

**PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED DEVELOPMENT
OF TWO BURROW PITS (DR02625 AND DR02614) IN THE ENOCH MGIJIMA
MUNICIPALITY, CHRIS HANI DISTRICT, EASTERN CAPE**

Prepared for:

isi-Xwiba Consulting CC

PO Box 2097

Komani

5322

20 September 2016

Prepared by

BANZAI ENVIRONMENTAL (PTY) LTD

P.O. BOX 11023

UNIVERSITAS

BLOEMFONTEIN

9323

EXECUTIVE SUMMARY

The Eastern Cape Department of Roads and Public Works, Chris Hani District is implementing a roads upgrade program in the former Inkwanca Local Municipal area, now incorporated with the former Lukhanji and Tsolwana Local Municipalities to form the new Enoch Mgijima Municipality. Two pre-existing gravel mines (burrow pits) have been identified in order to obtain construction materials to upgrade and re-surface roads located in the Enoch Mgijima Municipality. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is required to detect the presence of fossil material within the proposed development footprint and to assess the impact of the proposed burrow pits on the palaeontological resources. Banzai Environmental (PTY) LTD has been appointed to conduct the Palaeontological Impact Assessment as part of the Heritage Impact Assessment.

The proposed Gravel Mine DR02614 is underlain by the Early to Middle Triassic Burgersdorp Formation (*Cynognathus* Assemblage Zone (AZ), Tarkastad Subgroup, Beaufort Group, Karoo Supergroup). The second Gravel Mine DR02625 is completely underlain by the Triassic Molteno Formation. Although the palaeontological sensitivity of both development areas is rated high, the lack of fossiliferous exposure at the proposed site indicates that the impact on palaeontological material is negligible and regarded as insignificant.

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

CONTENTS

1	INTRODUCTION	5
1.1	LEGISLATION	9
2	Objective.....	10
3	GEOLOGICAL AND PALAEOONTOLOGICAL HISTORY.....	11
3.1	GEOLOGY.....	11
3.2	PALAEONTOLOGY	11
4	GEOGRAPHICAL LOCATION OF THE SITE.....	14
5	METHODS	14
5.1	ASSUMPTIONS AND LIMITATIONS.....	14
6	FIELD OBSERVATIONS.....	15
7	FINDINGS AND RECOMMENDATIONS	17
8	REFERENCES	18

1 INTRODUCTION

The Eastern Cape Department of Roads and Public Works, Chris Hani District is implementing a roads upgrade program in the former Inkwanca Local Municipal area, now incorporated with the former Lukhanji and Tsolwana Local Municipalities to form the new Enoch Mgijima Municipality. isi-Xwiba Consulting CC has been appointed by the Eastern Cape Department of Public works as the independent Environmental Assessment Practitioners (EAP) for the undertaking of the Environmental Impact Assessment process for the proposed road upgrade.

Two pre-existing gravel mines (burrow pits) have been identified in order to obtain construction materials to upgrade and re-surface roads located in the Enoch Mgijima Municipality (Fig. 1-3). The roads are DR02614 (Sterkstroom) and DR02625 (Birds River). An existing gravel mine has been identified on each road and these will be increased in size to obtain the required quantity of gravel material. The extent of the mines will be < 1,5 ha. The gravel mine on road DR02614 is situated approximately 300 m from the Haas Fontein River and an Eskom powerline is on the edge of the existing mine. The gravel mine on road DR02625 has a Telkom telephone line that runs adjacent to the existing mine.



Figure 1. A Google Earth (2016) image indicating the location of the two gravel mines in relation to Sterkstroom. DR02614 is located close to Sterkstroom while DR02625 is close to Birds River in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.

