Palaeontological Impact Assessment

on behalf of
Environmental Assurance (Pty) Ltd
for

proposed *Usutu Coal Colliery*, Ermelo, Mpumalanga province

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Introduction

The National Heritage Resources Act (Act 25 of 1999) (NHRA) requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. Thus, in accordance with SAHRA legislation, archaeological and palaeontological impact assessments must be done for new developments, so here is Phase 1 for the proposed Vunene Usutu Colliery at Ermelo. This project will involve opencast and surface coal mining. The farms affected are Leeuwenburg 137 IT, Roodewal 270 IT, Holbank 265 IT, Vlakfontein 266 IT, Vlakfontein 269 IT, Mooiplaats 290 IT, Witpunt 267 IT, Transutu 257 IT and Jan Hendriksfontein 263 IT, in the Msukaligwa Local Municipality, (Ermelo), Mpumalanga Province.

Geology and Palaeontology

The area proposed for coal mining is in the north northeastern part of the Karoo Basin and comprises Early to Middle Permian rocks of the Vryheid Formation (Artinskian, approximately 284-279 Ma) with numerous intrusive Jurassic dykes (approximately 190-150 Ma). The general geology of the region is shown in Fig 1. The depositional environment was deltaic and fluvial and deposited in an active tectono-sedimentary basin. These Early Permian coals are commonly sandstone hosted and in this part of the basin are fairly shallow, less than 200m below surface (Cairncross, 2001). Coal swamps developed on top of the clastic sediments that were deposited by deltaic systems and subsequently formed peat swamps. Post depositional erosion and/or repeats of the cycle have resulted in the formation of coal seams of varying thickness and quality. The intrusive dolerite dykes, much later, have also affected the coal quality as well as the fossilised plants.

All coal is made from plant matter but in the higher rank coals the original plant structure cannot be seen. In the low rank coals, and more specifically in the shales and sandstones between the coal seams is where the plant material is well preserved and identifiable. Therefore it is highly probable that fossil plants will be found during mining operations. Fossil bones do not preserve in the acidic environment associated with swamps and coals but fossil insects may be preserved.

Coal deposits of this age are widespread in southern Africa and preservation of the plants is quite variable but they represent the same general flora. It is most unlikely that unique fossils will occur in the proposed mining area, however, it is strongly recommended that the site engineer or geologist looks out for any well preserved fossil plant material, rescue it and send it to a palaeontological institute (such as the BPI Palaeontology, Johannesburg, or Ditsong Museum in Pretoria) for curation and study. If the mine or local town has a small museum they could display the fossils there for education and public outreach.

