PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

PROPOSED EXTENSION OF AN EXISTING BORROW PIT ON THE FARM KAREEBOSCH 63 NEAR MURRAYSBURG, CENTRAL KAROO DISTRICT MUNICIPALITY, WESTERN CAPE

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1. EXECUTIVE SUMMARY

The MR00587/50,2/0,1R borrow pit site on Farm Karee Bosch 63, situated between Nelspoort and Murraysburg, Western Cape, is excavated into overbank mudrocks within the Teekloof Formation (Lower Beaufort Group / Adelaide Subgroup) of Late Permian age. The fluvial sediments of the Teekloof Formation in this region are often highly fossiliferous, containing a range of reptiles, therapsids ("mammal-like reptiles"), plants and trace fossils (including large vertebrate burrows) that in the study region are assigned to the *Tropidostoma* Assemblage Zone. However, no fossil vertebrate remains were recorded during the present field assessment and it is concluded that further specialist palaeontological studies or mitigation for this project are not warranted.

The Environmental Control Officer (ECO) responsible for the borrow development should be aware of the possibility of important fossils (notably vertebrate bones and teeth) being present or unearthed on site and should monitor fresh (*i.e.* unweathered) sedimentary bedrock for fossil remains. In the case of any significant fossil finds made during construction, these should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to the relevant heritage management authority (Heritage Western Cape. Protea Assurance Building, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 086-142 142. Fax: 021-483 9842. Email: hwc@pgwc.gov.za) so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented, at the developer's expense. These recommendations should be incorporated into the Environmental Management Plan (EMP) for the borrow pit project.

2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to exploit road material from, and to extend, an existing borrow pit site situated on the Farm Karee Bosch 63 along the MR587 between Nelspoort and Murraysburg, Central Karoo District Municipality, Western Cape. The existing pit MR00587/50,2/0,1R (32° 1' 10.39" S, 23° 22' 4.47" E) lies on the south side of a dust road *c.* 35 km ENE of Nelspoort and 37 km WSW of Murraysburg, about 2.4 km WSW of the Kareebos homestead (Fig. 1).

This is Vidamemoria pit no. 330 and NID ref. no. 244. An initial desktop basic assessment of the original pit site by the author assessed its palaeontological heritage sensitivity as high due to the presence here of potentially fossiliferous sediments of the Lower Beaufort Group. A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC case ref. no. 15040125GT0422E, Interim comment 13 May 2015) in accordance with the requirements of the National Heritage Resources Act, 1999 (Section 38).

This palaeontological heritage field assessment and short report has accordingly been commissioned by Vidamemoria Heritage Consultants, Cape Town (Address: 3rd Floor, Guarantee House, 37 Burg Street, Greenmarket Square, Cape Town; tel: 021-424 8432; e-mail: yunus@vidamemoria.co.za). Fieldwork for this project was carried out on 14 June 2015.