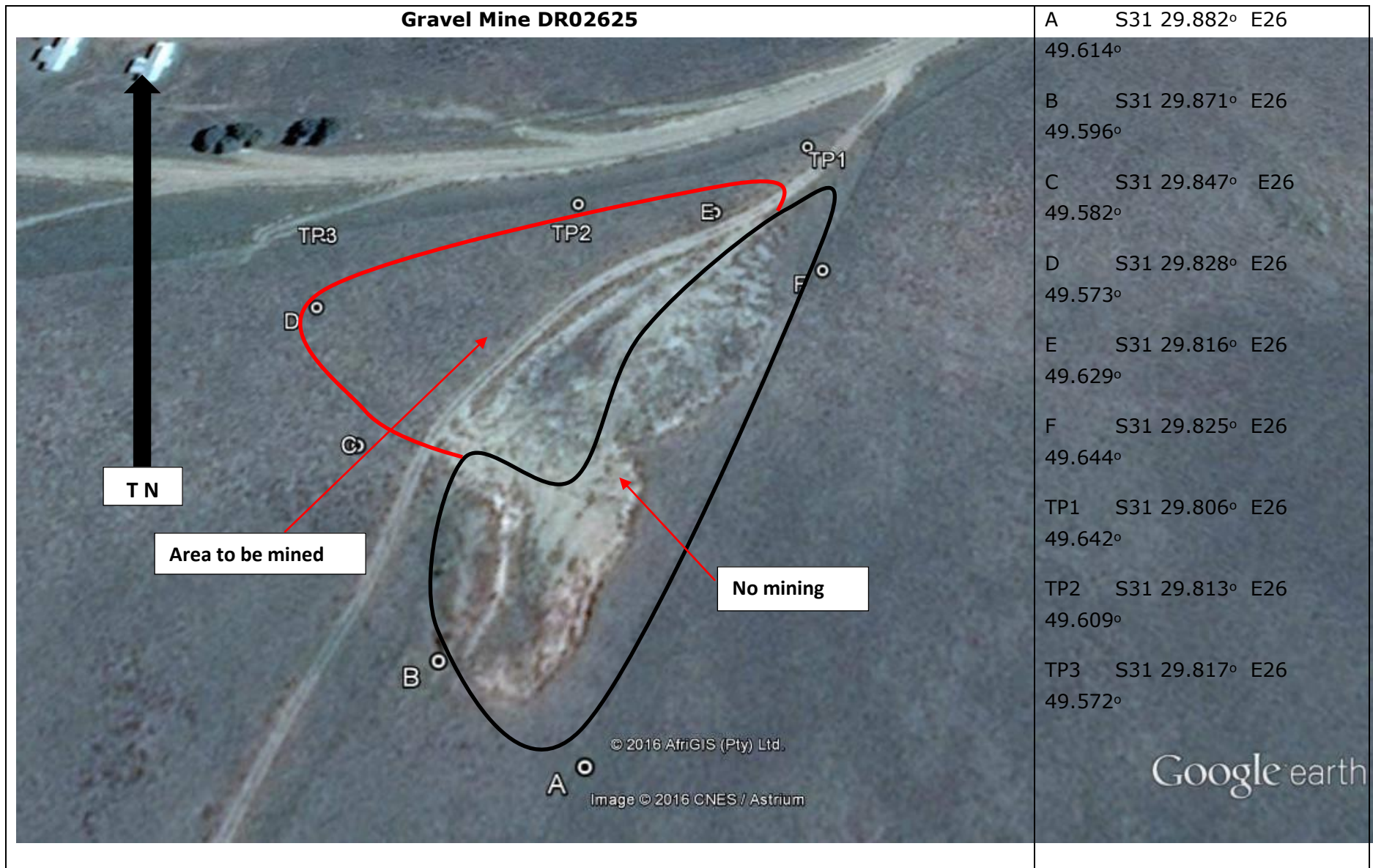


Figure 2. Location of Gravel Mine DR02625 in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape. (Map provided by isi-Xwiba Consulting CC).

