PROPOSED GRAVEL QUARRY ON EDENDALE FARM NO 185 NEAR MATATIELE, MATATIELE LOCAL MUNICIPALITY, EASTERN CAPE PROVINCE

John E. Almond PhD (Cantab.)
***Natura Viva* cc,**
PO Box 12410 Mill Street,
Cape Town 8010, RSA
naturaviva@universe.co.za

January 2021

EXECUTIVE SUMMARY

South African National Roads Agency SOC Limited (SANRAL) is proposing to develop a weathered gravel quarry on Edendale Farm No 185, situated on the southern side of the R56 between the towns of Cedarville and Matatiele, Matatiele Local Municipality, Eastern Cape Province. The proposed gravel quarry will be excavated into Late Caenozoic gravelly superficial sediments and soils as well as underlying sandstones and mudrocks of the Burgersdorp Formation (Upper Beaufort Group / Tarkastad Subgroup, Karoo Supergroup) of Early to Middle Triassic age *plus* intrusive Karoo dolerite. The superficial sediments are generally of low palaeosensitivity while the Karoo dolerite is entirely unfossiliferous. Elsewhere in the Eastern Cape the Burgersdorp Formation has yielded a wide range of Triassic fossil vertebrates (fish, reptiles, therapsids) as well as a small range of vertebrate and invertebrate trace fossils. However, no body fossils (bones, teeth, shells, petrified wood *etc*) were recorded within the quarry project area during a recent site visit. This may be due, at least in part, to the low levels of bedrock exposure within the project area and possibly also to baking by local dolerite intrusions. Small scale fossil invertebrate burrows associated with calcretised palaeosol horizons are recorded from Burgersdorp mudrocks outside the quarry project area; these are widely occurring forms of low conservation significance.

While there is clearly the potential for the disturbance and / or destruction of fossil material (*e.g.* fossil bones / teeth / burrows) during the operational phase of the proposed gravel quarry, it is likely that the fossils concerned are of widespread occurrence within the Upper Beaufort Group outcrop area. The loss of unique, irreplaceable fossil heritage is therefore considered unlikely. Pending the potential discovery of significant fossil remains during excavation (in which case the Chance Fossil Finds procedure outlined below applies), no further specialist palaeontological studies or mitigation are recommended for this gravel quarry project.

The Environmental Control Officer (ECO) responsible for the quarrying should be made aware of the potential occurrence of scientifically-important fossil remains – especially well-preserved fossilised bones and teeth - within the development footprint. Should substantial fossil remains be exposed during clearance and excavation, the ECO should safeguard these, preferably *in situ*. They should then alert the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za) as soon as possible. This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the

proponent's expense. These recommendations are summarized in the tabulated Chance Fossil Finds Procedure appended to this report (Appendix 2).

The palaeontologist concerned with any mitigation work will need a valid Fossil Collection Permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013). These monitoring and mitigation recommendations are to be incorporated into the Environmental Management Programme (EMPr) for the quarry development.

Provided that the Chance Fossil Finds Procedure outlined below and tabulated in Appendix 2 is consistently implemented, there are no objections on palaeontological heritage grounds to authorization of the proposed gravel quarry development.

1. PROJECT OUTLINE & BRIEF

The South African National Roads Agency SOC Limited (SANRAL) is proposing to develop a weathered gravel quarry adjacent to an existing, privately-owned hardrock quarry on Edendale Farm No 185, situated on the southern side of the R56 between the towns of Cedarville and Matatiele, Matatiele Local Municipality, Eastern Cape Province (Fig. 1). Access to the site is *via* an existing road leading from the R56. The purpose of the quarry is to provide SANRAL with weathered gravel (sandstone) material for the fill and subbase layer works associated with the upgrading of the R56 between Matatiele and Cedarville. The road upgrade was subject to a separate environmental assessment process, which was authorised by the National Department of Environment, Forestry and Fisheries (DEFF), previously known as the Department of Environmental Affairs (DEA), in 2016

The present combined desktop and field-based palaeontological heritage assessment of the proposed gravel quarry will contribute to the full Scoping and EIA processes as well as the mining-specific Environmental Management Programme (EMPR) for the project that are being co-ordinated on behalf of SANRAL by Coastal and Environmental Services (t/a CES) (Contact details: Ms Robyn Thomson, CES Environmental and Social Advisory Services, 6 Stewart Drive, Baysville, East London, 5214. P.O Box 8145, Nahoon, East London, 5241. Tel: (087) 726 7809. Fax:(086) 410 7822. E-mail:r.thomson@cesnet.co.za).

