

**PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE AUTHORISATION AND AMENDMENT
PROCESSES FOR MANUNGU MINE NEAR DELMAS, VICTOR KHANYE LOCAL MUNICIPALITY, VICTOR
KHANYE LOCAL MUNICIPALITY, MPUMALANGA**

Prepared for:

PGS Heritage (Pty) Ltd

DATE: 19 September 2018

Prepared by

BANZAI ENVIRONMENTAL (PTY) LTD

EXECUTIVE SUMMARY

Geo Soil and Water cc (GSW) was appointed by Tshedza Mining Resources (Pty) Ltd., a subsidiary of Mbuyelo Coal (Pty) Ltd as the Environmental Assessment Practitioner (EAP) to assist with the undertaking of the required authorisation and amendment procedures for Manungu Colliery. The planned new mining development falls within the list of properties approved under the NEMA for a range of listed activities. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is essential to detect the existence of fossil material within the planned development footprint and to evaluate the impact of the construction and operation of the proposed development on the palaeontological heritage.

The proposed development footprint of the Manungu Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposits.

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup. This Group is characterized by the presence of trace fossils (track ways, coprolites), body fossils of marine fish, gastropods and invertebrates as well as fossil plants. The rocks of the **Dwyka** are of **low palaeontological sensitivity**. The Vryheid Formation of the Ecca Group is well-known for the presences of coal beds which has been formed due to the accumulation of plant material over long periods of time. Trace fossils, fish, small crustaceans, insects, as well as plant fossils are common in this Formation. The sedimentary rocks of the **Vryheid Formation** have a **very high palaeontological sensitivity**. The **Dolerite** of the Jurassic has a **zero palaeontological sensitivity** as these rocks are unfossiliferous. The fossil assemblages of the Quaternary deposits with a low palaeontological sensitivity are usually rare, low in diversity, and occur over a wide geographic area.

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. Regardless of the uncommon occurrence of fossils in this biozone a single fossil may be of scientific value as many fossil taxa are known from only one fossil. The recording of fossils will improve our knowledge of the Palaeontological Heritage of the development area.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations or removal of vegetation, the ECO in charge for the developments ought to be informed immediately. These finds must be protected (if possible *in situ*) and the ECO must alert SAHRA (South African Heritage Research Agency) to make sure that mitigation (*e.g.* recording and collection) can be undertaken by a professional paleontologist.

Preceding any excavation of fossils a collection permit from SAHRA must be obtained. The fossil material must be housed in an accredited collection (museum or university collection) and the fieldwork and reports need to comply with the minimum standards for palaeontological impact studies developed by SAHRA.

Recommendations:

1. The following recommendations ought to form part of the EMP of the Manungu Colliery mining project.
2. The EAP and ECO for the Manungu Colliery should know that the sediments of the Vryheid Formation, Ecca Group contains important fossil remains of plant fossil assemblages and trace fossils.
3. A qualified palaeontologist must be employed to assess and record fossils recovered at the Manungu development footprint.
4. These fossils may be placed on a stockpile where a professional palaeontologist may examine them at regular intervals which must be determined by the mine and palaeontologist.

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1 INTRODUCTION

Tshedza Mining Resources (Pty) Ltd. (Tshedza) proposes the expansion of the existing beneficiation facility (crushing and screening plant) to include a coal processing facility at Manungu Colliery (Fig. 1). The Colliery will consist of opencast and underground mining operations and associated infrastructure. Tshedza will present an application for the appropriate approvals to cover their 30 year life-of-mine (LOM). The planned new processing facility will comprise of a coal wash plant with associated residue discard dump and water management infrastructure. The processing facility and discard dump will be situated within the mining right border. It is expected that several listed activities contained in the National Environmental Management Act (Act 107 of 1998) (NEMA), National Environmental Management Waste Act (Act 59 of 2008) (NEMWA) and National Water Act (Act 36 of 1998) (NWA) will be triggered by the planned facilities and/or amendments.

