



## PALAEONTOLOGICAL DESKTOP ASSESSMENT

AGRICULTURAL DEVELOPMENT ON THE REMAINDER OF THE FARM BULPAN 51, THE REMAINDER OF THE FARM WITPAN 52, PORTION 2 OF THE FARM EERSTE AAN LEG 50, AND A PORTION OF PORTION 16 OF THE FARM DROOGFONTEIN 62, IN THE SOL PLAATJE LOCAL MUNICIPALITY, FRANCES BAARD DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

February 2025

Compiled for: Environmental Impact Management Services (Pty) Ltd (EIMS)



## 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 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 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 favorable 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 realize that a false declaration is an offense 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.

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**SIGNATURE:**



This Palaeontological Impact Assessment report (as part of the Heritage Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

<b>Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).</b>		
<b>Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017</b>	<b>The relevant section in the report</b>	<b>Comment where not applicable.</b>
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix 2	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 2 – refer to <b>Appendix 2</b>	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Methods and TOR	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7	-



Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).		
Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Executive Summary, Section 8	Desktop Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Executive Summary, Section 8	
(g) An identification of any areas to be avoided, including buffers	Executive Summary, Section 8	
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Executive Summary, Section 8	



Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).		
Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
(k) Any mitigation measures for inclusion in the EMPr	Executive Summary, Section 8	
(l) Any conditions for inclusion in the environmental authorisation	Section 9	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Executive Summary, Section 8	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Executive Summary, Section 8	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Executive Summary, Section 8	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part of the Environmental Impact Assessment (EIA) and



Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).		
Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	The relevant section in the report	Comment where not applicable.
		Environmental Management Plan (EMP) process.
(p) A summary and copies of any comments that were received during any consultation process	N/A	Not applicable. To date, no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	



## **EXECUTIVE SUMMARY**

Banzai Environmental was commissioned by **Environmental Impact Management Services (Pty) Ltd (EIMS)** to perform the Palaeontological Desktop Assessment (PDA) for the proposed Agricultural Development on the Remainder of the Farm Bulpan 51, the Remainder of the Farm Witpan 52, Portion 2 of the Farm Eerste Aan Leg 50, and a Portion of Portion 16 of the Farm Droogfontein 62, located in the Sol Plaatje Local Municipality, Frances Baard District Municipality, Northern Cape Province. This Preliminary Development Assessment (PDA) is required to ascertain the potential presence of fossil material in the proposed development area, evaluate the prospective impact of the development on Palaeontological Heritage, and mitigate potential harm to fossil resources, in accordance with the National Environmental Management Act 107 of 1998 (NEMA) and the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA).

The proposed development is underlain by Quaternary to Recent red and grey aeolian dune sand, Calcrete, calcified pandune and surface limestones, Jurassic dolerite as well as the Allanridge Formation (Ventersdorp Supergroup). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Quaternary sands is Medium, that of the calcrete is High, that of Jurassic dolerite is Zero while that of the Allanridge Formation is Low. The suggested location is classified as having a High (Palaeontology Theme Sensitivity in the DFFE Screening Report. Due to the Palaeontological Sensitivity of the Site no site investigation was conducted for the project. But desktop research has indicated that the Palaeontological Sensitivity of the area is Low.

It is therefore considered that the proposed development in the Northern Cape will not lead to detrimental impacts on the palaeontological resources of the area. The construction of the development may therefore be authorised as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

However, if fossil remains are discovered during any phase of construction, either on the surface or uncovered by excavations, the **Chance Find Protocol** must be implemented. These discoveries must be secured and the ECO/site manager ought to alert SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that appropriate mitigation (documented and collection) can be undertaken by a professional palaeontologist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports must meet the minimum standards for palaeontological impact studies developed by SAHRA.

**These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the Project.**





## **TABLE OF CONTENT**

<b>1</b>	<b>INTRODUCTION .....</b>	<b>1</b>
<b>2</b>	<b>QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR.....</b>	<b>2</b>
<b>3</b>	<b>LEGISLATION .....</b>	<b>2</b>
	3.1 NATIONAL HERITAGE RESOURCES ACT (25 OF 1999).....	2
<b>4</b>	<b>METHODS AND TERMS OF REFERENCE .....</b>	<b>3</b>
	4.1 ASSUMPTIONS AND LIMITATIONS .....	5
<b>5</b>	<b>GEOLOGICAL AND PALAEONTOLOGICAL HISTORY .....</b>	<b>6</b>
<b>6</b>	<b>ADDITIONAL INFORMATION CONSULTED .....</b>	<b>15</b>
<b>7</b>	<b>IMPACT ASSESSMENT METHODOLOGY .....</b>	<b>16</b>
<b>8</b>	<b>FINDINGS AND RECOMMENDATIONS .....</b>	<b>17</b>
<b>9</b>	<b>MITIGATION AND EMPR REQUIREMENTS .....</b>	<b>17</b>
	9.1 LEGISLATION.....	18
	9.2 CHANCE FIND PROCEDURE.....	18
<b>10</b>	<b>BIBLIOGRAPHY .....</b>	<b>19</b>



## LIST OF FIGURES

<b>Figure 1: Locality Map of the proposed agricultural development near Kimberley, Northern Cape Province.....</b>	<b>1</b>
<b>Figure 2: Extract of the 1:250 000 Kimberly 2824 (1986) Geological Map (Council for Geosciences, Pretoria) indicating the study area is underlain by Quaternary red and grey aeolian dune sand (Qs, yellow), Calcrete (Qc, dark yellow), Jurassic Dolerite (Jd, red) as well as the Allanridge Formation (Ra, green) of the Ventersdorp Supergroup.....</b>	<b>8</b>
<b>Figure 3: Extract of the SAHRIS PalaeoMap (Council of Geosciences) indicating the High (orange), Moderate (green), Zero (grey) and Low (blue) Palaeontological Sensitivity of the study area.....</b>	<b>10</b>
<b>Figure 4: Palaeontological Sensitivity generated by the DFFE National Environmental Web-Based Screening indicating the High (red), Medium (orange) and Low (green) Palaeontological Sensitivity of the proposed development. ....</b>	<b>12</b>
<b>Figure 5: Ventersdorp stratigraphy (Taken from Van Der Westhuizen and Bruijn, 2006 after Winter, 1965, 1976; Linton et al., 1990 Meyers, 1990 and Meintjies, 1978).....</b>	<b>14</b>



## LIST OF TABLES

<i>Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).</i>	<i>iv</i>
<i>Table 2: Legend of the 2824 Kimberly (1993) Geological Map (Council for Geosciences, Pretoria).</i>	<i>9</i>
<i>Table 3: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website).</i>	<i>11</i>
<i>Table 4: Fossil Heritage from the Northern Cape [extracted from the Palaeotechnical report of the Northern Cape (Almond and Pether, 2009)].</i>	<i>13</i>
<i>Table 5: Summary of Impact Tables.</i>	<i>16</i>

## APPENDIX 1: IMPACT TABLE

## APPENDIX 1: CURRICULUM VITAE



## **GLOSSARY OF TERMS**

### **Fossil**

A fossil is the preserved remains or traces of an organism that lived in the distant past, typically millions of years ago. Fossils may include mineralized skeletal structures, shells, or other durable components of ancient flora and fauna, as well as impressions, moulds, and casts formed in sedimentary rock as a result of the decomposition of the organism's remains. These preserved remnants offer significant insights into the evolutionary processes and biodiversity of past species, thereby enabling scientists to investigate and comprehend.