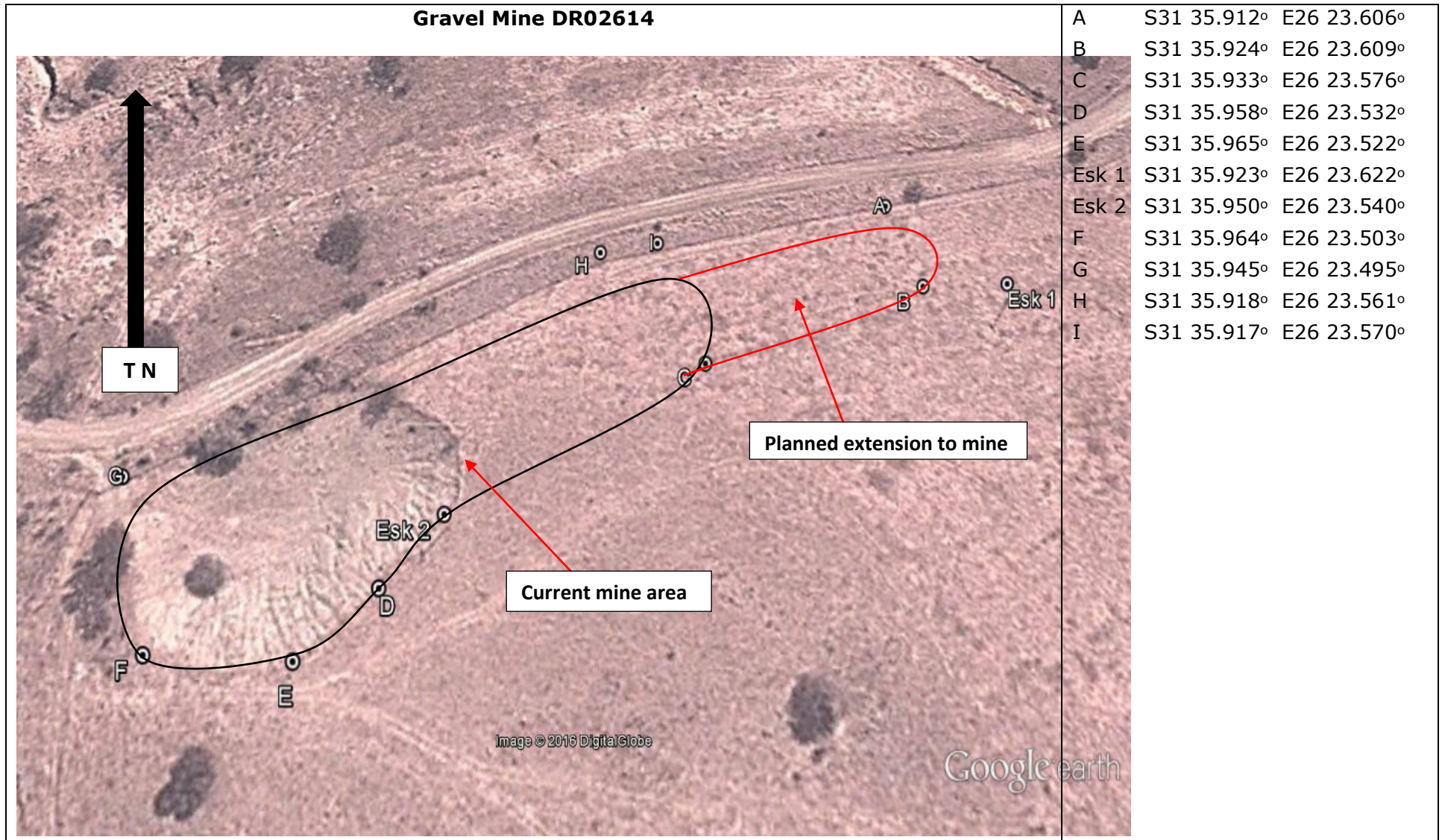


Figure 3. Location of Gravel Mine DR02614 in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape. (Map provided by isi-Xwiba Consulting CC).

1.1 LEGISLATION

Cultural Heritage in South Africa is governed by the National Heritage Resources Act (Act 25 of 1999). This Palaeontological Environmental Impact Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the above mentioned Act. In accordance with Section 38, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

SECTION 35 OF THE NATIONAL HERITAGE RESOURCES ACT 25 OF 1999

- The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
- All archaeological objects, palaeontological material and meteorites are the property of the State.
- Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
- No person may, without a permit issued by the responsible heritage resources authority—
 - destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
 - destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
 - trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
 - bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
- When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
 - serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order; and/or
 - carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary.

2 Objective

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:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources; and
- To make recommendations as to how the developer should conserve or mitigate damage to these resources.

The objective is thus to conduct a Palaeontological Impact Assessment, which forms of part of the Heritage Impact Assessment (HIA) and the EIA Report, to determine the impact of the development on potential palaeontological material at the site.

When a palaeontological desktop/scoping study is conducted, the potentially fossiliferous rocks (i.e. groups, formations, members, etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is collected from published scientific literature; fossil sensitivity map; consultations with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions may be consulted. This data is then used to assess the palaeontological sensitivity of each rock unit of the study area on a desktop level. The likely impact of the proposed development on local fossil heritage is subsequently established on the basis of the palaeontological sensitivity of the rocks and the nature and scale of the development itself (extent of new bedrock excavated).