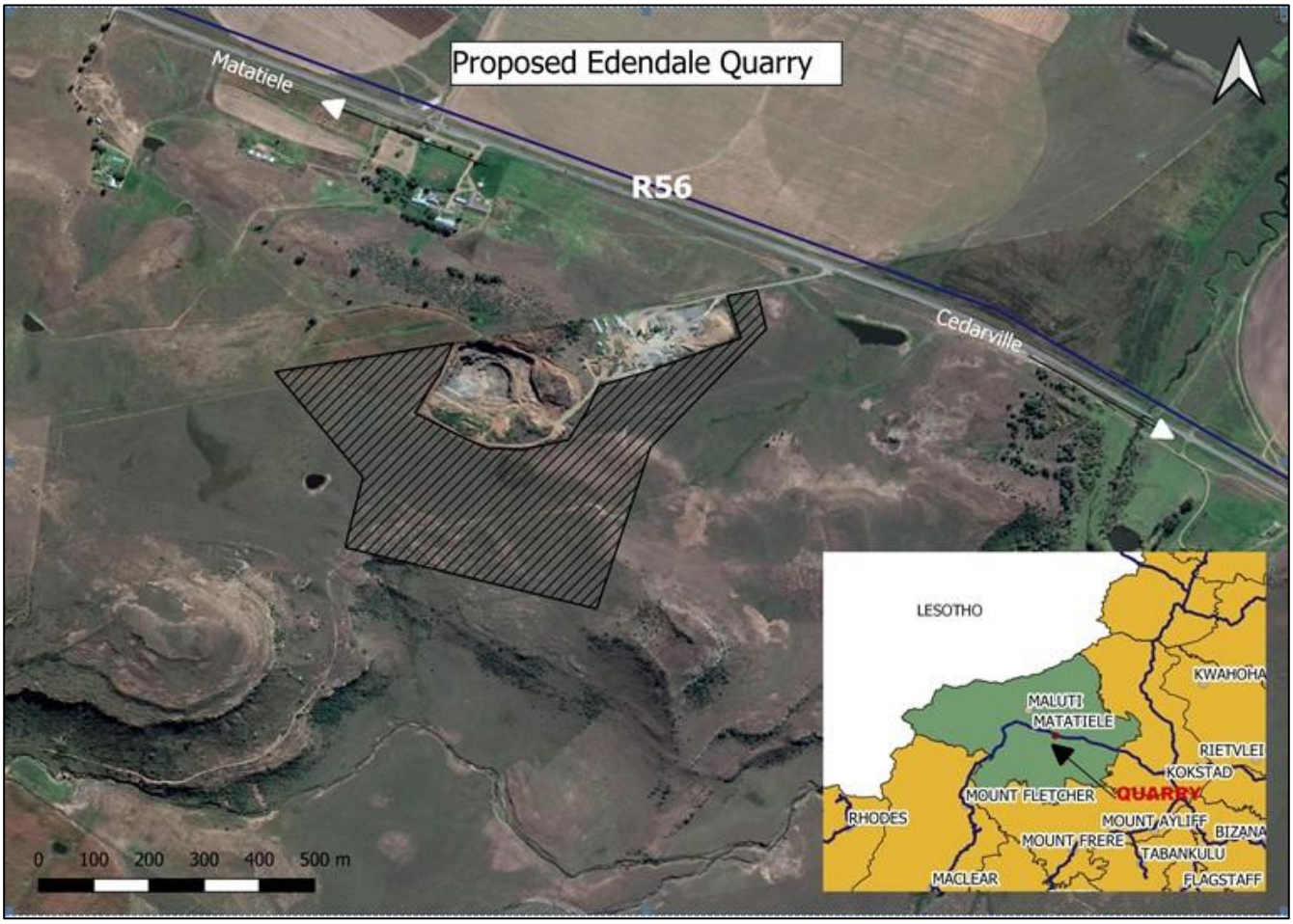

Figure 1: Map and satellite image showing the location and extent of the proposed new gravel quarry on Edendale Farm No 185 just south of the R56 near Matatiele, Matatiele Local Municipality, Eastern Cape Province (Image abstracted from the BID document by CES).

2. STUDY APPROACH

The approach to this palaeontological heritage study can be briefly summarized as follows. Fossil bearing rock units occurring within the broader study area (including all relevant land parcels) are determined from geological maps and relevant geological sheet explanations as well as satellite images. Known fossil heritage associated with each rock unit is inventoried from published and unpublished scientific literature, previous PIAs of the broader study region, and the author's field experience and palaeontological database (*cf* Almond et al. 2008). Based on this data as well as field examination of representative exposures of all major sedimentary rock units present, both within and in the vicinity of the project footprint, the impact significance of the proposed development is assessed and recommendations for any further studies or mitigation are outlined for inclusion within the EMPr for the development. Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013).

2.1. Sources of data

The present combined desktop and field-based palaeontological heritage assessment for the Hamburg quarry extension is based on:

1. A brief project outline and maps provided by CES;
2. A desktop review of (a) the relevant 1: 50 000 and 1: 250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) scientific literature, including published 1: 250 000 geological maps and accompanying sheet explanations (De Decker 1981) as well as (d) several previous fossil heritage assessments in the broader Matatiele region of the Eastern Cape by the author and palaeontological colleagues (*e.g.* Groenewald 2014a, 2014b, 2015, 2016, Trower 2018, Almond 2018a, 2018b);
4. The author's field experience with the formations concerned and their palaeontological heritage (*cf* Almond *et al.* 2008 and PIA reports listed in the References);
5. A one-day field assessment of the study area, including all land parcels involved, by the author and an experienced field assistant on 16 October 2020.

2.2. Assumptions and limitations

The accuracy and reliability of palaeontological specialist studies as components of HIAs are generally limited by the following constraints:

- Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.
- Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil etc.), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.
- Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information;
- The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (e.g. of commercial mining companies) - that is not readily available for desktop studies;
- Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

(a) underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

(b) overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium etc.).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails inferring the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a PIA may be significantly enhanced through field assessment by a professional palaeontologist. In the present case, site visits to the study areas in some cases considerably modified our understanding of the rock units (and hence potential fossil heritage) represented there.

In the case of the present study area in the Matatiele region (Eastern Cape) exposure of potentially fossiliferous bedrocks is very limited, due to extensive cover by superficial sediments and grassy vegetation. However, sufficient exposures were examined to allow a realistic assessment of the palaeontological sensitivity of the key rock units (See Section 4), while additional relevant geological and palaeontological data is available from previous PIAs carried out in the region, many of which are only at desktop level, however (See, for example, Groenewald 2014a, 2014b, 2015, 2016, Trower 2018, Almond 2018a, 2018b). Confidence levels for this assessment are accordingly rated as Medium. Comparatively few academic palaeontological studies have been carried out in the region, so any new data from impact studies here are of scientific interest.

3. LEGISLATIVE CONTEXT AND PERMIT REQUIREMENTS

All South African fossil heritage, including palaeontological sites and specimens, is protected by law (South African National Heritage Resources Act, 1999). South African fossils cannot be collected, damaged, destroyed or disturbed without a permit from SAHRA or the relevant Provincial Heritage Resources Agency. Heritage management in the Eastern Cape is the responsibility of the Eastern Cape Provincial Heritage Resources Authority, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za)

Where palaeontological mitigation of a development project in the Eastern Cape is required, the palaeontologist concerned with mitigation work would need a valid fossil collection permit from SAHRA. Any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for palaeontological studies developed by SAHRA (2013).

The present palaeontological heritage assessment falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project. The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
(2) All archaeological objects, palaeontological material and meteorites are the property of the State.
(3) 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.
(4) No person may, without a permit issued by the responsible heritage resources authority—
(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
(c) 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
(d) 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.
(5) 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—
(a) 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;
(b) 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;
(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

- **Legislative and Permit Requirements for potential specialist mitigation**

(1) Should professional palaeontological mitigation be necessary during the construction phase, the palaeontologist concerned will need to apply for a Fossil Collection Permit from SAHRA. (2) Palaeontological collection should comply with international best practice. (3) All fossil material

collected must be deposited, together with key collection data, in an approved depository (museum / university), such as the East London Museum. (4) Palaeontological mitigation work including the ensuing Fossil Collection reports should comply with the minimum standards specified by Heritage Western Cape (2016) and SAHRA (2013).

4. GEOLOGICAL CONTEXT

The project area for the proposed gravel quarry near Matatiele comprises semi-arid, hilly terrain between 1500 and 1500 m amsl that is largely covered by short, grassy vegetation, gravels and soils with very limited solid bedrock exposure (Figs. 3 to 5, 16). There are several farm tracks in the area with local development of shallow gully erosion on steeper slopes. Soils are more thickly developed in the NE sector of the project area which is underlain by readily-weathered mudrocks. Prominent-weathering sandstones build a narrow *kranz* overlooking this lower-lying sector from the south and east; they are also seen along the southern margins of the project area and as low patchy exposures within the upland grassy plateau here which also features sparse domical termitaria. Low hills with markedly stepped slopes marking sandstone horizons extend to the west of the project area. Small, shallow farm dams are situated just to the east and west of the area.