### **Heritage**

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act No 25 of 1999).

### **Heritage resources**

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance.
- places to which oral traditions are attached or which are associated with living heritage.
- historical settlements and townscapes.
- landscapes and natural features of cultural significance.
- geological sites of scientific or cultural importance.
- archaeological and palaeontological sites.
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa.

### **Palaeontology**

Any fossilised remains or fossil trace of animals or plants which lived in the geological past (other than fossil fuels or fossiliferous rock intended for industrial use) and any site which comprises of fossilised remains or traces of past life.



## LIST OF ABBREVIATIONS

BA	Basic Assessment
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
CA	National Competent Authority
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
HIA	Heritage Impact Assessment
Ma	Millions of years ago
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
S&EIA	Scoping & Environmental Impact Assessment
ToR	Terms of Reference
WUL	Water Use Licences



## **1 INTRODUCTION**

Environmental Impact Management Services (Pty) Ltd (EIMS) has been commissioned as the Environmental Assessment Practitioner (EAP) by Aqua Farming (Pty) Ltd (hereinafter referred to as the applicant) to assist with the requisite authorisation processes, including the mandated public participation, and to compile and submit the essential supporting documentation for the following applications:

- Environmental Authorisation (EA) issued in compliance with the National Environmental Management Act, NEMA (Act 107 of 1998-as amended), GNR984,2014 (Listing Notice 2), and GNR985, 2014 (Listing Notice 3).
- National Water Act (Act 36 of 1998) Water Use Licences (WUL) for a variety of relevant water uses.

It may be recommended that additional activities be applied for and confirmed during the process.

The applicant intends to construct approximately 33 center-pivot irrigation systems to cultivate other grass-feed crops, including onions, potatoes, and seed potatoes. In order to accommodate the new pivot farming zones, approximately 1050 hectares of native vegetation will be required to be removed as part of the proposed project. The proposed project is located in the Sol Plaatje Local Municipality, Frances Baard District Municipality, Northern Cape Province. It is situated on the Remainder of the Farm Bulpan 51, the Remainder of the Farm Witpan 52, Portion 2 of the Farm Eerste Aan Leg 50, and a portion of Portion 16 of the Farm Droogfontein 62. Furthermore, Aqua Farming intends to construct a buffer dam that will function as a reservoir for irrigation water from the Vaal River, with an approximate capacity of 50,000 m<sup>3</sup>.

The project is approximately 20 kilometres north of Kimberley.

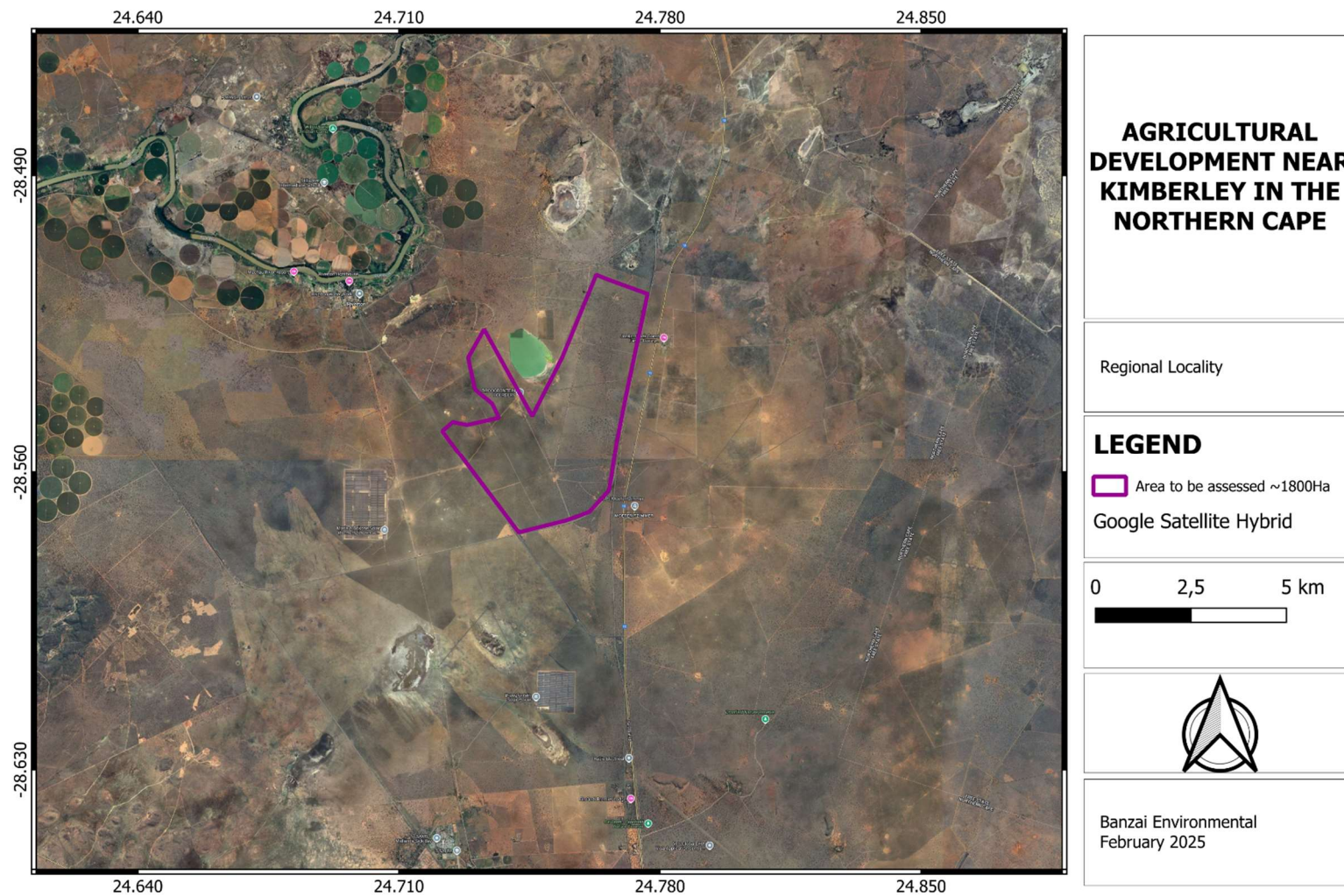


Figure 1: Locality Map of the proposed agricultural development near Kimberley, Northern Cape Province.