If rocks of moderate to high palaeontological sensitivity are present within the study area, a Phase 1 field-based assessment by a professional palaeontologist is necessary. Generally, damaging impacts on palaeontological heritage occur during the construction phase. These excavations will modify the existing topography and may disturb damage, destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study.

When specialist palaeontological mitigation is suggested, it may take place prior to construction or, even more successfully, during the construction phase when new, potentially fossiliferous bedrock is still exposed and available for study. Mitigation usually involves the careful sampling, collection and recording of fossils as well as relevant data concerning the surrounding sedimentary matrix. Excavation of the fossil heritage will require a permit from SAHRA and the material must be housed in a permitted institution. With appropriate mitigation, many developments involving bedrock excavation will have a *positive* impact on our understanding of local palaeontological heritage.

3 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The Main Karoo Basin covers more than 50 % of the surface of South Africa. The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this period the basin developed from an inland sea flooded by a melting ice cap, to a giant lake (Ecca Lake) fed by seasonal meandering (and periodically braided) rivers. The lake progressively shrank as it filled with sediment and the basin's rate of subsidence stabilised.

The Beaufort Group is subdivided into a series of biostratigraphic units on the basis of its faunal content (Fig. 4). The proposed development area in Queenstown (Fig. 5) is underlain by the Early to Middle Triassic Burgersdorp Formation (*Cynognathus* AZ, Tarkastad Subgroup, Beaufort Group, Karoo Supergroup) as well as the Molteno Formation.

3.1 GEOLOGY

The Tarkastad Subgroup

Gravel Mine DR02614 is completely underlain by the mudstone and sandstone sediments of the Burgersdorp Formation. The mudstones are brownish red and grey in colour.

The Molteno Formation

Gravel Mine DR02625 is underlain by the Triassic Molteno Formation that consists of coarse-grained grey sandstone, shale, gritty sandstone and occasional coal seams as well as grey mudstone.

3.2 PALAEOLOGY

The *Cynognathus* AZ (Burgersdorp Formation) is approximately 249 to 237 million years old [Kitching 1995, Rubidge 2005] is dominated by amphibians, reptiles and therapsids. The Burgersdorp biotas include rich freshwater vertebrate fauna, fish groups as well as large capitosaurid and trematosuchid amphibians. The reptile fauna includes lizard-like sphenodontids, rhynchosaurs, and primitive archosaurs. Therapsids include *Kannemeyeria* and numerous small to medium-sized carnivorous and herbivorous therocephalians and advanced cynodonts. Tetrapod trackways and burrows are also present.

Well preserved plant and insect fossils with sporadic coal deposits are present in the **Molteno Formation** (c. 220 million year old). This Formation is very diverse in vascular plants, ferns (e.g. *Dicroidium* flora), horsetails, Gymnosperms and silicified woods. Insect biota, dinosaur track ways and rare fish are also present although animal fossils are very scarce. The *Dicroidium* assemblage is an extinct genus of fork-leaved seed ferns that were dispersed over Gondwana. The invertebrate fossils present in this formation are restricted to trace fossils.

STRATIGRAPHY							
AGE		WEST OF 24°E	EAST OF 24° E	FREE STATE/ KWAZULU- NATAL	SACS RECOGNISED ASSEMBLAGE ZONES	PROPOSED BIOSTRATIGRAPHIC SUBDIVISIONS	
JURASSIC	"STORMBERG"		Drakensberg F.	Drakensberg F.			
			Clarens F.	Clarens F.			<i>Massospondylus</i>
TRIASSIC	TARKASTAD SUBGROUP		Elliot F.	Elliot F.		" <i>Euskelosaurus</i> "	
			MOLTENO F.	MOLTENO F.			
PERMIAN	BEAUFORT GROUP	ADELAIDE SUBGROUP	BURGERSDORP F.	DRIEKOPPEN F.	<i>Cynognathus</i>		
			KATBERG F.	VERKYKERSKOP F.	<i>Lystrosaurus</i>	A	
			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		Oukloof M.	MIDDELTON F.	<i>Tropidostoma</i>	
				Hoedemaker M.		<i>Pristerognathus</i>	
				Poortjie M.			
				ABRAHAMSKRAAL F.	KROONAP F.	<i>Tapinocephalus</i>	UPPER UNIT
							LOWER UNIT
					<i>Eodicynodon</i>		
PERMIAN	ECCA GROUP		WATERFORD F.	WATERFORD F.			
			TIERBERG/ FORT BROWN F.	FORT BROWN F.			
			LAINGSBURG/ RIPON F.	RIPON F.			VRYHEID F.
			COLLINGHAM F.	COLLINGHAM F.			PIETER- MARITZBURG F.
			WHITEHILL F.	WHITEHILL F.			
			PRINCE ALBERT F.	PRINCE ALBERT F.			MBIZANE F.
CARBON- IFEROUS	DWYKA GROUP		ELANDSVLEI F.	ELANDSVLEI F.			