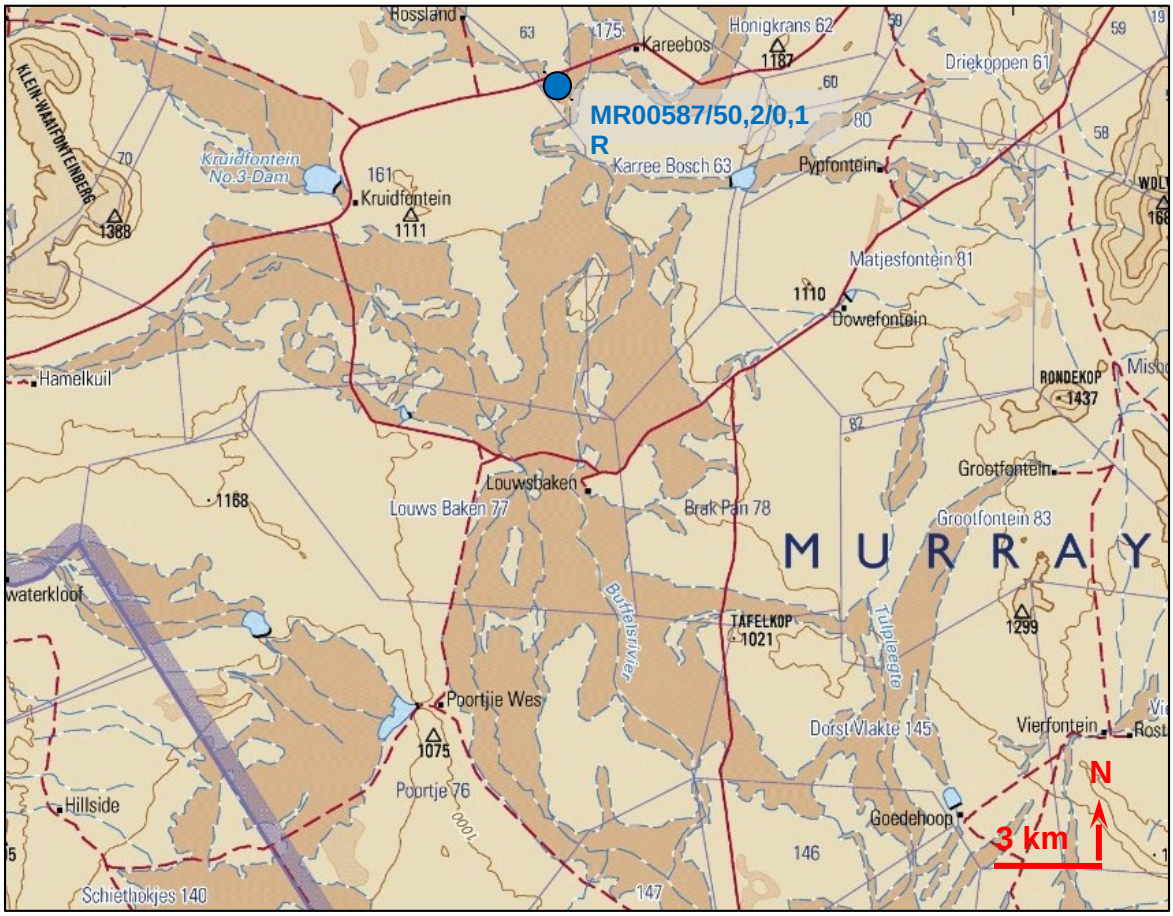

Fig. 1. Extract from topographical sheet 3222 Beaufort West (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the existing MR00587/50,2/0,1R borrow pit on the Farm Karee Bosch 63, on the western side of the Buffelsrivier and *c*. 35 km ENE of Nelspoort, Central Karoo District Municipality, Western Cape (blue dot).

3. GEOLOGICAL CONTEXT

The MR00587/50,2/0,1R borrow pit borrow pit study area lies in semi-arid Karoo terrain at 1020 m amsl. between various ephemeral tributaries of the Buffelsrivier (Fig. 1). The geology of the study area between Nelspoort and Murraysburg is outlined on the 1: 250 000 geology sheet 3222 Beaufort West, for which a separate sheet explanation has not yet been published (Fig. 2). The area is largely underlain by Late Permian continental sediments of the **Lower Beaufort Group** (Adelaide Subgroup, Karoo Supergroup). A useful overview of this internationally famous rock succession has been given by Johnson *et al.* (2006). The bedrocks in the study area are assigned to the fluvially-dominated **Teekloof Formation** (**Pt**) of Late Permian age, and specifically the mudrock-dominated Hoedemaker Member (Rubidge 1995). Bedding dips shown on the geological map are generally low, suggesting that the Beaufort Group succession here is largely flat-lying and undeformed. However, the Permian sediments are extensively intruded and thermally metamorphosed (baked) by sills and dykes of the Early Jurassic **Karoo Dolerite Suite** (**Jd**). A major dolerite intrusion (sill) is mapped just to the south of the present study area.

