PALAEONTOLOGICAL SPECIALIST STUDY: FIELD ASSESSMENT

EXISTING BORROW PIT ALONG THE DR1392 ROAD NEAR MONTAGU, WESTERN CAPE

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1. EXECUTIVE SUMMARY

The existing DR1392/3.3/L/10/A/R22 borrow pit situated on Portion 2 of Montagu Farm No. 87 (Middel Voetpad), *c*. 13.4 km northwest of Montagu, Western Cape is underlain by marginal marine to deltaic sediments of the Klipbokkop Formation (upper Bokkeveld Group / Bidouw Subgroup). Elsewhere in the Western Cape this formation has yielded well-preserved remains of placoderm fish fossils as well as low diversity plant and trace fossil assemblages of Middle Devonian age. However, in this borrow pit the bedrocks are mantled by thick gravelly colluvial (slope) deposits of low palaeontological sensitivity while the Klipbokkop Formation in this region is highly cleaved. The palaeontological sensitivity of the borrow pit site as a whole is therefore considered to be LOW. Pending exposure of new fossil remains such as fish, invertebrate shells or plants during development, no further specialist palaeontological studies or mitigation are recommended for this development.

2. INTRODUCTION

The Department of Transport, Western Cape, is applying to the Department of Mineral Resources for approval to exploit road material from an existing borrow pit along the unsealed DR1392 road in the western Little Karoo region (Montagu District). Pit **DR1392/3.3/L/10/A/R22** (= Vidamemoria Pit No. 160) is situated on the gentle east-facing footslopes of a low mountain range (Geewelkrans area south of the Waboomberge Range) on Portion 2 of Montagu Farm No. 87 (Middel Voetpad), *c*. 13.4 km northwest of Montagu, Western Cape (33º 41' 12.2" S, 20º 03' 33.9" E) (Figs. 1 & 4). A small intermittent river flows on the far side of the gravel road just to the east (Fig. 2).

A previous desktop basic assessment of the pit by the author assessed its palaeontological heritage sensitivity as high due to the presence here of potentially fossiliferous sediments of the Klipbokkop Formation (Upper Bokkeveld Group, Bidouw Subgroup). A palaeontological field assessment of the pit as part of an HIA was requested by Heritage Western Cape (HWC case case 1899 - 1994 120726JL32E, Interim Comment 8 August 2012) 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: 3rd Floor, Guarantee House, 37 Burg Street, Greenmarket Square, Cape Town; tel: 021-424 8432; e-mail: Quahnita@vidamemoria.co.za). Fieldwork for this project was carried out on 17 February 2013.

