Palaeontological Impact Assessment for the proposed Underground mining of the Schurvekop coal resource near Bethal, Mpumalanga Province

Desktop Study

For

Cabanga Environmental

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Expertise of Specialist

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Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 20 year PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Cabanga Environmental, Johannesburg, South Africa. The views expressed in this report are entirely those of the author and Cabanga Environmental 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 of the Schurvekop Coal Resource near Bethal by Mmakau Coal (Pty) Ltd has been completed. The deposit is in the Vryheid Formation, Ecca Group and there are fossil plants of the Glossopteris flora associated with the shales between the coal seams but not in the coal itself. The proposal is for underground mining targeting the No 4 and No 2 coal seams. The access to the underground will be via a box cut adit, the construction of which will pass through the shales but will be limited to a small footprint. It is possible that some fossil plants will be destroyed in the process but as they have not been reported from this area and would be very sparsely distributed if present. Since there is a small chance that fossil plants could be discovered when excavations or drilling commences a 'Chance Find' protocol and monitoring programme have been added to the report. It is concluded that the project may continue as far as the paleontology is concerned.

Palaeontological Impact Assessment for the proposed underground mining of the Schurvekop coal resource near Bethal, Mpumalanga Province

1. Background

The project area is situated within the Mpumalanga Province, 20 kilometres to the north of Bethal and 20 km east of the town of Ga-Nala (Kriel). It falls within the Gert Sibande District Municipality (DC30), specifically the Govan Mbeki Local Municipality (MP307).

The Schurvekop Resource will be mined using a mechanized board and pillar mining method using continuous miners. In mechanized board and pillar mining, extraction is achieved by developing a series of roadways (boards) in the coal seam and connecting them by splits (cut-through) to form pillars. These pillars are left behind as part of a primary roof support system. Main development panels will be designed to a Safety Factor SF2.0; whilst secondary panels will be designed to a Safety Factor SF1.6 using the Salamon Formulae and designs by a Rock Engineer (Metallurgical Resources Consulting, 2016).

The underground workings will be accessed via a boxcut adit. The high walls and sidewalls of the box-cut will be terraced where necessary in order to limit the possibility of weathering and sloughing. Entries will generally be limited via two or three portals, allowing for conveying and travelling, as well as return airways and escape routes.

Coal will be transferred from the underground to surface by means of a conveyor belt, whereby it will be sent to the plant area for processing (crushing, screening and if feasible washing). Product coal will be sized and stockpiled in designated areas for pre-qualification prior to being trucked to market.

Mine residue from the plant will be disposed of onto an integrated disposal dump. The plant will run 24/7. Should it prove viable, a filter press will be installed to recover fines from the slurry, allowing dried fines to be mixed with product. The water component will report to the PCD via dirty water trenches and form part of the process water on site.

The primary product will be produced for the Eskom market and if export prices improve sufficiently then a dual product for the international export market and for the Eskom market will be produced.

Currently it is expected that the coal will be trucked to market.

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.

This report complies with the requirements of the NEMA and environmental impact assessment (EIA) regulations (GNR 982 of 2014). The table below provides a summary of the

requirements, with cross references to the report sections where these requirements have been addressed.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	**Relevant section in report**
Details of the specialist who prepared the report	Prof Marion Bamford
The expertise of that person to compile a specialist report including a curriculum vitae	Palaeontologist (PhD Wits 1990) CV attached
A declaration that the person is independent in a form as may be specified by the competent authority	Page 2
An indication of the scope of, and the purpose for which, the report was prepared	Section 1, page 3
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	n/a Seasons make no difference to fossils
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2, page 4
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	See table 2
An identification of any areas to be avoided, including buffers	n/a
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
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6, page 10
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	n/a
Any mitigation measures for inclusion in the EMPr	n/a
Any conditions for inclusion in the environmental authorisation	n/a
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, page 11
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	n/a
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
A description of any consultation process that was undertaken during the course of carrying out the study	Section 3 page 6
A summary and copies if any comments that were received during any consultation process	n/a
Any other information requested by the competent authority.	n/a

2. Methods and Terms of Reference

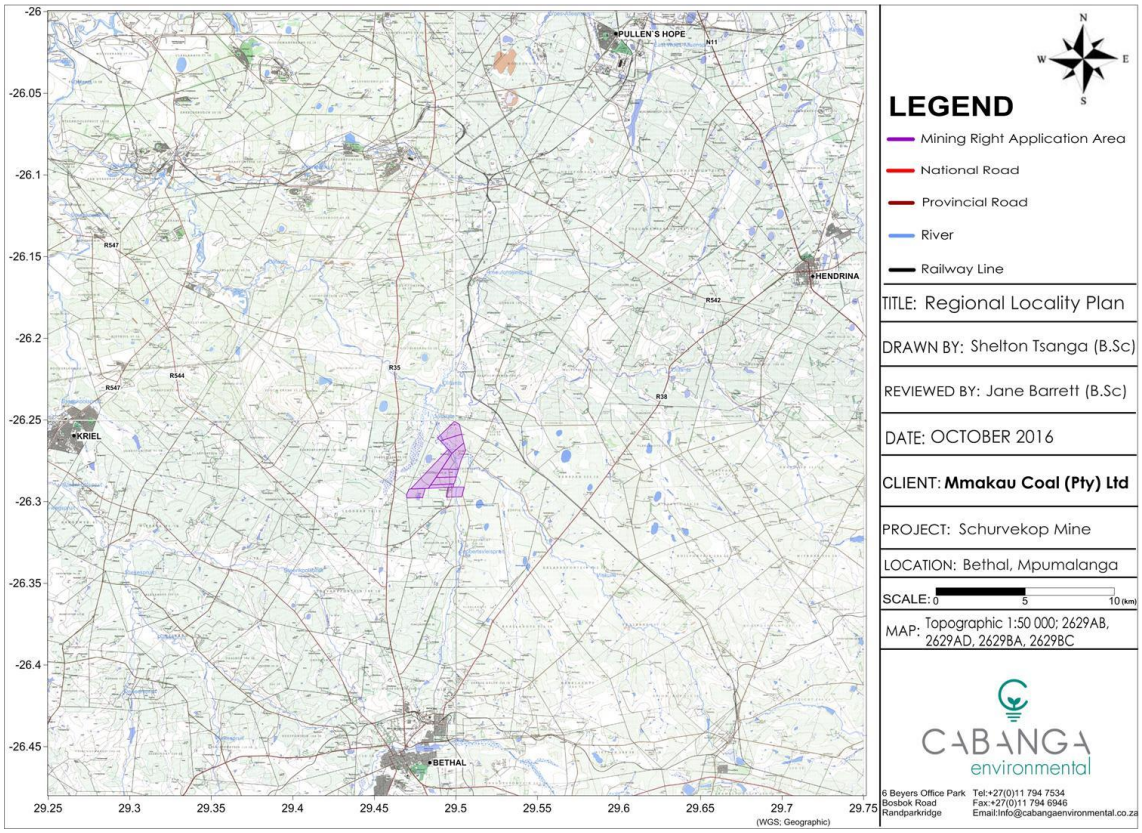
1. In order to determine the likelihood of fossils occurring in the affected area geological maps, literature, palaeontological databases and published and unpublished records must be consulted.

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.



Figures 1: Regional locality plan for the Schurvekop coal resouce, near Bethal. Map supplied by Cabanga Environmental.

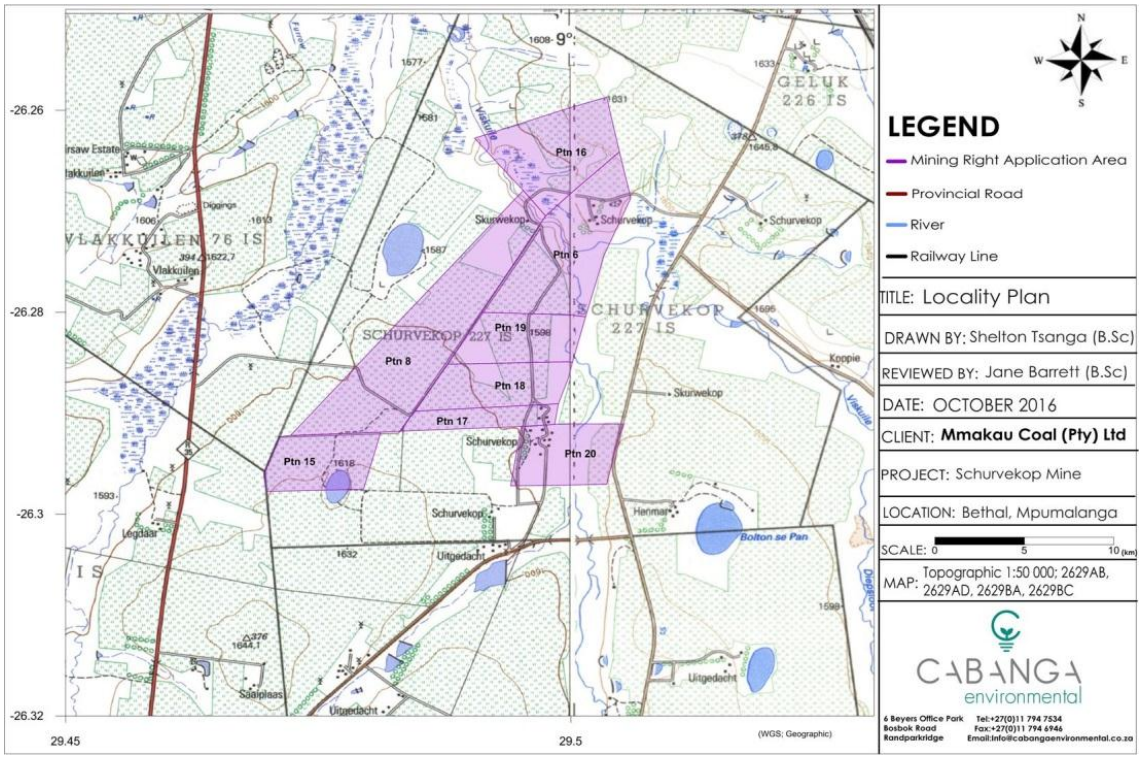


Figure 2: Detail of the locality plan for the Schurvekop coal resouce, near Bethal. Map supplied by Cabanga Environmental

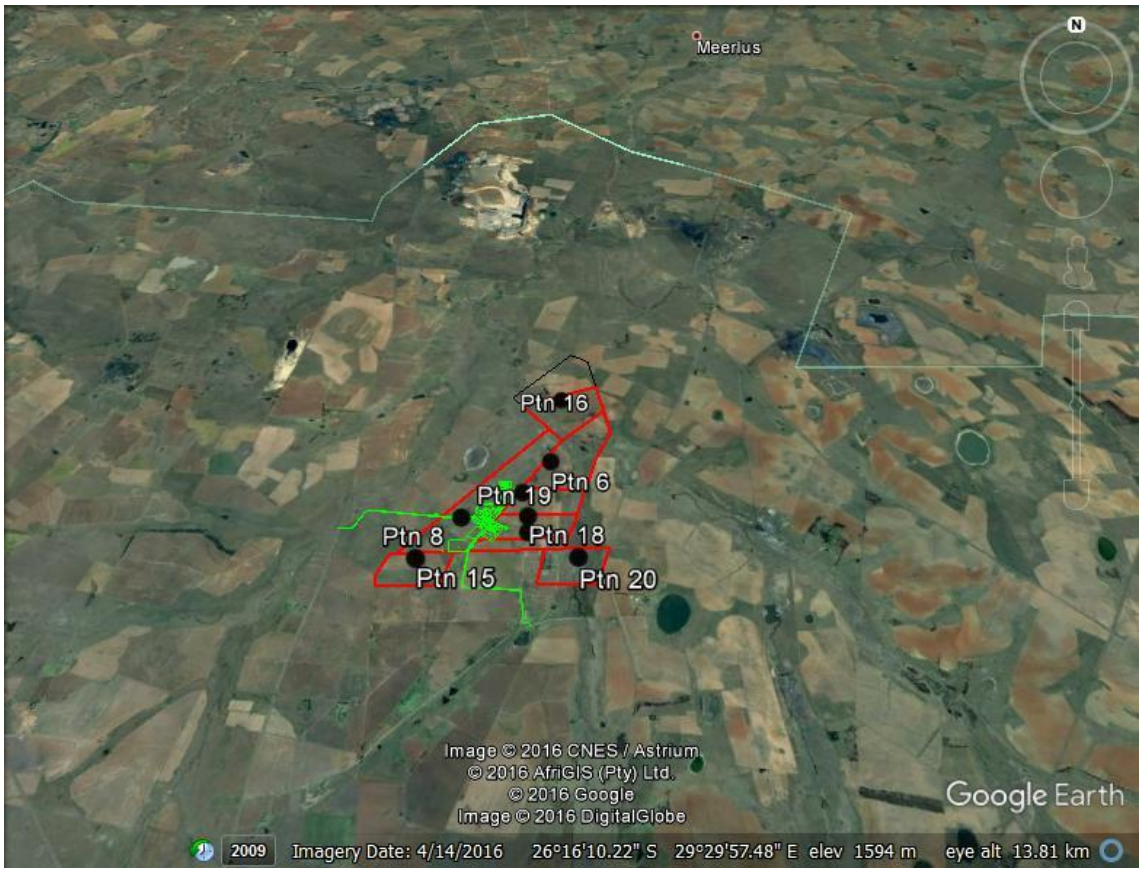


Figure 3: Google map of proposed mining area for Mmakau Coal (Pty) Ltd of the Schurvekop Resource near Bethal. Map supplied by Cabanga Environmental.

3. 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.

4. Geology and Palaeontology

<u>Project location and geological setting</u>

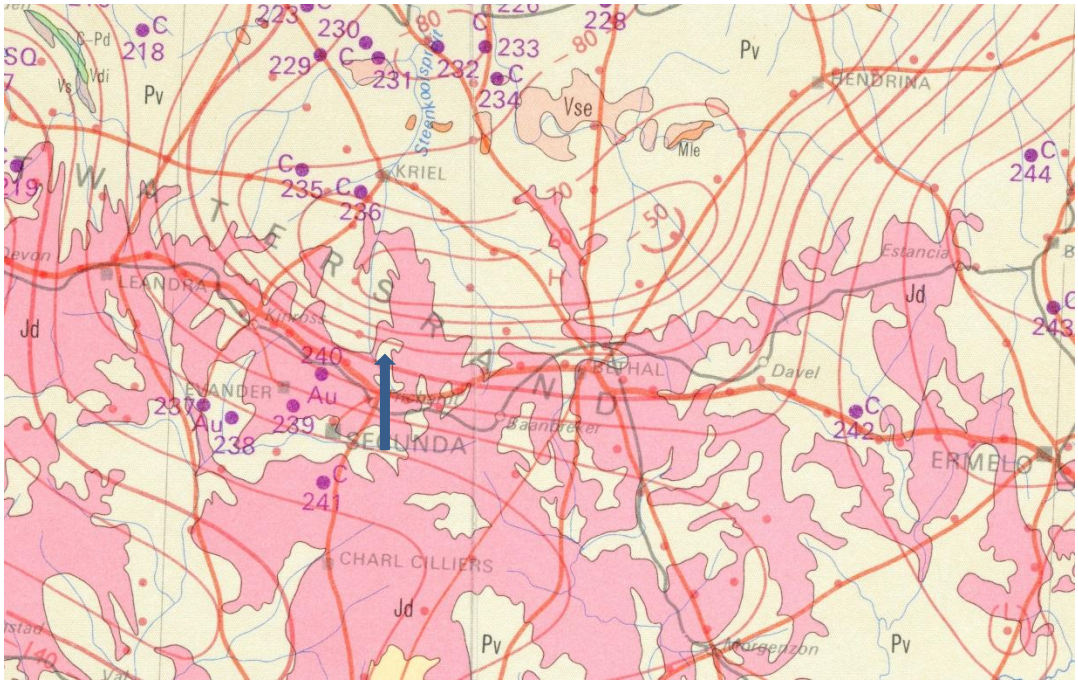


Figure 3: Geological map of the area between Bethal and Kriel (G-Nala) for the proposed mining of the Schurvekop Resource by Mmakau Coal (Pty) Ltd. The approximate location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Barbolini et al., 2016; Barker et al., 2006; Cawthorn, et al., 2006; Johnson et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Jd	Jurassic dolerite dykes	dolerite	Ca 180 Ma
Pv	Vryheid Fm, Ecca Group	Sandstone, shale, coal	Early Permian 269-296 Ma

Symbol	Group/Formation	Lithology	Approximate Age
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Upper Carboniferous, Early Permian 295-290 Ma
Mle	Lebowa Granite Suite, Bushveld Complex	Hornblende and biotite granites	2052
Vse	Selons River, Rooiberg Group	Red porphyritic rhyolite	Ca 2017 Ma

Geology

The area is situated in the north eastern extremity of the Highveld Coal field separated by the pre-Karoo Smithfield ridge from the Witbank Coal field to the north. The coals here are in the Vryheid Formation. The No 4 Seam depth ranges from 30m below surface in the north west and reaches depths of up to 60m at the deepest point on the property. The No 2 Seam is separated from the No 4 seam by sandstone and shale parting ranging in thickness between 15m to 20m.

The Jurassic dykes are volcanic and intrusive in origin but they destroy any fossils in their near vicinity. The coal miners will be targeting the coal seams and generally these are more than 10m below the surface in the Belfast area (Snyman, 1998).

Other rocks in the vicinity are the Lebowa Granite Suite and the Selons River Formation of the Rooiberg Group but these will not affected by the coal mining operation.

Palaeontology

(Refer to Figure 4 for SAHRIS palaeosensitivity)

The Lebowa Granite Suite would not preserve any fossils as it is igneous in origin. In contrast the Selons River Formation (Kwaggasnek and Schrikkloof Members; Rooiberg Group) is made up of finer grained sediments that have been deposited in a marginal basin context and may preserve ripple marks but these rocks are far from the proposed mining area.

Although coal is formed from compressed and heat altered plant material it is of no interest to palaeontologists because no plant structures can be seen. Fossil plants are preserved in the shales and partings between and within some coal seams. Here impressions or compressions of leaves of the *Glossopteris* plants, lycopods, sphenophytes and ferns can be preserved. They are of interest to palaeobotanists but in general they are widely scattered and difficult to locate. This flora is well known but there is always a very small chance that some new taxa may be discovered. To date no fossils have been reported from the Bethal and Kriel areas. Fossil vertebrates of this age are extremely rare and there are no known occurrences of vertebrate fossils associated with coals in southern Africa. Insect wings can occur with the leaves but they are extremely rare and difficult to find.

The area is highly disturbed from previous mining operations but there is a small chance that fossil plants could be found where new excavations are made.

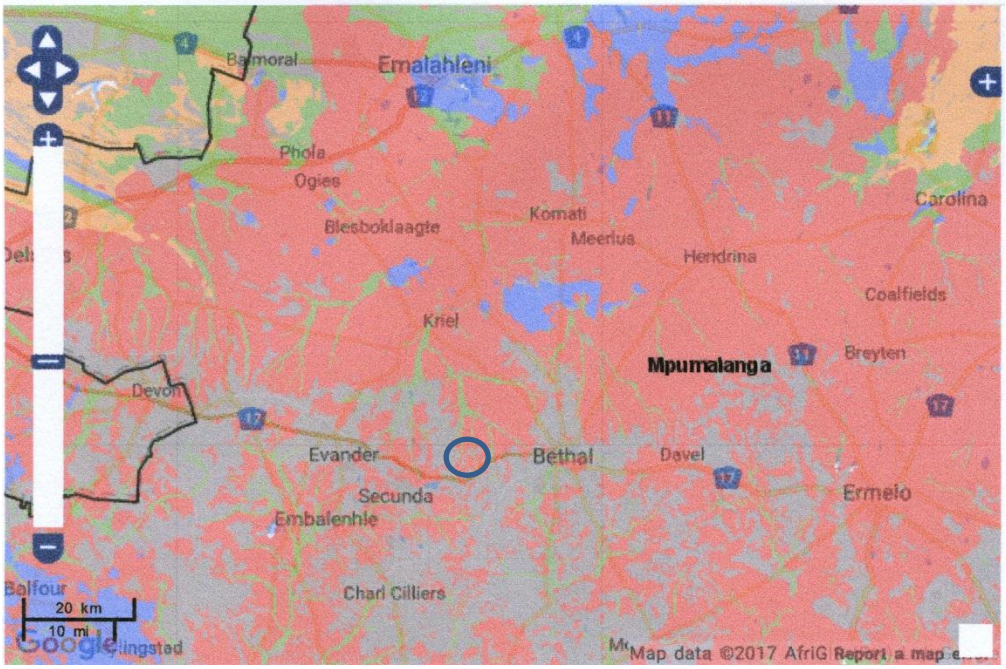


Figure 4: SAHRIS palaeosensitivity map. Gedex project shown within the blue circular outline. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

5. Impact assessment

Using the criteria in the table below, the impact of the underground coal mine and infrastructure has been assessed.

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

impacts	**H**	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

The surface activities would impact on the fossil heritage, only if preserved in this area, as the rocks are sedimentary and the correct age, however the area is already highly disturbed and the seams well below ground level. The IMPACT is very low (according to the scheme in Table 3).

Excavation for access and subsequent underground mining activities would penetrate down to Seam 2. With a relatively small footprint for the boxcut adits through the shales the chance of finding fossil plants is very small so there would be minor deterioration of the surface of sites and a minor impact on any potential fossils. Therefore the SEVERITY/NATURE of the environmental impact would be L.

DURATION of the impact would be permanent: H.

Since only the possible fossils within the area would be fossil plants such as leaf impressions from the *Glossopteris* flora in the shales, the SPATIAL SCALE will be localised within the site boundary: L.

There is a very small chance of finding leaf fossils in the shales between coal seams because these have been reported from the same formations but not in this particular area. However, the PROBABILITY of affecting any fossils is unlikely or seldom: L

6. 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 basement rocks, dolomites, sandstones, shales, coals, quartzites, basalts and volcanic rocks are typical for the country and do not contain any fossil material. The shales of the Vryheid Formation could contain impression fossils of plants of the *Glossopteris* flora, however, they have yet to be recorded from the proposed site for mining.

7. Recommendation

It is unlikely that many fossils occur in the proposed shaft sites in the shales between coal seams. Furthermore, no fossils have been recorded from this area. Nonetheless rocks of this type and age are potentially fossiliferous, as indicated in the SAHRIS palaeosensitivity map (Fig 4). As there is a chance find, a monitoring protocol is recommended.

As far as the palaeontology is concerned the proposed development can go ahead. Any further palaeontological assessment would only be required after excavations and drilling

have commenced and if fossils are found by the geologist or environmental personnel. The procedure can be added to the EMPr.

8. Monitoring Programme for Palaeontology – to commence once the excavations begin.

The following procedure is only required if fossils are seen on the surface and when excavations commence.

1. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, plants, insects, bone, and coal) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
2. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants 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.
3. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
4. On a regular basis, to be agreed upon by the developer and the qualified palaeontologist sub-contracted for this project, the palaeontologist should visit the site to inspect the selected material and check the dumps where feasible. The frequency of inspections should be monthly. However, if the onsite designated person is diligent and extracts the fossil material then inspections can be less frequent.
5. 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.
6. If no good fossil material is recovered then the site inspections by the palaeontologist can be reduced to annual events until construction has ceased. Annual reports by the palaeontologist must be sent to SAHRA.
7. If no fossils are found and the excavations have finished then no further monitoring is required.

9. References

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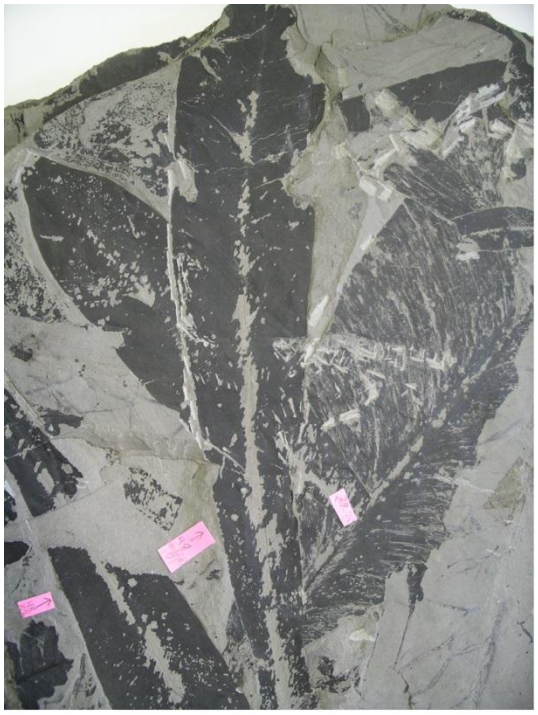

Wide and narrow Glossopteris leaves

Narrow Glossopteris leaves

Lycopod stem with leaf abscission scars

Astertotheca (fern)

Hammanskraal fossil plants

Figure 5: Examples of fossil leaf impressions and compressions of the *Glossopteris* flora (Ecca Group) that could possibly be found.