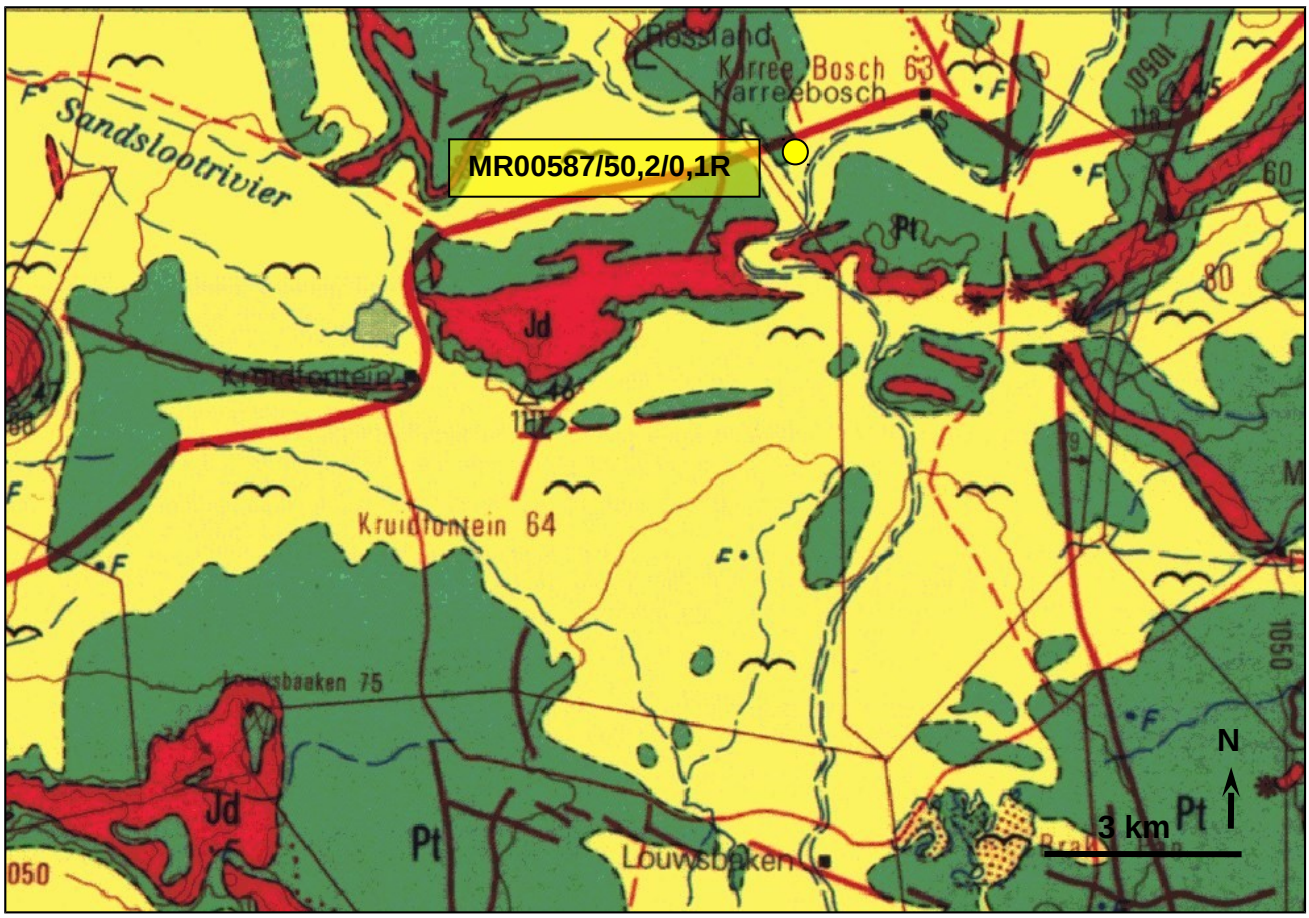

Fig. 2. Extract from 1: 250 000 geology sheet 3222 Beaufort West (Council for Geoscience, Pretoria) showing the location of the MR00587/50,2/0,1R borrow pit *c*. 35 km to the ENE of Nelspoort, Central Karoo District Municipality, Western Cape (yellow dot). The pit site is excavated into mudrocks within the lower part of the Teekloof Formation (Adelaide Subgroup, Lower Beaufort Group) (Pt, green) that are mantled here by Late Caenozoic alluvium and colluvium alluvium (pale yellow with flying bird symbol). The Beaufort Group rocks in this area are extensively intruded and baked by Early Jurassic dolerites of the Karoo Dolerite Suite (Jd, red), such as the west-east trending dolerite intrusion just to the south of the borrow pit site.

Extensive exposures of purple-brown or grey-blue overbank mudrocks of the Teekloof Formation with thin, well-jointed crevasse-splay sandstones are exposed on the floor and sloping walls of the existing MR00587/50,2/0,1R borrow pit (Figs. 3 & 4). The mudrocks are variously well-indurated, prominently colour-mottled siltstones and hackly-weathering, massive claystones (Fig. 5). No pedogenic palaeocalcrete nodules were observed here. Yellowish-stained zones within the mudrocks as well as ferruginisation of the sandstones may reflect secondary mineralisation due to dolerite intrusion in the region (Fig. 4). Thin, pale crevasse-splay sandstones on the pit margin are mantled with poorly-sorted downwasted gravels of pale brownish quartzite / sandstone and dolerite (Fig. 6). Soils in the area are locally calcretised and veins of creamy Quaternary to Recent calcrete extend down into the Lower Beaufort Group bedrocks.

Fig. 3. General view towards the southeast across the MR00587/50,2/0,1R borrow pit showing extensive exposure of Teekloof Formation mudrocks capped by alluvial gravels in the background.

Fig. 4. Hackly-weathering, purple-brown mudrocks with pale yellowish secondarily mineralised patches and thin mantle of alluvial gravels (Hammer = 30 cm).

Fig. 5. Mottled overbank siltstones exposed on the borrow pit floor (Hammer = 30 cm).

Fig. 6. Well-jointed crevasse-splay sandstone on the pit margin mantled by downwasted angular surface gravels (Hammer = 30 cm).

4. PALAEONTOLOGICAL HERITAGE

According to the latest biostratigraphic map of the Main Karoo Basin published by Van der Walt *et al.* (2010) the MR00587/50,2/0,1R borrow pit study area lies within the ***Tropidostoma* Assemblage Zone** of Late Permian age that characterizes the Hoedemaker Member of the Teekloof Formation (Smith & Keyser, 1995). The following major categories of fossils might be expected within *Tropidostoma* AZ sediments in the study area (Kitching 1977, Keyser & Smith 1977-78, Anderson & Anderson 1985, Smith & Keyser 1995, MacRae 1999, Cole *et al*., 2004, Smith *et al.* 2012):

- isolated petrified bones as well as rare articulated skeletons of **terrestrial vertebrates (tetrapods)** such as true **reptiles** (notably large herbivorous pareiasaurs, lizard-like archosauromorphs) and **therapsids** or "mammal-like reptiles" (*e.g.* diverse, small- to large-bodied herbivorous dicynodonts, flesh-eating gorgonopsians, carnivorous and insectivorous therocephalians, cynodonts);
- aquatic vertebrates such as large **temnospondyl amphibians** (*Rhinesuchus* spp., usually disarticulated), and **palaeoniscoid bony fish** (*Atherstonia*, *Namaichthys*, often represented by scattered scales rather than intact fish);
- freshwater **bivalves** (*e.g. Palaeomutela*);
- **trace fossils** such as worm, arthropod and tetrapod burrows and trackways, coprolites (fossil droppings), fish swimming trails;
- **vascular plant remains** including leaves, twigs, roots and petrified woods ("*Dadoxylon*") of the *Glossopteris* Flora (usually sparse, fragmentary), especially glossopterid trees and arthrophytes (horsetails).

According to Smith and Keyser (1995) the tetrapod fauna of the *Tropidostoma* Assemblage Zone is dominated by the small burrowing dicynodont *Diictodon* that constitutes some 40% of the fossil remains recorded here. This animal was probably responsible for many of the vertebrate scratch burrows, including helical burrow casts, encountered in the Hoedemaker Member (*e.g.* Smith 1986, 1987, 1993). There are several genera of toothed dicynodonts (*e.g. Emydops, Pristerodon*) as well as medium-sized forms like *Rachiocephalus* and *Endothiodon*. Carnivores are represented by medium-sized gorgonopsians (*e.g. Lycaenops, Gorgonops*) as well as smaller, insectivorous therocephalians such as *Ictidosuchoides*. Among the large (2.3-3 m long), lumbering pareiasaur reptiles the genus *Pareiasaurus* replaces the more primitive *Bradysaurus* seen in older Beaufort Group assemblages.

No fossil vertebrate remains were recorded during the field assessment of the MR00587/50,2/0,1R borrow pit. The only fossils seen were sparse small invertebrate horizontal burrows within well-consolidated mottled siltstones on the borrow pit floor (Fig. 7).

Fig. 7. Possible invertebrate horizontal burrow preserved within overbank siltstones on the borrow pit floor (Scale in cm).

5. CONCLUSIONS & RECOMMENDATIONS

The MR00587/50,2/0,1R borrow pit site on Farm Karee Bosch 63, situated between Nelspoort and Murraysburg, Western Cape, is excavated into overbank mudrocks within the Teekloof Formation (Lower Beaufort Group / Adelaide Subgroup) of Late Permian age. The fluvial sediments of the Teekloof Formation in this region are often highly fossiliferous, containing a range of reptiles, therapsids ("mammal-like reptiles"), plants and trace fossils (including large vertebrate burrows) that in the study region are assigned to the *Tropidostoma* Assemblage Zone. However, no fossil vertebrate remains were recorded during the present field assessment and it is concluded that further specialist palaeontological studies or mitigation for this project are not warranted.

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6. ACKNOWLEDGEMENTS

Ms Quahnita Samie and Mr Yunus Samodien of Vidamemoria Heritage Consultants, Cape Town, are thanked for commissioning this specialist study and for kindly providing the necessary background information.

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8. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape under the aegis of his Cape Town-based company *Natura Viva* cc. He is a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape, Gauteng, Limpopo and Free State for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Assessment Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed borrow pit project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

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