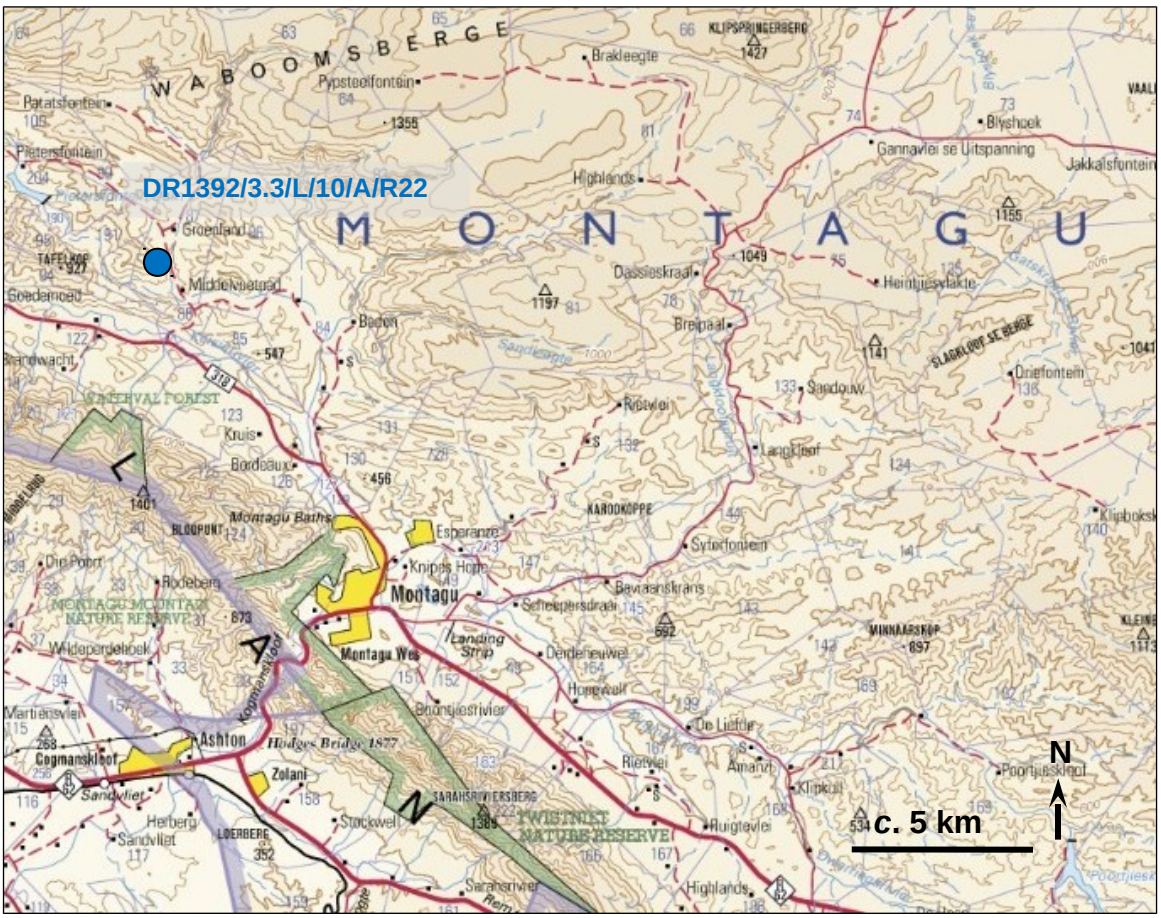

Fig.1. Extract from topographical sheet 3320 Ladismith (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the existing pit DR1392/3.3/L/10/A/R22 located on Portion 2 of Montagu Farm No. 87 (Middel Voetpad), *c*. 13.4 km northwest of Montagu, Western Cape (blue dot).

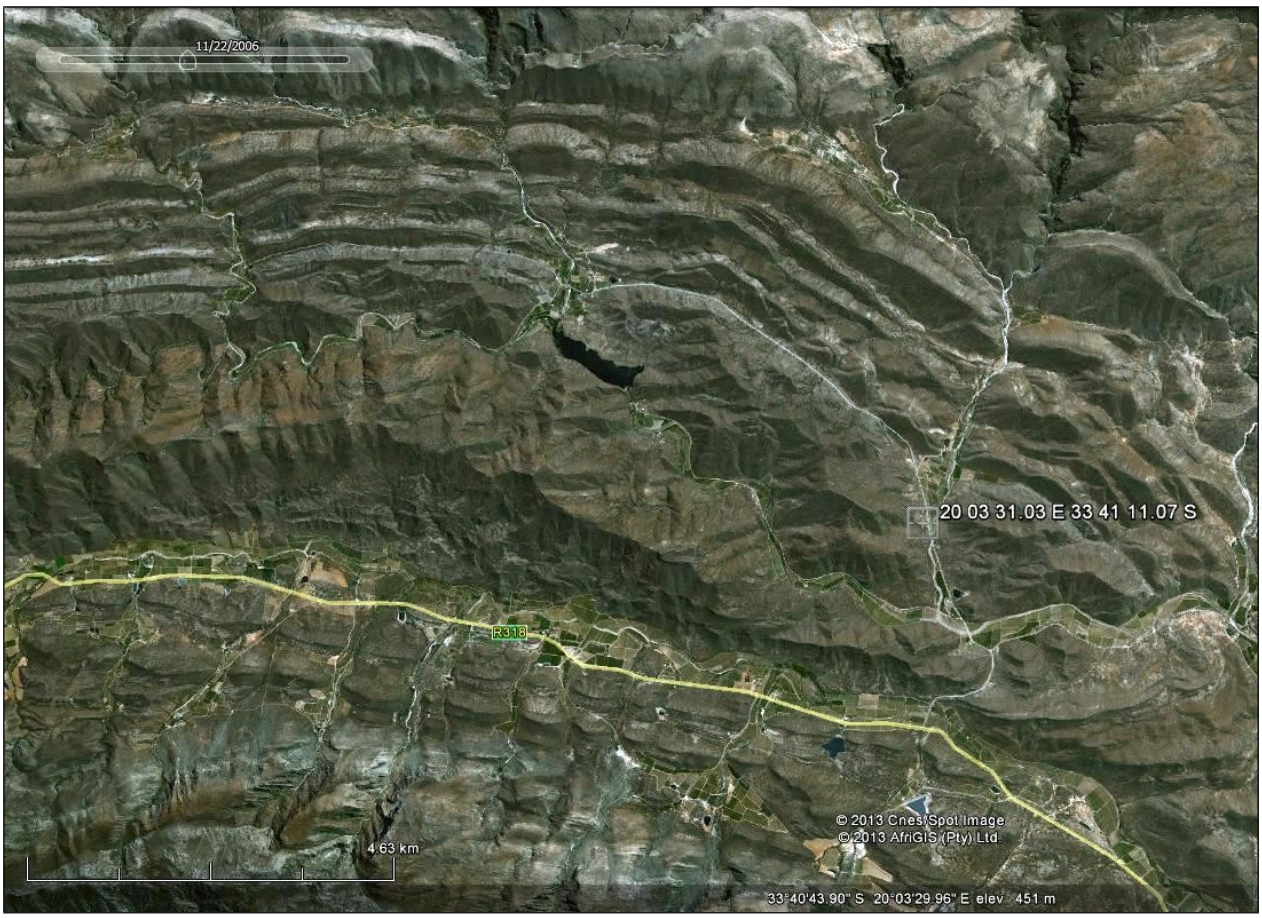

Fig. 2. Google earth© satellite image of the area northwest of Montagu showing the location of the existing pit DR1392/3.3/L/10/A/R22 located *c*. 13.4 km northwest of Montagu (grey square).

3. GEOLOGICAL CONTEXT

The geology of the Little Karoo study area northwest of Montagu is shown on 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) and is illustrated here in Fig. 3. A short sheet explanation to the map has been published by Theron *et al.* (1991).

The existing DR1392/3.3/L/10/A/R22 pit overlies the outcrop area of Middle Devonian sediments of the **Klipbokkop Formation** (**Dk**) within the Upper Bokkeveld Group (= Bidouw Subgroup). Short accounts of the Klipbokkop Formation in the Western Cape have been given by Theron *et al.* (1991), Gresse and Theron (1992) and Almond (2009). The depositional setting of this thick succession remains unresolved, but some authors prefer a restricted shallow inshore marine to delta platform environment.

The borrow pit site lies close to the core of a WNW – ESE trending syncline of Bokkeveld and Witteberg Group sediments situated on the southern edge of the Waboomberge mega-anticline built of older Table Mountain Group rocks. Since the entire Bokkeveld Group succession is present here, capped by resistant-weathering sandstones and quartzites of the lowermost Witteberg Group, this region plays a potentially important role in our understanding of these Early to Middle Devonian marine successions (*cf* Theron 1972, Theron & Johnson 1991).

Klipbokkop rocks are not seen at surface within the pit (Figs. 4 & 6) but are well exposed in road cuttings along a narrow pass about one kilometre to the north (Fig. 5). Here they consist of thinly interbedded to laminated as well as massive, greyish to grey-green, micaceous wackes (impure sandstones) and darker grey micaceous siltstones. Primary sedimentary structures such as wave

ripple and horizontal lamination are often obscured by high levels of bioturbation (biogenic sediment mixing), causing colour mottling. Some of the wackes contain horizons rich in small load balls (pseudonodules), pointing to sedimentary instability that probably resulted from rapid deposition of watery sediments following floods. Occasional examples of possible swaley or hummocky cross-stratification, generated by storms, are also seen. The Klipbokkop sediments in the road cuttings are steeply dipping and highly cleaved, and the same can probably be inferred for bedrocks in the borrow pit area although dips here are likely to be much lower closer to the anticlinal core (as also seen on adjacent hill slopes to the west, Fig. 4).

The Klipbokkop bedrocks in the DR1392/3.3/L/10/A/R22 pit are entirely mantled with coarse, poorly-sorted, orange-brown, mixed sandy and gravelly colluvial material, mainly angular to subangular clasts of quartzite and wacke derived from the Upper Bokkeveld and Lower Witteberg Group units upslope to the west (Fig. 6). Larger blocks are concentrated at the surface by downwasting. The geotechnical report for this project records up to 0.6 m of residual and colluvial soils at the site.

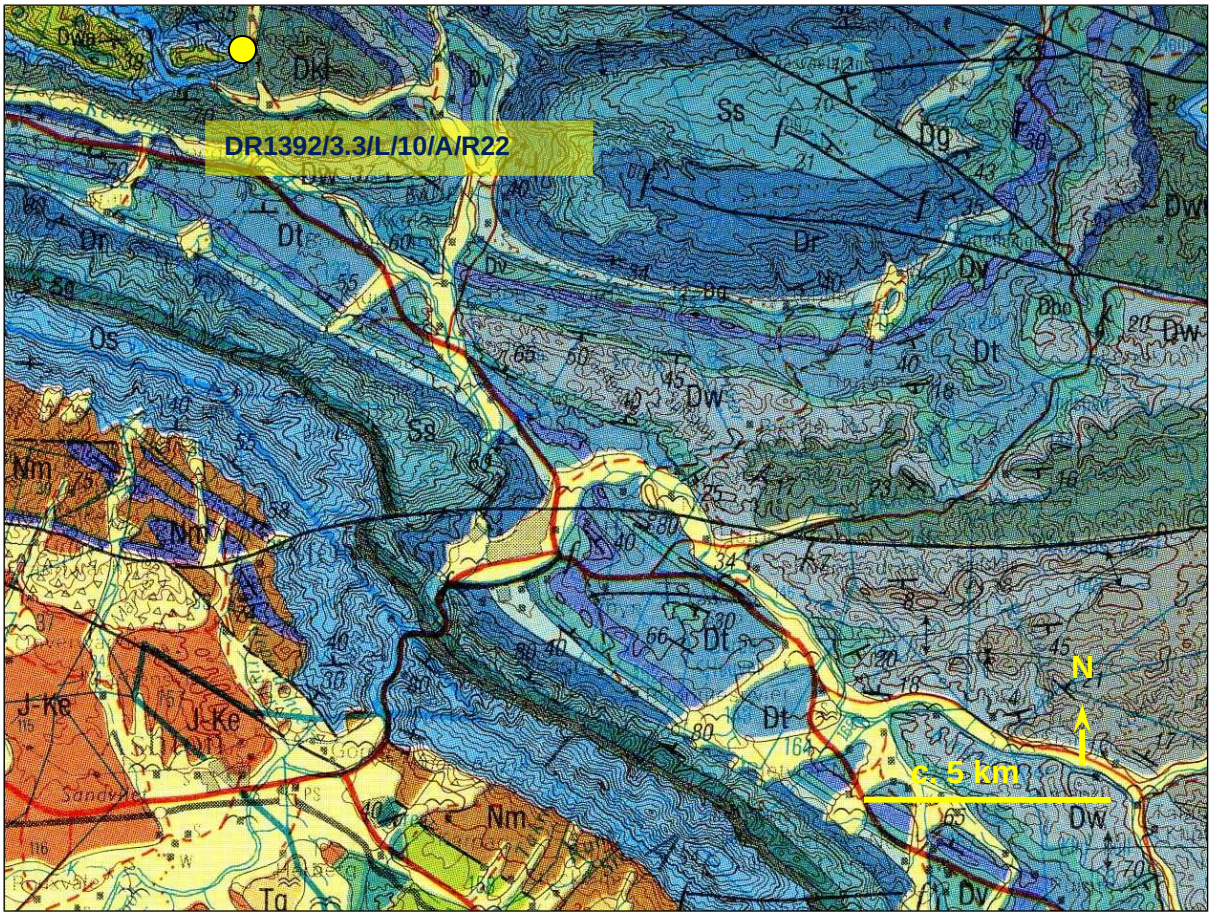

Fig. 3. Extract from 1: 250 000 geology sheet 3320 Ladismith (Council for Geoscience, Pretoria) showing location of the existing pit DR1392/3.3/L/10/A/R22, *c*. 13.4 km northwest of Montagu. The pit is excavated into gravelly colluvial (slope) deposits overlying siltstones and wackes of the Klipbokkop Formation (Dkl, Upper Bokkeveld Group, Bidouw Subgroup) (dark grey).

Fig. 4. View south-westwards across the existing DR1392/3.3/L/10/A/R22 borrow pit that is excavated into colluvial deposits on the footslopes of a dissected mountainous region (Gewelkrans area) to the south of the Waboomsberge Range and NW of Montagu.

Fig. 5. Steeply-dipping, intensely-cleaved grey siltstones of the Klipbokkop Formation exposed in a road cutting about one kilometre NNW of the DR1392/3.3/L/10/A/R22 borrow pit site (Hammer = *c*. 30 cm).

Fig. 6. Thick, poorly-sorted colluvial gravels overlying the Klipbokkop Formation in the DR1392/3.3/L/10/A/R22 pit area. Downwasted angular blocks of Bokkeveld wackes and Witteberg quartzites are concentrated at the land surface (Hammer = *c*. 30 cm).

4. PALAEONTOLOGICAL HERITAGE

An important, albeit low-diversity, non-marine fossil biota has been recorded from the Bidouw Subgroup (Klipbokkop and upper Kanies Formations in the western Bokkeveld outcrop area) as well as from laterally equivalent Middle Devonian sediments to the east – *i.e.* the Adolphspoort Formation of the Traka Subgroup (Plumstead 1977, Chaloner *et al.* 1980, Anderson & Anderson 1985, Almond 1997, Anderson *et al.* 1999a, 1999b, Anderson *in* MacRae 1999, Almond 2008a, 2008b, 2009). Important fossil sites within this formation are located some 85 km to the ESE of the Montagu pit site in the vicinity of the Warmwaterberg, for example. The Klipbokkop / Adolphspoort fossil assemblages are mainly preserved as moulds and comprise:

- Fragmentary vascular plants, including several species of lycopods (the club mosses *Archaeosigillaria*, *Haplostigma*) *plus* possible psilopsids;
- Non-marine, thin-shelled bivalves (possibly unionids), often preserved in dense clumps;
- Rare marine invertebrates (*e.g.* the articulate brachiopod *Australospirifer*);
- A limited variety of trace fossils including rare trilobite burrows (*Cruziana*), and unusually small versions of the complex helical burrow *Spirophyton*;
- A low-diversity assemblage of bony and cartilaginous fish, including acanthodians (“spiny sharks”), several primitive sharks, bony-plated jawed fish known as placoderms (Fig. 7), and rare crossopterygians (lobe-finned bony fish). These important Middle Devonian fossil fish have been described and illustrated in detail by Chaloner *et al.* (1980), Almond (1997), Anderson *et al.* (1999a, 1999b) and Long *et al*. (in prep). General accounts of Devonian fish groups from Gondwana are given by Anderson *in* MacRae (1999) and Long (1995).

Klipbokkop / Adolphspoort fish fossils mainly consist of disarticulated placoderm plates as well as isolated teeth and fin spines of antarctilamnid sharks and acanthodians. The fossils are found scattered throughout the succession within silty mudrocks and occasionally within ferruginous

carbonate-rich concretions. Thin conglomeratic layers of transported mudflakes mixed with fish teeth, spines and other skeletal elements are recorded from the mid to upper Klipbokkop Formation in the Cederberg region and elsewhere. Those parts of the succession with unionid-like bivalves, low-diversity trace assemblages dominated by small *Spirophyton*, vascular plants and fish fossils are considered to be non-marine in origin, perhaps accumulated on an extensive delta platform or prograding (advancing) shoreline zone. A mixture of fish originally from brackish to freshwater bodies near to the coastline (estuaries, lagoons, rivers. lakes) as well as salinity-tolerant marine forms may be represented in the fossil assemblages.

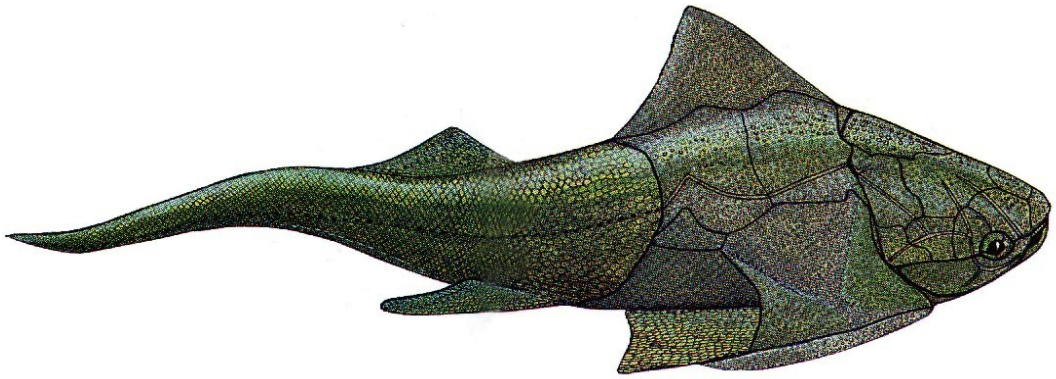

Fig. 7. Reconstruction of the armour-plated placoderm fish *Groenlandaspis*, which is recorded from Middle to Late Devonian sediments worldwide, including the Bidouw and Traka Subgroups (Bokkeveld Group) of South Africa (From Long 1995).

Good surface exposures of the Klipbokkop Formation bedrocks are not available in the pit area (but were intersected in geotechnical test pits) and no Bokkeveld Group fossils were recorded here during the site visit. Well-exposed Klipbokkop sediments just to the north are high cleaved, largely destroying any original fossil content. It is likely that the same applies to the bedrocks in the study area which are accordingly inferred to be of low palaeontological sensitivity. The overlying colluvial gravels and soils are generally unfossiliferous.

5. CONCLUSIONS & RECOMMENDATIONS

The existing DR1392/3.3/L/10/A/R22 borrow pit situated on Portion 2 of Montagu Farm No. 87 (Middel Voetpad), *c*. 13.4 km northwest of Montagu, Western Cape is underlain by marginal marine to deltaic sediments of the Klipbokkop Formation (upper Bokkeveld Group / Bidouw Subgroup). Elsewhere in the Western Cape this formation has yielded well-preserved remains of placoderm fish fossils as well as low diversity plant and trace fossil assemblages of Middle Devonian age. However, in this borrow pit the bedrocks are mantled by thick gravelly colluvial (slope) deposits of low palaeontological sensitivity while the Klipbokkop Formation in this region is highly cleaved. The palaeontological sensitivity of the borrow pit site as a whole is therefore considered to be LOW. Pending exposure of new fossil remains such as fish, invertebrate shells or plants during development, no further specialist palaeontological studies or mitigation are recommended for this development.

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 also very grateful to Ms Madelon Tusenius for logistical support and assistance with these borrow pit projects.

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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 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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