The geology of the quarry project area is shown on 1: 250 000 geology sheet 3028 Kokstad (Council for Geoscience, Pretoria) (Fig. 2) with a short sheet explanation by De Decker (1981). According to the geological map, the proposed quarry is underlain by Early to Middle Triassic fluvial sediments of the **Burgersdorp Formation** (Tarkastad Subgroup / Upper Beaufort Group, Karoo Supergroup) (TRb, green in Fig. 2). In this region of the Main Karoo Basin, close to the Drakensberg Escarpment, the Beaufort Group sediments are extensively intruded and locally baked by Early Jurassic sills and dykes of the **Karoo Dolerite Suite** (pink areas and red lines respectively in Fig. 2). These igneous rocks are the target of mining in the existing commercial quarry on Edendale Farm but are not well-exposed within the adjoining gravel quarry project area, although they are mapped here, have influenced gravel formation and can be seen on upper hillslopes further east (Fig. 12). Molteno Formation sandstones cap higher ground several kilometres to the east of the project area, where thick, pale sandstone units are clearly visible on satellite images, but are not mapped at lower elevations within the quarry project area itself.

The **Burgersdorp Formation** is the youngest subunit of the Permo-Triassic Beaufort Group (Karoo Supergroup) and is paraconformably overlain by the Molteno and Elliot Formations of the Stormberg Group. It is a mudrock-rich succession of Early to Middle Triassic age with a total thickness of some 900-1000 m in its southern outcrop area near Queenstown (Johnson *et a*l. 2006); Kitching (1995) quotes a thickness of 600m in the type area for this formation between Queenstown and Lady Frere. Geological descriptions of the formation are given by Dingle *et al.* (1983), Johnson (1976, 1984), Hiller & Stavrakis (1984), Johnson & Hiller (1990), Kitching (1995) Hancox (2000; see also extensive references therein) as well as Bordy and Krummeck (2016). Brief descriptions of the Burgersdorp beds in the Queenstown, Mthatha and Kokstad 1: 250 000 sheet areas are given by Johnson (1984), Karpeta and Johnson (1979) and De Decker (1981) respectively.

The Burgersdorp sediments were laid down within the Main Karoo Basin by northwest-flowing meandering rivers during a warm, arid to semi-arid climatic interval. They comprise isolated,

lenticular, feldspathic channel sandstones, abundant crevasse splay sandstones, and typically greyish-red to dusky-red overbank mudrocks, forming upward-fining cycles of a few meters to tens of meters in thickness. Intraformational mudflake breccio-conglomerates are common at the base of the sandstone units. The mudrocks are generally massive (unbedded) but occasionally display sand-infilled mudcracks and clastic dykes. Well-laminated reddish mudrocks with pedocrete horizons are interpreted as playa lake deposits. Lacustrine palaeoenvironments predominated in the northern part of the Karoo Basin at this time and these lake deposits have recently received considerable palaeontological attention (*e.g.* Free State; Welman *et al.* 1995, Hancox *et al.* 2010 and refs therein).

Mudrock facies of the Burgersdorp Formation are not exposed within the quarry project area itself but are well seen in a low, west-facing scarp some 400 m to the east (Figs. 6 to 8). Here crumbly-weathering, purple-brown massive to thin-bedded siltstones grade up into a grey-green heterolithic package of thin-bedded purplish-brown siltstones and paler sandstones (some with gullied bases) that is, in turn, capped by a thin- to medium-bedded, pale brown, tabular-bedded channel sandstone unit. The hackly-weathering floodplain mudrocks contain zones of dispersed, irregularly-shaped, pale palaeocalcrete concretions and veins of pedogenic origin (palaeosol horizons) (Fig. 7) that are associated with cylindrical invertebrate burrows (Section 5). At this site the Karoo bedrocks are intruded by Karoo dolerite which caps the higher ground to the east and shows typical corestone weathering (Fig. 12). Adjacent sandstones are pale grey and quartzitic, probably as a result of thermal metamorphosis (baking) during intrusion.

The pale brown to greyish-green, well-sorted, medium-grained, feldspathic channel sandstones of the Burgersdorp Formation are best exposed along the southern margins of the project area as well as in the low rocky *kranz* to the area's east (Figs. 5, 9 to 11). They show tabular to massive bedding (medium- to thick-bedded, horizontal to large-scale cross-bedding with NW-directed palaeocurrents), well-developed jointing and lenses of basal breccia with moulds of reworked mudstone intraclasts (but no visible bone / teeth). Irregular to subcircular, lobed superficial depressions are ascribed to lichen weathering while complex etched bedrock surfaces probably reflect relict karstification (solution weathering). Small exposures of rusty-brown, rubbly dolerite overlie the sandstones locally. Low, patchy bedrock exposures in the flatter-lying upland areas comprise brownish, slightly ferruginised sandstone which are elsewhere mantled with thin, gravelly soils and domical termitaria (Figs. 3 & 4).

Colluvial deposits exposed on steeper hillslope *c*. 300 m east of the project area mainly comprise blocky sandstone rubble, including several outsized blocks (Figs. 13 to 15). The hillslope fans of lobes of coarse, clast-supported, brown-patinated basal gravelly deposits are overlain, on lower slopes, by a prism of orange-brown, poorly-sorted, gravelly soils (clasts of sandstone, dolerite and mudrock), locally with a sparse admixture of flaked hornfels stone artefacts. Well-developed calcretised colluvial deposits of the Pleistocene Masotcheni Formation are not represented here. Thick to thin, pale brown gravelly soils overlying the Burgersdorp sandstones in both lower- and higher-lying sectors of the project area are best seen around the margins of the small farm dams just outside the area itself. They commonly contain ferricretised clumps and concentrations of pea-sized ferricrete glaebules as well as dispersed stone artefacts of grey hornfels (Figs. 17 & 18).