The wash plant will consist of the following: (information provided by Geo Soil and Water cc)

- Dry fines screening circuit;
- Dense Medium Separation (DMS) module;
- Feed de-sliming
- Circulating medium circuit
- Dilute medium circuit
- Grits dewatering circuit
- Tailings thickener circuit
- Tailings filter circuit
- Product handling circuit
- Plant services circuit
- Raw and potable water system; and
- Process water circuit.

Tshedza plan to incorporate the licensing of three new boreholes for domestic intake and a french drain system to increase the septic tank system for grey water as part of the application processes. Various possibilities are planned to manage spare water volumes within the pollution control dam. Several amendments to the present EA/EMP and IWUL will be applied for to support the specific conditions with the current status of the mine as well as to explain certain conditions.

The following application processes with associated activities are planned:

- New Integrated Environmental Authorization (Scoping and Environmental Impact Report (S&EIR)) for:

- Erection of a wash plant and related infrastructure to supplement the existing coal beneficiation plant; and
 - Dumping of wash plant waste (requiring Waste Management Licence).
 - New residue deposits and/or residue stockpiles (requiring Waste Management Licence); and
 - Several activities comprising the primary processing of a mineral resource associated to the 30 year LOM.
- New Integrated Water Use Licence (IWUL) for:
 - Discard (wash plant waste) disposal;
 - Abstraction boreholes;
 - A new French drain system; and
 - Evaporation sprays at the present pollution control dam (PCD).
 - Amendments to current Environmental Authorisation and Environmental Management Plan for among others:
 - Stockpile height amendments;
 - Stockpile vegetation requirements; and
 - Tree screen requirements.
 - Amendments to the existing IWUL for:
 - Update of water balance for PCD;
 - Water storage volume;
 - Ash layer condition below run of mine (ROM);
 - Flow meter reading frequency; and
 - Additional storm water structures within watercourses.
 - Section 102 Amendment (to be confirmed with the Competent Authority)
 - Revised Mine Works Programme to include wash plant; and
 - Revised consolidated EMPR to include wash plant.

LISTED ACTIVITIES APPLICATION:

The planned project must be authorized in terms of South African environmental legislation:

- The Mineral and Petroleum Resources Development Act (MPRDA, Act No. 28 of 2002);
- The National Environmental Management Act (NEMA, Act No. 107 of 1998);
- The National Environmental Management Waste Act (NEMWA, Act No. 59 of 2008); and
- The National Water Act (NWA, Act No. 36 of 1998).

The following listed activities are anticipated to be triggered by the proposed new infrastructure, facilities and amendments to existing licenses on Manungu Colliery.

- NEMA GNR 983: Activities 12,19, 20, 24, 34;
- NEMA GNR 984: Activities 6, 15
- NEMA GNR 985: Activity: 14
- NEMWA GNR 921: Category B11.
- NWA: Section 21 (a) and (g) water uses;
- NWA: GN 704