SANDSTONE-RICH UNIT HIATAL SURFACE END BEAUFORT GROUP HIATUS

Figure 4: Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions of the Beaufort Group with rock units and fossil assemblage zones relevant to the present study marked in red (Modified from Rubidge 1995). The subdivisions of the Beaufort Group include the Adelaide and Tarkastad Subgroups and range in age from Late Permian to Middle Triassic. Abbreviations: F. = Formation, M. = Member.

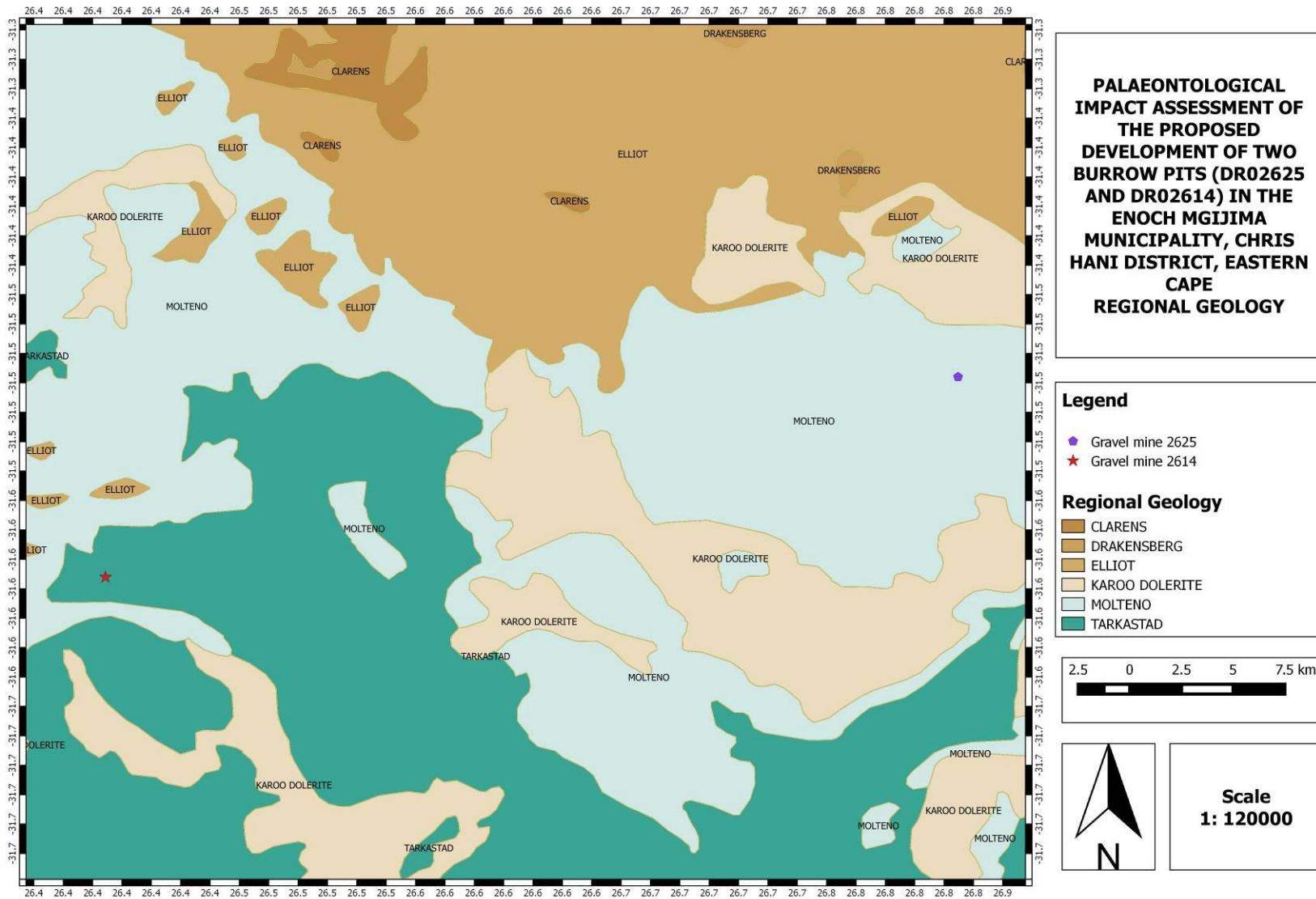


Figure 5. The surface geology of gravel mine DR02625 underlain by the Molteno Formation and gravel mine DR02614 underlain by the Tarkastad Subgroup near Queenstown, Chris Hani District, Eastern Cape.

4 GEOGRAPHICAL LOCATION OF THE SITE

Location:

Gravel mine DR02625

Remaining extent of Farm 159, Wodehouse RD, Eastern Cape Province

Coordinates 31° 29.816' S and 26° 49.629' E

Municipal Ward No.: Tsolwana/Inkwanca/Lukhanji 27

Land Owner: Mr L S Scheepers

Location:

Gravel Mine DR02614

Portion 7 of Farm No 47, Queenstown Road, Eastern Cape Province

Coordinates 31° 35.945' S and 26° 23.495' E

Municipal Ward No.: Tsolwana/Inkwanca/Lukhanji 2

Land owner: Mr C J Bartlett

5 METHODS

As part of the Palaeontological Impact Assessment, a field-survey of the development footprint proposed was conducted on 17 September 2016, to assess the potential risk to palaeontological material in the proposed footprint of the development. A physical field-survey was conducted on foot within the proposed development footprint. The results of the field-survey, the author's experience, aerial photos (using Google Earth, 2016) topographical and geological maps and other reports from the same area were used to assess the proposed development footprint. No consultations were undertaken for this Impact Assessment.

5.1 ASSUMPTIONS AND LIMITATIONS

The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impact assessments are normally limited by the following restrictions:

- Old fossil databases that have not been kept up-to-date or are not computerised. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist
- The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.
- Impact studies and other reports (*e.g.* of commercial mining companies) - is not readily available for desktop studies.

Large areas of South Africa have not been studied palaeontologically. Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on the possible occurrence of fossils in an unexplored area. Desktop studies of this nature therefore usually assume the presence of unexposed fossil heritage within

study areas of similar geological formations. Where considerable exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a Palaeontological Impact Assessment may be significantly improved through field-survey by a professional palaeontologist.

6 FIELD OBSERVATIONS

The following photographs were taken on a site visit to the proposed development sites on 17 September 2016.



Figure 6. The flat topography of Gravel Mine DR02614.



Figure 8. Topography of Gravel Mine DR02625

7 FINDINGS AND RECOMMENDATIONS

The proposed Gravel Mine DR02614 is underlain by the Early to Middle Triassic Burgersdorp Formation (*Cynognathus* Assemblage Zone, Tarkastad Subgroup, Beaufort Group, Karoo Supergroup). The second Gravel Mine DR02625 is completely underlain by the Triassic Molteno Formation. Although the palaeontological sensitivity of both development areas is rated high, the lack of fossiliferous exposure at the proposed site indicates that the impact on palaeontological material is negligible and regarded as insignificant.

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

8 REFERENCES

GROENEWALD, G.H. 1996. Stratigraphy of the Tarkastad Subgroup, Karoo Supergroup, South Africa. Unpublished PhD thesis, University of Port Elizabeth, South Africa.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. Pp. 461-499 in Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

MCCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

Smith, R., Rubidge, B. and van der Walt, M. 2012. Therapsid Biodiversity Patterns and Palaeoenvironments of the Karoo basin, South Africa in, *Forerunners of Mammals* ed Chinsamy-Turan. Indiana University Press.

RUBIDGE, B.S. (Ed.) 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1, 46 pp. Council for Geoscience, Pretoria.

RUBIDGE, B.S. 2005. Re-uniting lost continents – fossil reptiles from the ancient Karoo and their wanderlust. 27th Du Toit Memorial Lecture. South African Journal of Geology 108, 135-172.