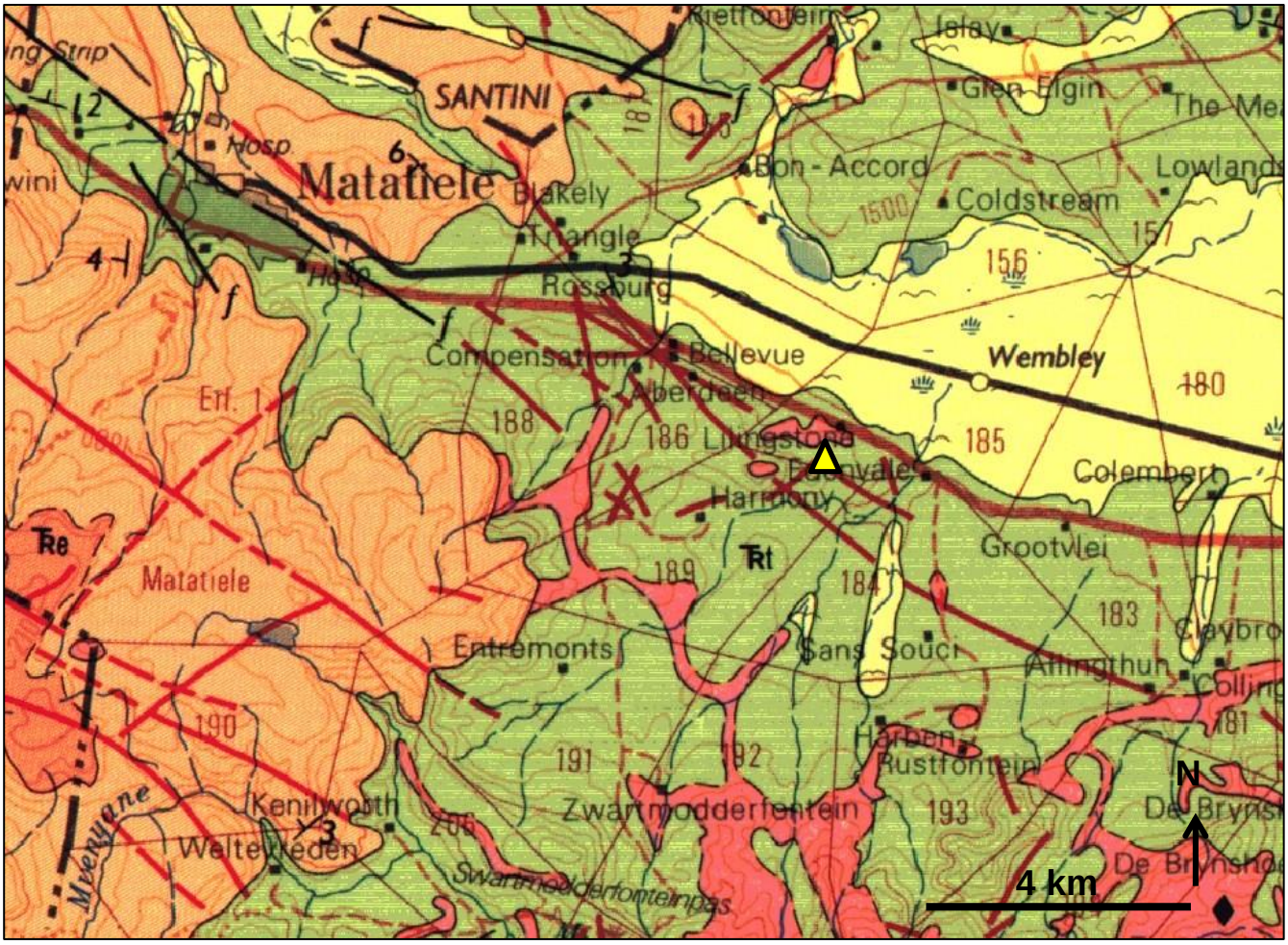

Figure 2: Extract from 1: 250 000 geology sheet 3028 Kokstad (Council for Geoscience, Pretoria) showing the location (yellow triangle) of the proposed gravel quarry on Edendale Farm No 185 near Matatiele, Matatiele Local Municipality, Eastern Cape Province. The quarry is underlain by Early Triassic fluvial sediments of the Tarkastad Subgroup (Upper Beaufort group, Karoo Supergroup) (Try, green). The sedimentary bedrocks here are extensively intruded and baked by Late Jurassic intrusions of the Karoo Dolerite Suite, including sills (pink areas) and ENE-WSW trending dykes (red lines). North of the R56 the Tarkastad sediments are extensively mantled by Late Caenozoic alluvial deposits (yellow) while in the hilly uplands to the west of the project area they are unconformably overlain by the sandstone-dominated Molteno Formation (orange).

Figure 3: View towards the SW across the southern, upland portion of the quarry project area showing undulating grassy terrain with isolated, low exposures of sandstone bedrock in the foreground and stepped hillslopes of the Burgersdorp Formation in the beackground.

Figure 4: South-eastern sector of the project area showing very limited bedrock exposure and domical termitaria emerging from thin, sandy to gravelly soil.

Figure 5: Low scarp or *krans* of Burgersdorp Formation channel sandstones skirted by gravelly scree stretching to the east of the quarry project area.

Figure 6: Gullied hillslope exposures of dusky purple-brown, crumbly overbank mudrocks of the Burgersdorp Formation with occasional calcretised palaeosol horizons, *c*. 400 m east of the quarry project area.

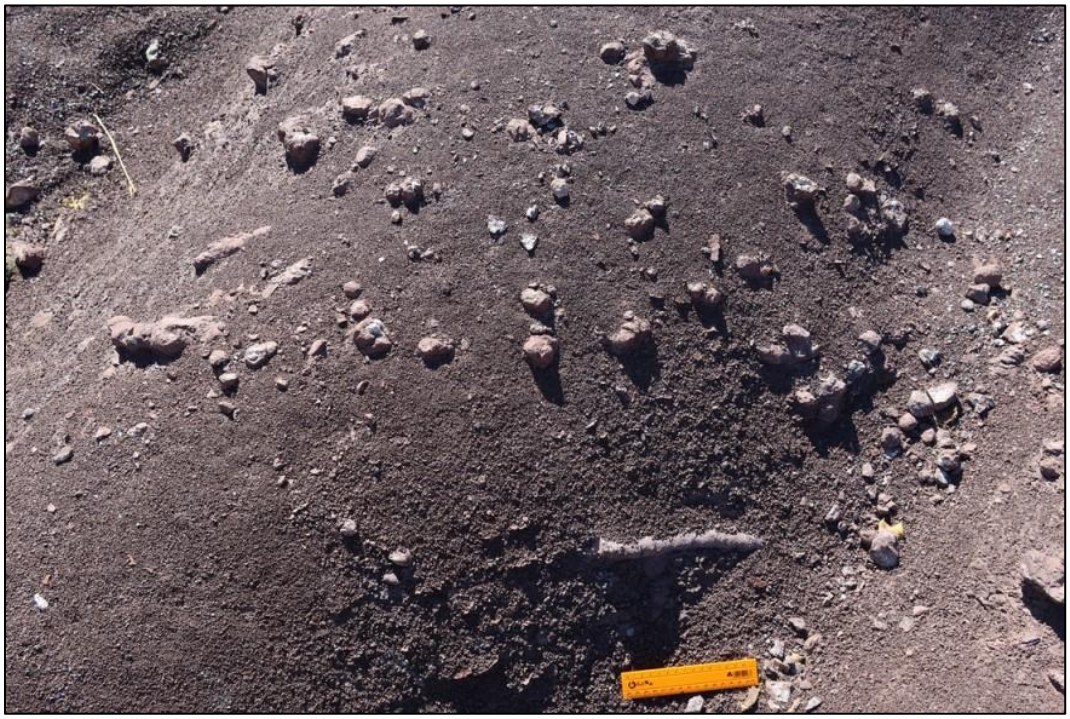

Figure 7: Close-up of the palaeosol (fossil soil) horizon seen in the previous figure marked by dispersed pale calcrete concretions and occasional subcylindrical fossil invertebrate burrows (Loc. 027) (Scale = 15 cm).