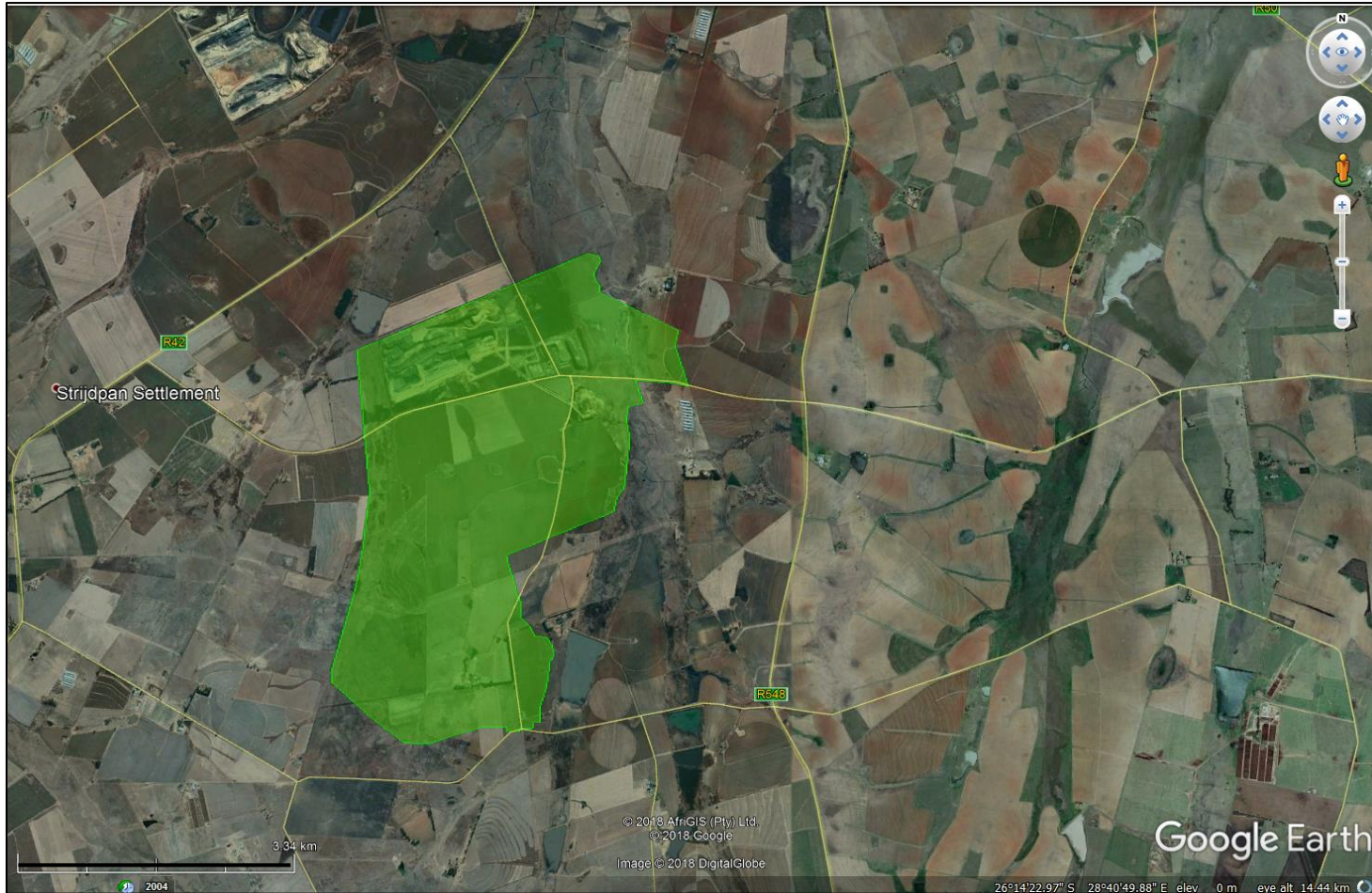


Figure 1 - Google Earth image (2018) of the proposed Manungu Colliery. Scale bar represents 334 km.

2 LEGISLATION

2.1 NATIONAL HERITAGE RESOURCES ACT (25 OF 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **“all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”**.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, moved, broken or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Desktop Assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—(exceeding 5 000 m² in extent; or
 - involving three or more existing erven or subdivisions thereof; or
 - involving three or more erven or divisions thereof which have been consolidated within the past five years; or
 - the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
 - the re-zoning of a site exceeding 10 000 m² in extent; or
 - any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

3 SCOPE

The objective of a Palaeontological Desktop Assessment is to determine the impact of the development on potential palaeontological material at the site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the aims of the palaeontological impact assessment are: 1) to identify the palaeontological importance of the exposed and subsurface rock formations in the development footprint 2) to evaluate the palaeontological importance of the formations 3) to determine the impact of the development on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

When a palaeontological desktop study is compiled, the potentially fossiliferous rocks (i.e. groups, formations, etc.) present within the study area are established from 1:250 000 geological maps. The topography of the development area is identified using 1:50 000 topography maps as well as Google Earth Images of the development area. Fossil heritage within each rock section is obtained from previous palaeontological impact studies in the same region, the PalaeoMap from SAHRIS; and databases of various institutions (identifying fossils found in locations specifically in areas close to the development area). The palaeontological importance of each rock unit of the development area is then calculated. The possible impact of the proposed development footprint on local fossil heritage is established on the following criteria: 1) the palaeontological importance of the rocks and 2) the type and scale of the development footprint and 3) quantity of bedrock excavated.

