate and assess the fossils and their importance.
3. Unique or rare fossils should either be collected (with the relevant South African Heritage Resources Agency (SAHRA) permit) and removed to a suitable storage and curation facility, for example a Museum or University palaeontology department or protected on site.
4. Common fossils can be sacrificed if they are of minimal or no scientific importance but a representative collection could be made if deemed necessary.

The published geological and palaeontological literature, unpublished records of fossil sites, catalogues and reports housed in the Evolutionary Studies Institute, University of the

Witwatersrand, and SAHRA databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there.

Consultation Process

No consultations were carried out during the desktop study. Apart from reviewing interested and/or affected party (IAP) comments received by the EIA consultant during the EIA process, no other consultation took place as part of the paleontological study.

Geology and Palaeontology

Project location and geological setting

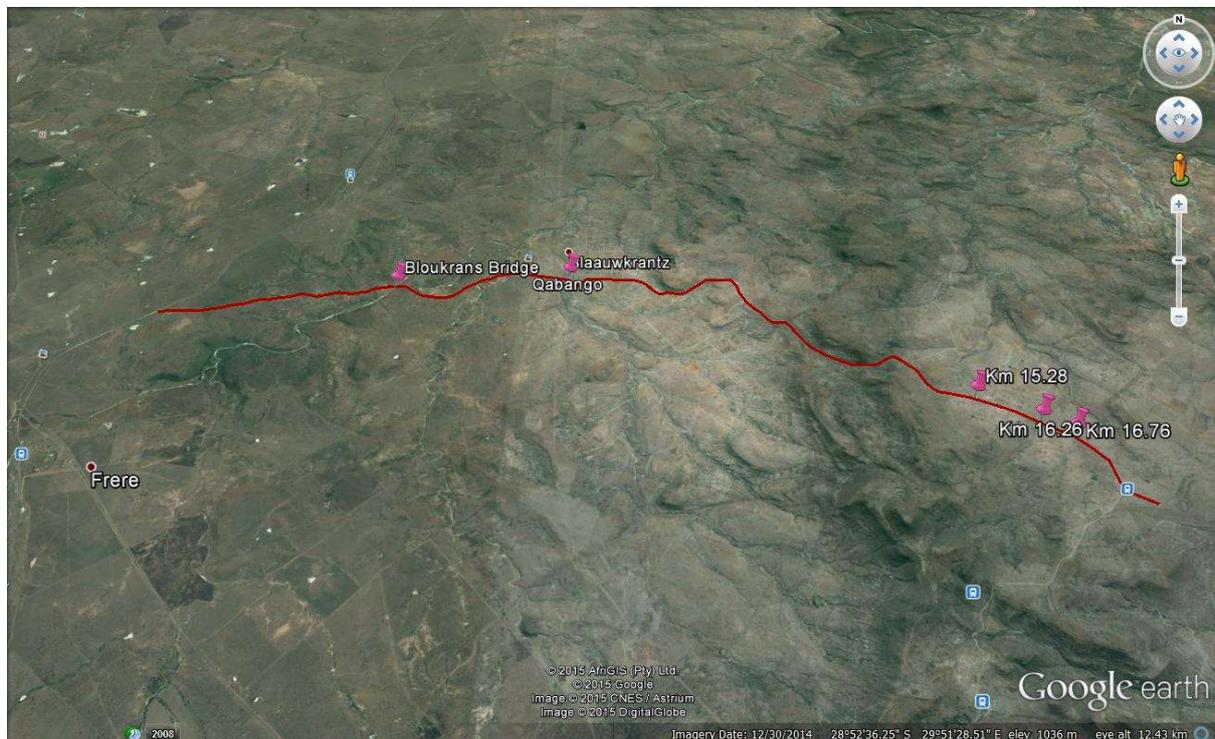


Figure 1. Google earth map of the route along which the proposed upgrades should take place.

Geology

The route for the road upgrade lies in the rocks of the Adelaide Subgroup, Estcourt Formations, (Beaufort Group, Upper Permian) and comprises mudstones and sandstones. There are also numerous intrusive dolerite dykes and sills in the area of Jurassic age and these disrupt the stratigraphy and destroy any fossils within their vicinity.

