

**PALAEONTOLOGICAL DESKTOP IMPACT ASSESSMENT OF THE PROPOSED  
PANORAMA FARM CENTRE PIVOT IRRIGATION DEVELOPMENT, CRADOCK  
DISTRICT, EASTERN CAPE PROVINCE**

Prepared by

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19-11-2016

Prepared for:

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## EXECUTIVE SUMMARY

The Burnside Farms Trading Trust proposes a change of irrigation method from flood irrigation to centre pivot irrigation on the existing irrigation lands. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is required to detect the presence of fossil material within the proposed development footprint and to assess the impact of the construction and operation of the project on the palaeontological resources.

The proposed development area is primarily represented by sedimentary rocks of the Permian Adelaide Subgroup; Balfour, Middleton and Kroonap Formations of the Beaufort Group. These rocks have a very high fossiliferous potential and thus a very high palaeontological sensitivity. Regardless of the sparse and sporadic occurrence of fossils in this biozone a single fossil can have a huge scientific importance as many fossil taxa are known from a single fossil.

The proposed development area has been previously disturbed as it has been utilized as agricultural lands for many years. The topography of the proposed development footprint is **flat with no outcrops or steep river gullies**. This is in contrast with fossils usually found in the Adelaide subgroup which are known from sharp outcrops and steep river gullies. The lack of fossiliferous exposure at the proposed site indicates that the impact on palaeontological material will be low.

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 are discovered during any phase of construction, either on the surface or exposed by new excavations, the ECO in charge of these developments should be notified. These discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist.

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

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## 1 INTRODUCTION

The farm Panorama, owned by Mr D J Mulder under Title Deed T 29410 / 94 and T 037648 / 2002, consists of the following properties:

- Portion 4 of the Farm Doorn Rivier No. 122, Division of Cradock measuring 30,1927 ha
- Portion 14 of the Farm Doorn Rivier No. 123, Division of Cradock District measuring 57,1661 ha
- Farm No. 70, in the Inxuba Yethemba Municipality, Division of Cradock measuring 251,9789 ha
- The Remainder of the Farm No. 69, in the Inxuba Yethemba Municipality, Division of Cradock measuring 108,8127 ha
- The Farm Goedehoop No. 126, in the Inxuba Yethemba Municipality, Division of Cradock measuring 27,1007 ha

The development will consist of

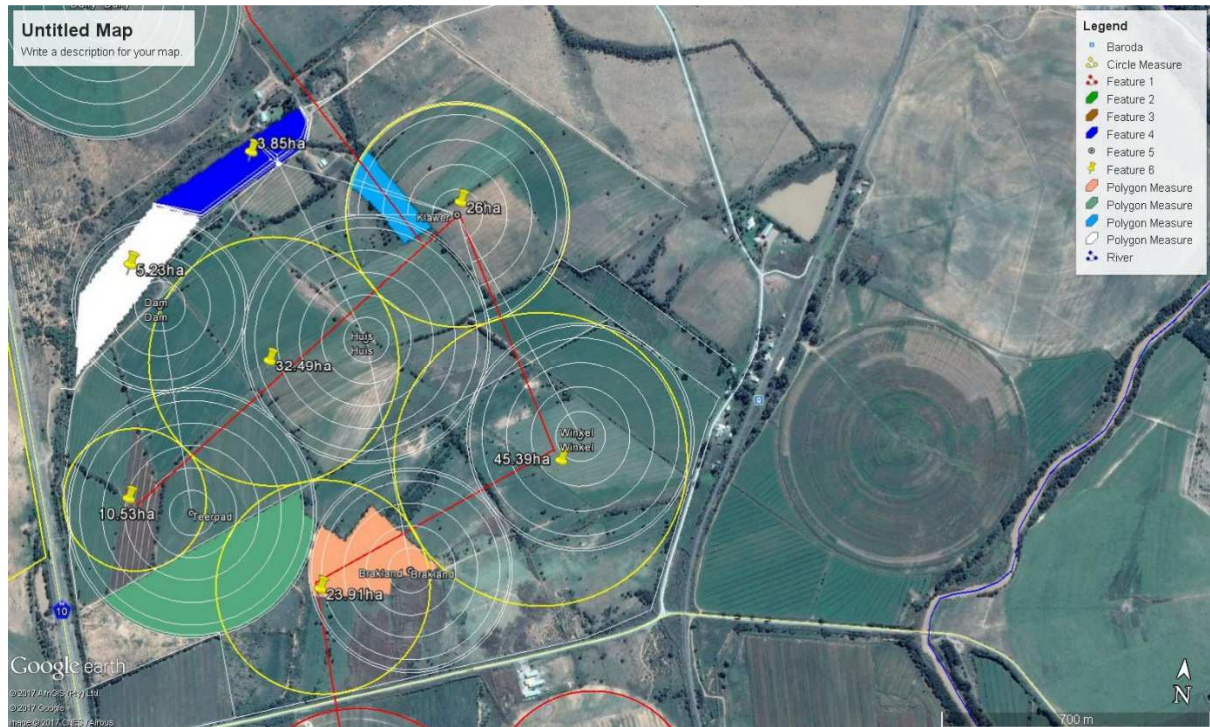
- Pipelines with an internal diameter of <360 mm
- Throughput discharge through the pipelines is < 120 lt/sec