In the event that rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a professional palaeontologist is required. Based on both the desktop data and field examination of the rock exposures, the impact significance of the planned development is measured with recommendations for any further studies or mitigation. In general, destructive impacts on palaeontological heritage only occur during construction. The excavations will transform the current topography and may destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation comprises the sampling, collection and recording of fossils and may precede construction or, more ideally, occur during construction when potentially fossiliferous bedrock is exposed. Preceding the excavation of any fossil heritage a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact is possible because our knowledge of local palaeontological heritage may be increased.

4 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed Manungu Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite and Quaternary superficial deposits (Fig.4-5). The geology of the development is illustrated on the 1:250 000 map

4.1 GEOLOGY

DWYKA GROUP

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup. South Africa was covered by an ice sheet during the Dwyka. The Dwyka deposits were thus deposited in a cold, glacially-dominated environment. This Group consists mainly of gravelly sediments with subordinate varved shales and mudstones with scraped and faceted pebbles. The retreating glaciers deposited dark-grey tillite. The Dwyka is known for its rich assemblage of dropstones of various sizes.

VRYHEID FORMATION

The Vryheid Formation is characterized by light grey, fine to coarse sandstone and siltstone sediments. The dark coloured siltstones can be ascribed to the presence of carbon enrichment and coal beds. Infrequent coal seams, deltaic mudrocks and sandstones as well as coastal and fluvial deposits are present in this formation. These sediments were probably deposited on a sandy shoreline that stretched out beyond swamplands. In these swamps, plants accumulated and formed the coal deposits that are mined today (Johnson et al, 2006).

KAROO DOLERITE SUITE

The Karoo Dolerite Suite were formed in the Early Jurassic Period (approximately 183 million years ago). The Karoo Dolerite Suite is a widespread system of igneous bodies (which include dyke and sills) that encroached into the sediments of the Main Karoo Basin. These igneous rocks are unfossiliferous.

QUATERNARY SUPERFICIAL DEPOSITS

The Tertiary to Quaternary Cenozoic superficial deposits consist of aeolian sand, alluvium (clay, silt and sand deposited by flowing floodwater in a river valley/ delta producing fertile soil), colluvium (material collecting at the foot of a steep slope), spring tufa/tuff (a porous rock composed of calcium carbonate and formed by precipitation from water, for example, around mineral springs.) and lake deposits, peats, pedocretes or duricrusts (calcrete, ferricrete), soils and gravels.

4.2 PALAEOLOGICAL HERITAGE

DWYKA GROUP

The Permo-Carboniferous Dwyka Group is known for its track ways (Ichnofacies) that was mostly formed by fish and arthropods (invertebrates) as well as fossilized faeces (coprolites). When body fossils do occur it is of marine fish, gastropods and invertebrates as well as fossil plants (a rich diversity of cordaitaleans, conifers, glossopterids, ginkgoaleans, pollens and spores have been described while ferns, horsetails and lycopods, are also found). Most of the Dwyka sediments are of low overall palaeontological sensitivity.

VRYHEID FORMATION

The Vryheid Formation (Ecca Group) is world renowned for the occurrence of coal beds formed by the accumulation of plant material over long periods of time. Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii*, *Sphenophyllum hammanskraalensis*, *Annularia sp.*, *Raniganjia sp.*, *Asterotheca spp.*, *Liknopetalon enigmata*, *Hirsutum sp.*, *Scutum sp.*, *Ottokaria sp.*, *Estcourtia sp.*, *Arberia sp.*, *Lidgettonia sp.*, *Noeggerathiopsis sp.*, *Podocarpidites sp.* as well as more than 20 *Glossopteris* species).