## 2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Please refer to Appendix 1 (Specialist CV).

This study has been conducted by Mrs. Elize Butler of Banzai Environmental (Pty) Ltd. She has conducted approximately 850 palaeontological impact assessments (PIA) for developments in the Free State, KwaZulu-Natal, Eastern, Western and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than thirty 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 (PSSA) since 2006 and has been conducting PIAs since 2014.

## 3 LEGISLATION

### National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act No. 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include **“all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”**.

The identification, evaluation and assessment of any cultural heritage site, artefact or finds in the South African context is required and governed by the following legislation:

- National Environmental Management Act (NEMA) Act No. 107 of 1998
- National Heritage Resources Act (NHRA) Act No. 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act No. 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act No. 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act No. 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38





The NEMA (No. 107 of 1998) states that an integrated EMP should (23:2 (b)) “...identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage”.

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies a comprehensive and legally compatible PIA report has been compiled.

Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to Section 38 (1), an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length.
- the construction of a bridge or similar structure exceeding 50 m in length.
- any development or other activity which will change the character of a site—
  - exceeding 5 000 m<sup>2</sup> in extent; or
  - involving three or more existing erven or subdivisions thereof; or
  - involving three or more erven or divisions thereof which have been consolidated within the past five years; or
  - the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority or
  - the re-zoning of a site exceeding 10 000 m<sup>2</sup> in extent or

any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

#### **4 METHODS AND TERMS OF REFERENCE**

This PIA assesses the development's potential impact on the fossil heritage. This Palaeontological Assessment is part of the HIA Report. The PIA's goals are to: 1) identify the palaeontological significance of the rock formations in the footprint; 2) evaluate the palaeontological magnitude of the formations; 3) clarify the impact on fossil heritage; and 4) make recommendations for how the developer might protect and minimize potential harm to fossil heritage, according to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports".

Calculations of the palaeontological state of each rock segment and the potential impact of development on fossil history take into account the palaeontological status of the rocks, the type of development, and the amount of bedrock removed.



The Provisional DFFE Screening Tool, the SAHRIS Palaeosensitivity map, all Palaeontological Impact Assessment reports for the same area, Google Earth images, topographical and geological maps, as well as academic articles about specimens from the development area and Assemblage Zones, are all used to create scoping reports.

When the development footprint has a moderate to high palaeontological sensitivity, a field-based assessment is necessary. A desktop or field assessment of the exposed rock is used to evaluate the significance of the proposed development's impact, and recommendations for more research or mitigation are made. Excavations for the project often only take place during the building phase, changing the terrain and destroying or permanently encasing fossils at or below the ground surface. Then, access to Fossil Heritage will no longer be available for academic study.

When doing a site investigation, a palaeontologist examines the local development as well as the quantity and variety of fossils found there. This can be demonstrated by looking at representative fossiliferous rock exposures (most igneous and metamorphic rocks are not fossiliferous, whereas sedimentary rocks contain fossil heritage). Examined rock exposures frequently contain a sizeable portion of the stratigraphic unit, which is primarily made up of recently exposed (unweathered) rock. These exposures may be man-made (such as quarries, open building excavations, even railway and road cuttings) or natural (such as cliffs, and dongas as well as rocky outcrops along stream or river banks). It is usual practice for palaeontologists to record well-preserved fossils (GPS, and stratigraphic data) during field assessment examinations.

Although mitigation is often done prior to construction, it may take place if potentially fossiliferous bedrock is revealed. Fossil collection and documentation are examples of mitigation. A permit from SAHRA must be obtained before beginning any fossil excavation, and the material must be stored at an authorized facility. When mitigation is properly used, it is possible to have a positive impact by raising awareness of the palaeontological past of the area.

By physically evaluating bedrock outcrops to determine their lithology and fossil richness and crisscrossing the development footprint, one can assess an area's fossil potential. Because the presence of fossils at the surface is so unexpected, an average sample size of the region is investigated. To be clear, however, the lack of fossils in a development footprint does not automatically suggest that there is no palaeontologically important material present on the site (on or below the ground surface).

The terms of reference of a PIA are as follows:

**General Requirements:**



- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Describe of the proposed project and provide information regarding the developer and consultant who commissioned the study;
- Describe location of the proposed development and provide geological and topographical maps
- Provide palaeontological and geological history of the affected area;
- Identify sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluate the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
  - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
  - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
  - c. **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided);
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Detail the implications of specialist findings for the proposed development (such as permits, licenses etc).

#### **4.1 Assumptions and Limitations**

The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas of South Africa have never been examined by palaeontologists, and data is typically dependent solely on aerial pictures. Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented.

Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological formations are used for Desktop studies, it is commonly assumed that exposed fossil exists within the footprint.



## 5 GEOLOGICAL AND PALAEOONTOLOGICAL HISTORY

The proposed agricultural development near Kimberley in the Northern Cape is depicted on the 1: 250 000 Kimberley 2824 (1993) Geological Map (Council for Geosciences, Pretoria (**Figure 2, Table 2**). The proposed development is underlain by Quaternary to Recent red and grey aeolian dune sand (Qs, yellow) (Qs), Calcrete, calcified pandune and surface limestones (Qc, dark yellow), Jurassic dolerite (Jd, red) as well as the Allanridge Formation (Ventersdorp Supergroup).

According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Quaternary sands is Medium (green), that of the calcrete is High (orange), that of Jurassic dolerite is Zero (grey) while that of the Allanridge Formation is Low (blue) (**Figure 3, Table 3**). The suggested location is classified as having a High (red) Palaeontology Theme Sensitivity in the DFFE Screening Report, as seen in **Figure 4**.

The best exposures of the Ventersdorp Supergroup are in the North West Province as well as in the Northern Cape Province, Gauteng, and southern Botswana. This Supergroup is divided in the Klipriviersberg Group (oldest) which is overlain by the Platberg Group followed by the sedimentary Bothaville Formation and the volcanic Allanridge Formation (uppermost Ventersdorp unit, youngest Formation) (**Figure 5**).

The Platberg Group is subdivided in four formations namely the Kameeldoorns-, Goedgenoeg-, Makwassie-, and Rietgat Formations. These formations consist of heterogeneous rock varying from chemical and classic sediments, to felsic and mafic volcanics. These rocks were deposited in linear vault troughs during graben developments (Visser et al, 1975-1976, Buck, 1980). These deep intermontane grabens formed in older underlying andesitic terranes and formed areas of alluvial fan deposits and debris as well as scree flows. Ooids and stromatolites accumulated under lacustrine conditions in fine-grained chemical and terrigenous sediments. (Buck, 1980) Stromatolites were identified in the Rietgat Formation between Prieska and Britstown. In time fluvial processes prevailed causing widespread prograding of alluvial fans across basins (Buck, 1980).