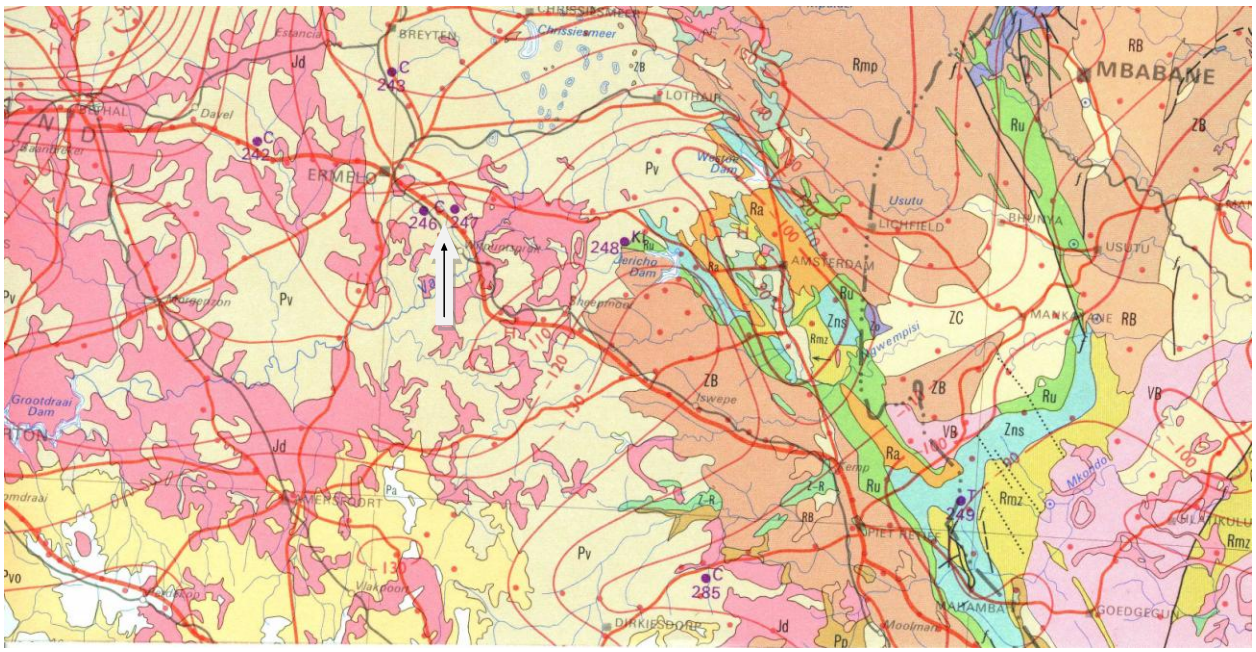

Figure 1: Geological map of the area where the proposed mining operation is to take place. Arrow marks the area. Pv = Permian Vryheid Formation; Jd = Jurassic intrusive dykes. Map from the Geolological Survey, Pretoria; 1984, 1: 1 000 000.

Fossil plants from the Early Permian

Fossil plants have been collected by Heidi and John Anderson from the Ermelo area and are now housed in the palaeobotany herbarium of the Bernard Price Institute for Palaeontological Research, university of the Witwatersrand. These plants are typical examples from fossil floras of this age. In Table 1 is a full list of plants from this age and the species that occur in the Ermelo region are indicated. A selection of these extinct fossil plants is illustrated in Figure 2 to assist with recognition of the fossils.

Plant group/common name	***Genus and species***	**Ermelo**
Lycopods	*Haplostigma permianica*	
	Leptophloem santae-helenae	
	Azaniadendron fertile	
	Cyclodendron leslii	yes
Sphenopsids	*Sphenophyllum hammanskraalensis*	
	Sphenophyllum mesoccaense	
	Sphenohyllum speciosum	
	Annularia hammanskraalensis	
	Raniganjia rayneri	
	Raniganjia lanceolate	

	Raniganjia kilburnensis	
	Phyllotheca lawleyensis	
Ferns	*Asterotheca hammanskraalensis*	
	Asterotheca leeuwkuilensis	
	Sphenopteris lobifolia	
	Liknopetalon enigmata	
Glossopteridales	*Numerous leaves – morphotypes, not species*	
- Female fructifications	*Arberia hlobanensis*	
-	*Arberia madagascariensis*	
-	*Bifariala intermittens*	
-	*Dictyopteridium natalensis*	
-	*Dictyopteridium flabellatum*	
-	*Elatra leslii*	yes
-	*Estcourtia conspicua*	
-	*Gladiopomum acadarense*	
-	*Gonophylloides strictum*	
-	*Gonophylloides waltonii*	
-	*Lidgettonia africana*	
-	*Lidgettonia elegans*	
-	*Lidgettonia lidgettonioides*	
-	*Ottokaria buriadica*	
-	*Ottokaria hammanskraalensis*	yes
-	*Ottokaria transvaalensis*	
-	*Plumsteadia gibbosa*	
-	*Plumsteadia lerouxii*	
-	*Rigbya arberioides*	
-	*Scutum leslii*	yes
-	*Vereenia leeukuilensis*	
- -male fructifications	*Eretmonia spp.*	
Ginkgoales	*Sphenobaiera eccaensis*	
	Metreophyllum lerouxii	
	Ginkgophyllum kidstonii	
	Ginkgophyllum spatulifolia	
	Flabellofolium leeukuilensis	
Conifers	*Noeggerathiopsis hislopii*	yes
	Walkomiella transvaalensis	
	Podozamites hlobanensis	
	Cyparissidium sp.	
Incertae sedis	*Taeniopteris gemmina*	
	Botrychiopsis valida	
	Various seeds	

Table 1: List of Early to middle Permian plants from the Karoo Basin, South Africa, with those taxa occurring near Ermelo. From Plumstead, 1969; Anderson and Anderson, 1985; Adendorff, 2004; Adendorff et al., 2003; Prevec et al., 2008, Taylor et al., 2009.