Bamford (2011) is of the opinion that only a small amount of data have been published on these potentially fossiliferous deposits and that most likely good material are present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur they are usually abundant. According to Bamford it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

The Vryheid Formation is also characterised by its trace fossil assemblages of the non-marine *Mermia* Ichnofacies, insect fossils track ways, fish and small crustaceans. The *Mesosaurus* reptile may also be present

QUATERNARY SUPERFICIAL DEPOSITS

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may sometimes occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not concentrate their research on Cenozoic superficial deposits although they sometimes comprise of important fossil biotas. Fossils assemblages may comprise of bones, horn cores and mammalian teeth; reptile skeletons as well as fragments of ostrich eggs. Microfossils, non-marine mollusc shells and freshwater stromatolites are

also known from Quaternary deposits. Plant material such as foliage, pollens peats and wood are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

STRATIGRAPHY							
AGE		WEST OF 24°E	EAST OF 24°E	FREE STATE/ KWAZULU- NATAL	SACS RECOGNISED ASSEMBLAGE ZONES	PROPOSED BIOSTRATIGRAPHIC SUBDIVISIONS	
JURASSIC	"STORMBERG"	[Dotted pattern]	Drakensberg F.	Drakensberg F.			
			Clarens F.	Clarens F.		<i>Massospondylus</i>	
TRIASSIC	TARKASTAD SUBGROUP	[Dotted pattern]	Elliot F.	Elliot F.		" <i>Euskelosaurus</i> "	
			MOLTENO F.	MOLTENO F.			
PERMIAN	BEAUFORT GROUP	ADELAIDE SUBGROUP	BURGERSDORP F.	DRIEKOPPEN F.	<i>Cynognathus</i>	[Diagram of Procolophon]	
			KATBERG F.	VERKYKERSKOP F.	<i>Lystrosaurus</i>		
			Palingkloof M.	Harrismith M.	<i>Daptocephalus</i>		
			Elandsberg M.	Schoondraai M.			
			Barberskrans M.	Rooinekke M.			
			Daggaboersnek M.	Frankfort M.			
	TEEKLOOF F.	OUDEBERG M.	<i>Cistecephalus</i>				
	BEAUFORT GROUP	ADELAIDE SUBGROUP	ADELAIDE SUBGROUP	Hoedemaker M.	MIDDELTON F.	<i>Tropidostoma</i>	
				Poortjie M.		<i>Pristerognathus</i>	
				ABRAHAMSKRAAL F.	KROONAP F.	<i>Tapinocephalus</i>	UPPER UNIT
							LOWER UNIT
						<i>Eodicynodon</i>	
PERMIAN	ECCA GROUP	ADELAIDE SUBGROUP	WATERFORD F.	WATERFORD F.			
			TIERBERG/ FORT BROWN F.	FORT BROWN F.			
			LAINGSBURG/ RIPON F.	RIPON F.	VRYHEID F.		
			COLLINGHAM F. WHITEHILL F.	COLLINGHAM F. WHITEHILL F.	PIETER- MARTZBURG F.		
			PRINCE ALBERT F.	PRINCE ALBERT F.		<i>'Mesosaurus'</i>	
					MBIZANE F.		
CARBON- IFEROUS	DWYKA GROUP	ELANDSVLEI F.	ELANDSVLEI F.	ELANDSVLEI F.			

SANDSTONE-RICH UNIT
 HIATAL SURFACE
 END BEAUFORT GROUP
HIATUS

Figure 2 - Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions of the Eccca and Beaufort Group of the Karoo Supergroup with rock units and fossil assemblage zones relevant to the present study marked in green (Modified from Rubidge 19)