The Platberg is mostly absent in the north-east of the Ventersdorp depository while the outcrops are erratic with changes in thickness. The type-area of the Platberg Group is between Welkom and Klerksdorp and was described by Winter (1976), while the Klerksdorp area was described by J.M. Myers (1990). The Rietgat Formation crops out in the, north, northwest, and southwest of Vryburg, south-southeast of Douglas, Taung-Hartswater area, west of Klerksdorp, T'Kuip in the Northern Cape Province and southwest of Ventersdorp. The Rietgat Formation consist of alternating sedimentary and volcanic rocks which varies in thickness across the basin.

The uppermost **volcanic Allanridge Formation** crops out in the North West, Northern Cape, and Free State Provinces. Witmer (1976) came to the conclusion that the Allanridge Formation has a conformable relationship with the Bothaville Formation (deeper parts of the basin) while Keyser (1998), found a very prominent unconformable relationship in the direction of the northwestern boundary of the Ventersdorp



depository. The Allanridge formations consists primary of light green–grey porphyritic lava and pyroclastic rocks as well as dark-green amygdaloidal lava. The dark-green lava is the thickest unit in the Allanridge Formation. Both lava types consist of amygdales but is more widespread in the dark-green lava. A Low Sensitivity has been allocated to the Allanridge Formation as lacustrine stromatolites is preserved in carbonates with possible organic walled microfossils (Groenewald et al, 2014).

The development area is extensively intruded by dolerite dikes and sills of the Karoo Dolerite (Jd, red) of the Karoo Igneous Province. This Province in southern Africa is a classic continental flood basalt province that was formed during the Early Jurassic Period. This Suite is entirely unfossiliferous.

The Quaternary superficial deposits are the youngest geological deposits formed during the most recent period of geological time (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of gravel, sand, silt, and clay, and they form relatively thin, often discontinuous patches of sediments or larger spreads onshore.

The Quaternary deposits are of significant importance due to the palaeoclimatic changes that are reflected in the different geological formations (Hunter et al., 2006). During the climate fluctuations in the Cenozoic Era most geomorphologic features in southern Africa where formed (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Cenozoic but states that climatic changes during the Quaternary Period, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past. Climate variations that occurred in the Quaternary Period were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

The sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge et al., 2006). The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine-grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters (De Witt et al., 2000; Johnsen et al, 2006). The Gordonia dune sands are dated as Late Pliocene/Early Pleistocene to Recent times by the Middle to Later Stone Age stone tools recovered from them (Dingle et al., (1983). The boundary of the Pliocene-Pleistocene has been extended back from 1.8 Ma to 2.588 Ma placing the Gordonia Formation almost entirely within the Pleistocene Epoch. The fossil assemblages of the Kalahari are generally low in diversity and occur over a wide range. These fossils represent terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils. The palaeontology of the Quaternary superficial deposits has been relatively neglected in the past. Late Cenozoic calcrete may comprise of bones, horn cores as well as mammalian teeth (Klein, 1984). Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile skeletons have been uncovered where the depositional settings in the past were wetter.



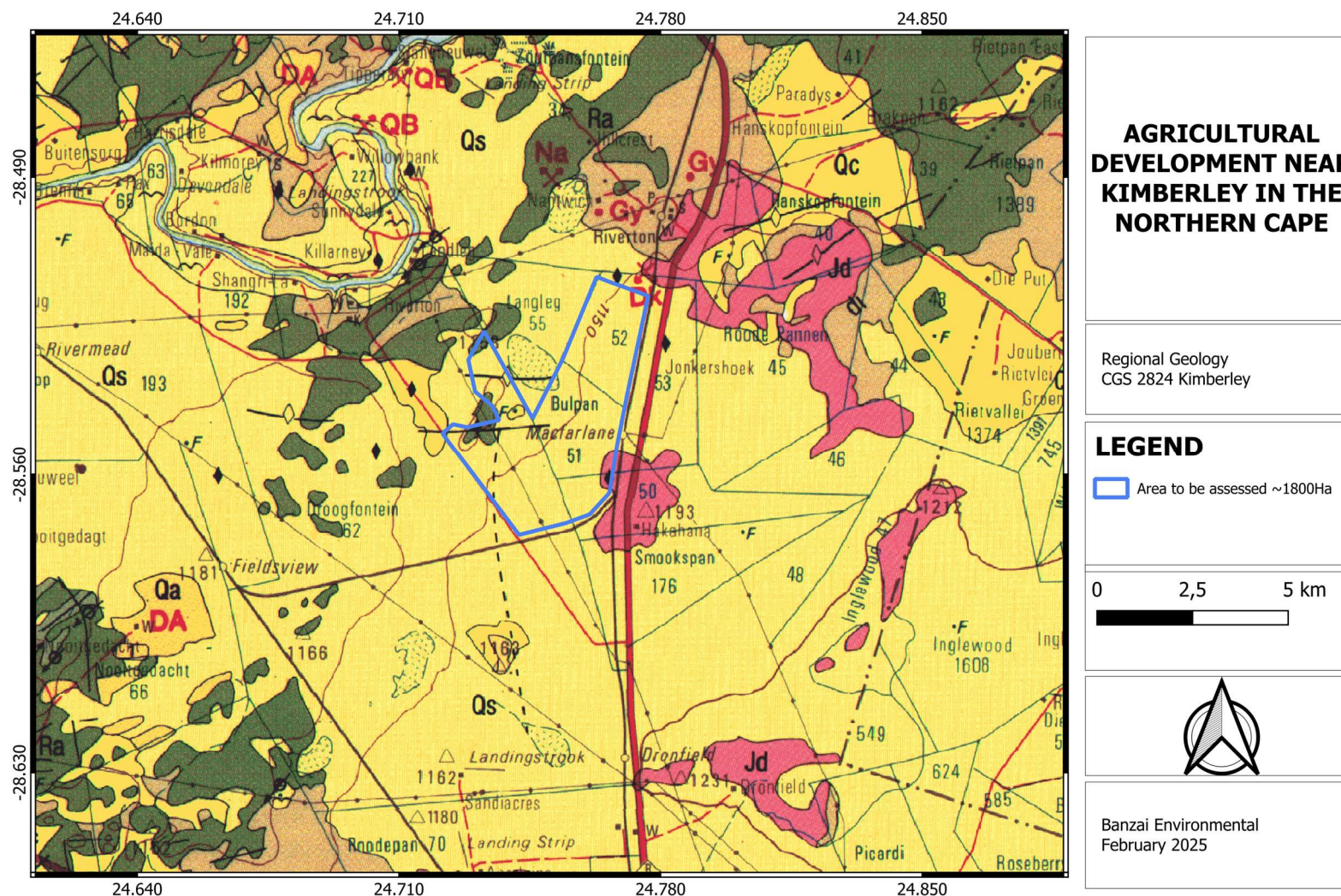


Figure 2: Extract of the 1:250 000 Kimberly 2824 (1986) Geological Map (Council for Geosciences, Pretoria) indicating the study area is underlain by Quaternary red and grey aeolian dune sand (Qs, yellow), Calcrete (Qc, dark yellow), Jurassic Dolerite (Jd, red) as well as the Allanridge Formation (Ra, green) of the Ventersdorp Supergroup.

