

**PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE  
PROPOSED TOWNSHIP ESTABLISHMENT ON THE  
REMAINDER OF PORTION 6 AND 7 OF THE FARM  
SUNNYSIDE 2620, BLOEMFONTEIN, MANGAUNG  
METROPOLITAN MUNICIPALITY, FREE STATE**



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## EXECUTIVE SUMMARY

The Mangaung Metro Municipality proposes the construction and development of a new township near the airport in the south east of Bloemfontein. Due to Section 35 of the National Heritage Resources Act, a palaeontological impact assessment is required to detect the presence of fossil material at the proposed site.

The proposed development area is completely underlain by potentially fossiliferous sedimentary rocks of the Late Permian *Dicynodon* Assemblage Zone. The potentially fossiliferous bedrocks are mantled by fossil-poor superficial sediments (soils, residual gravels) of much younger, Quaternary to Recent age.

Although the palaeontological sensitivity is rated high, the development area is largely an area with a low relief that has already been disturbed by farming activities. There is no **steep river gulleys or sharp outcrops present** on the proposed development site. The lack of appropriate exposure at the proposed site indicates that the impact on palaeontological material is **negligible and regarded as insignificant**.

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, **pending the discovery** or exposure of any **fossil remains** during the construction phase.

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# 1 INTRODUCTION

Destudio was appointed as the independent Environmental Assessment Practitioners by the Mangaung Metro Municipality for the proposed development of a township near the airport in the south east of Bloemfontein, Free State. The proposed mixed development area includes 404 stands, which will comprise several blocks of flats, town houses, residential homes, streets, public open spaces as well as the associated infrastructure (Fig. 1-2).

The excavations will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb damage or destroy scientific valuable fossil heritage exposed at the surface or buried below ground. Palaeontological material is unique and non-renewable and is protected by the National Heritage Resources Act (Act No. 25 of 1999, section 35). A Palaeontological Impact Assessment of the proposed development is therefore necessary to certify that palaeontological material is either removed, or is not present.



**Figure 1.** The location of the proposed township development (bordered in white) near the airport in relation to Bloemfontein, Mangaung Metro Municipality, Free State as indicated by a satellite image (modified from Google Earth 2015; Map provided by Destudio).



**Figure 2.** Proposed development area near the airport in the south east of Bloemfontein, Mangaung Metro Municipality, Free State. (Map provided by Destudio).

## 2 LEGISLATION

Cultural Heritage in South Africa is dealt with by the National Heritage Resources Act (Act 25 of 1999). This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the above mentioned Act. In accordance with Section 38, a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

### SECTION 25 OF THE NATIONAL HERITAGE RESOURCES ACT 1999

The various categories of heritage resources are recognised as part of the National Estate in Section 3 of The National Heritage Resources Act. This include among others:

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

According to Section 25 of the National Heritage Resources Act 1999, dealing with archaeology, palaeontology and meteorites:

- The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
- All archaeological objects, palaeontological material and meteorites are the property of the State.
- 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.
- No person may, without a permit issued by the responsible heritage resources authority—



- destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
  - destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
  - 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
  - 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.
- 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—
    - 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;
    - 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.

### 3 Objective

*According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the aims of the palaeontological impact assessment are:* • to identify exposed and subsurface rock formations that are considered to be palaeontologically significant; • to assess the level of palaeontological significance of these formations; • to comment on the impact of the development on these exposed and/or potential fossil resources and • to make recommendations as to how the developer should conserve or mitigate damage to these resources. The objective is thus to conduct a desktop study to determine the impact on potential palaeontological material at this site.

When a palaeontological desktop study is conducted, the potentially fossiliferous rocks (i.e. groups, formations, members, etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is collected from published scientific literature; Fossil sensitivity map; consultations with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions may be consulted. This data is then used to assess the palaeontological sensitivity of each rock unit of the development area. The likely impact of the proposed development on local fossil heritage is subsequently established on the basis of

- the palaeontological sensitivity of the rocks and
- the nature and scale of the development itself (extent of new bedrock excavated)

When rocks of moderate to high palaeontological sensitivity are present within the development area, a field-based assessment by a professional palaeontologist is necessary. Based on this desktop data as well as a field examination of representative exposures of all major sedimentary rock present, the impact significance of the planned development is considered with recommendations for any further studies or mitigation.

## 4 BACKGROUND TO THE GEOLOGICAL AND PALAEOLOGICAL HISTORY

The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this period the Karoo basin developed from an inland sea flooded by a melting ice cap, to a giant lake (Ecca Lake) fed by seasonal meandering (and periodically braided) rivers. The lake progressively shrank as it filled with sediment and the basin's rate of subsidence stabilised.

The Beaufort group consists of largely fluvial sediments which were deposited on the floodplains of rivers. The land became progressively more arid and was covered with windblown sand just before the end of the basin's cycle. Finally the subcontinent was inundated with basaltic lava to form the capping basalts of the Jurassic aged Drakensberg Group. During the Jurassic the volcanic Drakensberg were formed and cracks in the earth's crust were filled with molten lava that cooled to form dolerite dykes. Magma injected horizontally between sediments, cooled down and formed horizontal sills of dolerite.

The development area in Bloemfontein is underlain by continental sediments of the Beaufort Group, Adelaide Subgroup, Karoo Supergroup (Fig. 3-4). Adelaide sediments are assigned to the Late Permian *Dicynodon* Assemblage Zone of the Normandien Formation (Rubidge 1995, Van der Walt 2010) (Fig.3-4). The Adelaide Subgroup succession has been assigned to the Changhsingian Stage (= Late Tartarian), right at the end of the Permian Period, with an approximate age range of 253.8-251.4 million years (Rubidge 1995, 2005).

The diverse *Dicynodon* Assemblage Zone biotas are of extraordinary interest in that they provide some of the best available information on ecologically-complex terrestrial ecosystems immediately preceding the catastrophic end-Permian mass extinction (Rubidge 2005, Gastaldo *et al.* 2005, Retallacket *al.*, 2006).

Sediments of the Beaufort Group are relatively rich in fossils, especially vertebrate fossils. This *Dicynodon* Assemblage Zone is characterized by the occurrence of the two therapsids

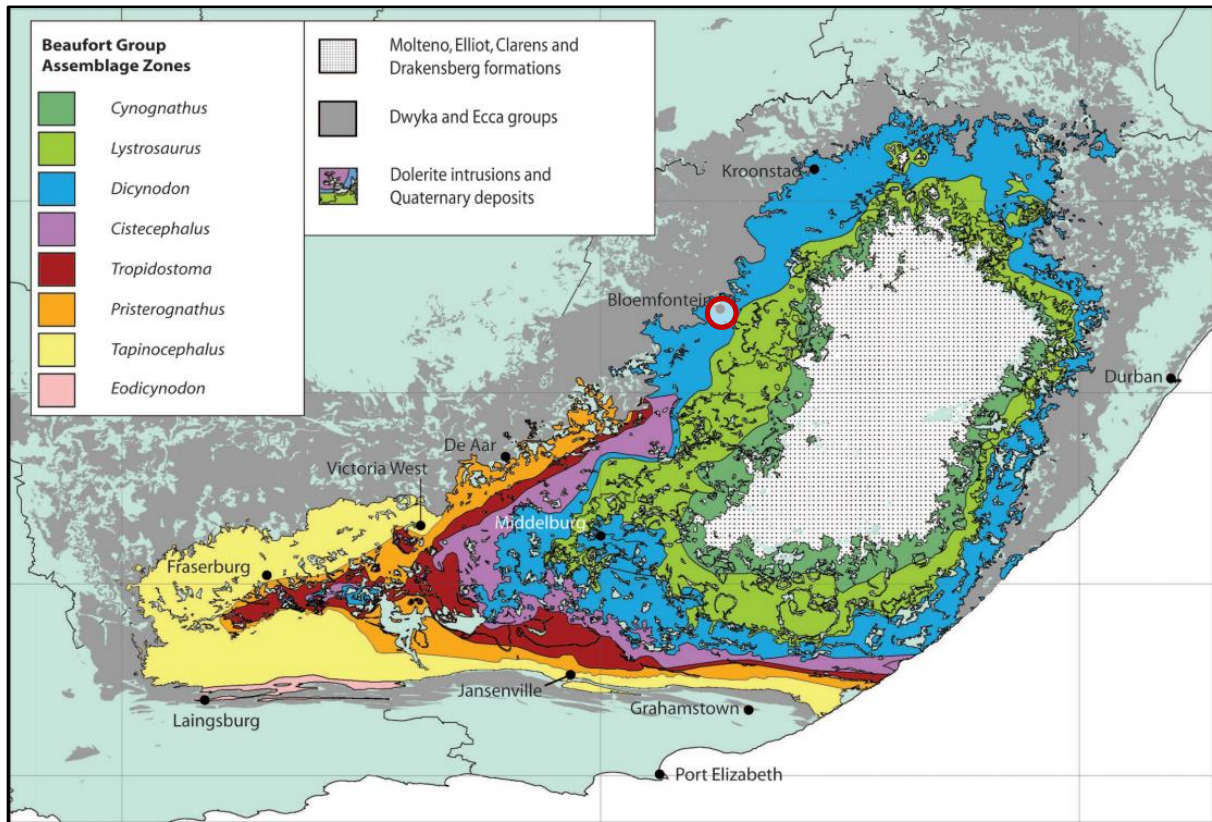
namely *Dicynodon* and *Theriognathus* and may also include the following specimens (Kitching, 1977; National Palaeontology Museum databases):

- Dicynodonta: *Aulacephalodon*, *Dicynodon*, *Diictodon*, *Dinanomodon*, *Emydops*, *Lystrosaurus*, *Oudenodon*, *Palemydops*, *Pelanomodon* and *Pristerodon*
- Biarmosuchia: *Burnettia*, *Ictidorhinus*, *Lemurosaurus* and *Rubidgea*
- Gorgonopsida: *Broomicephalus*, *Cielandina*, *Cyonosaurus*, *Dinogorgon*, *Lycaenops*, *Prorubidgea*, *Rubidgea*, *Paragalerhinus* and *Leontocephalus*
- Therocephalia: *Akidnognathus*, *Cerdops*, *Homodontosaurus*, *Ictidosuchoides*, *Lycideops*, *Moschorinus*, *Nanictidops*, *Promoschorhynchus*, *Scaloporhinus*, *Tetracyndon* and *Theriognathus*
- Cynodontia: *Cynosaurus*, *Nanictosaurus* and *Procynosuchus*
- Captorhinida: *Anthodon*, *Milleretta*, *Millerosaurus*, *Owenetta*, *Pareiasaurus*, *Procolophon* and *Spondylolestes*
- Eosuchia: *Saurosternon* and *Youngia*
- Amphibians: *Laccocephalus*, and *Rhinesuchus*
- Fish: *Athestonia* and *Namaichthy*.
- freshwater mollusk: *Palaeomutella* and
- Fossil plants are relatively rare compared to the vertebrate fossil assemblages. The presence of the wood genera, *Agathoxylon* and *Australoxylon*, was described by Bamford (2004).

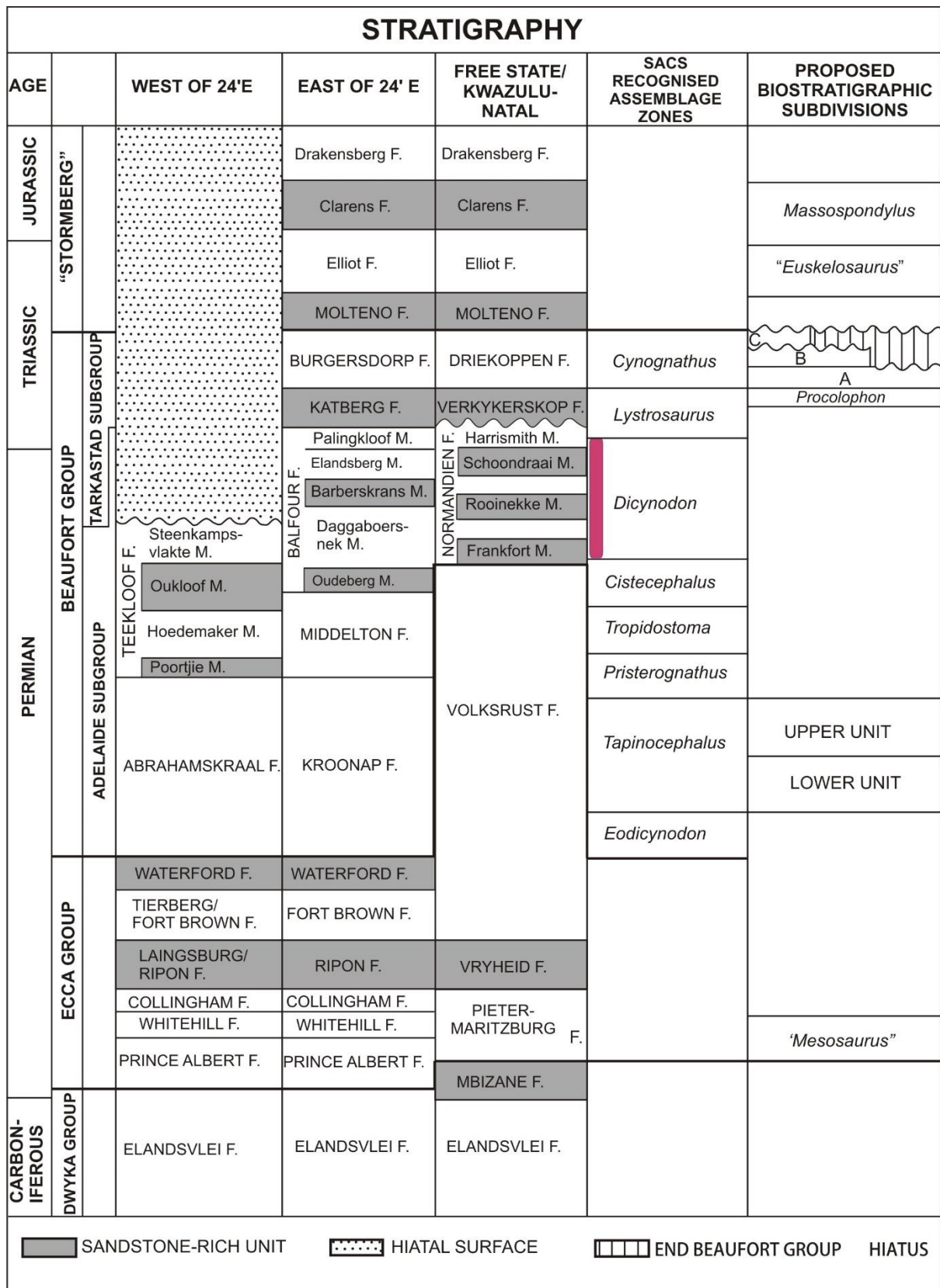
### **Late Caenozoic superficial deposits**

Fossils from late Caenozoic deposits may occasionally contain important fossil biotas *e. g.* bones, teeth and horn cores of mammals as well as remains of reptiles. These superficial deposits may also include non-marine molluscs (bivalves, gastropods), ostrich egg shells, tortoise remnants, trace fossils (calcretised termitaria, coprolites, invertebrate burrows), and plant material such as peats or palynomorphs (pollens).

Quaternary deposits, fossil remains may be associated with human artefacts such as stone tools and are also of archaeological interest.



**Figure 3.** The proposed development area in the south east of Bloemfontein, outlined as a red circle, as shown on the most recent fossil assemblage zone map for the Main Karoo Basin (Map modified from Van der Walt *et al.* 2010). The Adelaide Subgroup sediments beneath the development area near Bloemfontein are situated within the latest Permian *Dicynodon* Assemblage Zone (blue area).



**Figure 4:** Karoo stratigraphy and biostratigraphy (after Smith *et al.*, 2012). Pink line indicates the stratigraphic interval impacted by the proposed development.



**Figure 5.** The surface geology of the proposed township development in Bloemfontein, indicated by a black square. Note that the position of the roads in the area has not been updated. The development area is underlain by Late Permian, *Dicynodon* Assemblage Zone. (Modified from the 1: 250 000 geological map 2926 Bloemfontein (Council for Geoscience, Pretoria).

## 5 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development area of the township in the south east of Bloemfontein is located on the N8 road to Thaba Nchu and Botshabelo (Fig 1 -2). Google Earth Images show the proposed development site as an area of low lying relief with no potentially fossiliferous gulleys and appropriate exposures.

## 6 METHODS

A Palaeontological Impact Assessment was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed areas of development. The author's experience, aerial photos (using Google, 2015), topographical and geological maps and other reports from the same were used to assess the proposed area of development.

### i. Assumptions and Limitations

The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impact assessments are normally limited by the following restrictions:

- Old fossil databases that have not been kept up-to-date or are not computerized. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist.
- The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.



- Impact studies and other reports (*e.g.* of commercial mining companies) - is not readily available for desktop studies.

Large areas of South Africa have not been studied palaeontologically. Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on possible occurrence of fossils in an unexplored area. Desktop studies of this nature therefore usually assume the presence of unexposed fossil heritage within study areas of similar geological formations. Where considerable exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly improved through field assessment by a professional palaeontologist.

## 7 SITE VISIT



Figure 6. Human activities on the proposed development site in Bloemfontein.



Figure 7. Farming activities on the development site.



Figure 8. Low relief of the development site.



Figure 9. Freshly exposed bedrock on the development site.



Figure 10. Late Caenozoic superficial deposits near the Renosterspruit.

## 8 FINDINGS AND RECOMMENDATIONS

The development area in Bloemfontein is underlain by sediments of the Beaufort Group, Adelaide Subgroup, Karoo Supergroup. Adelaide sediments in the proposed development area are assigned to the Late Permian *Dicynodon* Assemblage Zone. On the flat-lying development area the potentially fossiliferous bedrocks are mantled by fossil-poor superficial sediments (soils, residual gravels) of much younger, Quaternary to Recent age.

The **low-lying relief** and **absence of potentially fossiliferous gulleys** and **appropriate exposures** on the development site in Bloemfontein strongly suggest that fossils are absent from this site. The impact on paleontological material is thus **negligible and regarded as insignificant**. It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

**Should fossil remains be discovered** during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional paleontologist.

The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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## QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Elize Butler has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working at the National Museum since 1993 and currently holds the position of Collection Manager of the Karoo Vertebrate Collection of the Palaeontology Department at the National Museum in Bloemfontein. Her current research interests comprise of Permo-Triassic vertebrate palaeobiology, with a special focus on gorgonopsians at the End-Permian Mass Extinction.

## Declaration of Independence

I, Elize Butler, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed 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 my objectivity in this work.

Sincerely

A handwritten signature in black ink that reads "Butler." The signature is written in a cursive style with a large initial 'B'.

Mrs. Elize Butler