

RECOMMENDED EXEMPTION FROM FURTHER PALAEOLOGICAL STUDIES:

PROPOSED SEAVIEW & GREENBUSHES BULK WATER SUPPLY NEAR PORT ELIZABETH, NELSON MANDELA BAY MUNICIPALITY, EASTERN CAPE

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EXECUTIVE SUMMARY

The proposed bulk water supply developments in the Seaview and Greenbushes area overlie Late Caenozoic aeolian (*i.e.* wind-blown) sand deposits and are rated as of LOW (negative) significance in terms of potential impacts on local palaeontological heritage. This is because (1) the sedimentary rocks underlying the site (Nanaga and Schelm Hoek Formations of the Algoa Group) are of generally low palaeontological sensitivity, while (2) the project footprint is comparatively small, with little bedrock excavation envisaged.

It is therefore recommended that, pending the potential discovery of well-preserved chance fossil finds during excavation, exemption from further specialist palaeontological studies and mitigation should be granted for the proposed bulk water supply developments for Greenbushes and Seaview.

Should any well-preserved fossil remains (*e.g.* vertebrate bones and teeth, petrified wood, plant or trace fossil assemblages, fossil shells) be encountered during excavation, these should be safeguarded, preferably *in situ*, and reported by the ECO to ECPHRA (*i.e.* The Eastern Cape Provincial Heritage Resources Authority. Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za). This is necessary so that so that the fossil specimens may be professionally examined, recorded and, if necessary, excavated at the developer's expense.

The specialist involved would require a collection permit from SAHRA (Contact details: Mrs Colette Scheermeyer, P.O. Box 4637, Cape Town 8000; Tel: 021 462 4502; Email: cscheermeyer@sahra.org.za). Fossil material must be curated in an approved repository (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

1. OUTLINE OF PROPOSED DEVELOPMENT

The proposed water infrastructure development by Nelson Mandela Bay Municipality involves the upgrading of the bulk water supply to the areas around Seaview and Greenbushes, situated on the coastal plain some 25 km west of Port Elizabeth, Eastern Cape (See satellite image Fig. 2). The following project outline has been abstracted from the Background Information Document produced by SRK Consulting (January 2016):

The proposed development aims to expand current bulk water supply infrastructure in order to address the future provision of potable water to the Seaview and Greenbushes supply areas. The Nelson Mandela Bay Municipality proposes to develop Phase 1 which entails the provision of bulk water infrastructure to 8,020 erven within the relevant supply areas. The proposed bulk infrastructure for this phase is based on proposed developments currently at planning stage. The proposed project has been authorized before in 2009; however, the authorization lapsed and a new application and process are required.

Seaview Bulk Water Supply (Phase 1)

This supply area is currently supplied from the Seaview pump station 1.2 ML sump/ reservoir and *via* a number of small local schemes drawing directly from the two adjacent Churchill pipelines. The existing Seaview pump station complex will be expanded to accommodate the proposed bulk infrastructure. The infrastructure planned for the Seaview supply area is as follows:

- The construction of a 2.5 ML clear water bulk storage reservoir at the existing Seaview pump station complex;
- The construction of a 2.5 ML clear water bulk storage reservoir at the proposed Upper Seaview Bulk Storage Reservoir site;
- The construction of a 3 m wide gravel access road at the 2.5 ML reservoir at the Upper Seaview Bulk Storage Reservoir site;
- The upgrading / modification of the pump station at the existing Seaview pump station complex to supply the proposed 2.5 ML reservoir at the Upper Seaview reservoir site;
- The construction of a pumping main, 315 mmØ pipeline from the Seaview pump station complex to the 2.5 ML Upper Seaview Bulk Storage Reservoir, approximately 1,630 m in length within a proposed 3 m wide servitude;
- The construction of a 350 mmØ bulk gravity supply pipeline from the 2.5 ML bulk storage reservoir at the Upper Seaview site, approximately 1,300 m in length, which connects to a Tee above the Seaview pump station complex and thereafter splits towards the supply areas;
- The construction of a 250 mm Ø gravity main pipeline (approximately 3,220 m in length) connecting Zone 2 to the Tee above the Seaview pump station, along a 3 m wide pipeline servitude;
- The construction of a 315 mmØ (1,500 m in length) gravity main pipeline connecting Zone 5 to the Tee above the Seaview pump station, along a 3 m wide pipeline servitude;
- The construction of a 315 mmØ (400 m in length) bulk gravity supply pipeline from the 2.5 ML bulk storage reservoir at the Seaview pump station complex connecting into the existing and future pipe-work below the reservoir;