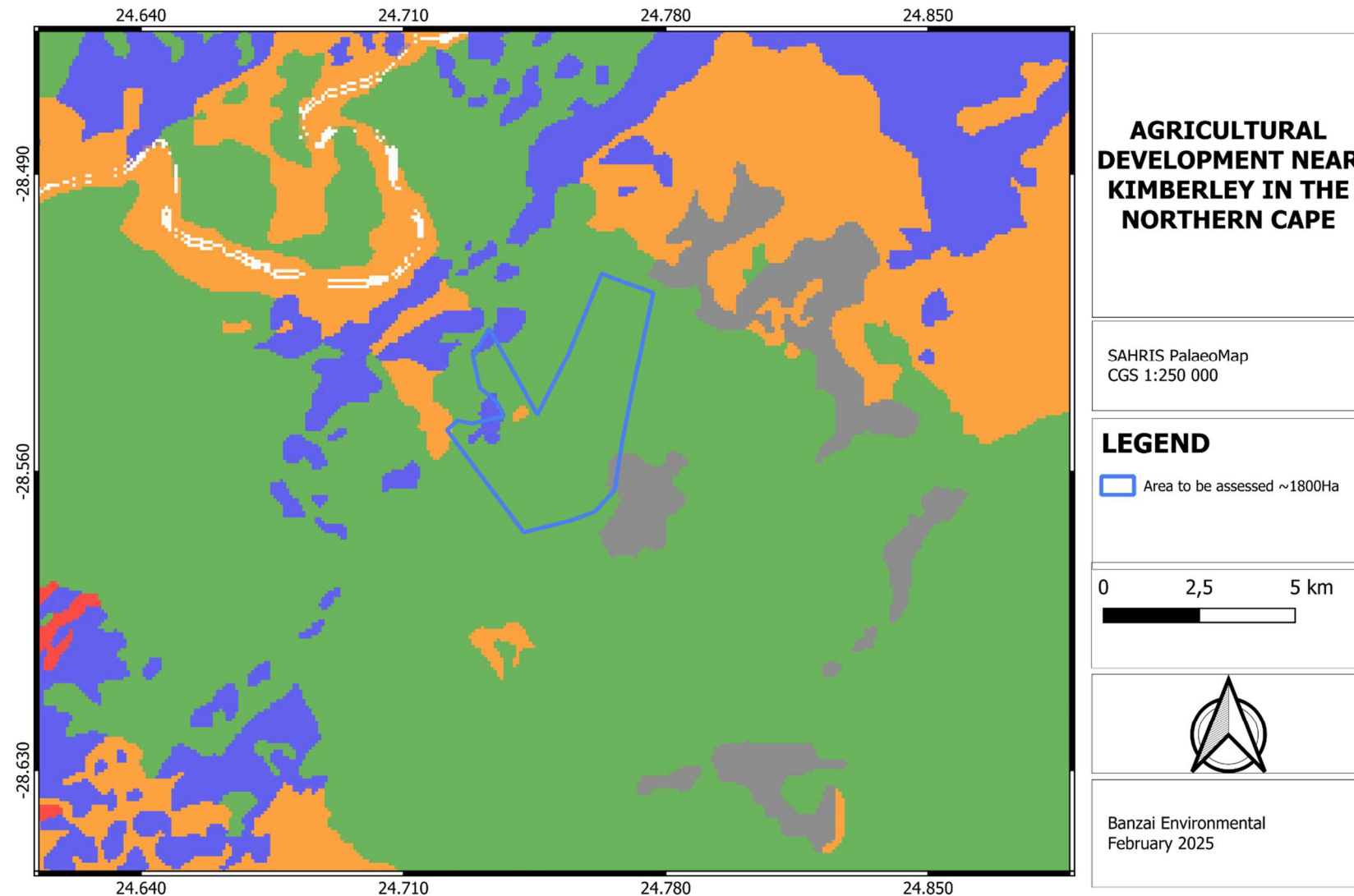


Table 2: Legend of the 2824 Kimberly (1993) Geological Map (Council for Geosciences, Pretoria).

		GROUP GROEP	SUBGROUP SUBGROEP	FORMATION FORMASIE	MEMBER LID	
QUATERNARY KWARTÊR					Qs	
					Qa	
					Qc	
CRETACEOUS KRYT						
JURASSIC JURA						
RANDIAN RANDIUM	VENTERSDORP SUPERGROUP VENTERSDORP SUPERGROEP	PLATBERG	Allanridge Bothaville Rietgat Makwassie			
					Jd	
					Ra	
					Rb	
					Rr	
					Rm	

Qa	Alluvial diamondiferous gravel Alluviale diamantdraende gruis
Qc	Calcrete, calcified pandune and surface limestone Kalkreet, verkalkte panduin en oppervlakkalksteen
Qa	Alluvium and scree Alluvium en olooiingspuin
Qs	Sand: Red and grey aeolian dune sand Sand: Rooi en grys eoliese duinsand
Jd	Dolerite: dolerite dyke shown as ( — ) Doleriet: dolerietoang aangetoon deur ( — )
Ra	Andesite, in places amygdaloidal and/or porphyritic; quartzite and conglomerate lens near bottom ( — ) Andesiet, op plekke amandelhoudend en/of porfirities; kwartsiet-en-konglomeraatlens naby onderkant ( — )
Rb	Quartzite, conglomerate Kwartsiet, konglomeraat
Rr	Quartz-porphry Kwartsporfier
Rm	Andesite, dacite, volcanic breccia, tuff, chert Andesiet, dasiet, vulkaniese breksie, tuf, chert



**Figure 3: Extract of the SAHRIS PalaeoMap (Council of Geosciences) indicating the High (orange), Moderate (green), Zero (grey) and Low (blue) Palaeontological Sensitivity of the study area.**