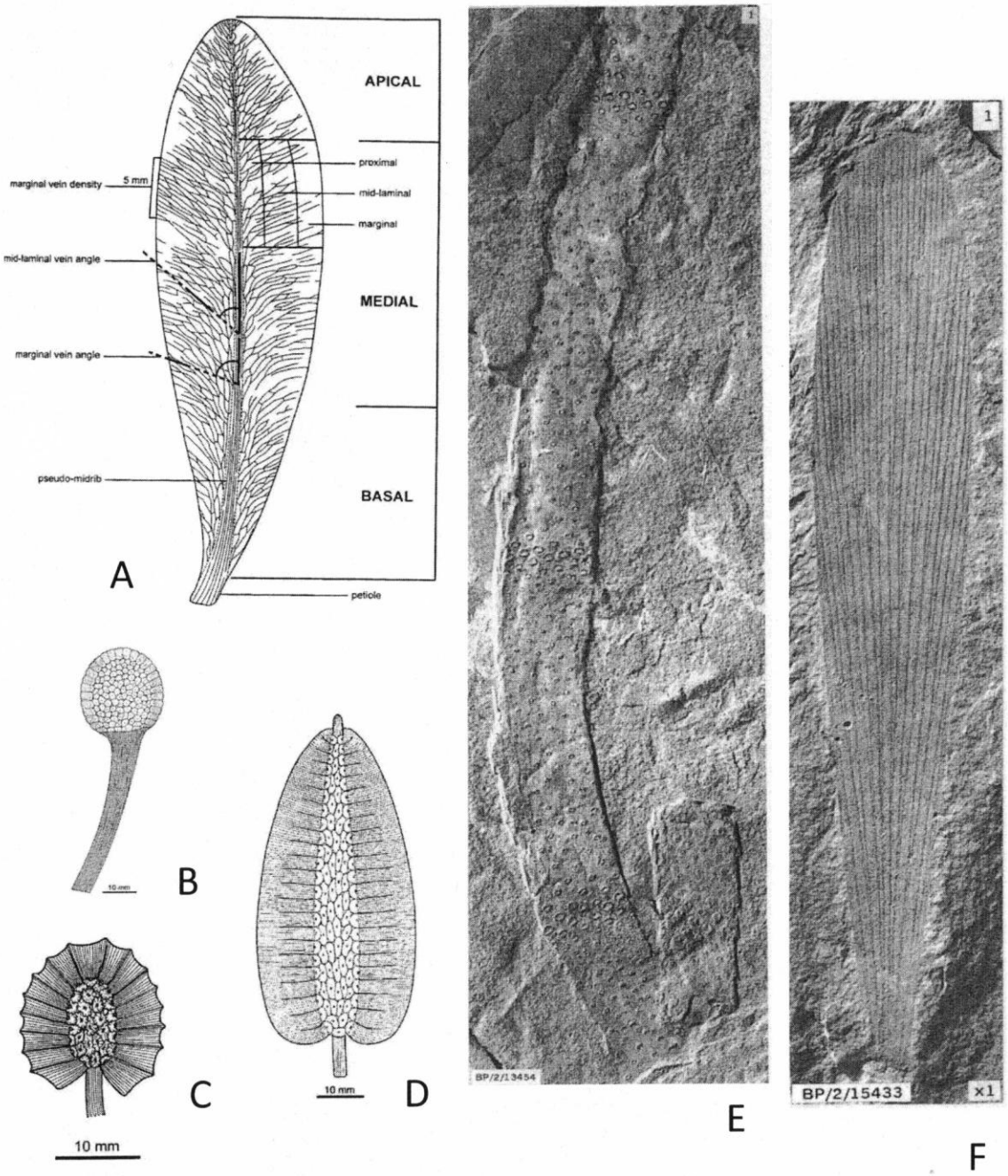

Figure 2: Fossil plants from the Ermelo area that could be found in the shale lenses between or within the coal seams. A – diagram of a *Glossopteris* leaf. The shape and size may vary but constant features are more or less elliptic to linear outline, entire margin, midrib with almost parallel veins travelling to the margin. B, C, D – diagrams of Glossopteris female fructifications, *Ottokaria* sp., *Scutum leslii, Gladiopomum elongatum*, respectively. Note the basic structure: central part contains numerous round to oval seeds, surrounded by a wing which is very narrow (B), fluted (C) or elongate (D). E = photograph of the lycopod *Cyclodendron leslii*. Note the circular to oval leaf abscission scars along the stem with uneven spacing and size, reflecting

variable growth rate. F – photograph of the conifer leaf *Noeggerathiopsis hislopii*. Compare this with the *Glossopteris* leaf: this leaf has a similar shape and size but has no midrib; all the veins arise from the base and extend to the margin along the central and upper part of the leaf. Diagrams A-D from Adendorff 2004; photographs D-E of fossils from the collection at BPI.

Recommendation

Fossil vertebrates are most unlikely to be found in the proposed area. Fossil plants will most likely be found during the development of the mine and during mining operations but they are fairly common and not of great significance. If, however, good material is discovered then they should be rescued and sent to a palaeontological institute for curation and storage. As far the palaeontological heritage is concerned mining operations may commence.

References

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