Figure 8: Successive packages of thinly interbedded purple-brown siltstone and paler, occasionally gullied sandstone followed by thin-bedded, tabular, grey-green silty sandstone and sharp-based, pale brown feldspathic channel sandstones. These Burgersdorp beds cap the overbank mudrocks shown in Figure 6 above.

Figure 9: Tabular-bedded, horizontally-laminated channel sandstones of the Burgersdorp Formation showing polygonal karstic weathering, southern margins of quarry project area.

Figure 10: Hollow moulds of well-rounded mudflakes within a lens of intraclast breccia within a Burgersdorp channel sandstone package (Scale = 15 cm). Fossil bones and teeth may occasionally be preserved within such channel breccias.

Figure 11: Irregularly lobed, shallow depressions in the surface of a Burgersdorp channel sandstone, a consequence of lichen weathering (Scale = 15 cm), southern margins of project area.

Figure 12: Typical corestone weathering of Karoo dolerite seen on upper hillslopes *c*. 500 m east of the quarry project area.

Figure 13: Rubbly colluvial deposits dominated by angular to subrounded Burgerdorp sandstone blocks and weathered purple-brown mudrock on steeper hillslopes *c*. 250 m east of the quarry project area.

Figure 14: Colluvial gravels of subrounded sandstone clasts and occasional flaked grey hornfels (arrowed) mantling lower hillslopes east of the project area (Hammer = 30 cm).

Figure 15: Thick, sparsely gravelly soils mantling colluvial gravels due east of the project area (The existing dolerite quarry is seen in the background).

Figure 16: Thick, dark-brown soils exposed in erosion gullies in the east-central sector of the project area. The dark colour may be associated with weathering of dolerite upslope.

Figure 17: Shallow farm dam just west of the quarry project area showing thick, sparsely gravelly, greyish-brown soils that obscure the sandstone and dolerite bedrocks here.

Figure 18: Clumps of finely nodular, rusty-brown ferricrete embedded within soils in the south-western sector of the project area (Scale = 15 cm). These ferruginous pedocretes may have formed in waterlogged superficial sediments in Late Caenozoic times.

5. PALAEONTOLOGICAL HERITAGE

The Beaufort Group outcrop area is generally designated as being of high to very high palaeontological sensitivity due to its rich fossil record of terrestrial vertebrates (reptiles, therapsids, fish, amphibians), vascular plants and trace fossils (Rubidge 1995, Johnson *et al.* 2006, Smith *et al.* 2012). The Burgersdorp Formation is characterized by a diverse continental fossil biota of Early to Middle Triassic (Olenekian to Anisian) age, some 245 to 240 million years old (Kitching 1995, Hancox 2000, Rubidge 2005, Neveling *et al.* 2005, Smith *et al.* 2012, Almond 2018b, Hancox *et al.* 2020). Karoo fossil biotas of this age are of special interest in that they document the recovery of life on land following the catastrophic end-Permian mass extinction event. The Burgersdorp fauna is dominated by a wide variety of tetrapod taxa, notably a range of amphibians, reptiles and therapsids ("mammal-like reptiles"). This distinctive biota is referred to the ***Cynognathus* Assemblage Zone** and has been well-reviewed by authors such as Smith *et al.* (2012) and Hancox *et al.* (2020). Comparable Triassic faunas have been described from various parts of the ancient supercontinent Pangaea, including Russia, China, India, Argentina, Australia and Antarctica.

Useful accounts of the palaeontological heritage of the Burgersdorp Formation – which has recently being recognised as yielding one of the richest Early-Mid Triassic biotas worldwide – are given by Kitching (1977, 1995), Keyser and Smith (1977-78), MacRae (1999), Hancox (2000; see also many references therein), Cole *et al.* (2004), Rubidge (2005) and Smith *et al.* (2012). The most recent palaeontological review by Hancox *et al.* (2020) proposes a three-fold biostratigraphic subdivision of the Burgersdorop succession. The Burgersdorp biotas include a rich freshwater vertebrate fauna, with a range of fish groups (*e.g.* sharks, lungfish, coelacanths, ray-finned bony fish such as palaeoniscoids) as well as large capitosaurid and trematosuchid amphibians; the latter are of considerable important for long-range biostratigraphic correlation. The interesting reptile fauna includes lizard-like sphenodontids, beaked rhynchosaurs, and various primitive archosaurs (distant relatives of the dinosaurs) such as the crocodile-like erythrosuchids, some of which reached body lengths of 5 m, as well as the more gracile *Euparkeria*. The therapsid fauna contains large herbivorous dicynodonts like *Kannemeyeria*, which may have lived in herds, *plus* several small to medium-sized carnivorous or herbivorous therocephalians (*e.g. Bauria*) and advanced cynodonts. The most famous cynodont here is probably the powerful-jawed genus *Cynognathus*, but remains of the omnivorous *Diademodon* are much commoner. Tetrapods are also represented by several fossil trackways while large *Cruziana*–like burrow systems with coarsely scratched ventral walls are attributed to burrowing vertebrates (*cf* Shone 1978, Bordy *et al.* 2019). Locally abundant vertebrate burrows have been attributed to small procolophonid reptiles (Groenewald *et al.* 2001; see also Bordy & Krummeck 2016) while a limited range of smaller-scale invertebrate burrows of uncertain origin are also known (Bordy & Krummeck 2016). Important new studies on lacustrine biotas in the northern Burgersdorp outcrop area have yielded rich microvertebrate faunas as well as vertebrate coprolites; sites such as Driefontein in the Free State are now among the best-documented non-marine occurrences of Early Triassic age anywhere in the world (Bender & Hancox 2003, 2004, Hancox *et al.* 2010, Ortiz *et al.* 2010 and refs. therein).

No fossil vertebrate or plant remains were recorded within the Burgersdorp Formation bedrocks underlying or outside the gravel quarry project area, either in the mudrock or sandstone facies. This might be attributable, at least in part, to the low levels of sedimentary bedrock exposure and perhaps also baking of the country rocks by local dolerite intrusions. The only undoubted fossils recorded in the region (but *outside* the quarry project area) are several occurrences of small-scale (2-4 cm wide),

subcylindrical to irregular burrow casts of probable invertebrate origin that are associated with calcretised pedocrete horizons within the overbank mudrock facies (Figs. 7, 19 & 20). Sectors of the burrows observed vary from steeply-inclined to subhorizontal (possibly portions of J-shaped burrow systems) with a round to elliptical or irregular cross section and no marked surface ornament (*e.g.* scratches). Comparable burrows have been described from Early Triassic continental sediments of the Main Karoo Basin in the Eastern Cape by Bordy and Krummeck (2016) as well as Almond (2018a). Ill-defined, inclined, pale greyish sandstone bodies (*c*. 10 cm across) embedded within overbank mudrocks (Fig. 21) *might* be vertebrate burrow casts, similar to those illustrated by Bordy and Krummeck (2016), but further fieldwork is required to test this.