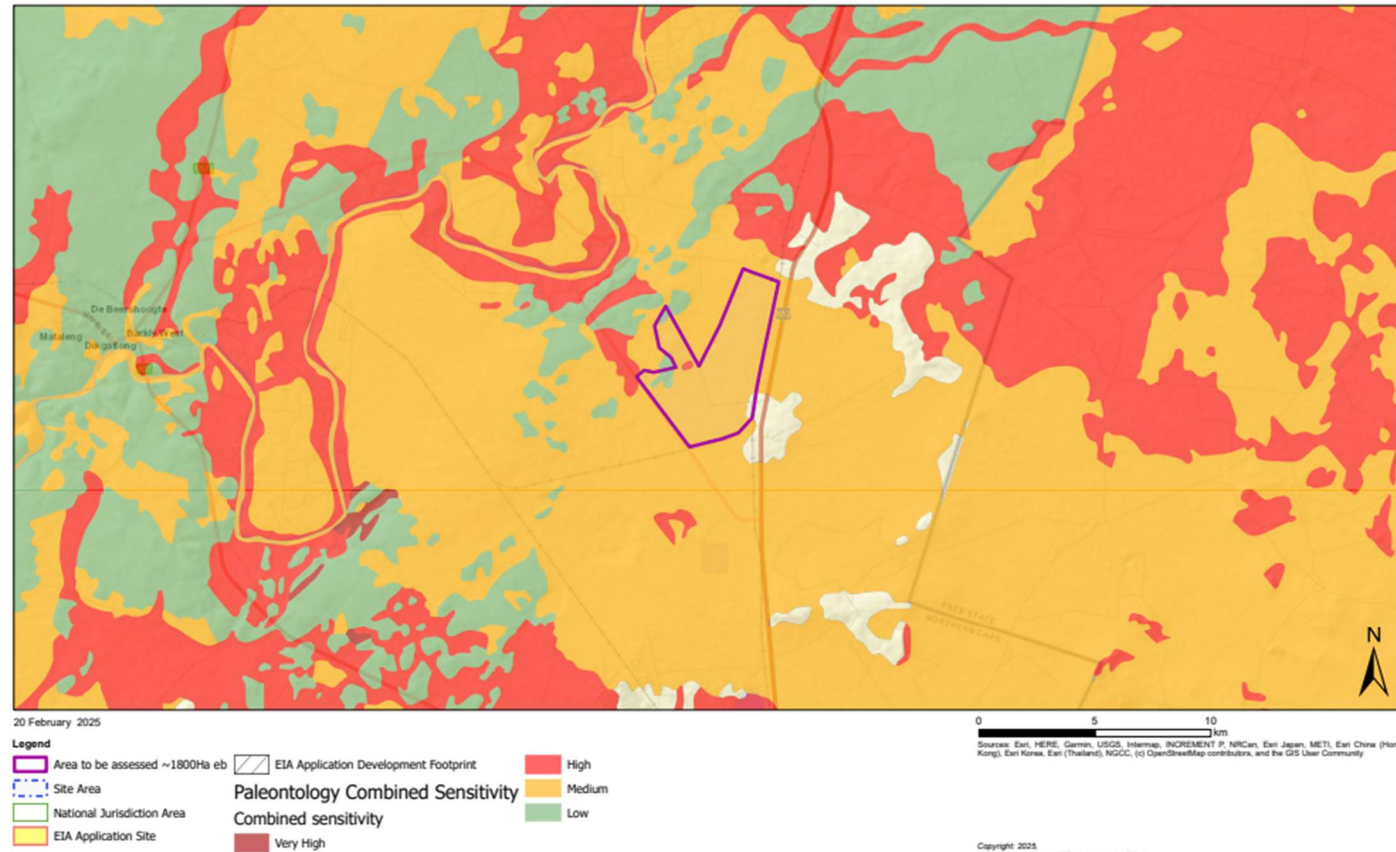


Table 3: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website)		
Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

The SAHRIS Palaeomap (Figure 4) and the DFFE Screening Tool (Figure 5) indicates a High (orange) Palaeontological Sensitivity. No site investigation was conducted for this study as desktop research has indicated that the Sensitivity of the area is LOW.



## Screening Report Map

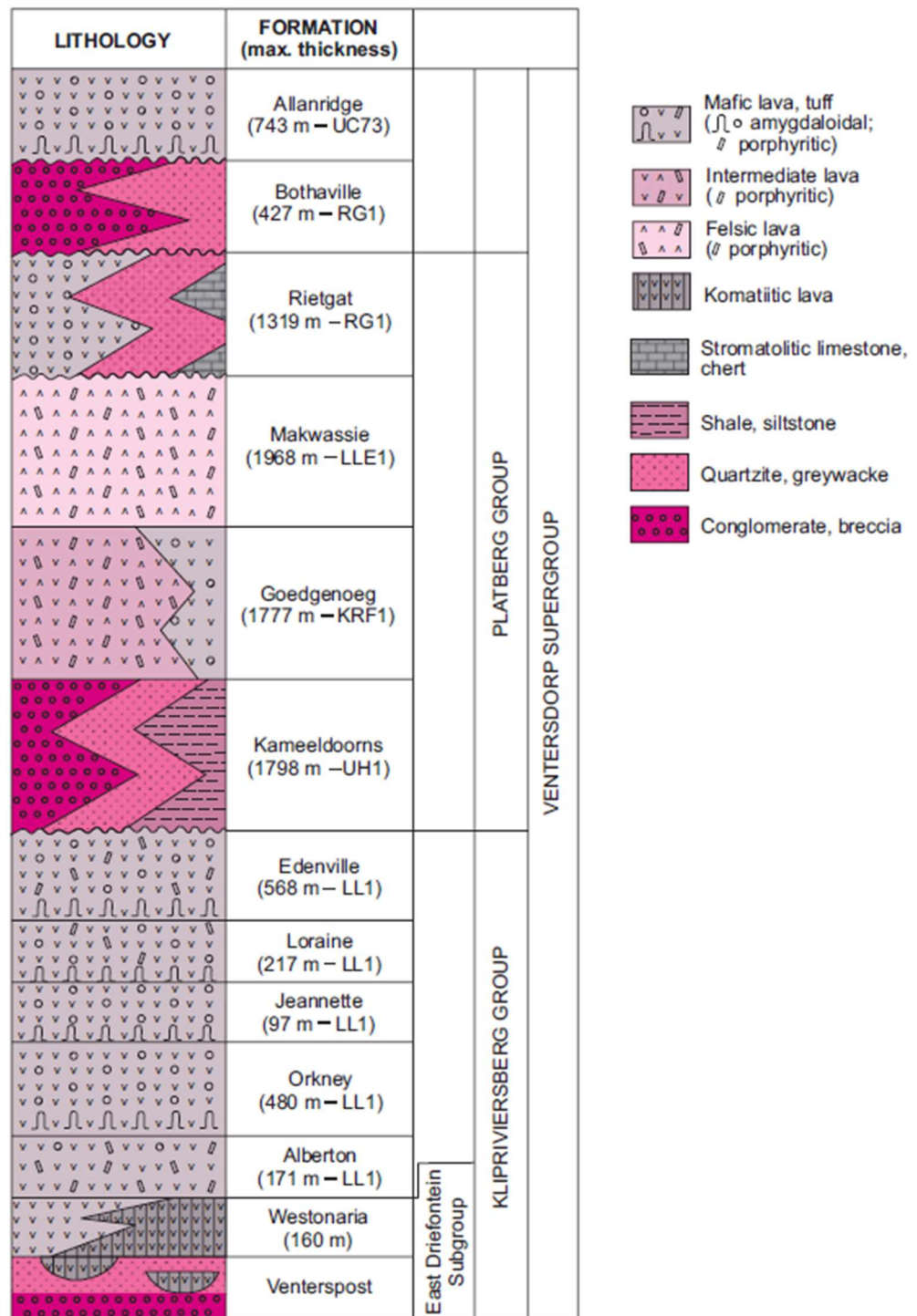


**Figure 4: Palaeontological Sensitivity generated by the DFFE National Environmental Web-Based Screening indicating the High (red), Medium (orange) and Low (green) Palaeontological Sensitivity of the proposed development.**



Table 4: Fossil Heritage from the Northern Cape [extracted from the Palaeotechnical report of the Northern Cape (Almond and Pether, 2009)].

<b>15. FLUVIAL, LACUSTRINE &amp; TERRESTRIAL DEPOSITS</b> (most too small to be indicated on small scale geological maps)  including <i>eg</i> Kwaggaskop Fm (Q)	Fluvial, pan, lake and terrestrial sediments, including diatomite (diatom deposits), pedocretes, tufa, cave deposits   Late Cretaceous to Holocene c. 65 Ma → 0 Ma	Bones and teeth of mammals ( <i>eg</i> proboscideans, rhinos, bovids, horses, micromammals), reptiles, fish, freshwater molluscs, petrified wood, trace fossils ( <i>eg</i> termitaria), rhizoliths, diatom floras	<ul style="list-style-type: none"> <li>Scattered records, many poorly studied (<i>eg</i> from ancient drainage systems)</li> <li>Include equivalents of famous Arrisdrift Miocene fauna from S. Namibia</li> <li>Threatened by alluvial diamond mining (<i>eg</i> Gariep, Vaal river gravels)</li> <li>Orange River Man (100-50 Ka, <i>H. heidelbergensis</i>)</li> </ul>
<b>14. KALAHARI GROUP</b> (K-Q)	Fluvial gravels, sands, lacustrine and pan mudrocks, evaporites, aeolian sands, pedocretes (especially calcrete)   Late Cretaceous to Recent <90 Ma → 0 Ma	Palynomorphs, root casts (rhizomorphs) and burrows ( <i>eg</i> termitaria), rare vertebrate remains (mammals, fish, ostrich egg shell <i>etc</i> ), diatom-rich limestones, freshwater stromatolites, freshwater and terrestrial shells (gastropods, bivalves), ostracods, charophytes	Fossils mainly associated with ancient pans, lakes and river systems   Palaeontology poorly studied
<b>1. VENTERSDORP SUPERGROUP</b> (Rk, Rp, Rka, Rgd, Rm, Rri, Rbt, Ral)	Metasediments (fluvial & lacustrine siliciclastics, chert, dolomite), lavas Neoarchaeon (Randian) c. 2.7 Ga	Lacustrine stromatolites in carbonates, Possible organic-walled microfossils	<ul style="list-style-type: none"> <li>Non-marine stromatolites</li> <li>LIP (Large Igneous Province) voluminous basaltic eruptions</li> </ul>



**Figure 5:** Ventersdorp stratigraphy (Taken from Van Der Westhuizen and Bruijn, 2006 after Winter, 1965, 1976; Linton et al., 1990 Meyers, 1990 and Meintjies, 1978).



## **6 ADDITIONAL INFORMATION CONSULTED**

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- A Google Earth map with polygons of the proposed development was obtained from EIMS.
- Google Earth© satellite imagery.
- 1:250 000 Kimberly 2824 (1993) Geological Map (Council for Geosciences, Pretoria)
- Palaeosensitivity map on SAHRIS (South African Heritage Resources Information System) website
- Department of Forestry, Fisheries and the Environment Screening tool report
- PIAs in the immediate area of the proposed development includes that of Butler 2020a and 2020b, Fourie 2020



## 7 IMPACT ASSESSMENT METHODOLOGY

Table 5: Summary of Impact Tables

Identifier	Discipline	Impact	Alternative	Phase	Event
Palaeontology	Loss of fossil Heritage	No	Construction	Normal Operation	
		-1			Pre-Nature
		1			Pre-Extent
		5			Pre-Duration
		3			Pre-Magnitude
		5			Pre-Reversibility
		-3.5			Consequence
		3			Pre-Probability
		-10.5			Pre-Mitigation Significance Score
		-Medium to High			Pre-Mitigation Significance
		-1			Post-Nature
		1			Post-Extent
		5			Post-Duration
		1			Post-Magnitude
		5			Post-Reversibility
		-3			Consequence2
		1			Post-Probability
		-2			Post-mitigation Significance Score
		-Medium to Low			Post-Mitigation Significance
		High			Confidence
		1			Cumulative Impact
		3			Irreplaceable loss
		-7.5			Priority Factor
		-3.75			Final score
		-Medium to Low			Post-Mitigation Significance





## 8 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary to Recent red and grey aeolian dune sand, Calcrete, calcified pandune and surface limestones, Jurassic dolerite as well as the Allanridge Formation (Ventersdorp Supergroup). According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) the Palaeontological Sensitivity of the Quaternary sands is Medium, that of the calcrete is High, that of Jurassic dolerite is Zero while that of the Allanridge Formation is Low. The suggested location is classified as having a High (Palaeontology Theme Sensitivity in the DFFE Screening Report. Due to the Palaeontological Sensitivity of the Site no site investigation was conducted for the project. But desktop research has indicated that the Palaeontological Sensitivity of the area is Low.

It is therefore considered that the proposed development in the Northern Cape will not lead to detrimental impacts on the palaeontological resources of the area. The construction of the development may therefore be authorised as the development footprint is not considered sensitive in terms of palaeontological resources. It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils.

However, if fossil remains are discovered during any phase of construction, either on the surface or uncovered by excavations, the **Chance Find Protocol** must be implemented. These discoveries must be secured and the ECO/site manager ought to alert SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: [www.sahra.org.za](http://www.sahra.org.za)) so that appropriate mitigation (documented and collection) can be undertaken by a professional palaeontologist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports must meet the minimum standards for palaeontological impact studies developed by SAHRA.