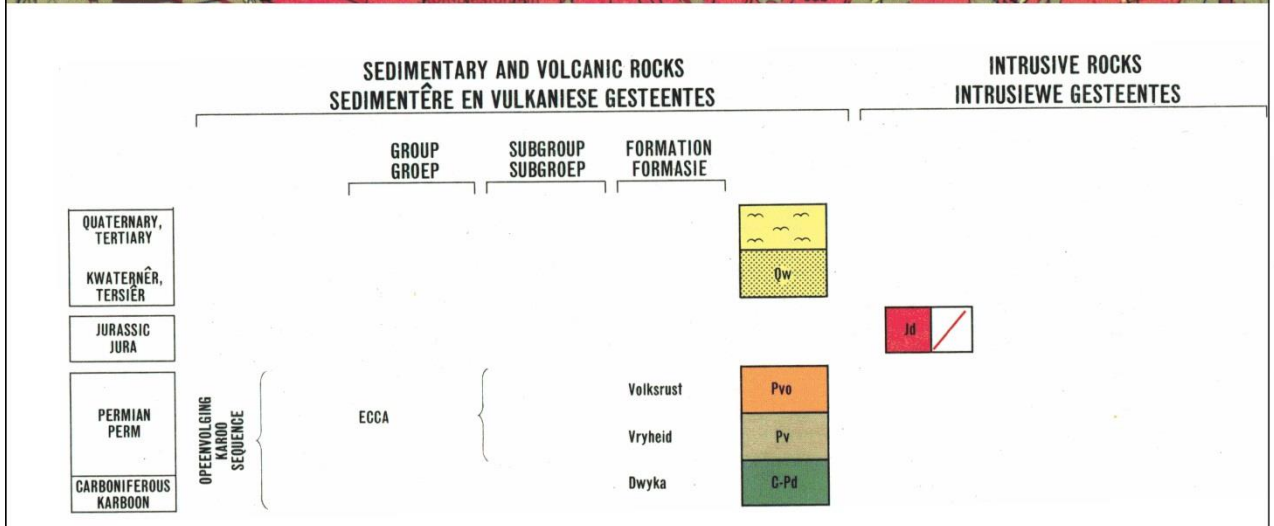


Figure 3 - Extract of the 2628 Geological map of the East Rand. The general surface geology of the proposed Manungu Colliery (approximate location in black) near Delmas. The development site is completely underlain by by sedimentary rocks of the Permo-Carboniferous Dwyka Group (shaded in green); Permian aged Vryheid Formation (sandy coloured), (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (red) (Karoo Supergroup) and Quaternary superficial deposit (yellow).

5 GEOGRAPHICAL LOCATION OF THE SITE

The existing Manungu Colliery is located 9 km south of Delmas. The Colliery covers all portions of the farms Weilaagte 271IR and Welgevonden 272IR (comprising the approved mining right area) within the Victor Khanye Local Municipality, Mpumalanga, South Africa (Fig. 1).

6 METHODS

A Palaeontological Scoping study was thus conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2018), topographical and geological maps and other reports from the same area were used to assess the proposed area of the development. The proposed development area has been heavily changed from natural habitats by decades of agricultural development. As the ground surface has been disturbed the possibility of recovering fossil heritage on the surface is small.

26° 14' 27" S; 28° 40' 13" E



26° 13"52E; 28°38" 60'S



26° 16"53'S; 28°39" 56'E



26° 16' 33" S; 28° 40' 25" E



26° 16' 33" S; 28° 40' 25" E



26° 13"32'S; 28°43" 45'E



6.1 ASSUMPTIONS AND LIMITATIONS

The accuracy of Palaeontological Desktop Impact Assessments is reduced by old fossil databases that do not always include relevant locality or geological formations. The geology in various remote areas of South Africa may be less accurate because it is based entirely on aerial photographs. The accuracy of the sheet explanations for geological maps is inadequate as the focus was never intended to be on palaeontological material.

The entirety of South Africa has not been studied palaeontologically. Similar Assemblage Zones but in different areas, might provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations generally assume that unexposed fossil heritage is present within the development area. Thus, the accuracy of the Palaeontological Impact Assessment is improved by a field-survey.

7 IMPACT ASSESSMENT

Impacts from mining are rated as medium significance (**Error! Reference source not found.**).

Table 1 - Assessment of impact of mining on palaeontological resources

A. Destruction of Fossil Heritage -					
Impact Name	Destruction of Fossil Heritage				
Alternative	0				
Phase	Construction				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	5	5	Probability	3	1
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
<p>It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.</p> <p>In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations or removal of vegetation, the ECO in charge for the developments ought to be informed immediately. These finds must be protected (if possible <i>in situ</i>) and the ECO must alert SAHRA (South African Heritage Research Agency) to make sure that mitigation (e.g. recording, sampling or collection) can be undertaken by a professional paleontologist.</p> <p>Preceding any excavation of fossils, a collection permit from SAHRA must be obtained. The fossil material must be housed in an approved collection (museum or university collection) and the fieldwork and reports need to comply with the minimum standards for palaeontological impact studies developed by SAHRA.</p>					
Environmental Risk (Post-mitigation)					-2,50
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					1
<i>Low: Issue not raised in public responses</i>					
Cumulative Impacts					2
<i>Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.</i>					
Degree of potential irreplaceable loss of resources					1
<i>The impact is unlikely to result in irreplaceable loss of resources.</i>					
Prioritisation Factor					1,17
Final Significance					-2,92

8 FINDINGS AND RECOMMENDATIONS

The proposed consolidation footprint of the Manungu Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite and Quaternary superficial deposits.

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During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. However, although fossils occurrences are generally uncommon, a single fossil may scientifically be very important as many fossil taxa are known from a single fossil.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations and removal of vegetation, the ECO in charge of these developments should be informed immediately. These discoveries must be protected (preferably *in situ*) and the ECO must alert SAHRA (South African Heritage Research Agency) to ensure that mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist.

Preceding any excavations of fossils a collection permit from SAHRA must be obtained. Fossil material ought to be curated in an accredited collection (*e.g.* museum or university collection) and all fieldwork and reports must comply with the minimum standards for palaeontological impact studies developed by SAHRA.

Recommendations:

1. The following recommendations ought to form part of the EMP of the Manungu Colliery mining project.
2. The EAP and ECO for the Manungu Colliery should know that the sediments of the Vryheid Formation, Ecca Group contains important fossil remains of plant fossil assemblages and trace fossils.
3. A qualified palaeontologist must be employed to assess and record fossils recovered at the Manungu development footprint.
4. These fossils may be placed on a stockpile where a professional palaeontologist may examine them at regular intervals which must be determined by the mine and palaeontologist.

9 REFERENCES

ALMOND, J., PETHER, J., and GROENEWALD, G. 2013. South African National Fossil Sensitivity Map. Fossil Heritage Layer Browser, SAHRA and Council for Geoscience.

BAMFORD M. 2011. Desktop study Palaeontology Ermelo to Empangeni – Eskom powerline. Internal report Bernard Price Institute for Palaeontological Research, University of the Witwatersrand.

DU TOIT, A. 1954. The geology of South Africa. xii + 611pp, 41 pls. Oliver & Boyd, Edinburgh.

JOHNSON, M.R, ANHAUSER, C.R, and THOMAS, R.J. 2006. *The Geology of South Africa*. Geol. Soc. S. Africa. Council for Geoscience, Pretoria.

KENT, L. E., 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. SACS, Council for Geosciences, Pp 535-574.

MCCARTHY, T & RUBIDGE, B. 2005. *The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey*. Struik. Pp 333

MACRAE, C. 1999. Life etched in stone. *Fossils of South Africa*. 305 pp. The Geological Society of South Africa, Johannesburg.

SNYMAN, C.P. 1996. Geologie vir Suid-Afrika, Departement Geologie, Universiteit van Pretoria, Pretoria, Volume 1, Pp 513.

VAN DER WALT, M., DAY, M., RUBIDGE, B. S., COOPER, A. K. & NETTERBERG, I., 2010. Utilising GIS technology to create a biozone map for the Beaufort Group (Karoo Supergroup) of South Africa. *Palaeontologia Africana*, **45**: 1-5.

10 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty three years. She has been conducting Palaeontological Impact Assessments since 2014.

11 DECLARATION OF INDEPENDENCE

I, Elize Butler, declare that –

General declaration:

- *I act as the independent palaeontological specialist in this application*
- *I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant*
- *I declare that there are no circumstances that may compromise my objectivity in performing such work;*
- *I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;*
- *I will comply with the Act, Regulations and all other applicable legislation;*
- *I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;*
- *I have no, and will not engage in, conflicting interests in the undertaking of the activity;*
- *I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be*

taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;

- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;*
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not*
- All the particulars furnished by me in this form are true and correct;*
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and*
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.*

Disclosure of Vested Interest

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;*

PALAEONTOLOGICAL CONSULTANT:

Banzai Environmental (Pty) Ltd

CONTACT PERSON:

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SIGNATURE:

