

**PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT & RECOMMENDATION  
FOR EXEMPTION FROM FURTHER SPECIALIST STUDIES**

**PROPOSED EXTENSION OF TWO EXISTING BORROW PITS NEAR  
LAINGSBURG, LAINGSBURG MUNICIPALITY, WESTERN CAPE**

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**1. EXECUTIVE SUMMARY**

The two proposed borrow pit extensions along the MR374 some 40 km northeast of Laingsburg involve pit MR00374/2.4/0.1R on the farm Grootfontein and Pit MR00374/8.4/0.05R on the farm Fonteintjies, Laingsburg Municipality, Western Cape. Both pits overlie the outcrop area of the Middle Permian Abrahamskraal Formation (Lower Beaufort Group, Karoo Supergroup).

However, pit MR00374/2.4/0.1R is largely excavated into thick silty to gravelly Late Cenozoic alluvial deposits overlying a pediment surface along the northern banks of a tributary of the Wilgerbosrivier. The alluvium contains calcretised root casts and / or invertebrate burrows but is otherwise probably only sparsely fossiliferous. The Abrahamskraal Formation sandstones beneath contain poorly preserved fossil burrow assemblages (probably *Scoyenia*) while Permian overbank mudrocks are not exposed.

Pit MR00374/8.4/0.05R is excavated into channel sandstones and overbank mudrocks of the Abrahamskraal Formation but here the bedrocks are extensively brecciated, quartz veined and calcretised due to faulting. No fossils were recorded either from the bedrocks or the thin veneer of coarse surface gravels and modern stream alluvium.

The palaeontological sensitivity of both borrow pit sites is assessed as LOW. It is possible that vertebrate and other fossil remains may be exposed during excavation of the pit area. However, the anticipated low density of fossil material subsurface does not warrant specialist mitigation measures or further studies at this stage, pending the discovery of significant new remains during excavation.

In the case of any substantial fossil finds during construction (e.g. vertebrate teeth, bones, burrows, petrified wood), these should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to Heritage Western Cape, so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented (Contact details: 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). 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 extend and exploit road material from two existing pits along the MR374 gravel road between the N1 and Merweville, some 40 km to the ENE of Laingsburg, Laingsburg Municipality, Western Cape (Fig. 1):

- **Pit MR00374/2.4/0.1R**, situated on both sides of the MR374 on the farm Grootfontein, some 1.6 km NE of the Grootfontein homestead and 2 km north of the N1 tar road. The study area (33° 6' 17.28" S, 21°16' 51.24" E) lies on a gravel-mantled pediment surface at c. 680 m amsl on the north side of a west-east flowing tributary of the Wilgebosriver, itself a tributary of the Dwyka.
- **Pit MR00374/8.4/0.05R**, situated on the northern side of the MR374 on the farm Fonteintjies, some 1.3 km NW of the farmstead and 6.6 km north of the N1 tar road. The study area (33° 3' 48.60" S, 21°16' 50.16" E) lies along a fault zone transecting WSW-ENE striking Abrahamskraal Formation sediments and is 0.75 km east of the Wilgebosrivier.

This portion of the Great Karoo region is known as the Koup.

A previous desktop basic assessment of the two pit sites by the author assessed their palaeontological heritage sensitivity as high due to the presence here of potentially fossiliferous sediments of the Lower Beaufort Group (Abrahamskraal Formation). Palaeontological field assessments of the two pit sites as part of an HIA were requested by Heritage Western Cape (HWC case ref. no.130311JW25E, Interim comment 17 April 2013) in accordance with the requirements of the National Heritage Resources Act, 1999 (Section 38).

The present palaeontological heritage field assessment and short report were accordingly commissioned by Vidamemoria Heritage Consultants, Cape Town (Address: 3<sup>rd</sup> Floor, Guarantee House, 37 Burg Street, Greenmarket Square, Cape Town; tel: 021-424 8432; e-mail: Quahnita@vidamemoria.co.za). These are Vidamemoria pit nos. 232 (Pit MR00374/2.4/0.1R) and 233 (MR00374/8.4/0.05R) and NID ref. no. 162 . Fieldwork for this project was carried out on 13 August 2013.

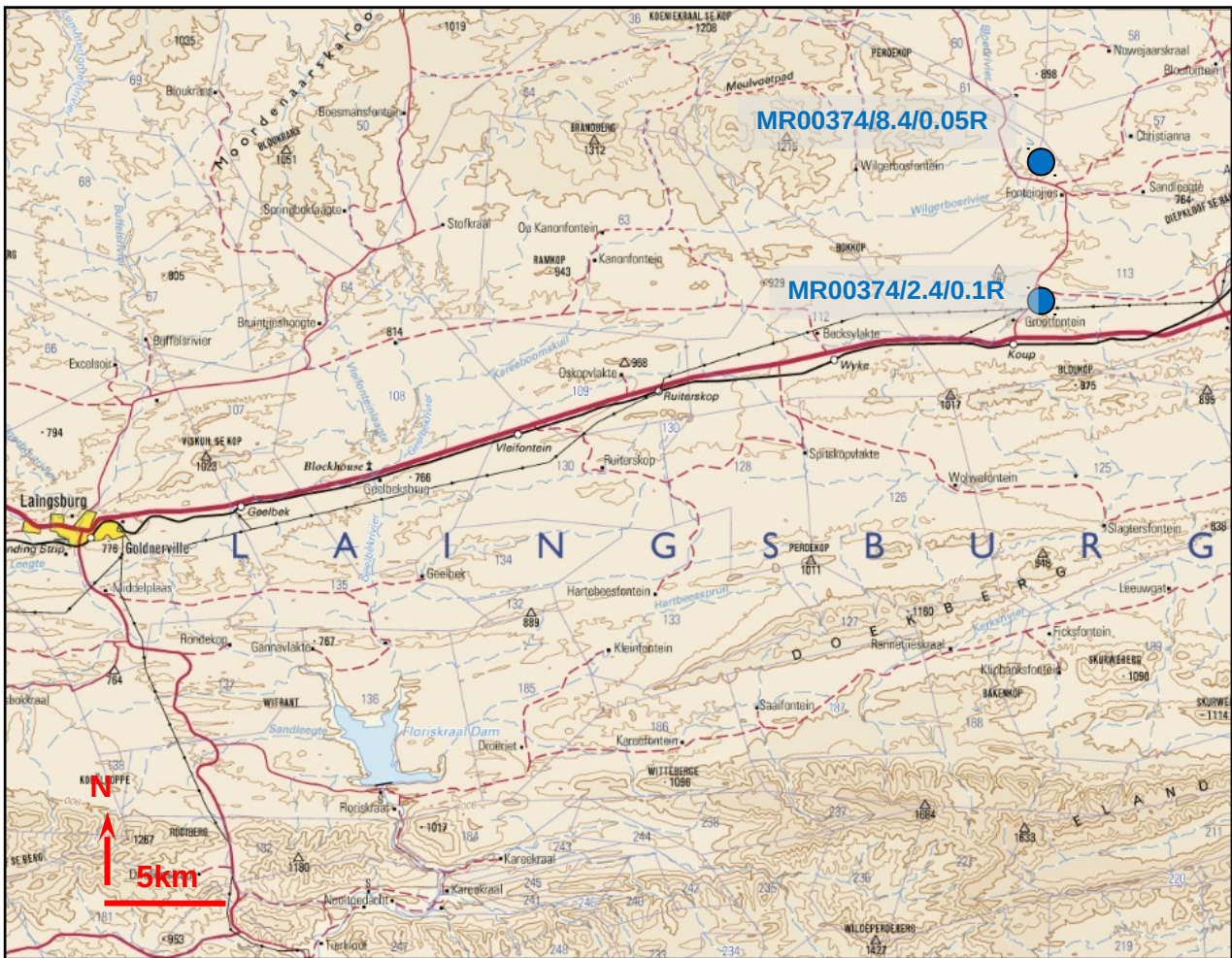


Fig. 1. Extract from topographical sheet 3320 Ladismith (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the two existing borrow pits along the MR374, Pit MR00374/2.4/0.1R on the farm Grootfontein and Pit MR00374/8.4/0.05R on the farm Fonteintjies, Laingsburg Municipality, Western Cape (blue dots).

### 3. GEOLOGICAL CONTEXT

The geology of the two study areas is shown on 1: 250 000 sheet 3320 Ladismith (Fig. 2) (Theron *et al.* 1991). The study region is underlain by continental sedimentary rocks within the lowermost part of the **Abrahamskraal Formation (Pa)** (Lower Beaufort Group / Adelaide Subgroup, Karoo Supergroup) of Middle Permian age. The Abrahamskraal succession consists of a wide range of fluvial deposits, including river channel sandstones and minor intraformational breccio-conglomerates, well-bedded floodplain mudrocks with common pedocrete horizons (ancient soils) and sheet-like crevasse splay sandstones, as well as more localized playa lake deposits (e.g. laminated mudrocks) (Rossouw & De Villiers 1952, Johnson & Keyser 1979, Smith & Keyser 1995, Looek *et al.*, 1994, Johnson *et al.*, 2006, Almond 2010).

The Abrahamskraal Formation along the southern margins of the Great Karoo (e.g. Koup region) lies within the Cape Fold Belt and displays medium scale folding along east-west axes. Dips between 20 to 60 degrees are indicated on the geological map (Fig. 2), and tectonic deformation has led to the distortion of some fossil vertebrae remains previously collected from this region.

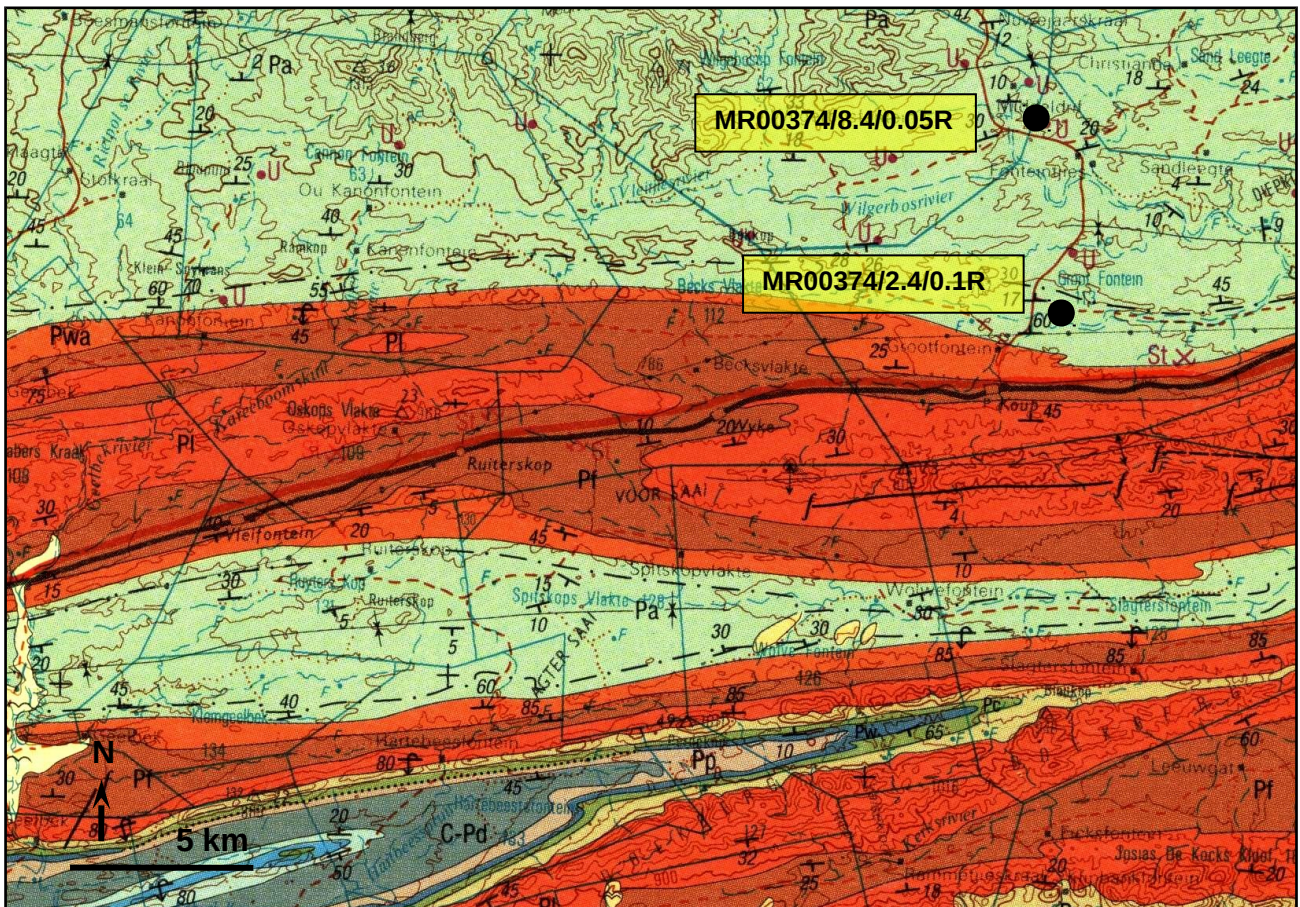


Fig. 2. Extract from 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) showing the location of the two existing borrow pits along the MR374, Pit MR00374/2.4/0.1R on the farm Grootfontein and Pit MR00374/8.4/0.05R on the farm Fonteintjies, some 40 km ENE of Laingsburg, Western Cape (black dots). The pits are both excavated into the lower part of the Abrahamskraal Formation (Adelaide Subgroup, Lower Beaufort Group) (Pa, green) and overlying superficial deposits. Note occurrence of uranium ores (U) close to the pit study areas.

The existing **MR00374/2.4/0.1R** pit on the farm Grootfontein is excavated into a gently south-sloping pediment surface along the northern margins of a small ephemeral river (Fig. 3). The surface is mantled by a considerable thickness (several meters) of silty and fine gravelly alluvium capped by poorly-sorted, coarse downwasted surface gravels (Fig. 4). The silty alluvium contains clast-supported gravel beds and lenses (Fig. 7) as well as numerous irregularly developed horizons of calcrete-cemented sediment that feature abundant burrow casts or root casts (*rhizoliths*) (Fig. 6). Where the “armouring” by surface gravels has been removed by earlier mining activities the underlying, poorly-consolidated siltier sediments are extensively gullied (Fig. 5). The surface gravels mainly consist of angular sandstone and quartzite clasts, but some subrounded clasts also occur. Dispersed crudely flaked Acheulian bifaces occur as surface scatters here.

Small exposures of yellowish-buff, medium-grained, thinly- and tabular-bedded to laminated bedrock sandstones of the Abrahamskraal Formation are exposed in the northern face of the existing pit where they dip gently towards the north (Fig. 8). It is possible that a steep cut bank of the river is being re-exhumed here from under Late Caenozoic channel-fill and overbank deposits. Ferruginous carbonate (*koffieklip*) lenses within the Abrahamskraal sandstones are visible in the pit extension on the west side of the gravel road. No *in situ* Abrahamskraal mudrocks were observed in the study area. Heaps of dark grey mudrock that have been dumped on the floor of the pit are of exotic provenance.



**Fig. 3.** View across the eastern part of the MR00374/2.4/0.1R pit study area showing the extensive flattish pediment surface here on the northern side of a small river, a tributary of the Wilgebosrivier (riverine trees on the right).



**Fig. 4. Coarse, downwasted sandstone and quartzite gravels mantling the pediment surface along the northern edge of pit site MR00374/2.4/0.1R (Hammer = 30 cm). These gravels include crudely-flaked Acheulian bifaces.**



**Fig. 5. Heavily gullied exposure of thick, silty to gravelly alluvial deposits along the northern edge of pit site MR00374/2.4/0.1R.**



**Fig. 6. Vertical section through finer-grained silty to gravelly alluvium on the northern cutface of pit site MR00374/2.4/0.1R showing more resistant-weathering calcretised horizons associated with root casts and / or invertebrate burrows (arrow) (Hammer = 30 cm).**



**Fig. 7. Silty to sandy alluvium sharply overlain by a horizon of coarse, clast-supported gravels, locally showing current imbrication, pit site MR00374/2.4/0.1R (Hammer = 30 cm).**



**Fig. 8. Thin- and tabular-bedded, medium-grained channel sandstones of the Abrahamskraal Formation, pit site MR00374/2.4/0.1R (Hammer = 30 cm).**

The existing pit **MR00374/8.4/0.05R** on the farm Fonteintjies is situated at c. 700 m amsl at the western edge of a sandstone ridge, some 750 m east of the Wilgerboschrivier and 6.6 km north of the N1 tar road (Fig. 9). The pit is elongated east-west and lies on the northern side of a hard-weathering, secondarily silicified, well-jointed and extensively brecciated quartzitic horizon. This probably marks a north-dipping fault plane and bears a thin calcrete veneer (pale surface in Fig. 9).

On the 1: 250 000 geological map an occurrence of uranium ore (U) is marked just to the east of the borrow pit site. This probably refers to mineralisation associated with *koffieklip* lenses within the Abrahamskraal sandstone ridge here (Cole & Smith 2008).

The Abrahamskraal Formation mudrocks in the pit study area vary between hackly-weathering grey-green siltstones with occasional palaeocalcrete nodules to purple-brown and mottled beds (Figs. 10 & 11). The associated sandstones are extensively brecciated and quartz veined as a consequence of faulting; locally they are friable and weathered in appearance, perhaps as a result of leaching along the fault zone.

The north-dipping Abrahamskraal bedrocks are overlain by angular colluvial and downwasted gravels, mainly of angular sandstone and quartzite blocks with a substantial admixture of vein quartz associated with the local faulting and reworked *koffieklip* clasts (Fig. 12). Small streams with unconsolidated silts and gravels run to the north and west of the study area.





**Fig. 9.** View eastwards across the MR00374/8.4/0.05R pit study site showing the Abrahamskraal Formation sandstone ridge in the background, the pale (calcrete-veneered), N-dipping fault plane on the right and angular colluvial gravels in the foreground.



**Fig. 10.** Close up of brecciated grey-green sandstones and mudrocks at the eastern end of the MR00374/8.4/0.05R pit (Hammer = 30 cm).



Fig. 11. Hackly-weathering, purple-brown siltstones of the Abrahamskraal Formation exposed in a shallow stream bed in the northern part of the MR00374/8.4/0.05R pit study area (Hammer = 30 cm).



Fig. 12. Coarse surface gravels in the MR00374/8.4/0.05R pit study area, dominated by reddish-brown, angular to subangular sandstone and quartzite *plus* abundant milky quartz blocks related to local faulting (Hammer = 30 cm).

#### 4. PALAEOLOGICAL HERITAGE

Apart from the uppermost 50 m or so of beds directly underlying the Poortjie Member sandstones, the Abrahamskraal Formation has been assigned in biostratigraphical terms to the *Tapinocephalus* Assemblage Zone, dated to around 266-260 Ma (Rubidge 1995, 2005, Rubidge *et al.* 2013). The fossil biota of the *Tapinocephalus* Assemblage Zone, with particular reference to the biostatigraphically important tetrapod fauna, has been reviewed by Smith and Keyser *in* Rubidge (1995) as well as in earlier works by Rossouw and De Villiers (1952), Boonstra (1969), Keyser and Smith (1979) and others (See also MacRae, 1999 for a well-illustrated popular account and Almond 2010 for a recent palaeontological field assessment in the Merweville area). Many individual fossil localities are indicated on published geological maps such as 1: 125 000 sheet 198 Merweville, 1: 250 000 sheets 3222 Beaufort West and 3220 Sutherland, as well as maps in Keyser & Smith (1979). The lowermost beds of the Abrahamskraal Formation are generally fossil-poor, for reasons that remain unclear (Loock *et al.* 1994).

The fauna of the *Tapinocephalus* Assemblage Zone is dominated by two groups of large-bodied tetrapods. The dinocephalians are primitive therapsids that include the large-bodied, thick-skulled herbivorous or omnivorous tapinocephalids (*e.g.* *Moschops*) as well as much rarer carnivorous anteosaurs (*Anteosaurus*). Pareiasaurs are a group of heavily-armoured herbivores belonging to the primitive reptile subgroup, the Captorhinida (*e.g.* *Bradysaurus*). Some 18 genera and 30 species of dinocephalians alone have been described from this assemblage zone. However, many of these taxa are based on very incomplete or deformed material, and ongoing research is likely to whittle down their true biodiversity to more realistic levels, particularly when ontogenetic variation and sexual dimorphism are taken into account). Other important tetrapod taxa represented in the same Lower Beaufort Group assemblages are (c) two groups of carnivorous therapsids, the therocephalians and gorgonopsians, the former of which are quite common and diverse; (d) small-bodied herbivorous dicynodonts, including some primitive toothed genera as well as the long-ranging *Diictodon*, (e) rare varanopid pelycosaurs (primitive synapsids, *e.g.* *Elliotsmithia*), biarmosuchians (primitive therapsids), the tortoise-like captorhinid *Eunotosaurus*, and large, crocodile-like temnospondyl amphibians (*Rhinesuchus*). Since the brief faunal review by Smith and Keyser *in* Rubidge (1995), a number of new tetrapod taxa have been described from the Abrahamskraal Formation, notably by Professor Bruce Rubidge of the BPI (Wits University, Johannesburg) and colleagues. Concentrations of transported plant debris are sometimes associated with uranium minerals within the Abrahamskraal sandstones. These plant-rich zones are often also enriched in ferruginous carbonate forming a dark brown rock locally known as *koffieklip* (Cole & Smith 2008).

The only fossil remains recorded within the MR00374/2.4/0.1R pit study area include (1) locally abundant, poorly-preserved, small, vertical to oblique cylindrical invertebrate burrows associated with flaggy Abrahamskraal Formation sandstones, probably belonging to the arthropod ichnogenus *Scoyenia* (Fig. 13), and (2) numerous ill-defined to irregular calcretised casts of plant roots and / or invertebrate burrows within the silty to gravelly alluvium (Fig. 6). The latter were probably formed during more arid intervals of the Pleistocene Epoch.

No fossil remains were recorded either within the Abrahamskraal Formation bedrocks or the overlying superficial sediments in the MR00374/8.4/0.05R pit study area.

The palaeontological sensitivity of both borrow pit sites is assessed as LOW.



**Fig. 13. Poorly-defined oblique and horizontal burrows (probably arthropod-generated *Scoyenia*) within buff, tabular bedded sandstones of the Abrahamskraal Formation, MR00374/2.4/0.1R pit site (Scale in cm and mm).**

## **5. CONCLUSIONS & RECOMMENDATIONS**

The two proposed borrow pit extensions along the MR374 some 40 km northeast of Laingsburg involve pit MR00374/2.4/0.1R on the farm Grootfontein and Pit MR00374/8.4/0.05R on the farm Fonteintjies, Laingsburg Municipality, Western Cape. Both pits overlie the outcrop area of the Middle Permian Abrahamskraal Formation (Lower Beaufort Group, Karoo Supergroup).

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In the case of any substantial fossil finds during construction (e.g. vertebrate teeth, bones, burrows, petrified wood), these should be safeguarded - preferably *in situ* - and reported by the

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## 6. ACKNOWLEDGEMENTS

Ms Quahnita Samie of Vidamemoria Heritage Consultants, Cape Town, is thanked for commissioning this specialist study and for kindly providing the necessary background information. I am grateful to Madelon Tusenius for assistance and companionship in the field.

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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 for SAHRA and HWC. Dr Almond is an accredited member of PSSA and AHP (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.



**Dr John E. Almond (Palaeontologist, *Natura Viva* cc)**