The farms have been sold to Burnside Farms Trading Trust who will lease the farms for 1 year with transfer of ownership to be effective from October 2018. In terms of the agreement of sale, Burnside Farms Trading Trust may implement the proposed development on the farms immediately. The cultivation of land is currently under flood irrigation with scheduled water rights under the Great Fish River Water User's Association and a section of natural vegetation.

The planned development comprises the change of the irrigation method from flood irrigation to centre pivot irrigation on the existing irrigation lands. This will require the installation of four centre pivots covering an area of 114.41 ha with an additional centre pivot to be developed in future (Brakland - southernmost pivot), covering an area of 23.91ha

The excavations for the installation of the centre pivots will involve excavations into the superficial sediment cover and into the underlying bedrock. These excavations will transform the existing topography and may disturb, destruct or demolish fossil heritage of scientific value exposed at the surface or buried below ground. Palaeontological material is unique and non-renewable and is protected by the National Heritage Resources Act. 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 development which consists of the installation of four centre pivots (yellow) covering an area of 114.41 ha with an additional centre pivot (yellow) to be developed in future (Brakland – southernmost pivot), covering an area of 23.91ha.

## 2 LEGISLATION

All Cultural Heritage in South Africa is managed by the National Heritage Resources Act (Act 25 of 1999). This Palaeontological Environmental Impact Assessment forms part of the Heritage Impact Assessment (HIA) and abide by the requirements of the above mentioned Act. In accordance with Section 38, an HIA is required to evaluate any potential impacts to palaeontological heritage within the site.

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

The various categories of heritage resources are recognized as part of the National Estate in Section 3 of The National Heritage Resources Act. This includes:

- geological sites of scientific or cultural significance
- palaeontological sites
- palaeontological objects and material, meteorites and rare geological samples.

According to Section 35 of the National Heritage Resources Act 1999, dealing with archaeology, palaeontology and meteorites:

- The protection of archaeological and palaeontological sites and material and meteorites are 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 legally 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 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 reason 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; and/or
- 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 aim of the palaeontological impact assessment are to:

- Identify exposed and subsurface rock formations that are expected to be palaeontologically important;
- Evaluate the level of palaeontological importance of the formations;
- Comment on the impact of the development on the potential fossil heritage and
- Recommend how the developer ought to conserve or mitigate damage to palaeontological heritage.

The objective of a Palaeontological Impact Assessment, which forms of part of the Heritage Impact Assessment, is to determine the impact of the development on potential palaeontological heritage on the site.

When a palaeontological desktop study is written, the potentially fossiliferous rocks (i.e. groups, formations, etc.) present within the study area are established from geological maps. The known fossil heritage within each rock unit is obtained from previous palaeontological impact studies in the same region, published scientific literature; PalaeoMap from SAHRIS; as well as databases of various institutions. The palaeontological importance of each rock unit of the development area is then calculated. The probable impact of the proposed development footprint on local fossil heritage is established on the basis of

- the palaeontological importance of the rocks and
- the character and magnitude of the development footprint and
- Quantity of new bedrock excavated.

When rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a professional palaeontologist is necessary. Destructive impacts on palaeontological heritage generally only occur during the construction phase.

The excavations will transform the current topography and may disrupt and destruct or permanently seal-in fossils at or below the ground surface. These fossils are then no longer accessible for scientific study.

Mitigation usually precede construction or, more effectively, take place during the construction phase when new, potentially fossiliferous bedrock, is exposed. Mitigation comprises the sampling, collection and recording of fossils. Preceding the excavation of fossil heritage a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. With proper mitigation, many developments involving bedrock excavation will have a *positive* impact on our understanding of local palaeontological heritage.

#### **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. The Beaufort Group of the Karoo Basin consists of a lower Adelaide Subgroup and an upper Tarkastad Subgroup. The Beaufort group consists of largely fluvial sediments which were deposited on the floodplains of rivers. The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals.

##### **4.1 PALAEOLOGY**

The proposed development footprint is underlain by the Adelaide Subgroup, Beaufort Group of the Karoo Supergroup (Fig. 2 & 3). In the southeastern portion of the basin the Late Permian Adelaide subgroup includes the Kroonap, Middleton and Balfour Formations (oldest to youngest formations) of the Adelaide Subgroup. The Beaufort Group is subdivided into a series of biostratigraphic units on the basis of its faunal content (Fig. 3).

The Balfour Formation has an abundant assemblage of vertebrates. Fossils of the Balfour Formation includes vertebrates from the *Daptocephalus* and *Lystrosaurus* Assemblage Zones (AZ) (Rubidge et al, 1995; MacRae, 1999; McCarthy and Rubidge, 2005; Johnson et al, 2009). Several important trace fossil assemblages, comprising vertebrate tracks and casts of vertebrate burrows have also been described (Groenewald, 1996; Johnson *et al.*, 2009).

The *Daptocephalus* AZ expands into the lower Palingkloof Member of the Upper Balfour Formation. This Zone is characterized by the occurrence of the two therapsids namely



*Dicynodon* and *Theriognathus*. The *Dicynodon* AZ of the Beaufort Group shows the greatest vertebrate diversity and includes numerous well preserved genera and species of biarmosuchians, dicynodonts, gorgonopsian, therocephalian and cynodont therapsid Synapsida as well as captorhinid Reptilia and less well represented eosuchian Reptilia, Amphibia and Pisces. Trace fossils of vertebrates and invertebrates as well as *Glossopteris* flora plants have also been described.

The lower Palingkloof Member is of special importance as it precedes the Permo-Triassic Extinction Event which destroyed the vertebrate fauna and extinguished the diverse glossopterid plants.

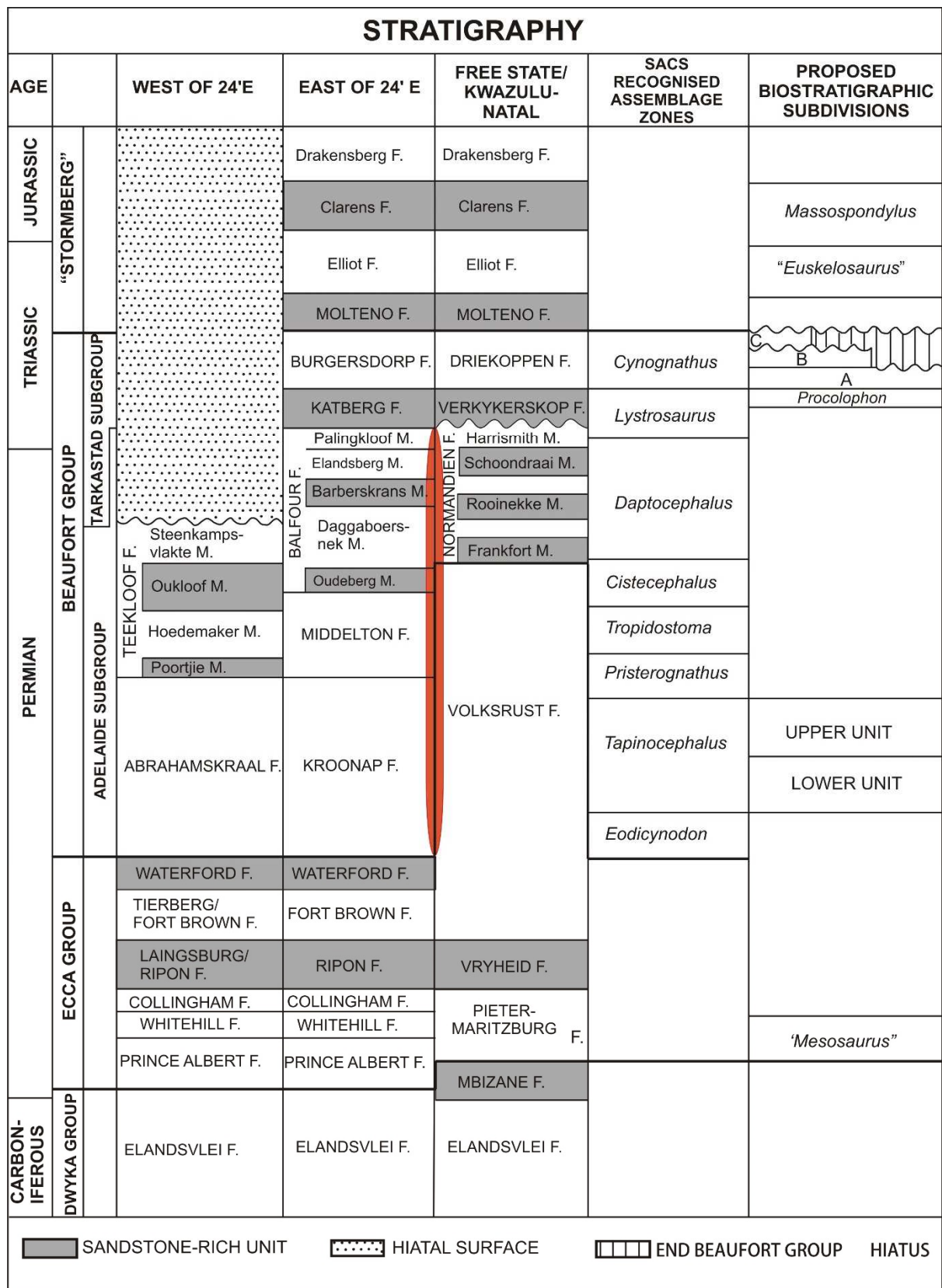
The Middleton Formation is known for its *Glossopteris* fossils plant assemblages. This fossil plant assemblage peaked during the Permian and inhabited diverse ecological niches, which includes forests dominated by conifers, cycadeoids and ginkos. Diverse insect assemblages are also recorded from this Formation. This Formation is represented by a rich assemblage of vertebrates found in the *Pristerognathus*, *Tropidostoma* and *Cistecephalus* Assemblage Zones of the Karoo Basin, (Rubidge et al, 1995; MacRae, 1999; McCarthy and Rubidge, 2005).

The *Eodicynodon* and *Tapinocephalus* Assemblage Zones are present in the Kroonap Formation. The *Eodicynodon* AZ is characterised by *Eodicynodon* and *Tapinocaninus* fossils. The *Tapinocephalus* AZ has a rich diversity of Therapids, dinocephalia, while fish, amphibia and plant fossils are also present.

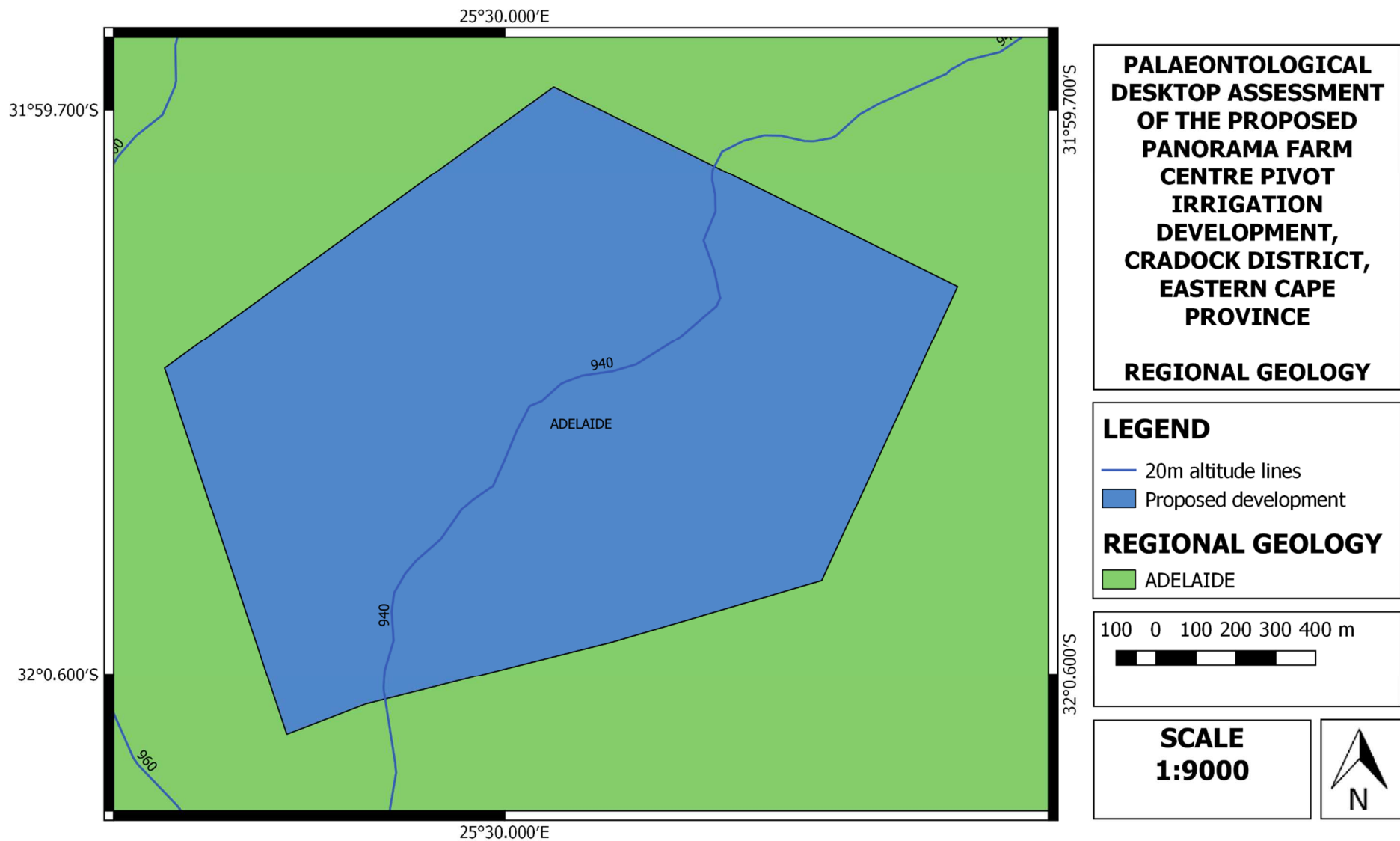
## **4.2 GEOLOGY**

The Permian Adelaide Subgroup is a thick sequence of sedimentary rocks characterized by light grey to yellow colour fine-grained sandstones with interbedded green, grey and red coloured shale. These sandstones and mudstones were deposited in prehistoric meandering rivers (next to swamps).

The sedimentary rocks of the Permian Middleton Formation is characterized by red mudstone units, whilst the Balfour Formation is, dominated by grey-green coloured mudstone units. The rocks of the Kroonap Formation varies from greyish olive green to dark yellowish brown.



**Figure 2:** Karoo stratigraphy and biostratigraphy (after Smith *et al.*, 2012). Red line indicates the stratigraphic interval impacted by the proposed development.



**Figure 3.** The surface geology of the Cradock development area. The proposed development footprint is underlain by the Adelaide Subgroup, Beaufort Group of the Karoo Supergroup. The Late Permian Adelaide subgroup includes the Kroonap, Middleton and Balfour Formations of the Adelaide Subgroup. Map drawn by QGIS Desktop version 2.18.14.

## **5 GEOGRAPHICAL LOCATION OF THE SITE**

The proposed development is located on the following farms: Doorn Rivier No. 122; Doorn Rivier No. 123 in the Division of Cradock District and Farm No. 70, Farm No. 69 as well as Goedehoop No. 126 in the Inxuba Yethemba Municipality.

## **6 METHODS**

A Palaeontological Scoping study was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2015), topographical and geological maps and other reports from the same area were used to assess the proposed area of the development. No consultations were undertaken for this PIA.

### **6.1 ASSUMPTIONS AND LIMITATIONS**

The accurateness and dependability of desktop Palaeontological Impact Assessments as part of heritage impact assessments are normally restricted by the following:

- Old fossil databases does not always include relevant locality or geological informations. Vast areas of South Africa have not been studied palaeontologically
- In various areas of South Africa the geology is based exclusively on aerial photographs. The accuracy of these areas is debatable and the sheet explanations for geological maps are unsatisfactory as the focus is not on palaeontological material

Vast areas of South Africa have not been studied palaeontologically. Fossil data gathered from different areas but in similar Assemblage Zones might provide information on the probable presence of fossils in an unmapped area. Desktop studies thus generally assume the presence of unexposed fossil heritage within the development areas of similar geological formations. Where extensive exposures of bedrocks or potentially fossiliferous superficial sediments are present in the development area, the accuracy of a Palaeontological Impact Assessment may be improved through a field-survey.

## 7 SITE VISIT

The Archaeologist, Ms Karen Van Reyneveld, visited the site and **took numerous photographs** of the proposed development area. The proposed development area has been previously disturbed by agricultural activities for numerous years. The topography of the proposed footprint is **flat with no outcrops or steep river gullies**. This is in contrast with fossils usually found in the Adelaide subgroup, which are known from sharp outcrops and steep river gullies.



**Figure 4.** Flat topography of the proposed development area.



**Figure 5.** Flat topography of the agricultural land.



**Figure 6.** Agricultural land with a flat topography.



**Figure 7.** Agricultural land with a flat topography.



**Figure 8.** Irrigation channel in the proposed development area.





**Figure 9.** Irrigation channel in the proposed development area.

## 8 FINDINGS AND RECOMMENDATIONS

The proposed development area is primarily represented by sedimentary rocks of the Permian Adelaide Subgroup; Balfour-, Middleton- and Kroonap Formations of the Beaufort Group. These rocks have a very high fossiliferous potential and thus a very high palaeontological sensitivity. Regardless of the sparse and sporadic occurrence of fossils in this biozone a single fossil can have a huge scientific importance as many fossil taxa are known from a single fossil.

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However, should fossil remains be exposed during any phase of construction, either on the surface or by fresh excavations, the ECO in charge 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 mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist.

The specialist 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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## **10 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR**

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty three years. She has experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 10 years and have been been conducting Palaeontological Impact Assessments since 2014. 80 Technical reports on palaeontology (scoping reports have been written

## **Declaration of Independence**

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological 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 favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological 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 section 38 of the NHRA 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 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;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

- 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 Regulations;

**PALAEONTOLOGICAL CONSULTANT:**

Banzai Environmental (Pty) Ltd

**CONTACT PERSON:**

Elize Butler

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**SIGNATURE:**

A handwritten signature in black ink that reads "Elize Butler". The signature is written in a cursive style with a large initial 'E' and a period at the end.