Palaeontology

Fossil vertebrates of the *Dicynodon* Assemblage Zone (Rubidge et al., 1995) could occur here but the area has not been well explored for the vertebrate fossils. Fossil plants are much

more common in the Estcourt Formation (Anderson and Anderson, 1985). These include typical *Glossopteris* flora elements such as leaves, fructifications, roots and wood of *Glossopteris*, sphenophytes, lycopods and ferns. They can be fairly common but their distribution is erratic and preservation is variable (see Table 2). Vertebrate fossils very seldom occur with the plant fossils.

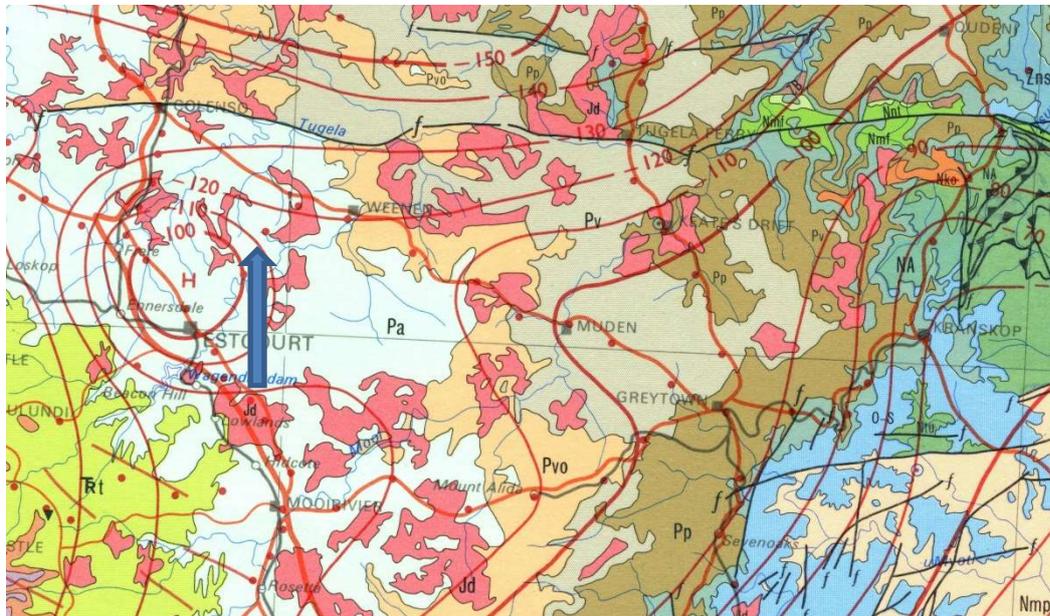


Figure 2. Geological map of the area where the proposed road upgrade should take place, to the east-northeast of Frere. The approximate location of the proposed route is indicated with the arrow. Abbreviations of the rock types are explained in Table 1. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 1: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006; Johnson et al., 2006; Snyman, 1998).

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Tr-t			
Pa	Adelaide and Estcourt	Mudstone, sandstone	Beaufort
Pvo	Volksrust	shale	Middle Permian, Upper Ecca
Pv	Vryheid	Shales, sandstone, coal	Lower Permian, Middle Ecca
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Upper Carboniferous to Lower Permian

Table 2: List of Estcourt Formation plant species (compiled from Anderson and Anderson, 1985, Adendorff 2004).

Plant group	Species
Sphenophyta	<i>Phyllothea australis</i>
	<i>Raniganjia kilburnensis</i>
	<i>Sphenophyllum speciosum</i>
Lycophyta	<i>Lepidodendron sp?</i>
Ferns	<i>Sphenopteris lobifolia</i>
Glossopteridales	<i>Estcourtia vandijkii</i>
	<i>Lidgetonia mooriveriensis</i>
	<i>Lidgetonia lidgetonioides</i>
	<i>Glossopteris leaves (8 morphotypes)</i>
incertae sedis	<i>Taeniopteris sp.</i>

The SAHRIS palaeosensitivity map for the site indicates red (very sensitive and very high probability of fossils occurring there), orange (high probability), green (moderate) and grey (insignificant to zero) (Table 3). This region has red and green indicators but as there are no records of fossils plants from this area, most likely because the deposits are not exposed, or the area has been well surveyed.

As there are no exposures at this stage a desktop study has been done. It is recommended that the site geologist/environmental officer be tasked with carefully observing the excavations. If fossils are exposed then they should immediately be protected or removed from danger, and a palaeontologist called to assess their importance and sensitivity. Then a rescue operation would be required with the necessary permits from Amafa. This must be built into the EMPr as a mitigation procedure (see below).

Table 3: SAHRIS palaeosensitivity scheme

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Impact assessment

A road already exists along this route, the D489, and was constructed a long time before the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) were promulgated. The proposed upgrades will be alongside this road at the various sites listed above, therefore any new impact to the potential fossil record will be minimal and along the ground surface or in shallow excavations. The impact is negligible.

Once the proposed upgrade activities start excavations could possibly encounter fossils, however these are not expected to be of significant scientific interest because the surface ones will be badly weathered. It is possible that excavations could expose fresh fossil material. Therefore the SEVERITY/NATURE of environmental impact would be low: L (according to the scheme in Table 3.

DURATION of the impact would be permanent.

Since only the possible fossils within the mine will be affected the SPATIAL SCALE will localized within the site boundary and any fossils found are not expected to be of regional or national interest: L.

The upgrades will be at the surface and in shallow excavations at the designated sites so the PROBABILITY of affecting any fossils is unlikely or seldom: L

TABLE 3 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	H	Definite/ Continuous
	M	Possible/ frequent

impacts)	L	Unlikely/ seldom
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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 distribution of the fossil plants in fine-grained mudstones is typical of the Estcourt Formation and vertebrates would be extremely rare, so no fossil animals will occur there. Plant impressions on the surface would be weathered from long exposure to the elements and would be of little scientific interest. Until the shallow excavations have begun and any fresh fossils are revealed and examined this remains an uncertainty, but a minor one.

Recommendation

While it is possible that plant fossils occur in the proposed road upgrade sites they will not be detected until excavations begin. A site visit is therefore not feasible until such stage.

If fossil plant material is discovered during the road upgrade activities, then it is strongly recommended that a professional palaeontologist, preferably a palaeobotanist, be called to assess the importance and to rescue them if necessary (with the relevant Amafa permit).

If the fossil material is deemed to be of scientific interest then further visits by a professional palaeontologist would be required to collect more material.

As far as the palaeontology is concerned the proposed road upgrade can go ahead. Any further palaeontological assessment would only be required after any excavations have commenced and if fossils are found by the geologist or environmental personnel.

EMPr.

Monitoring Programme for Palaeontology – to commence as soon as the upgrading and excavations start.

1. The responsible site geologist or environmental officer should monitor the excavations and if any fresh fossil material is exposed then:
2. Protect the fossil; this may require careful removal if they are in danger of being crushed or washed away.
3. Call a professional palaeontologist to assess the scientific value of the fossils and if necessary obtain a permit from Amafa to remove and house the fossils in a recognized institute.
4. In the unlikely event of the fossils site being extremely important then the site will have to be protected and the excavation/road upgrade diverted to a less sensitive area.

References

Anderson, J.M. Anderson, H.M. 1985. Palaeogloria of Southern Africa. AA Balkem, Rotterdam.

Cadle, A.B., Cairncross, B., Christie, A.D.M., Roberts, D.L., 1993. The Karoo Basin of South Africa: the type basin for the coal bearing deposits of southern Africa. *International Journal of Coal Geology* 23, 117-157.

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.

Rubidge, B.S., (Ed). 1996 Biostratigraphy of the Beaufort Group (Karoo Supergroup). SACS. Biostratigraphy series No 1. 48 pp. Council for Geoscience, South Africa.