No fossil remains of any sort are recorded within the superficial deposits (colluvial gravels, soils, pedocretes) within the quarry project area. Potential fossils within such geologically youthful sediments include concentrations of petrified fossil wood reworked from the Karoo Supergroup bedrocks as well as calcretised trace fossils (*e.g.* root casts / rhizoliths, termitaria), charcoal fragments, rare mammalian bones and teeth as well as Early to Middle Stone Age stone artefacts (Examples of these last, comprising flaked and patinated grey-brown hornfels, do occur among colluvial gravels on hillslopes *c*. 250 m east of the present project area) (Fig. 14). However, their palaeontological sensitivity is generally low.

Figure 19: Small-scale (*c.* 2-4 cm wide), steeply-inclined burrow casts of irregular to elliptical cross-section associated with a calcrete palaesol horizon within purple-brown overbank mudrocks at Loc. 027, *c*. 440 m east of and outside the quarry project area (Scale = 15 cm).

Figure 20: Subcyclindrical sections of small, horizontal burrow casts (*c*. 2 cm wide) at the same locality as the previous figure. Together they may form parts of J-shaped burrow systems which were probably constructed by invertebrates. Surface scratches are not obvious here.

Figure 21: Isolated, possibly subcylindrical bodies of pale greyish sandstone embedded within purple-brown mudrocks – possible small vertebrate burrow casts, but this requires confirmation (Loc. 028) (Scale = 15 cm).

6. CONCLUSIONS & RECOMMENDATIONS

The proposed gravel quarry near Matatiele, Eastern Cape, will be excavated into Late Caenozoic gravelly superficial sediments and soils as well as underlying sandstones and mudrocks of the Burgersdorp Formation (Upper Beaufort Group / Tarkastad Subgroup, Karoo Supergroup) of Early to Middle Triassic age *plus* intrusive Karoo dolerite. The superficial sediments are generally of low palaeosensitivity while the Karoo dolerite is entirely unfossiliferous. Elsewhere in the Eastern Cape the Burgersdorp Formation has yielded a wide range of Triassic fossil vertebrates (fish, reptiles, therapsids) as well as a small range of vertebrate and invertebrate trace fossils. However, no body fossils (bones, teeth, shells, petrified wood *etc*) were recorded within the quarry project area during a recent site visit. This may be due, at least in part, to the low levels of bedrock exposure within the project area and possibly also to baking by local dolerite intrusions. Small scale fossil invertebrate burrows associated with calcretised palaeosol horizons are recorded from Burgersdorp mudrocks outside the quarry project area; these are widely occurring forms of low conservation significance.

While there is clearly the potential for the disturbance and / or destruction of fossil material (*e.g.* fossil bones / teeth / burrows) during the operational phase of the proposed gravel quarry, it is likely that the fossils concerned are of widespread occurrence within the Upper Beaufort Group outcrop area. The loss of unique, irreplaceable fossil heritage is therefore considered unlikely. Pending the potential discovery of significant fossil remains during excavation (in which case the Chance Fossil Finds procedure outlined below applies), no further specialist palaeontological studies or mitigation are recommended for this gravel quarry project.

The Environmental Control Officer (ECO) responsible for the quarrying should be made aware of the potential occurrence of scientifically-important fossil remains – especially well-preserved fossilised bones and teeth - within the development footprint. Should substantial fossil remains be exposed during clearance and excavation, the ECO should safeguard these, preferably *in situ*. They should then alert the Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za) as soon as possible. This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist at the proponent's expense. These recommendations are summarized in the tabulated Chance Fossil Finds Procedure appended to this report (Appendix 2).

The palaeontologist concerned with any mitigation work will need a valid Fossil Collection Permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013). These monitoring and mitigation recommendations are to be incorporated into the Environmental Management Programme (EMPr) for the quarry development.

Provided that the Chance Fossil Finds Procedure outlined below and tabulated in Appendix 2 is consistently implemented, there are no objections on palaeontological heritage grounds to authorization of the proposed gravel quarry development.

7. ACKNOWLEDGEMENTS

Ms Robyn Thomson, CES Environmental and Social Advisory Services, is thanked for commissioning this study and for providing the necessary background information. I am grateful to Ms Madelon Tusenius for logistical back-up as well as for assistance and companionship in the field.

8. REFERENCES

ALMOND, J.E. 2018a. Proposed Bulk Water Supply Scheme for Ward 4 of Matatiele Local Municipality, Alfred Nzo District, Eastern Cape Province. Desktop & field-based palaeontological & geological heritage input, 30 pp. Natura Viva cc. Cape Town.

ALMOND, J.E. 2018b. Proposed SANRAL R61 (Section 6) Borrow Pit in the Engcobo Local Municipality, Chris Hani District Municipality, Eastern Cape Province. Palaeontological heritage assessment: combined desktop & field study, 33 pp. Natura Viva cc, Cape Town.

ALMOND, J.E., DE KLERK, W.J. & GESS, R. 2008. Palaeontological heritage of the Eastern Cape. Draft report for SAHRA, 20 pp. *Natura Viva* cc, Cape Town.

ANDERSON, J.M. & ANDERSON, H.M. 1985. Palaeoflora of southern Africa. Prodromus of South African megafloras, Devonian to Lower Cretaceous, 423 pp. Botanical Research Institute, Pretoria & Balkema, Rotterdam.

BAMFORD, M. 1999. Permo-Triassic fossil woods from the South African Karoo Basin. Palaeontologia africana 35, 25-40.

BAMFORD, M.K. 2004. Diversity of woody vegetation of Gondwanan southern Africa. Gondwana Research 7, 153-164.

BENDER, P.A. & HANCOX, P.J. 2003. Fossil fishes of the *Lystrosaurus* and *Cynognathus* Assemblage Zones, Beaufort Group, South Africa: correlative implications. Council for Geoscience, Pretoria, Bullletin 136, 1-27.

BENDER, P.A. & HANCOX, P.J. 2004. Newly discovered fish faunas from the Early Triassic, Karoo Basin, South Africa, and their correlative implications. Gondwana Research 7, 185-192.

BORDY, E.M. & KRUMMECK, W.D. 2016. Enigmatic continental burrows from the Early Triassic transition of the Katberg and Burgersdorp Formations in the Main Karoo Basin, South Africa. Palaios 31, 389-403.

BORDY, E.M., SZTANOB, O., RAMPERSADHA, A., ALMOND, J. & CHOINIERE, J.N. 2019. Vertebrate scratch traces from the Middle Triassic Burgersdorp Formation of the main Karoo Basin, South Africa: Sedimentological and ichnological assessment. Journal of African Earth Sciences 160

BOTHA, G.A. 1992. The geology and palaeopedology of the late Quaternary colluvial sediments in northern Natal, South Africa. Unpublished PhD thesis, University of Natal.

BOTHA, G.A., DE VILLIERS, J.M. & VOLGEL, J.C. 1990. Cyclicity of erosion, colluvial sedimentation and palaeosol formation in Quaternary hillslope deposits from northern Natal, South Africa. Palaeoecol. Afr. 19, 195-210.

CATUNEANU, O., WOPFNER, H., ERIKSSON, P.G., CAIRNCROSS, B., RUBIDGE, B.S., SMITH, R.M.H. & HANCOX, P.J. 2005. The Karoo basins of south-central Africa. Journal of African Earth Sciences 43, 211-253.

COLE, D.I., NEVELING, J., HATTINGH, J., CHEVALLIER, L.P., REDDERING, J.S.V. & BENDER, P.A. 2004. The geology of the Middelburg area. Explanation to 1: 250 000 geology Sheet 3124 Middelburg, 44 pp. Council for Geoscience, Pretoria.

DE DECKER, R.H. 1981. Geology of the Kokstad area. Explanation to 1: 250 000 geology sheet 3028 Kokstad, 22 pp. Council for Geoscience, Pretoria.

DINGLE, R.V., SIESSER, W.G. & NEWTON, A.R. 1983. Mesozoic and Tertiary geology of southern Africa. viii + 375 pp. Balkema, Rotterdam.

DUNCAN, A.R. & MARSH, J.S. 2006. The Karoo Igneous Province. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 501-520. Geological Society of South Africa, Marshalltown.

GROENEWALD, G. 2014a. Phase 1 palaeontological assessment for the proposed development of a water supply scheme for Matatiele Wards 5&7, Alfred Nzo District Municipality, Eastern Cape Province, 20 pp. PGS Heritage.

GROENEWALD, G. 2014b. Phase 1 palaeontological assessment for the proposed development of a water supply scheme for Matatiele Ward 15, Alfred Nzo District Municipality, Eastern Cape Province, 21 pp. PGS Heritage.

GROENEWALD, G. 2015. Construction of the Cedarville Middle Income Housing Development in the Matatiele Local Municipality, Alfred Nzo District Municipality, Eastern Cape Province. Palaeontological desktop assessment, 10 pp.

GROENEWALD, G. 2016. Proposed road upgrade development: Matatiele to Strydfontein, Matatiele Local Municipality, Alfred Nzo District Municipalty, Eastern Cape Province. Palaeontological desktop assessment, 13 pp. PGS Heritage.

GROENEWALD, G. H., J. WELMAN, AND J. A. MACEACHERN. 2001. Vertebrate burrow complexes from the Early Triassic *Cynognathus* Assemblage Zone (Driekoppen Formation, Beaufort Group) of the Karoo Basin, South Africa. Palaios16,148–160.

HANCOX, P.J. 2000. The continental Triassic of South Africa. Zentralblatt für Geologie und Paläontologie, Teil 1, 1998, 1285-1324.

HANCOX, J., NEVELING, J. & RUBIDGE, B. 2010. Life in an Early Triassic lake: new developments from the Driefontein site, Burgersdorp Formation (*Cynognathus* Assemblage Zone), South Africa. Proceedings of the 16th Conference of the PSSA, Howick, Umgeni Valley Nature Reserve, 41-42.

HANCOX, P.J., NEVELING, J. & RUBIDGE, B.S. 2020. Biostratigraphy of the *Cynognathus* Assemblage Zone (Beaufort Group, Karoo Supergroup), South Africa. South African Journal of Geology 123, 217-238.

HILLER, N. & STAVRAKIS, N. 1984. Permo-Triassic fluvial systems in the southeastern Karoo Basin, South Africa. Palaeogeography, Palaeoclimatology, Palaeoecology 34, 1-21.

JOHNSON, M.R. 1966. The stratigraphy of the Cape and Karoo Systems in the Eastern Cape Province. Unpublished MSc Thesis, Rhodes University, Grahamstown.

JOHNSON, M.R. 1976. Stratigraphy and sedimentology of the Cape and Karoo sequences in the Eastern Cape Province. Unpublished PhD thesis, Rhodes University, Grahamstown, xiv + 335 pp, 1pl.

JOHNSON, M.R. 1984. The geology of the Queenstown area. Explanation to 1: 250 000 geology Sheet 3126 Queenstown, 21 pp. Council for Geoscience, Pretoria.

JOHNSON, M.R. & VERSTER, P.S.J. 1994. Die geologie van die gebied Harrismith. Explanation to 1: 50 000 geology sheet 2828, 24 pp. Council for Geoscience, Pretoria.

JOHNSON, M.R. & HILLER, N. 1990. Burgersdorp Formation. South African Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 2, 9-10. Council for Geoscience, Pretoria.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., DE V. WICKENS, H., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Marshalltown.

KARPETA, W.P. & JOHNSON, M.R. 1979. The geology of the Umtata area. Explanation to 1: 250 000 geology Sheet 3128 Umtata, 16 pp. Council for Geoscience, Pretoria.

KEYSER, A.W. & SMITH, R.M.H. 1977-78. Vertebrate biozonation of the Beaufort Group with special reference to the western Karoo Basin. Annals of the Geological Survey of South Africa 12, 1-35.

KITCHING, J.W. 1977. The distribution of the Karroo vertebrate fauna, with special reference to certain genera and the bearing of this distribution on the zoning of the Beaufort beds. Memoirs of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, No. 1, 133 pp (incl. 15 pls).

KITCHING, J.W. 1995. Biostratigraphy of the *Cynognathus* Assemblage Zone. Pp. 13-17 in Rubidge, B.S. (ed.) Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Stratigraphy, Biostratigraphic Series No. 1. Council for Geoscience, Pretoria

LINDSTRŐM, W. 1981. Die geologie van die gebied Drakensberg. Explanation to 1: 250 000 geology sheet 2928 Drakensberg, 33 pp. Council for Geoscience, Pretoria.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa. 305pp. The Geological Society of South Africa, Johannesburg.

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.

NEVELING, J., RUBIDGE, B.S. & HANCOX, P.J. 1999. A lower *Cynognathus* Assemblage Zone fossil from the Katberg Formation (Beaufort Group, South Africa). South African Journal of Science 95, 555-556.

NEVELING, J., HANCOX, P.J. & RUBIDGE, B.S. 2005. Biostratigraphy of the lower Burgersdorp Formation (Beaufort Group; Karoo Supergroup) of South Africa – implications for the stratigraphic ranges of early Triassic tetrapods. Palaeontologia Africana 41, 81-87.

NICOLAS, M.V. 2007. Tetrapod diversity through the Permo-Triassic Beaufort Group (Karoo Supergroup) of South Africa. Unpublished PhD thesis, University of Witwatersrand, Johannesburg.

NICOLAS, M. & RUBIDGE, B.S. 2010. Changes in Permo-Triassic terrestrial tetrapod ecological representation in the Beaufort Group (Karoo Supergroup) of South Africa. Lethaia 43, 45-59.

ORTIZ, D., LEWIS, P.J., KENNEDY, A.M., BHULLAR, B.S. & HANCOX, J. 2010. Preliminary analysis of lungfish (Dipnoi) tooth plates from Driefontein, South Africa. Proceedings of the 16th Conference of the PSSA, Howick, Umgeni Valley Nature Reserve, 72-74.

PARTRIDGE, T.C., BOTHA, G.A. & HADDON, I.G. 2006. Cenozoic deposits of the interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

ROSSOUW, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust Farm, Central Free State, South Africa. Navorsinge van die Nasionale Museum Bloemfontein 22, 145-162.

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

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

RUBIDGE, B.S., ERWIN, D.H., RAMEZANI, J., BOWRING, S.A. & DE KLERK, W.J. 2013. High-precision temporal calibration of Late Permian vertebrate biostratigraphy: U-Pb zircon constraints from the Karoo Supergroup, South Africa. Geology published online 4 January 2013. doi: 10.1130/G33622.1.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SHONE, R.W. 1978. Giant *Cruziana* from the Beaufort Group. Transactions of the Geological Society of South Africa 81, 327-329.

SMITH, R., RUBIDGE, B. & VAN DER WALT, M. 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. Chapter 2 pp. 30-62 in Chinsamy-Turan, A. (Ed.) Forerunners of mammals. Radiation, histology, biology. xv + 330 pp. Indiana University Press, Bloomington & Indianapolis.

TROWER, G. 2018. Palaeontological Impact Assessment (Phase 2) for the construction of the Matatiele truck stop off the R56, 13 pp.

VAN DER WALT, M., DAY, M., RUBIDGE, B., COOPER, A.K. & NETTERBERG, I. 2010. A new GIS-based biozone map of the Beaufort Group (Karoo Supergroup), South Africa. Palaeontologia Africana 45, 1-5.

WELMAN, J., GROENEWALD, G.H. & Kitching, J.W. 1991. Confirmation of the occurrence of *Cynognathus* Zone (*Kannemeyeria – Diademodon* Assemblage-Zone) deposits (uppermost Beaufort Group) in the northeastern Orange Free State, South Africa. South African Journal of Geology 94, 245-248.

9. 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 Province, Mupumalanga, KwaZulu-Natal 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.

Dr John E. Almond
Palaeontologist
***Natura Viva* cc**

APPENDIX 1: GPS FOSSIL LOCALITY DATA

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. Fossil sites are plotted in the context of the quarry project area on the satellite image in Figure A1. The datum used is WGS 84. Please note that:

- The fossil sites recorded here represent only a small sample of potential sites present at or beneath the ground surface within or outside the project area.

- This palaeontological site data is *not* for public release, due to conservation concerns.

LOC	GPS DATA	COMMENTS
027	30 22 36.9 S 28 55 04.4 E	Calcretised palaeosol horizon within purple-brown overbank mudrocks of the Burgersdorp Formation with several small-scale (2-4 cm wide), steeply inclined to horizontal burrow casts, possibly parts of J-shaped burrow systems. Proposed Field Rating IIIC Local Resource. No mitigation required (outside quarry footprint).
028	30 22 36.5 S 28 55 04.4 E	Possible small (c. 10 cm wide) inclined sandstone vertebrate burrow casts embedded within purple-brown overbank mudrocks. Fossil status requires confirmation. Proposed Field Rating IIIC Local Resource. No mitigation required (outside quarry footprint).

Figure A1: Google Earth© satellite image of the Matatiele gravel quarry project area on Edendale Farm No 185 (yellow polygon) showing numbered recorded fossil sites (fossil burrows), all of which fall well outside the project footprint.

APPENDIX 2: CHANCE FOSSIL FINDS PROCEDURE: GRAVEL QUARRY ON EDENDALE FARM NO 185 NEAR MATATIELE, EASTERN CAPE PROVINCE		
Province & region:	EASTERN CAPE, Matatiele Local Municipality	
Responsible Heritage Resources Agency	Eastern Cape Provincial Heritage Resources Agency, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; smokhanya@ecphra.org.za)	
Rock unit(s)	Burgersdorp Formation (Early – Middle Triassic), Karoo Supergroup; late Caenozoic colluvial gravels and soils	
Potential fossils	In bedrocks: petrified wood, vertebrate bones and teeth, plant compressions, trace fossils . In colluvium and alluvium: teeth, bones and horncores of mammals, non-marine molluscs, calcretised trace fossils (*e.g.* termitaria), reworked fossil wood.	
ECO protocol	1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (*N.B.* safety first!), safeguard site with security tape / fence / sand bags if necessary.	
	2. Record key data while fossil remains are still *in situ:* • Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo • Context – describe position of fossils within stratigraphy (rock layering), depth below surface • Photograph fossil(s) *in situ* with scale, from different angles, including images showing context (*e.g.* rock layering)	
	3. If feasible to leave fossils *in situ*: • Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation • Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency for work to resume	3. If *not* feasible to leave fossils *in situ* (emergency procedure only): • *Carefully* remove fossils, as far as possible still enclosed within the original sedimentary matrix (*e.g.* entire block of fossiliferous rock) • Photograph fossils against a plain, level background, with scale • Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags • Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist • Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
	4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.	
	5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency	
Specialist palaeontologist	Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (*e.g.* museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.	

Province of the
EASTERN CAPE
ECONOMIC DEVELOPMENT, ENVIRONMENTAL AFFAIRS & TOURISM

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST IN TERMS OF REGULATIONS 12 AND 13 OF THE AMENDMENTS TO THE ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, 2014 AS AMENDED.

	(For official use only)
File Reference Number:	
NEAS Reference Number:	
Date Received:	

Application for environmental authorization in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Amendments to the Environmental Impact Assessment Regulations, 2014. This form is valid as of 6 January 2021.

PROJECT TITLE

Proposed Edendale Quarry, Matatiele Local Municipality in the Eastern Cape Province

SPECIALIST *	Natura Viva cc		
Contact person:	Dr John Almond		
Postal address:	PO Box 12410 Mill Street, Cape Town		
Postal code:	8010	Cell:	071 947 0577
Telephone:	021 4623622	Fax:	
E-mail:	naturaviva@universe.co.za		
Professional affiliation(s) (if any)	Palaeontological Society of SA, Association of Professional Heritage Practitioners (WCape), Geological Society of SA		

Project Consultant:	CES Environmental and Social Advisory Services - Dr Alan Carter		
Contact person:	Ms Robyn Thomson		
Postal address:	PO Box 8145, Nahoon, East London		
Postal code:	5210		
Telephone:	0826198203		
E-mail:	r.thomson@cesnet.co.za		

*Curriculum Vitae (CV) attached as Annexure 1

4.2 The SPECIALIST

I, **Dr John Edward Almond**, declare that –

General declaration:

- I act as the independent Specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by
- interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Amendments to Environmental Impact Assessment Regulations, 2014 as amended.
- ~~I have a vested interest in the proposed activity proceeding, such vested interest being:~~

Signature of the Specialist:

Name of Company:

NATURA VIVA CC

Date:

30 MARCH 2021

Signature of the Commissioner of Oaths:

Date:

2021-03-30

Designation: CONSTABLE

Official stamp (below).

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
30 MAR 2021
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

Annexure 1 – Specialist CV

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, Gauteng, KwaZulu-Natal, Mpumalanga 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).