- Gravity connections from the service reservoirs to existing and proposed reticulation (inter-connections between proposed and new pipelines within the Seaview pump station complex); and
- Installation of metering at the Seaview pump station complex.

Greenbushes Bulk Water Supply (Phase 1)

As a result of increasing developments inland and up to Cape Road it is necessary to augment the reticulation of water to this area. Therefore, it is proposed to install a 750 mm Ø (outside diameter) steel pipeline, approximately 3,500 m in length, connecting the Greenbushes reservoir to the existing pipe-work at the Chelsea reservoir site.

A Basic Assessment for the water infrastructure project is being conducted by SRK Consulting (South Africa) Pty Ltd., Port Elizabeth, who have commissioned this palaeontological heritage comment (Contact details: Ms Tammy Burton. SRK Consulting. Ground Floor, Bay Suites, 1a Humewood Rd, Humeral, Port Elizabeth, 6001. P O Box 21842, Port Elizabeth, 6000. Tel: +27-041-5094800. Fax: +27-041-5094850. Email: tburton@srk.co.za).

2. GEOLOGICAL BACKGROUND

The geology of the Port Elizabeth region has been outlined by Toerien and Hill (1989) and Le Roux (2000) and is shown in the geological map in Figure 1 below, abstracted from the 1: 250 000 geology sheet map 3324 Port Elizabeth (Council for Geoscience, Pretoria). The proposed bulk water infrastructure project areas are situated on the south coastal plain to the west of Port Elizabeth which is mantled here by thick aeolian (wind-blown) sand deposits of the Late Caenozoic **Algoa Group** (Toerien & Hill 1989, Le Roux 2000, Roberts *et al.* 2006).

As shown on the geological map, the Greenbushes project area is underlain by coastal aeolianites of the **Nanaga Formation (Algoa Group)** of Pliocene to Early Pleistocene age. These ancient dune sands crop out extensively to the west and east of Port Elizabeth (Le Roux 1992). In the Greenbushes area they unconformably overlie Palaeozoic sandstones and quartzites of the **Peninsula Formation (Table Mountain Group)** that crop out near-surface in the region (Op, pale blue in map Fig. 1). This Ordovician succession was laid down by braided streams and comprises cross-bedded sandstones and quartzites with occasional mudrock intervals and thin, pebbly conglomerates (Thamm & Johnson 2006).

The Nanaga beds comprise calcareous sandstones and sandy limestones that often display large scale aeolian cross-bedding - well seen, for example, in deep N2 roadcuts between Colchester and Grahamstown. They may reach thicknesses of 150 m or more (Maud & Botha 2000). The Nanaga aeolianites are normally partially to well-consolidated, although unconsolidated sands also occur west of Port Elizabeth (Le Roux 2000). The upper surface of the aeolianites weathers to calcrete and red, clay-rich soil, and the dune sands themselves may be profoundly reddened. The age of the palaeodunes decreases towards the modern coastline, reflecting marine regression (relative sea level fall) during the period of deposition. The oldest outcrops located furthest from the modern coast are the most elevated, having experienced some 30 m of uplift in the Pliocene, and may even be Miocene in age (Roberts *et al.*, 2006). Typically the ancient dunes are preserved as undulating ridges of rounded hills trending parallel to the modern shoreline (Le Roux 1992).

The Seaview project area overlies younger coastal aeolianites of the **Schelm Hoek Formation** (Algoa Group) that are of Holocene age. Modern aeolian calcareous sands of the Schelm Hoek Formation build still-active dune sands along the South Coast (Illenberger 1992, Le Roux 2000). Deposition probably started during regression from the Mid Holocene transgressive maximum (*i.e.* the Flandrian transgression of 2-3 m amsl at 4000-3000 BP). The dune sands may be up to 140 m thick with an average of 30 m, and extend up to 6 km from the coast. Active sand dunes near the coast are unvegetated while those further inland are stabilized by dense dune thicket. In addition to unconsolidated, well-sorted, calcareous aeolian sands the Schelm Hoek Formation contains abundant shell middens of the Late Stone Age (Roberts *et al.*, 2006, Webley & Hall, 1998). Palaeosols (ancient soil horizons) and peats are absent according to Le Roux (2000, his Table 3) whereas Illenberger (1992) as well as Goedhart and Hattingh (1997) record the presence of fossil soils. These Holocene dune deposits may be semi-consolidated at depth, and difficult to distinguish from the older, generally better cemented Nahoon Formation aeolianites (*cf* Almond 2010).

3. PALAEOLOGICAL HERITAGE

The palaeontological record of the rock units represented in the study area has been reviewed by Almond (2010; see numerous references therein).

Fossils in the **Peninsula Formation** consist only of a small range of trace fossils (burrows, trackways *etc*) and organic-walled microfossils associated with the occasional marine-influenced mudrock intervals, which are usually very poorly exposed at surface. Low-diversity trace fossil assemblages have been recorded from a Peninsula Formation succession near Humansdorp (Almond 2012). The Table Mountain Group sediments in the Eastern Cape have often suffered high levels of tectonic deformation, compromising preservation of fossils, especially within the less resistant mudrock horizons. The palaeontological sensitivity of the Peninsula Formation here, as well as of the overlying superficial sediments (downwasted gravels, colluvium, soils, pedocretes *etc*) is considered to be generally LOW (Almond *et al.* 2008).

The sparse palaeontological record of the Pliocene to Early Pleistocene **Nanaga Formation** is summarised by Le Roux (1992) and Almond (2010). The fossil biota consists of fragmentary marine shells, foraminifera (shelled protozoans), and a small range of terrestrial snails (*eg Achatina, Tropidophora, Trigonephrus, Natalina*). Dense arrays of calcretised rhizoliths (root casts) commonly occur in these and contemporary Plio-Pleistocene aeolianites along the southern and southwestern coast. A wider range of terrestrial fossils might be found here in future, albeit only rarely due to extensive post-depositional diagenesis (*e.g.* solution and reprecipitation of carbonate by groundwater). They might include mammal remains from hyaena lairs, such as are recorded from contemporary Langebaan Formation aeolianites in the SW Cape (Roberts *et al.*, 2006 and refs therein).

The overall palaeontological sensitivity of the Nanaga Formation is assessed as LOW, although pockets of locally HIGH sensitivity may occur locally.

An authoritative review of the palaeontological potential of Quaternary coastal sands of the Cape region, including the **Schelm Hoek Formation**, is provided by Pether (2008); see also the short review by Almond (2010). Categories of scientifically valuable fossils mentioned by Pether (*ibid.*) and others that may be preserved in these sands include:

- rare fossil bones, teeth and other remains of mammals (e.g. rhino, elephant, bovids, moles), reptiles (e.g. tortoises, lizards), and ostriches (e.g. egg shells)
- terrestrial gastropods
- plant remains such as charcoal, decayed plant roots
- calcareous and siliceous microfossils (foraminiferans, ostracods, diatoms, shell fragments, calcareous algae, echinoid spines)
- organic-walled microfossils (pollen, spores) from mudrocks deposited in interdune ponds and vleis, which may also contain fossil frogs, fish, aquatic snails and plant macrofossils (reeds, leaves, seeds, roots *etc*)
- trace fossils (e.g. mole and arthropod burrows, vertebrate tracks)

Illenberger (1992) records fragmentary remains of molluscs, calcareous algae, and sea urchins as well as foraminiferans, terrestrial snails (e.g. *Achatina*, *Trigonephrus*) and root casts (rhizoliths) from the Schelm Hoek Formation in particular. Shell middens close to open beaches are dominated by white sand mussels (*Donax serra*) but also contain remains of marine and terrestrial mammals, stone artifacts, bone tools and occasionally pottery.

The overall palaeontological sensitivity of the Schelm Hoek Formation is assessed as LOW, although pockets of locally HIGH sensitivity may occur locally.

4. CONCLUSIONS & RECOMMENDATIONS

The proposed bulk water supply developments in the Seaview and Greenbushes area overlie Late Caenozoic aeolian sand deposits and are rated as of LOW (negative) significance in terms of potential impacts on local palaeontological heritage (See Table 1 below). This is because (1) the sedimentary rocks underlying the site (Nanaga and Schelm Hoek Formations of the Algoa Group) are of generally low palaeontological sensitivity, while (2) the project footprint is comparatively small, with little bedrock excavation envisaged.

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Should any well-preserved fossil remains (e.g. vertebrate bones and teeth, petrified wood, plant or trace fossil assemblages, fossil shells) be encountered during excavation, these should be safeguarded, preferably *in situ*, and reported by the ECO to ECPHRA (i.e. The Eastern Cape Provincial Heritage Resources Authority. Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za). This is necessary so that so that the fossil specimens may be professionally examined, recorded and, if necessary, excavated at the developer's expense.

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Table 1: Assessment of impacts on local palaeontological heritage due to the proposed bulk water infrastructure developments near Port Elizabeth: construction phase (This applies equally to *both* the Seaview and Greenbushes projects). Further significant impacts are not anticipated during the operational and decommissioning phases.

Impact Phase: Construction							
Potential impacts on palaeontological heritage:							
1. Disturbance, damage, destruction or sealing-in of <i>scientifically important</i> fossil remains preserved at or beneath the ground surface within the development footprint, most notably by bedrock excavations and surface clearance during the construction phase of the bulk water infrastructure.							
2. Improved knowledge regarding local fossil heritage following any mitigation (positive).							
ASSESSMENT OF ANTICIPATED IMPACTS							
	Extent	Duration	Intensity	Status	Significance	Probability	Confidence
Without Mitigation	Low	Permanent	Low	Negative	LOW (-)	Low	High
With Mitigation	Low	Permanent	Low	Negative & Positive	LOW (-)	Low	High
Reversal of impacts			NO – palaeontological heritage resources are generally non-renewable.				
Irreplaceable loss or resources?			Unlikely, since the fossils recorded here are also represented outside the development area (<i>i.e.</i> not unique).				
Can impact be avoided, managed or mitigated?			YES (see below), although small residual impacts are unavoidable.				
Mitigation measures to reduce residual risk or enhance opportunities:							
1. Monitoring of all substantial (> 1m) bedrock excavations on an on-going basis for chance fossil finds (e.g. petrified wood, shells, bones & teeth) by ECO.							
2. Reporting of new palaeontological finds to ECPHRA for possible specialist mitigation.							
Cumulative impacts:							
Unknown (Insufficient data on other local developments available) but likely to be LOW (negative).							
Residual impacts:							
Negative impacts due to loss of local fossil heritage will be partially offset by <i>positive</i> impacts resulting from mitigation (<i>i.e.</i> improved palaeontological database).							

5. KEY REFERENCES

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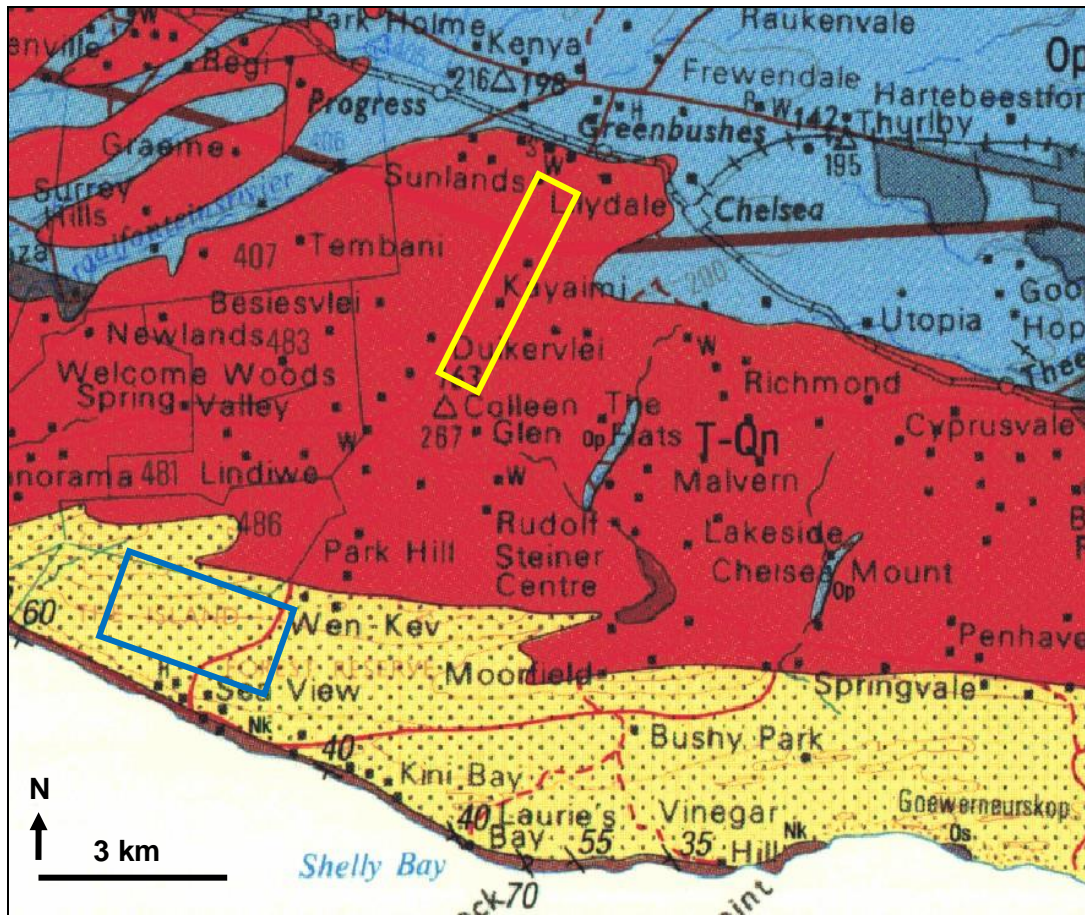


Figure 1: Extract from 1: 250 000 geology map sheet 3324 Port Elizabeth (Council for Geoscience, Pretoria) showing the *approximate* location of the proposed bulk water supply infrastructure developments at Seaview (blue rectangle) and Greenbushes (yellow rectangle). The Seaview project area is underlain by Quaternary to recent Aeolian sands of the Schelm Hoek Formation (Algoa Group) (Qw, pale yellow with stipple). The Greenbushes project area is underlain by Plio-Pleistocene aeolian sands of the Nanaga Formation (Algoa Group) (T-Qn, red) that overlie Palaeozoic quartzites and sandstones of the Peninsula Formation (Table Mountain Group) (Op, pale blue) at depth.

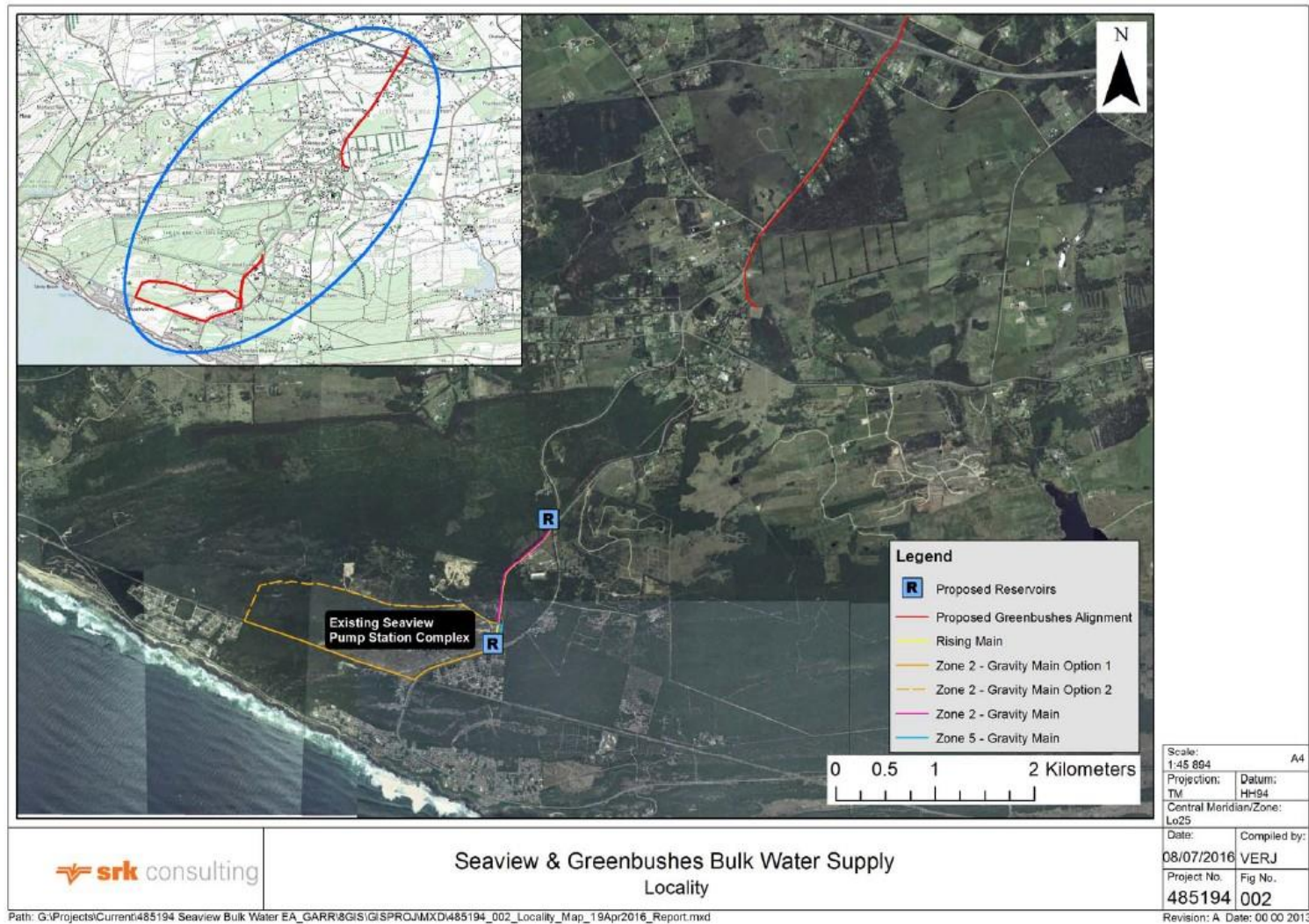


Figure 2: Satellite image and 1: 50 000 topographical map insert showing the location of the study areas for the proposed bulk water infrastructure developments near Seaview and Greenbushes, Nelson Mandela Bay Municipality, Eastern Cape (Image kindly supplied by SRK Consulting, PE).

6. 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, Limpopo, Northwest and the Free State under the aegis of his Cape Town-based company *Natura Viva cc*. He has served as 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 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 development 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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