**These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the Project.**

## 9 MITIGATION AND EMPr REQUIREMENTS

The naturally preserved remnants (or traces) of plants or animals embedded in rock are known as fossils. These plants and animals existed millions of years ago in the geologic past. Fossils are incredibly valuable and difficult to replace. It is possible to identify the environmental conditions in a certain geographical area millions of years ago by analysing fossils.

This fact sheet is intended for construction workers and foremen. It describes what to do if fossil material is discovered accidentally during the construction and operational phase activities.

It is the responsibility of the project's Environmental Control Officer (ECO) or site manager to train the workers and foremen on **what to do** if a fossil is accidentally discovered. In the absence of the ESO, a



member of staff must be designated to be accountable for the effective application of the chance discovery protocol so that the conservation of fossil material is not jeopardised.

If fossils are discovered during excavation, the following method shall be followed:

## **9.1 Legislation**

Cultural Heritage in South Africa (including all heritage resources) is protected by the **National Heritage Resources Act (Act No 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources include **"all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens"**.

The NHRA protects and owns the state's palaeontological legacy, which is unique and non-renewable. It is consequently the responsibility of the state to manage and protect fossils on behalf of South African citizens. According to Section 35 of the NHRA, palaeontological resources may not be excavated, broken, transferred, or destroyed by any development without previous assessment and a permit from the relevant heritage resources authority.

## **9.2 Chance Find Procedure**

- If a chance find is made, the person responsible for the find must immediately stop working, and all work in the immediate vicinity of the find must stop as well.
- The individual who discovered the item must immediately notify his or her direct supervisor, who must then notify his or her management and the ECO or site manager. The ECO or site manager must notify the relevant Heritage Agency (South African Heritage Resources Agency, SAHRA) of the discovery. (Contact information: SAHRA, 111 Harrington Street, Cape Town, South Africa. PO Box 4637, Cape Town 8000, South Africa. Fax: +27 (0)21 462 4509. Tel: 021 462 4502. Web address: [www.sahra.org.za](http://www.sahra.org.za)). Photographs of the find from various perspectives, as well as GPS coordinates, must be submitted to the Heritage Agency.
- Within 24 hours of the discovery, a preliminary report must be sent to the Heritage Agency, which must include the following: 1) the date of finding; 2) a description of the discovery; and 3) a description of the fossil and its context (depth and position of the fossil), as well as GPS coordinates.
- Photographs of the discovery (the more the merrier) must be of high quality, in focus, and accompanied by a scale. Photographs of the vertical part (side) where the fossil was discovered are also required.
- Upon receipt of the preliminary report, the Heritage Agency will notify the ECO (or site manager) whether a palaeontologist rescue excavation or collection is required.
- The fossil site must be guarded to prevent future damage. There should be no attempt to remove material from their environment. Stabilize the exposed items and cover them with a plastic sheet or sand bags. The Heritage organization will also be able to advise on the best way to protect the find.





- If the fossil cannot be stabilized, the ECO (site manager) may carefully collect the fossil.
- Once the Heritage Agency has received the written authorization, the applicant may continue with the proposed activity in the affected area.
- Fossil finds must be placed in tissue paper and in an appropriate box while necessary care must be taken to remove any fossil material from the rescue site.

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## APPENDIX 1

### IMPACT ASSESSMENT

Nature	-1	Likely to result in a negative/ detrimental impact	CONSEQUENCE	ENVIRONMENTAL SIGNIFICANCE
	1	Likely to result in a positive/ beneficial impact		
Extent	1	Activity (i.e. Highly localised, limited to the area applicable to the specific activity)		
	2	Site (i.e. within the development property or site boundary, or the area within a few hundred meters of the site)		
	3	Local (i.e. beyond the site boundary within the Local administrative boundary (e.g. Local Municipality) or within consistent local geographical features, or the area within 5 km of the site)		
	4	Regional (i.e. Far beyond the site boundary, beyond the Local administrative boundaries within the Regional administrative boundaries (e.g. District Municipality), or extends into different distinct geographical features, or extends between 5 and 50 km from the site).		
	5	Provincial / National / International (i.e. extends into numerous distinct geographical features, or extends beyond 50 km from the site).		
Duration	1	Immediate (<1 year, quickly reversible)		
	2	Short term (1-5 years, less than project lifespan)		
	3	Medium term (6-15 years)		
	4	Long term (15-65 years, the impact will cease after the operational life span of the project)		
	5	Permanent (>65 years, no mitigation measure of natural process will reduce the impact after construction/ operation/ decommissioning).		
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected)		
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected, or affected environmental components are already degraded)		
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; moderate improvement for +ve impacts; or where change affects area of potential conservation or other value, or use of resources).		
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease; high improvement for +ve impacts; or where change		



		affects high conservation value areas or species of conservation concern)		
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease, substantial improvement for +ve impacts; or disturbance to pristine areas of critical conservation value or critically endangered species)		
Reversibility	1	Impact is reversible without any time and cost.		
	2	Impact is reversible without incurring significant time and cost.		
	3	Impact is reversible only by incurring significant time and cost.		
	4	Impact is reversible only by incurring prohibitively high time and cost.		
	5	Irreversible Impact		
Probability	1	Improbable (Rare, the event may occur only in exceptional circumstances, the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <5% chance).	PROBABILITY	
	2	Low probability (Unlikely, impact could occur but not realistically expected; >5% and <20% chance).		
	3	Medium probability (Possible, the impact may occur; >20% and <50% chance).		
	4	High probability (Likely, it is most probable that the impact will occur- > 50 and <90% chance).		
	5	Definite (Almost certain, the impact is expected to, or will, occur, >90% chance).		
Cumulative Impact	1	Low: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.	PRIORITISATION FACTOR	
	2	Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.		
	3	High: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.		
Irreplaceable loss of resources	1	Low: Where the impact is unlikely to result in irreplaceable loss of resources.		
	2	Medium: Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but		



		the value (services and/or functions) of these resources is limited.	
	3	High: Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Degree of Confidence	Low	<30% certain of impact prediction	
	Medium	>30 and < 60% certain of impact prediction	
	High	>60% certain of impact prediction	



## APPENDIX 2

### CURRICULUM VITAE

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	30 years in Palaeontology
EDUCATION:	University of the Orange Free State B.Sc Botany and Zoology, 1988  University of the Orange Free State B. Sc (Hons) Zoology, 1991  University of the Free State M. Sc. <i>Cum laude</i> (Zoology), 2009

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

#### EMPLOYMENT HISTORY

Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–2022
<b>Banzai Environmental</b>	2016 to present

Elize Butler has conducted approximately 850 Palaeontological Impact Assessments for developments in the Free State, KwaZulu-Natal, Eastern, Northern and Western Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa. She has experience in locating, collecting, and curating fossils. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

#### MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently.