



PALAEONTOLOGICAL IMPACT ASSESSMENT

PROPOSED

Delphi SUBSR+TATION
EXPANSIONIN THE EASTERN
CAPE PROVINCE

July 2024

Compiled for 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.
- I realize that a false declaration is an offense in terms of Regulation 71 of the EIA

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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This Palaeontological Impact Assessment report (as part of the Heritage Impact Assessment), 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.

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	Relevant section in report
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 A
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to Appendix A
(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 8
(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 7 and 9
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 4 Approach and Methodology
(f) details of an assessment of the specific 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 alternative;	Executive Summary and Section 9
(g) An identification of any areas to be avoided, including buffers	Section 5
(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



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	Relevant section in report
(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 and Section 9
(k) Any mitigation measures for inclusion in the EMPr	Section 10
(l) Any conditions for inclusion in the environmental authorisation	Section 10
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 10
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Executive Summary and Section 9
(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 and Section 9
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A
(p) A summary and copies if any comments that were received during any consultation process	N/A
(q) Any other information requested by the competent authority.	N/A
(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 appointed by EIMS to conduct the Palaeontological Impact Assessment (PIA) for the proposed Delphi Substation expansion in the Eastern Cape Province. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to confirm if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The proposed Delphi Substation extension is underlain by the Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup) as well as Jurassic Dolerite. The PalaeoMap of SAHRIS shows that the project's palaeontological sensitivity is Very High (Burgersdorp Formation) and Zero (grey, Jurassic Dolerite) (Almond and Pether, 2009; Almond et al., 2013). According to updated geology (Council of Geosciences, Pretoria), the Tarkastad Subgroup sediments underlie the planned Project. The DFFE Screening tool shows that the project is underlain by sediments with a Very High Palaeontological value.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 24 May 2024. Several weathered plant and trace fossils were detected in the proposed development area. It is however, possible that better preserved specimens are located outside the development. Based on the site investigation as well as desktop research it is concluded that fossil heritage of **scientific and conservational interest in the area is relatively rare. A High Palaeontological Significance has been allocated for the construction phase of the development which is in agreement with the Very High Palaeontological Sensitivity allocated to the development area by the SAHRIS Palaeontological Sensitivity Map and DFFE Screening Tool. A low Palaeontological Significance has been allocated to the development post mitigation.** The construction phase will be the only development phase impacting Palaeontological Heritage and **no significant impacts are expected to impact the Operational and Decommissioning phases.** As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The **Cumulative impacts of the development is considered to be Low pre- mitigation and Very Low post mitigation and falls within the acceptable limits for the project.** With mitigation measures implemented it is considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. **With the necessary mitigation measures in place, the construction of the development may be permitted in its whole extent.** It is consequently



recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of significant newly discovered fossils.

It is thus recommended that:

- The Environmental Control Officer (ECO), responsible for the development should be aware of the distinct possibility of finding fossils in the Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group).
- The fossils identified during the site investigation was found ex-situ and in fragments. It is therefore recommended that the ECO should manually remove these blocks, before site clearance, to a safe distance outside the construction area.
- It is possible that with site clearance more fossils could be recovered from the site. If significant fossils are uncovered during surface clearing and excavations, the **Chance find Protocol** attached should be implemented immediately. These discoveries ought to be protected (if possible, *in situ*) and the ECO/EO must report to 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) so that correct mitigation (recording and collection) can be carry out by a paleontologist.
- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012). It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of significant newly discovered fossils.



TABLE OF CONTENT

1	INTRODUCTION	13
1.2	Project Background (provided by Eskom)	13
1.3	Project Description	13
2	QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR	17
3	LEGISLATION	17
4	METHODS AND TERMS OF REFERENCE.....	19
4.1	Assumptions and Limitations	20
5	GEOLOGICAL AND PALAEONTOLOGICAL HISTORY	21
6	ADDITIONAL INFORMATION CONSULTED	38
7	SITE VISIT.....	38
8	IMPACT ASSESSMENT METHODOLOGY	43
9	FINDINGS AND RECOMMENDATIONS.....	45
10	CHANCE FINDS PROTOCOL.....	46
10.1	Legislation	46
10.2	Background	46
10.3	Introduction	47
10.4	Chance Find Procedure	47
11	REFERENCES	48



LIST OF FIGURES

Figure 1: Regional Locality of the proposed Delphi Substation expansion in the Eastern Cape Province. 15

Figure 2: Locality of proposed extension of the Delphi Substation expansion in the Eastern Cape Province 16

Figure 3: Extract of the 1: 250 000 King Williams Town 3236 Geological map (1976) (Council of Geoscience, Pretoria) indicates that the development is underlain by the Burgersdorp Formation (TRlb) (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup)...... 24

Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicates that the proposed study area is underlain by sediments with a Very High (red) and Zero (grey) Palaeontological Sensitivity...... 26

Figure 5: Updated Geology (Council of Geosciences, Pretoria) indicates that the proposed study area is underlain by the Tarkastad Subgroup (Beaufort Group, Karoo Supergroup). 28

Figure 6: The DFFE National Environmental Web-based Screening Tool indicates that the Palaeontological Sensitivity of the Delphi Substation expansion in the Eastern Cape Province is Very High (dark red)...... 29

Figure 7: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa...... 30

Figure 8: Lateral and dorsal views of the index taxa defining the Lystrosaurus declivis Assemblage Zone. (top) Lystrosaurus declivis, (centre) Thrinaxodon liorhinus, (bottom) Procolophon trigoniceps...... 31

Figure 9: Reconstruction of Lystrosaurus 32

Figure 10: Synchrotron scan of a burrow cast from the Early Triassic indicates an injured temnospondyl amphibian (Broomistega) that sheltered in a burrow occupied by an aestivating therapsid (Thrinaxodon) Image taken from Fernandez, et al., 2013. 33

Figure 11: Cynognathus crateronotus the index taxon of the Cynognathus Assemblage Zone (Figure taken from Hancox et al, 2020) 34

Figure 12: Index taxa of the Langbergia-Garjainia Subzone namely Langbergia modisei (top) and Garjainia prima (bottom) (Figure taken from Hancox et al, 2020) 35

Figure 13: Index taxa of the Trirachodon-Kannemeyeria Subzone namely Trirachodon berryii (top) and Kannemeyeria simocephalus (bottom) (Figure taken from Hancox et al, 2020) 36

Figure 14: Index taxa of the Cricodon-Ufudocyclops Subzone namely Cricodon metabolus (top) and Ufudocyclops mukaneli (bottom) (Figure taken from Hancox et al, 2020)...... 37

Figure 15: Fossil finds during the site investigation on 24 May 2024. 38

Figure 16: Plant fossils (-32.011828, 26.808989) 39

Figure 17: Leaf imprints (-32.011828, 26.808989) 40

Figure 18: Fossilized leaf and infilled stem or trace fossil/tunnel...... 41

Figure 19: Fossil slab is very weathered...... 42



LIST OF TABLES

Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended) iv

Table 2: Legend to the King Williams Town 3236 Geological map (1976) (Council for Geoscience, Pretoria)..... 25

Table 3: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website)..... 27

LIST OF APPENDICES

Appendix A: CV



GLOSSARY OF TERMS

Fossil

A fossil is the preserved remnants or vestiges of a long-dead organism, generally from millions of years ago. Fossils can be mineralized skeletons, shells, or other hard pieces of ancient animals and plants, as well as impressions, moulds, and casts left in sedimentary rock when the organism's remains decomposed and left an impression. Fossils provide valuable insights into the evolution and biodiversity of ancient species, allowing scientists to study and understand their evolution and biodiversity.

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
FFP	Fitness for Purpose
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



1 INTRODUCTION

1.2 Project Background (provided by Eskom)

- This project forms part of an initiative to unlock Grid capacity by connecting renewable energy generation by year 2027.
- The 2022 TDP generation assumptions forecasts that 31 095 MW of PV and wind generation will be required by 2030 of which 16 604 MW will be required as early as 2027.
- Currently there is limited or no capacity available in many of the Transmission supply areas.
- Those areas have already been identified by analysing applications processed in bid window 5 (BW5) and those received for bid window 6 (BW6) as well as by conducting an industry survey amongst various RE associations.
- Several additional transformer capacities at substations that lie within the future areas of interest for RE generation were identified and Delphi is one of those identified substations for this initiative.
- A 500 MVA 400/132 kV transformer is required at Delphi Substation to make provision to connect an additional 300 MW to the 100 MW which has already been approved up to BW5.

The total of 400 MW will be connected at an N-1 level of network redundancy

1.3 Project Description

The following is a proposed scope of work at Delphi Substation:

- 400kV Yard Extend the 400kV in the North Easterly direction by one bay.
- Equip 1x400kV transformer bay.
- Install 1x400/132kV 500MVA transformer.
- Equip 400kV B/B1B/S1.
- Equip 400kV B/CB.

132kV Yard

- Extend the 132kV B/Bin the NE by 7 bays.
- Equip 1x132kV transformer bay.
- Equip 132kV B/B1B/S1.
- Equip 132kV B/CB in a new position.



Civil/Structural Requirements

- Fence, Yard Terrace and Road Extension.
- Oil Dam Relocation.
- Special Earthworks.
- Deviation of the existing stormwater drainage

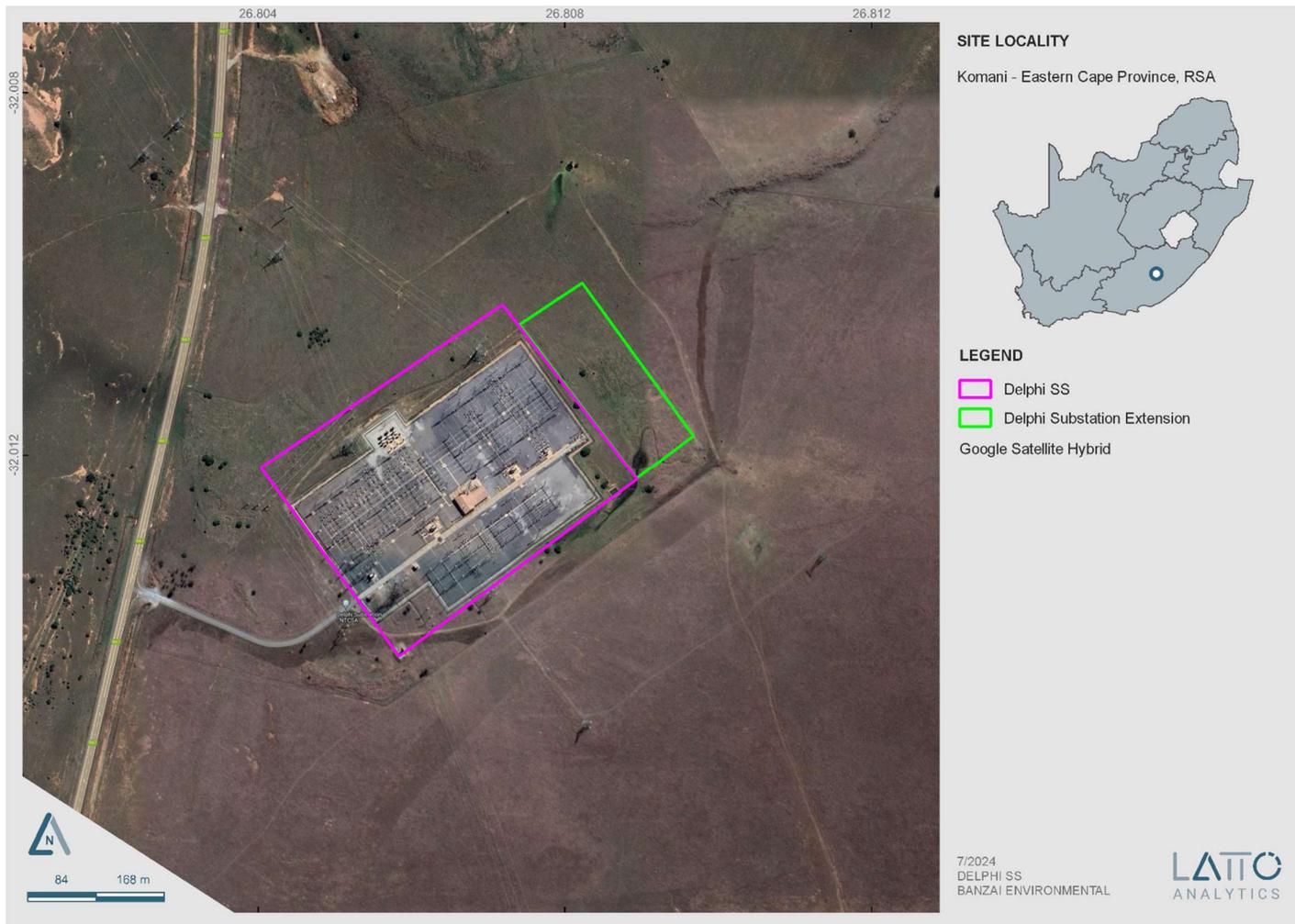


Figure 1: Regional Locality of the proposed Delphi Substation expansion in the Eastern Cape Province.



2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The current study was carried out by Mrs. Elize Butler. She has done around 750 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She holds an MSc (cum laude) in Zoology with a focus on Palaeontology from the University of the Free State in South Africa and has over 30 years of experience in the subject. She is knowledgeable about finding, collecting, and preserving fossils. She first performed PIAs in 2014 and has been a member of the Palaeontological Society of South Africa (PSSA) since 2006.

3 LEGISLATION

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 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 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 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 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 25 of 1999

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



MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51
- Environmental management plan – Regulation 52

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 the following comprehensive and legally compatible PIA report have 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 m² 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
- the re-zoning of a site exceeding 10 000 m² 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 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 construction 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. As a result, a field assessment will improve the accuracy of the desktop evaluation.

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed Delphi Substation extension in the Eastern Cape Province is depicted on the 1: 250 000 King Williams Town 3226 (1976) Geological map (Council of Geoscience, Pretoria). This map indicates that the proposed project is underlain by the Burgersdorp Formation (T_{RIB}, Tarkastad Subgroup, Beaufort Group, Karoo Supergroup) as well as Jurassic Dolerite (Jd, red) (**Figure 3, Table 2**). The PalaeoMap of SAHRIS shows that the project's palaeontological sensitivity is Very High (red, Burgersdorp Formation) and Zero (grey, Jurassic Dolerite) (Almond and Pether, 2009; Almond et al., 2013; **Figure 4, Table 3**). According to updated geology (Council of Geosciences, Pretoria; **Figure 5**), the Tarkastad Subgroup sediments underlie the planned Project. The DFFE Screening tool (**Figure 6**) shows that the project is underlain by sediments with a Very High Palaeontological value.

The Triassic Tarkastad Subgroup (**Figure 7**) comprises of a lower Katberg (sandstone-rich) and upper Burgersdorp Formation (mudstone-rich). The Katberg Formation is an arenaceous unit which comprise of 90-95% of sandstone and 5 to 10% of mudstone. In the southern parts of the basin the Tarkastad Subgroup is 2000m thick and reduces to 800m in the centre of the basin thinning to 150m in the northern part of the basin (Groenewald, 1989). The sandstones of this Subgroup are moderately sorted, fine to medium grained, crossbedded, horizontally laminated and ripple cross laminated varying in colour from pale olive or greenish grey tabular subarkose sandstones. The mudstones are horizontally laminated or structureless horizontally laminated, and thick to medium bedded. Mudstones are minor green to red in colour. Thin mudstone beds occur, with red mudstone beds growing in abundance towards the upper border of the formation as it grades into the Burgersdorp Formation (Johnson, 1976; Johnson et al. 2006). The Burgersdorp Formation is mostly argillaceous and can be interpreted as a meandering fluvial to lacustrine deposit (Johnson et al, 2006; Groenewald, 1996).

The Vertebrate Assemblage Zone present in the Katberg Formation is the *Lystrosaurus declivis* Assemblage Zone (AZ) (Botha & Smith, 2020). In the western part of the basin this biozone spans the upper Palingkloof Member (Balfour Formation) as well as the overlying Katberg Formation. This Assemblage Zone (AZ) is of particular importance as it records the survival and recovery from the end-Permian mass extinction. The argillaceous Palingkloof Member (Balfour Formation) is found in the lower *Lystrosaurus declivis* Assemblage Zone. Olive-grey and massive maroon-bedded siltstone interbedded with minor sandstones with sharp flat basal and upper contacts characterizes the Palingkloof Member. Gastaldo et al., (2020) found that the upper Palingkloof Member is not older than 252.24 +/-0.1 while Botha et al (2020) found that it may be as young as 251.7 +/-0.3.

Two species dominate the *Lystrosaurus declivis* AZ namely the small to medium-sized herbivorous dicynodonts *Lystrosaurus murrayi* and *Lystrosaurus declivis* (**Figure 8-9**). These species are small to medium-sized herbivores.



Similarly abundant in this biozone is smaller, less common insectivores and faunivorous taxa. Insectivores include *Galesaurus*, *Platycrianiellus* and *Thrinaxodon* while theropods are represented by *Olivierosuchus*, *Promoschorhynchus* and *Regisaurus*. Small parareptiles include *Colleta*, *Saurodekteles*, *Sauropareion*, *Phonodus* and *Procolophon* while euryptiles are represented by migrant taxa for example *Heleosuchus*, *Noteosuchus*, and *Prolacerta*. The large carnivores include the saber-toothed *Moschorhinus* as well as the long-snouted archosauromorph *Proterosuchus*. After the end-Permian mass extinction, small temnospondyl taxa like *Broomistega*, *Lydekkerina*, and *Micropholis* is abundantly found (Botha et al, 2020). This terrestrial biozone is well-known in the west of Gondwana with closely related species present in Antarctica and India.

Vertebrate fossils are mostly found in the mudrock units between channel sandstones in the *Lystrosaurus declivis* Assemblage Zone. Specimens are well preserved and articulated skull and skeleton specimens have been abundantly found. Several bonebeds have been recorded. A common contributor to the floodplain bonebeds is juvenile *Lystrosaurus declivis* that most probably died due to severe drought conditions (Smith and Botha, 2005, Viglietti et al., 2013, Smith and Botha-Brink, 2014). Numerous positively identified skeletons have been identified in burrows in this Assemblage Zone (Bordy et al., 2011; Botha-Brink, 2017, Damiani et al., 2003, Kitching, 1977; Modesto and Botha-Brink, 2010; Smith and Botha-Brink, 2014). Synchrotron scanning made it possible for Fernandez, et al., 2013 to describe a burrow cast from the Early Triassic of the Karoo (**Figure 10**). This scan depicts a unique mixed-species association of an injured temnospondyl amphibian (*Broomistega*) sheltering in a burrow inhabited by an aestivating *Thrinaxodon*

The Burgersdorp Formation is the youngest stratigraphic unit of the Permo-Triassic Beaufort Group in the main Karoo Basin (**Figure 7**) and contain continental fossil biota from the Early to Middle Triassic (Olenekian-Anisian age). This Formation is paraconformably overlain by the Molteno and Elliot Formations of the Stormberg Group. The Burgersdorp formation is rich in mudrocks and is 900-1000 m thick in its southern outcrop area near Queenstown (Johnson et al. 2006). Kitching (1995) found that the type area near Queenstown was about 600m thick. The sandstones of this Subgroup are moderately sorted, fine to medium grained, crossbedded, horizontally laminated and ripple cross laminated. The sandstones vary in colour from pale olive or greenish grey tabular subarkose sandstones. The mudstones are horizontally laminated or structureless horizontally laminated, thick to medium bedded. These mudstones are minor green to red in colour. The Burgersdorp Formation is mostly argillaceous and can be interpreted as a meandering fluvial to lacustrine deposit (Johnson et al, 2006; Groenewald, 1996).

The Burgersdorp Formation comprise of the *Cynognathus* Assemblage Zone (CAZ). The biostratigraphy and lithostratigraphy for the *Cynognathus* Assemblage Zone have been revised by Hancox et al (2020). This Assemblage Zone (AZ) is underlain by the *Lystrosaurus declivis* AZ and is at the base of the overlying Molteno Formation of the Stormberg Group. This Formation is characterized by the presence of the cynodont *Cynognathus* throughout the Zone (**Figure 11**). The CAZ is about 650m thick in the southeast of the basin thinning towards the north where it is only about 50m thick. The CAZ is divided in three subdivisions namely the lower Langbergia-Garjainia Subzone (**Figure 12**); a middle Trirachodon-Kannemeyeria Subzone (**Figure 13**) and an upper Cricodon-Ufudocyclops Subzone (**Figure 14**). The basal contact is where the first appearance of *Langbergia modisei* and



Cynognathus crateronotus occurs. The upper limit of the *Cynognathus* AZ is not defined and is unconformably terminated by the overlying Molteno Formation.

Biotas of the Burgersdorp Formation include freshwater vertebrate fauna and several fish groups have been described namely lungfish, coelacanths and sharks. Reptiles include the distant relatives of the dinosaurs namely the primitive archosaurs and crocodile-like erythrosuchids. Therapsid fauna comprise of the small to medium sized therocephalian carnivores and herbivores as well as dicynodonts (*Kannemeyeria*) and advanced cynodonts (*Diademodon*) (Anderson and Anderson, 1985; Kitching, 1995; Bamford, 2004; Abdala et al., 2005; Rubidge, 2005; Neveling et al., 2005; Abdala and Smith, 2009; **It must be noted that only a few fossils have been described from the old Transkei region (Bordy et al, 2020).**

A low diversity of plants has also been uncovered in the Burgersdorp Formation and include *Dicroidium*, conifers, ginkgos, cycads, ferns, lycophytes, and gymnospermous fossil woods.

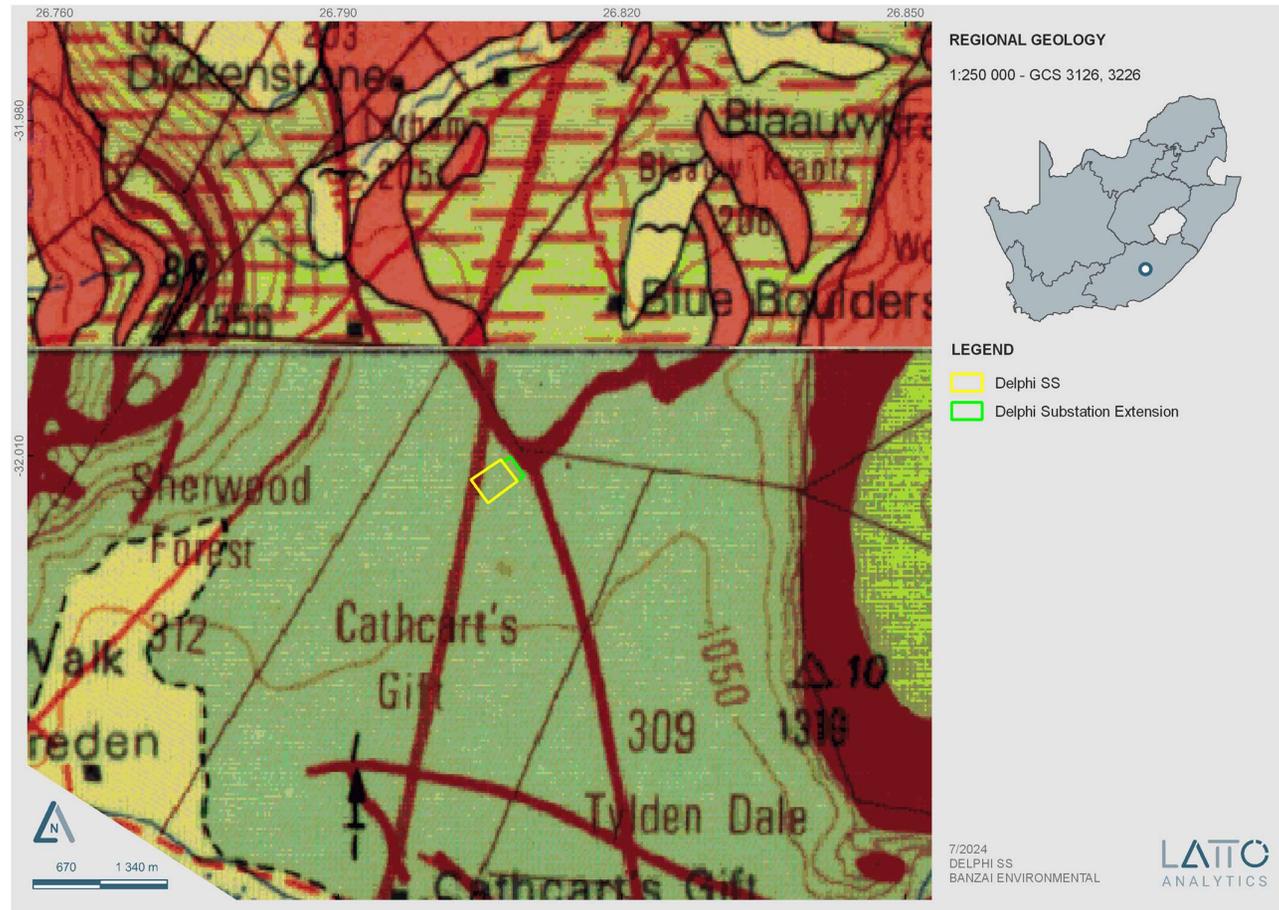
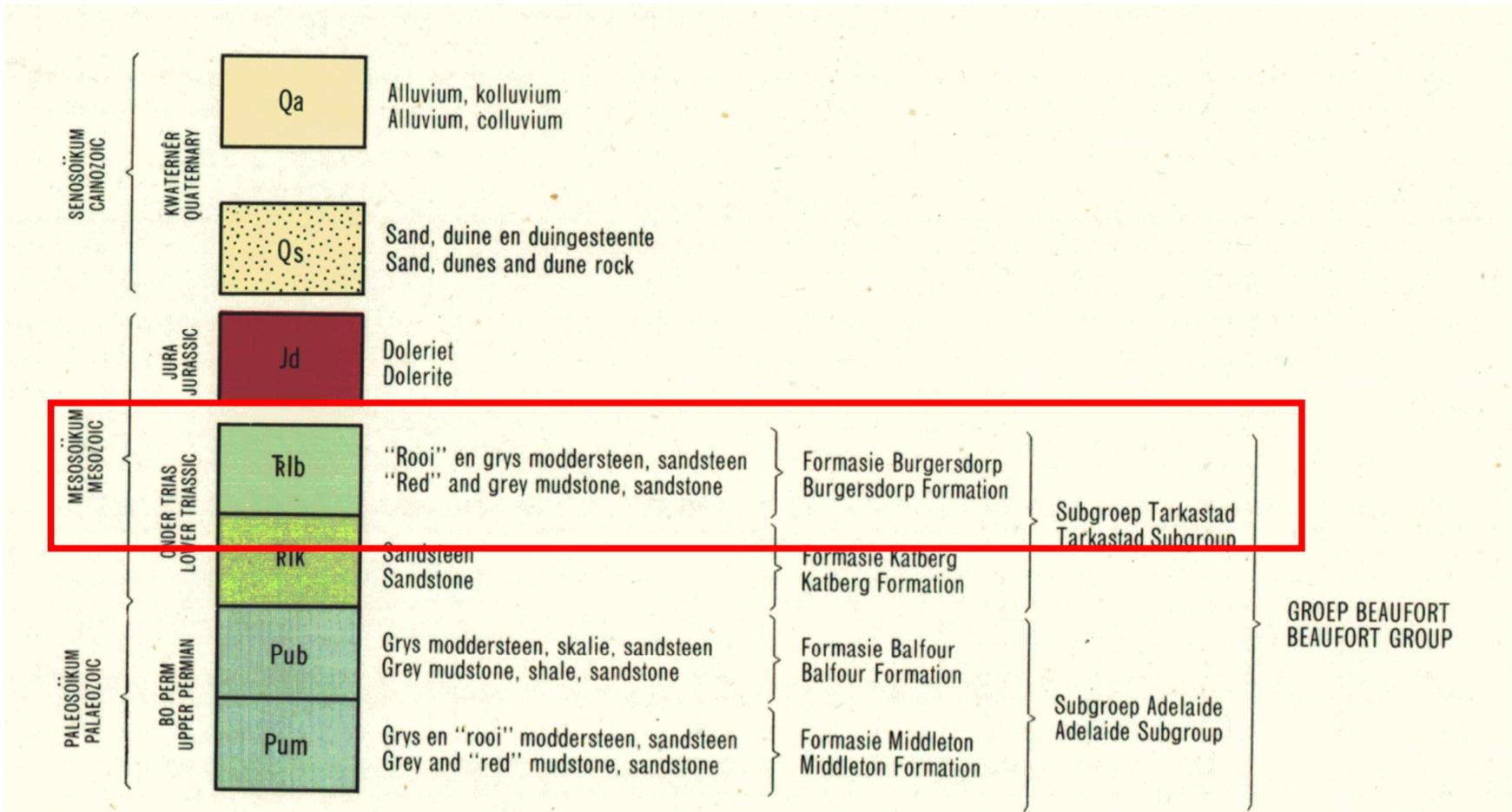


Figure 3: Extract of the 1: 250 000 King Williams Town 3236 Geological map (1976) (Council of Geoscience, Pretoria) indicates that the development is underlain by the Burgersdorp Formation (TR1b) (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup).



Table 2: Legend to the King Williams Town 3236 Geological map (1976) (Council for Geoscience, Pretoria).

Relevant sediments are indicated in a red polygon.



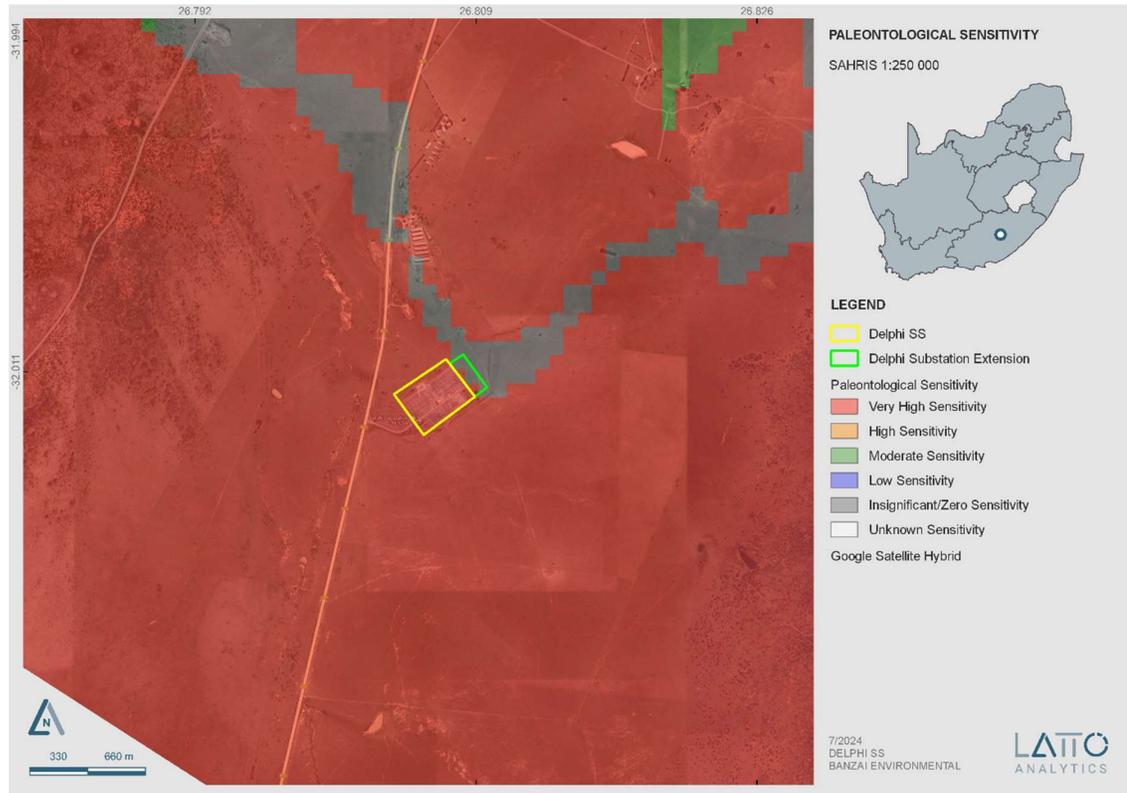


Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicates that the proposed study area is underlain by sediments with a Very High (red) and Zero (grey) Palaeontological Sensitivity.



Table 3: Palaeontological Sensitivity according to the SAHRIS PalaeoMap (Almond et al, 2013; SAHRIS website)

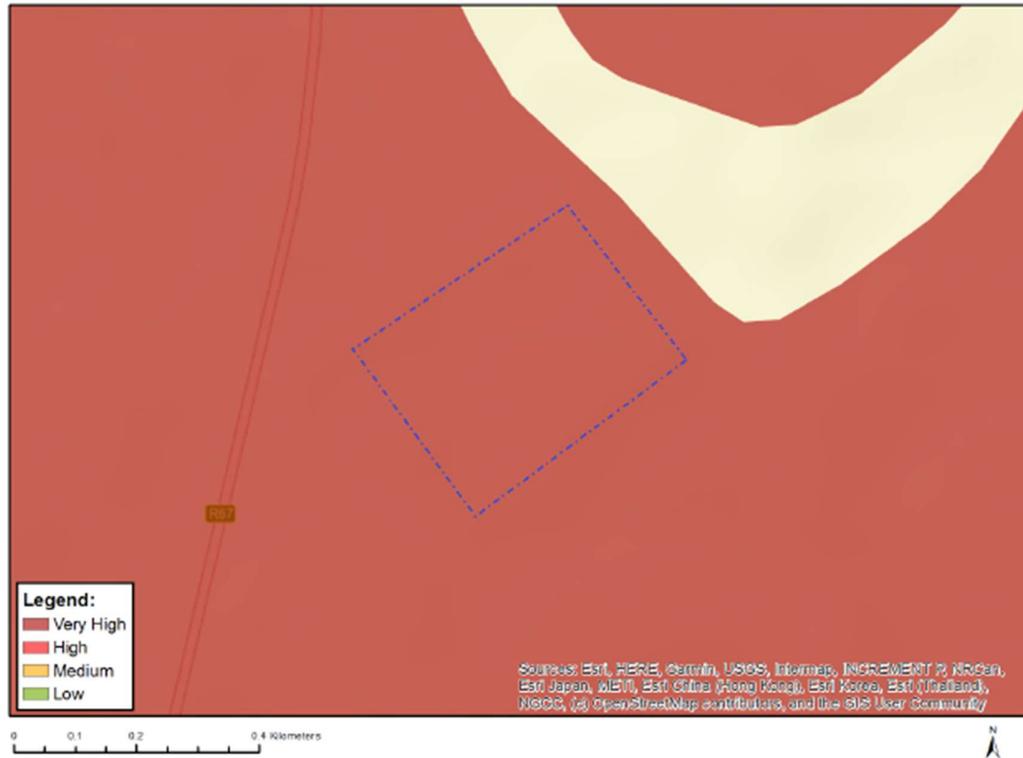
Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No palaeontological studies are 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.

According to the SAHRIS Palaeosensitivity map (Figure 4) the proposed development is underlain by sediments with a Very High (red) and Zero (grey) Palaeontological Sensitivity.



Figure 5: Updated Geology (Council of Geosciences, Pretoria) indicates that the proposed study area is underlain by the Tarkastad Subgroup (Beaufort Group, Karoo Supergroup).

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Features with a Very High paleontological sensitivity

Figure 6: The DFFE National Environmental Web-based Screening Tool indicates that the Palaeontological Sensitivity of the Delphi Substation expansion in the Eastern Cape Province is Very High (dark red).

The proposed Delphi Substation expansion has a very High Palaeontological Sensitivity according to the SAHRIS Palaeomap (Figure 4) and DFFE Screening tool (Figure 6). Several trace fossils have been recorded during the site investigation of 24 May 2024. This High Palaeontological Sensitivity is thus confirmed with the actual findings in the field on the 24 May 2024.



Age	Gp	West of 24° E	East of 24° E	Free State / KwaZulu-Natal	Vertebrate Assemblage Zones	Vertebrate Subzones			
JURASSIC	STORMBERG		Drakensberg Gp	Drakensberg Gp	Massospondylus				
			Clarens Fm	Clarens Fm					
			upper Elliot Fm	upper Elliot Fm					
TRIASSIC	Tarkastad Subgp		lower Elliot Fm	lower Elliot Fm	Scalenodontoides				
			Molteno Fm	Molteno Fm					
			Burgersdorp Fm	Driekoppen Fm	Cynognathus		Cricodon-Ufudocyclops Trirachodon-Kannemeyeria Langbergia-Gargainia		
	BEAUFORT	Adelaide Subgp	Teekloof Fm	Katberg Fm	Verkykerskop Fm	Lystrosaurus declivis			
				Palingkloof M.	Normandem Fm	Harrismith M.		Daptocephalus	Lystrosaurus maccaigi-Moschorhinus
				Elandsberg M.		Schoondraai M.			Dicynodon-Theriongnathus
Ripplemead M.	Rooinekke M.	Frankfort M.	Cistecephalus						
Daggaboersnek M.	Oudeberg M.				Volksrust Fm	Endothiodon	Tropidostoma-Gorgonops Lycosuchus-Eunotosaurus		
Steenkampsvlakte M.	Middleton Fm	Tapinocephalus	Diictodon-Styracocephalus Eosimops-Glanosuchus						
Oukloof M.	Abrahamskraal Fm		Koonap Fm	Eodicynodon					
Hoedemaker M.		Waterford Fm			Waterford Fm				
Poortjie M.	Tierberg/Fort Brown		Fort Brown						
ECCA									

Figure 7: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa.

Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphy is position of the taxa that have only been recovered from a single bed. Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES Mammaliaformes. Gp=group, Subgp-Subgroup, Fm=Formation, M=Member.

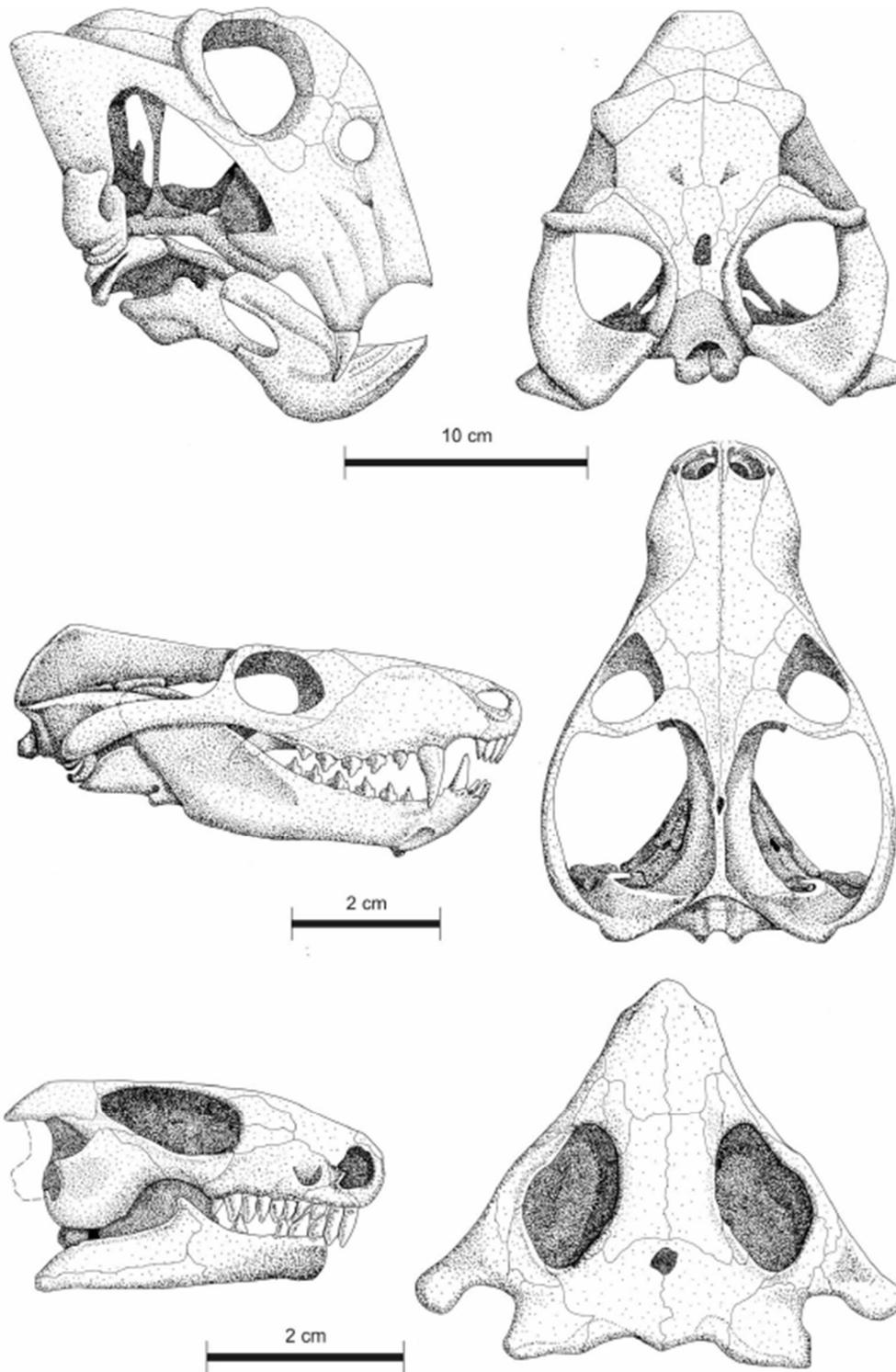
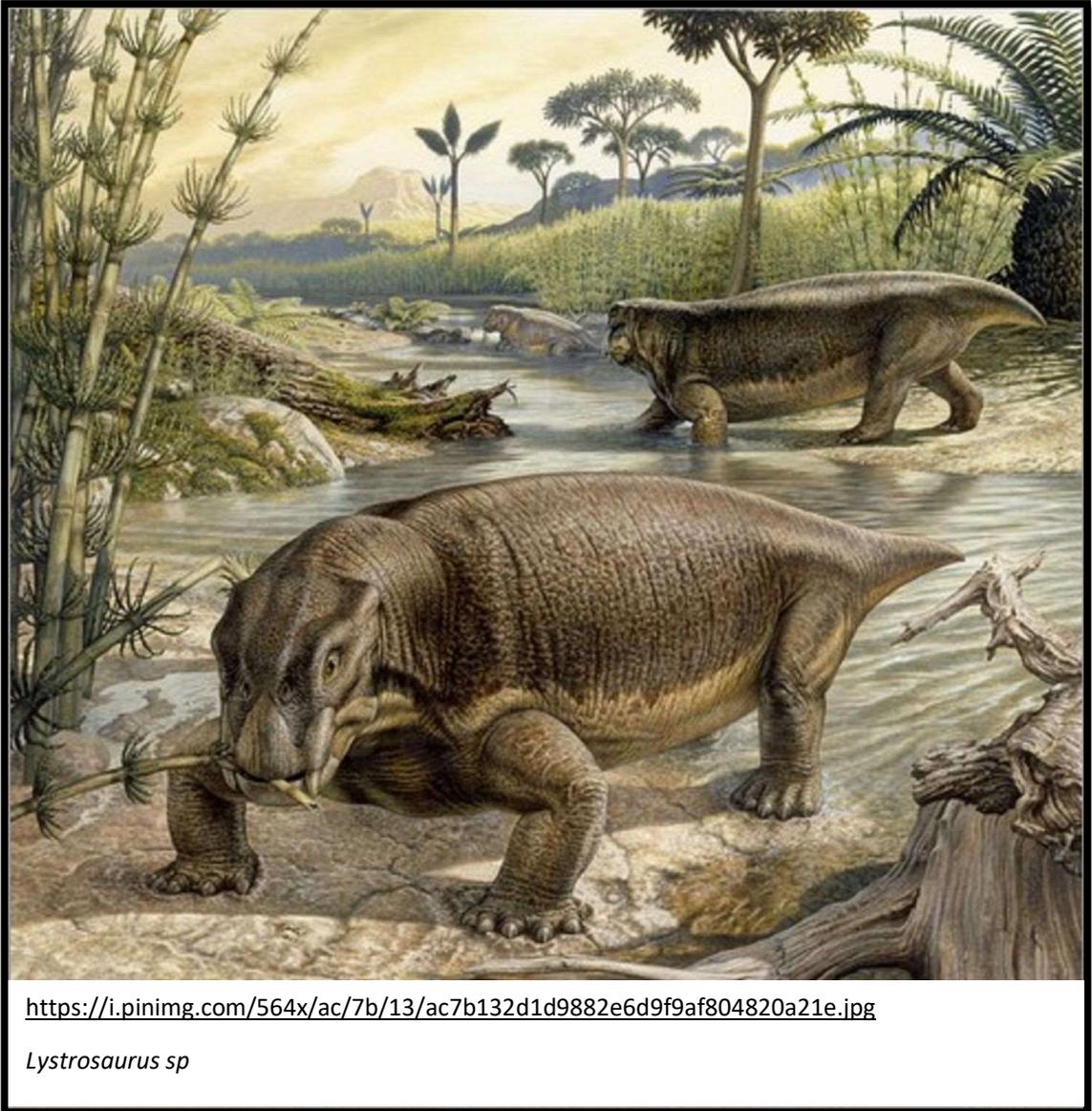


Figure 8: Lateral and dorsal views of the index taxa defining the *Lystrosaurus declivis* Assemblage Zone. (top) *Lystrosaurus declivis*, (centre) *Thrinaxodon liorhinus*, (bottom) *Procolophon trigoniceps*.



<https://i.pinimg.com/564x/ac/7b/13/ac7b132d1d9882e6d9f9af804820a21e.jpg>

Lystrosaurus sp

Figure 9: Reconstruction of Lystrosaurus

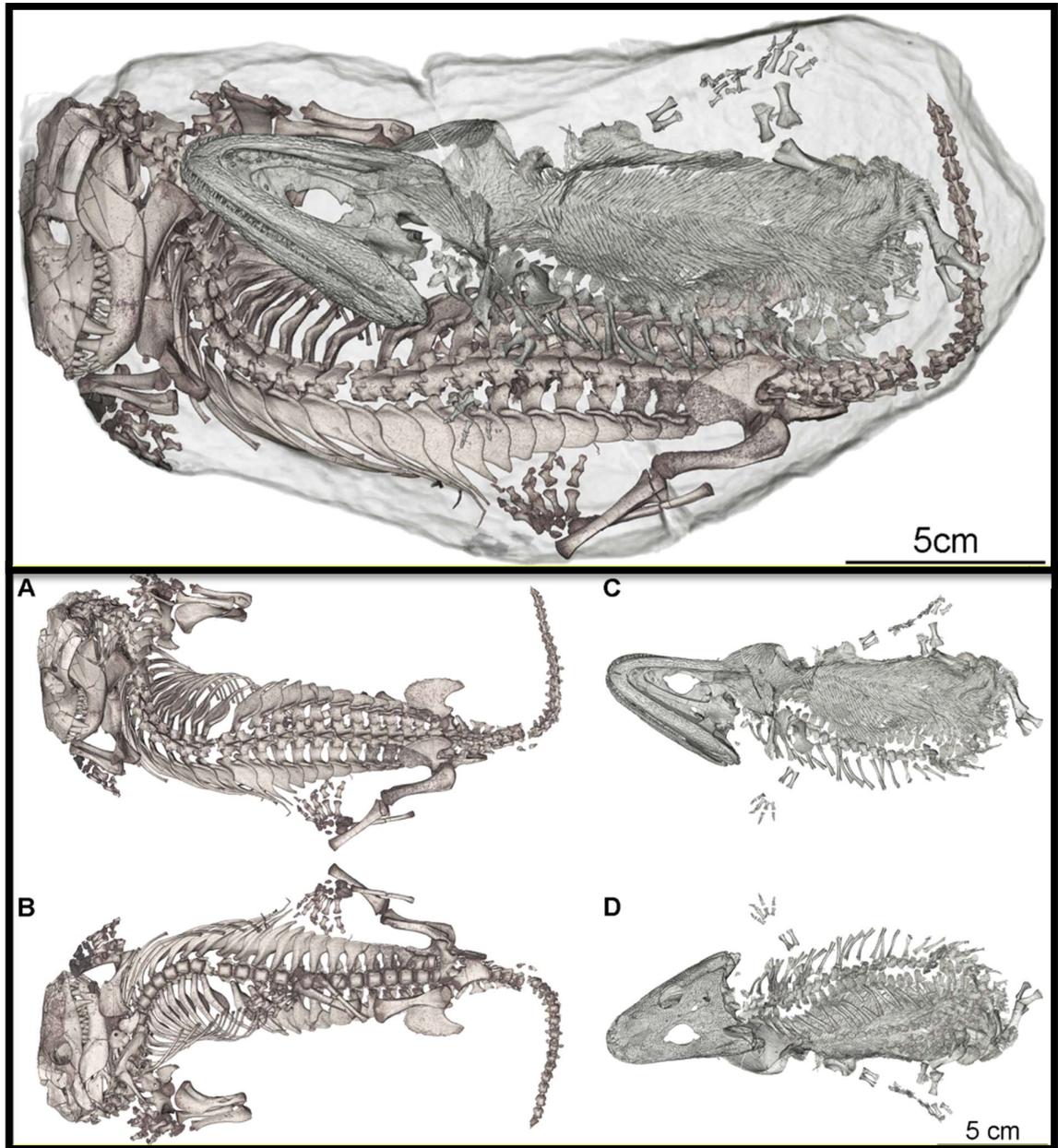


Figure 10: Synchrotron scan of a burrow cast from the Early Triassic indicates an injured temnospondyl amphibian (*Broomistega*) that sheltered in a burrow occupied by an aestivating therapsid (*Thrinaxodon*)
 Image taken from Fernandez, et al., 2013.

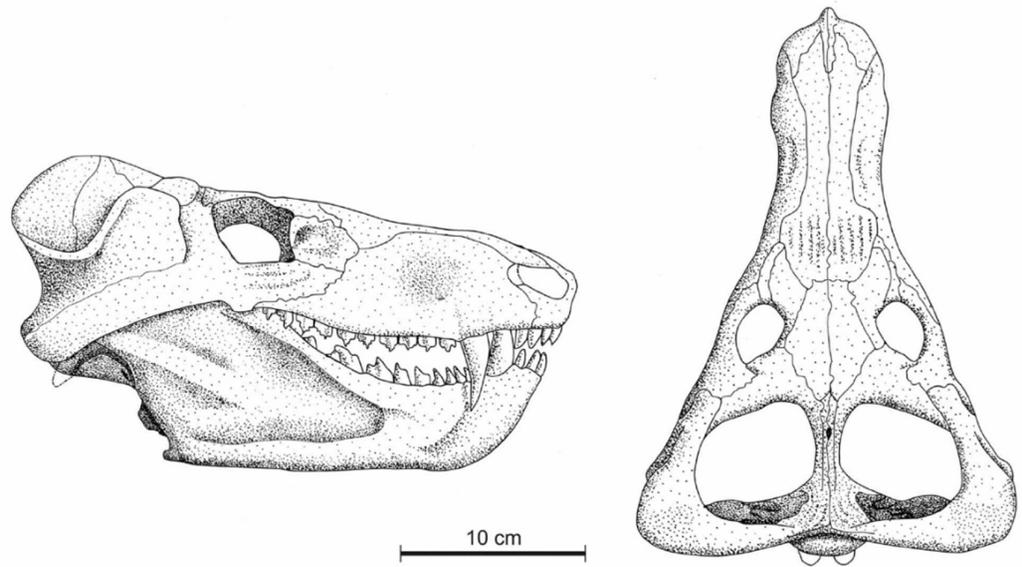


Figure 11: *Cynognathus crateronotus* the index taxon of the *Cynognathus* Assemblage Zone (Figure taken from Hancox et al, 2020)

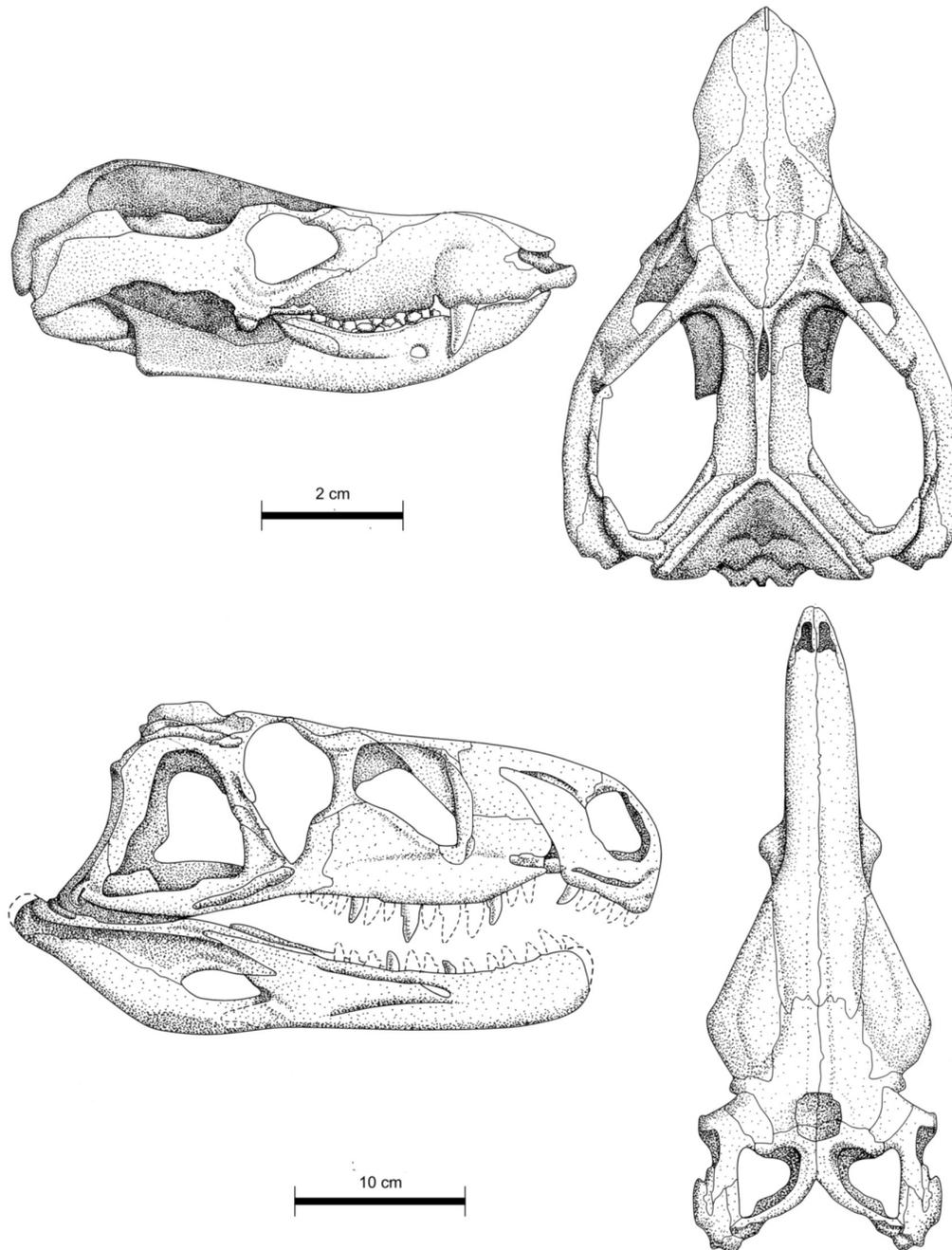


Figure 12: Index taxa of the Langbergia-Garjainia Subzone namely *Langbergia modisei* (top) and *Garjainia prima* (bottom) (Figure taken from Hancox et al, 2020)

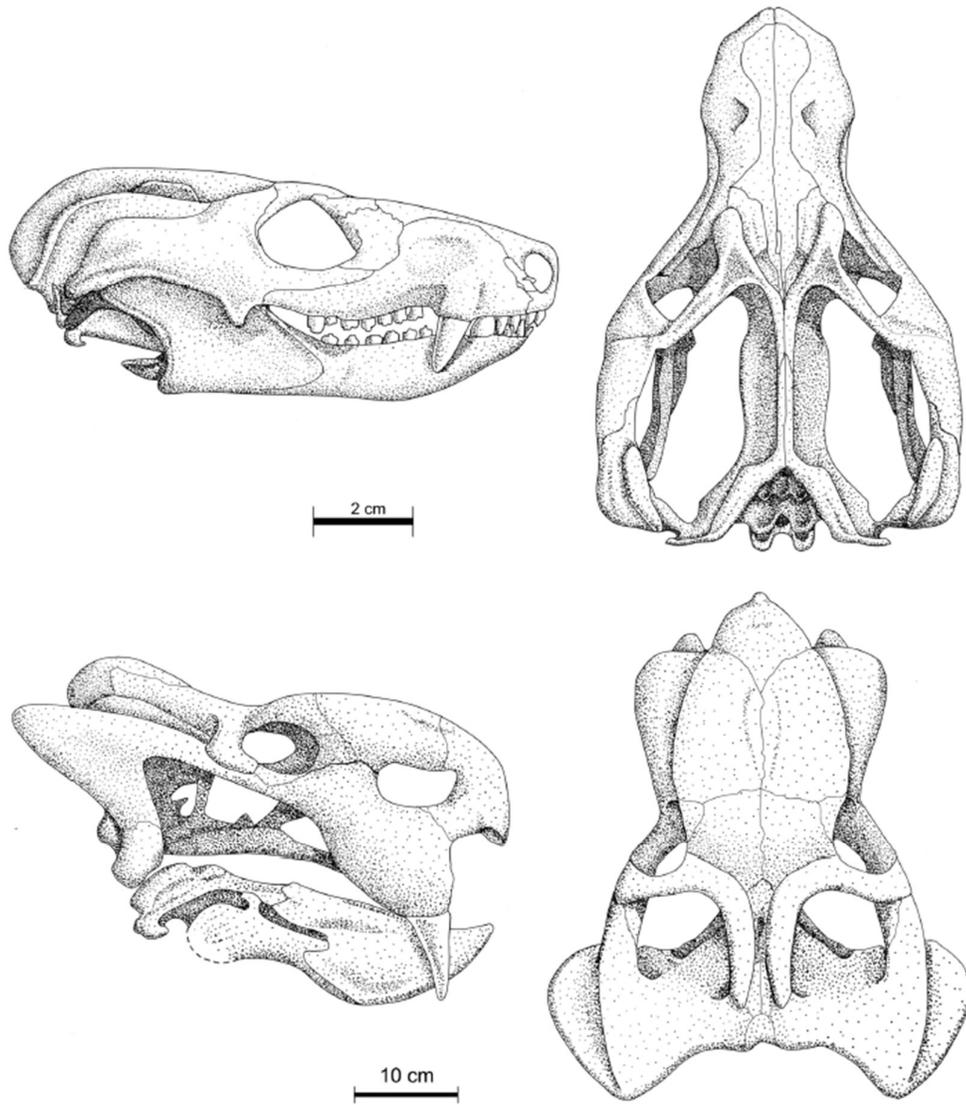


Figure 13: Index taxa of the Trirachodon-Kannemeyeria Subzone namely *Trirachodon berryii* (top) and *Kannemeyeria simocephalus* (bottom) (Figure taken from Hancox et al, 2020)

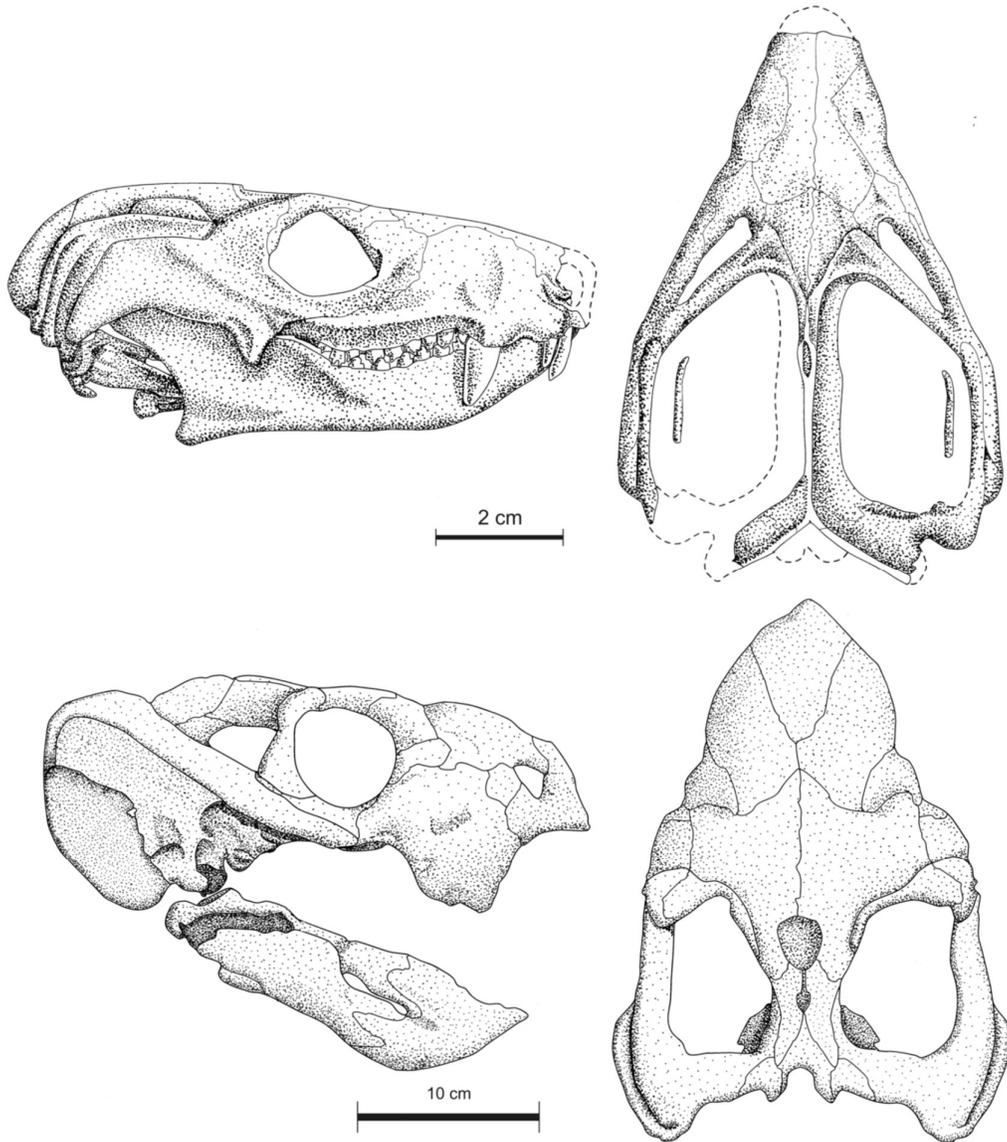


Figure 14: Index taxa of the Cricodon-Ufudocyclops Subzone namely *Cricodon metabolus* (top) and *Ufudocyclops mukaneli* (bottom) (Figure taken from Hancox et al, 2020).

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)
- Palaeosensitivity map on SAHRIS (South African Heritage Resources Information System) website
- The National Environmental Web-based Screening Tool.
- Google Earth© satellite imagery.
- 1:250 000 King Williams Town 3228 (1976) Geological Map (Council for Geosciences, Pretoria),
- Published geological and palaeontological literature.

7 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot and vehicle on 24 May 2024. Several ex-situ trace fossils were detected in the north-eastern corner of the proposed development. All fossils were located within n meter from each other.

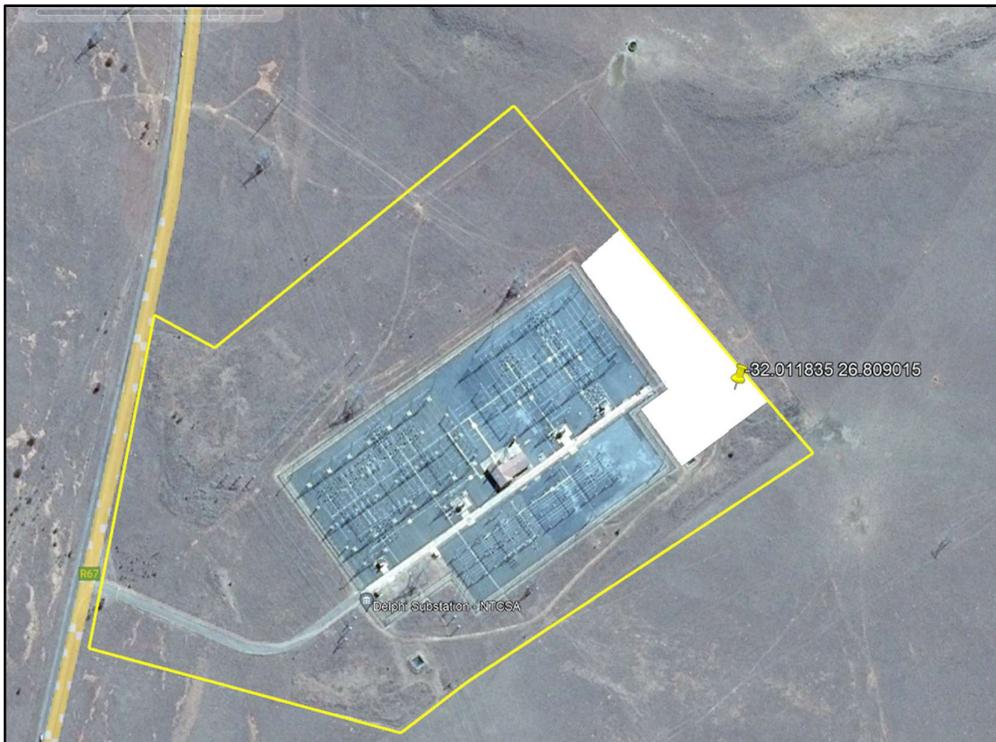


Figure 15:Fossil finds during the site investigation on 24 May 2024.



Figure 16: Plant fossils (-32.011828, 26.808989)



Figure 17: Leaf imprints (-32.011828, 26.808989)

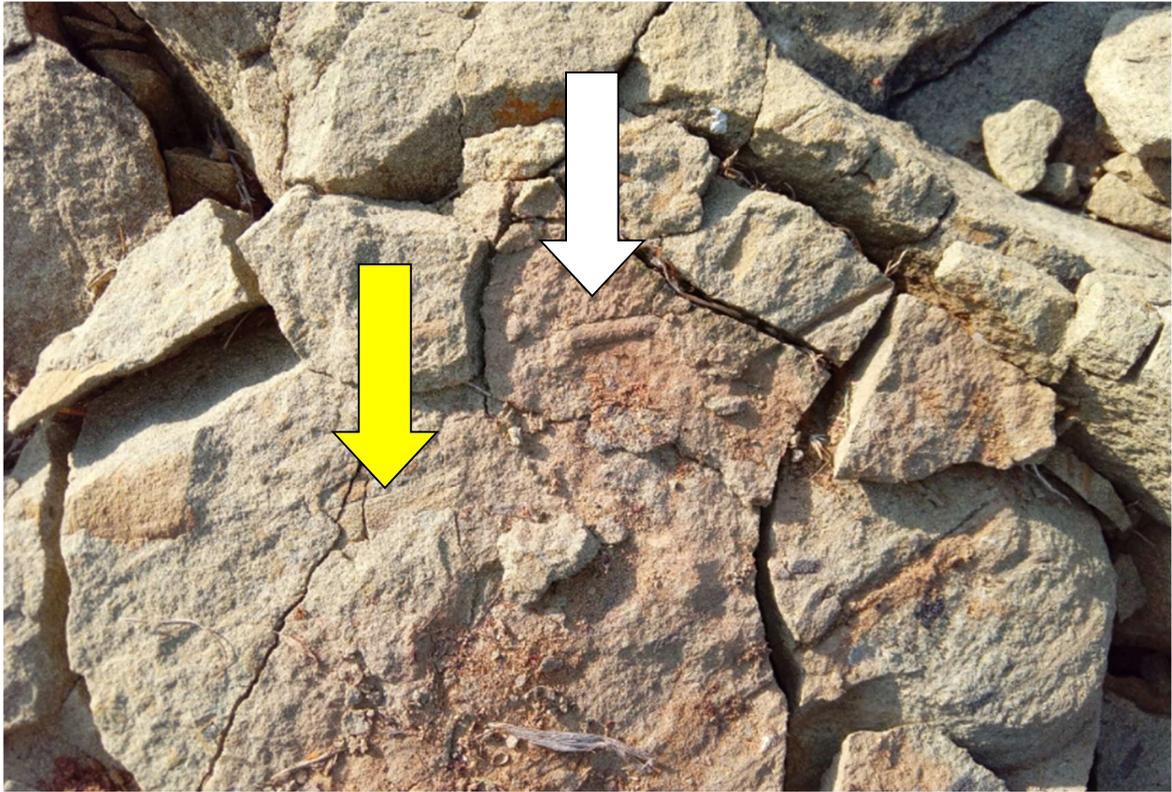


Figure 18:Fossilized leaf and infilled stem or trace fossil/tunnel



Figure 19: Fossil slab is very weathered



8 IMPACT ASSESSMENT METHODOLOGY

An assessment of the impact significance of the Delphi Substation expansion indicates that development is underlain by the Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup).

Nature of the Impact

The excavations and site clearance of the Delphi Substation expansion will involve minor excavations into the superficial sediments and also into the underlying bedrock. Minor to no modification to the existing topography may occur but fossils may be destroyed or sealed-in, at the surface or below ground surface. The geology of the development indicates that fossils may be present in the development footprint.

Geographical extent of the impact

Minor Impacts on fossil heritage will occur during the construction phase of the development when new excavations into fresh potentially fossiliferous bedrock takes place. The extent of the area of potential impact is thus limited to the project site.

Sensitive areas

The Delphi Substation expansion is completely underlain by the Clarens and Elliot Formations of the Karoo Supergroup.

Duration of the Impact

If and when an impact on a fossil do occur, it would have a permanent effect on the fossil. Heritage of the area in the absence of mitigation procedures (and if fossils are present in the development area) the harm or destruction of palaeontological heritage will be permanent.

Potential Significance of the Impact

The destruction/damage of fossil heritage in the development, underlain by the Tarkastad Subgroup of the Karoo Supergroup, will be permanent and irreversible. Any fossil heritage in the development area is considered to be of scientific and culturally significant and thus any negative impact on the fossil heritage will be highly significant.

Severity/ Beneficial scale

The development of the proposed Delphi Substation expansion is beneficial, not only a local level, but regional as well. A secondary advantage of the construction of the project would be that the excavations may uncover fossils hidden beneath the surface and would have remained unknown to science. Thus, in



the absence of mitigation the impact on fossil heritage will be negative but with mitigation the impact could be positive.

Intensity of impact occurring

Probable significant impacts on palaeontological heritage during the construction phase are high

Probability

According to the Geology of the proposed development, fossil heritage can be found in the proposed development. The probability of significant impacts on palaeontological heritage during the construction phase are thus high.

Mitigation

If fossil heritage is present in the development footprint any negative or detrimental impact on these fossils can be mitigated by describing and collecting of the well-preserved fossils (by a professional palaeontologist). Mitigation should take place after vegetation clearance and before the ground is levelled for construction. A SAHRA permit will be required for fossil collection and the fossil heritage must be housed in an accredited institution (university or museum). If fossil heritage cannot be excavated a buffer could be placed around the fossil heritage thus protecting the fossils and fossil locality.

Mitigation would involve the collection and describing of fossils within the development footprint by a professional palaeontologist. This would take place after initial vegetation clearance but *before* the ground is levelled for construction.

Degree of irreversible Loss

Impacts on fossil heritage are generally irreversible. Scientifically all well-documented records and palaeontological studies of any fossils exposed during construction would represent a positive impact. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate mitigation procedures. If mitigation is undertaken the benefit scale for the project will be beneficial.

Irreplaceable loss

Fossil heritage may be present in Tarkastad Subgroup underlying the development. Significant loss of fossil heritage may be limited by taking a precautionary approach.



9 FINDINGS AND RECOMMENDATIONS

The proposed Delphi Substation extension is underlain by the Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group, Karoo Supergroup) as well as Jurassic Dolerite. The PalaeoMap of SAHRIS shows that the project's palaeontological sensitivity is Very High (Burgersdorp Formation) and Zero (grey, Jurassic Dolerite) (Almond and Pether, 2009; Almond et al., 2013). According to updated geology (Council of Geosciences, Pretoria), the Tarkastad Subgroup sediments underlie the planned Project. The DFFE Screening tool shows that the project is underlain by sediments with a Very High Palaeontological value.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 24 May 2024. Several weathered plant and trace fossils were detected in the proposed development area. It is however, possible that better preserved specimens are located outside the development. Based on the site investigation as well as desktop research it is concluded that fossil heritage of **scientific and conservational interest in the area is relatively rare. A High Palaeontological Significance has been allocated for the construction phase of the development which is in agreement with the Very High Palaeontological Sensitivity allocated to the development area by the SAHRIS Palaeontological Sensitivity Map and DFFE Screening Tool. A low Palaeontological Significance has been allocated to the development post mitigation.** The construction phase will be the only development phase impacting Palaeontological Heritage and **no significant impacts are expected to impact the Operational and Decommissioning phases.** As the No-Go Alternative considers the option of 'do nothing' and maintaining the status quo, it will have a Neutral impact on the Palaeontological Heritage of the development. The **Cumulative impacts of the development is considered to be Low pre- mitigation and Very Low post mitigation and falls within the acceptable limits for the project.** With mitigation measures implemented it is considered that the proposed development will not lead to damaging impacts on the palaeontological resources of the area. **With the necessary mitigation measures in place, the construction of the development may be permitted in its whole extent.** It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of significant newly discovered fossils.

It is thus recommended that:

- The Environmental Control Officer (ECO), responsible for the development should be aware of the distinct possibility of finding fossils in the Burgersdorp Formation (Tarkastad Subgroup, Beaufort Group).
- The fossils identified during the site investigation was found ex-situ and in fragments. It is therefore recommended that the ECO should manually remove these blocks, before site clearance, to a safe distance outside the construction area.
- It is possible that with site clearance more fossils could be recovered from the site. If significant fossils are uncovered during surface clearing and excavations, the **Chance find Protocol**



attached should be implemented immediately. These discoveries ought to be protected (if possible, *in situ*) and the ECO/EO must report to 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) so that correct mitigation (recording and collection) can be carry out by a paleontologist.

- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012). It is consequently recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of significant newly discovered fossils.

10 CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

10.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 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”.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, 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.

10.2 Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils, it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.



10.3 Introduction

This informational document is intended for workmen and foremen on the construction site. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Site Officer (ESO) or site manager of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ESO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

10.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, 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). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.



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Appendix A

Curriculum Vitae

PROFESSION: Palaeontologist
YEARS' EXPERIENCE: 30 years in Palaeontology
EDUCATION: B.Sc Botany and Zoology, 1988
University of the Orange Free State

B. Sc (Hons) Zoology/Palaeontology, 1991
University of the Orange Free State

Management Course, 1991
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009
University of the Free State

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

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

EMPLOYMENT HISTORY
Part time Laboratory assistant Department of Zoology & Entomology
University of the Free State Zoology 1989-1992

Part time laboratory assistant Department of Virology
University of the Free State Zoology 1992

Research Assistant National Museum, Bloemfontein 1993 – 1997

Principal Research Assistant and Collection Manager National Museum, Bloemfontein
1998–2022

TECHNICAL REPORTS

- Butler, E. 2014. Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.
- Butler, E. 2014. Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoot, Northern Cape Province. 2014. Bloemfontein.
- Butler, E. 2015. Palaeontological impact assessment of the proposed consolidation, re-division, and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2015. Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.
- Butler, E. 2015. Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.
- Butler, E. 2015. Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.



- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.
- Butler, E. 2015. Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.
- Butler, E. 2015. 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, Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.
- Butler, E. 2015. Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
- Butler, E. 2016. Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City of Johannesburg, Gauteng Province. Bloemfontein.
- Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Modikwa Filling Station on a Portion of Portion 2 of Mooihoek 255 Kt, Greater Tubatse Local Municipality, Limpopo Province. Bloemfontein.
- Butler, E. 2016. Recommendation from further Palaeontological Studies: Proposed Construction of the Heidedal filling station on Erf 16603, Heidedal Extension 24, Mangaung Local Municipality, Bloemfontein, Free State Province. Bloemfontein.
- Butler, E. 2016. Recommended Exemption from further Palaeontological studies: Proposed Construction of the Gunstfontein Switching Station, 132kv Overhead Power Line (Single or Double Circuit) and ancillary infrastructure for the Gunstfontein Wind Farm Near Sutherland, Northern Cape Province. Savannah South Africa. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoot concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoot, Northern Cape. Savannah South Africa. Bloemfontein.



- Butler, E. 2016. Palaeontological Impact Assessment of the proposed upgrading of the main road MR450 (R335) from Motherwell to Addo within the Nelson Mandela Bay Municipality and Sunday's River valley Local Municipality, Eastern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment construction of the proposed Metals Industrial Cluster and associated infrastructure near Kuruman, Northern Cape Province. Savannah South Africa. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of up to a 132kv power line and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces. PGS Heritage. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment of the proposed development of two burrow pits (DR02625 and DR02614) in the Enoch Mgijima Municipality, Chris Hani District, Eastern Cape.
- Butler, E. 2016. Ezibeleni waste Buy-Back Centre (near Queenstown), Enoch Mgijima Local Municipality, Eastern Cape. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment for the proposed construction of two 5 Mw Solar Photovoltaic Power Plants on Farm Wildebeestkuil 59 and Farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
- Butler, E. 2016. Palaeontological Impact Assessment for the proposed development of four Leeuwberg Wind farms and basic assessments for the associated grid connection near Loeriesfontein, Northern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological impact assessment for the proposed Aggeneys south prospecting right project, Northern Cape Province. Bloemfontein.
- Butler, E. 2016. Palaeontological impact assessment of the proposed Motuoane Ladysmith Exploration right application, KwaZulu Natal. Bloemfontein.
- Butler, E. 2016. Palaeontological impact assessment for the proposed construction of two 5 MW solar photovoltaic power plants on farm Wildebeestkuil 59 and farm Leeuwbosch 44, Leeudoringstad, North West Province. Bloemfontein.
- Butler, E. 2016: Palaeontological desktop assessment of the establishment of the proposed residential and mixed-use development on the remainder of portion 7 and portion 898 of the farm Knopjeslaagte 385 Ir, located near Centurion within the Tshwane Metropolitan Municipality of Gauteng Province. Bloemfontein.
- Butler, E. 2017. Palaeontological impact assessment for the proposed development of a new cemetery, near Kathu, Gamagara local municipality and John Taolo Gaetsewe district municipality, Northern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of The Proposed Development of The New Open Cast Mining Operations on The Remaining Portions Of 6, 7, 8 And 10 Of the Farm Kwaggafontein 8 In the Carolina Magisterial District, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Development of a Wastewater Treatment Works at Lanseria, Gauteng Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Scoping Report for the Proposed Construction of a Warehouse and Associated Infrastructure at Perseverance in Port Elizabeth, Eastern Cape Province.
- Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Establishment of a Diesel Farm and a Haul Road for the Tshipi Borwa mine Near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the Proposed Changes to Operations at the UMK Mine near Hotazel, In the John Taolo Gaetsewe District Municipality in the Northern Cape Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Ventersburg Project-An Underground Mining Operation near Ventersburg and Henneman, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological desktop assessment of the proposed development of a 3000 MW combined cycle gas turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment for the Development of the Proposed Revalidation of the lapsed General Plans for Elliotdale, Mbhashe Local Municipality. Bloemfontein.
- Butler, E. 2017. Palaeontological assessment of the proposed development of a 3000 MW Combined Cycle Gas Turbine (CCGT) in Richards Bay, Kwazulu-Natal. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the new open cast mining operations on the remaining portions of 6, 7, 8 and 10 of the farm Kwaggafontein 8 10 in



the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed mining of the farm Zandvoort 10 in the Albert Luthuli Local Municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Lanseria outfall sewer pipeline in Johannesburg, Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of open pit mining at Pit 36W (New Pit) and 62E (Dishaba) Amandelbult Mine Complex, Thabazimbi, Limpopo Province. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment of the proposed development of the sport precinct and associated infrastructure at Merrifield Preparatory school and college, Amathole Municipality, East London. PGS Heritage. Bloemfontein.

Butler, E. 2017. Palaeontological impact assessment of the proposed construction of the Lehae training and fire station, Lenasia, Gauteng Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new open cast mining operations of the Impunzi mine in the Mpumalanga Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed rehabilitation of 5 ownerless asbestos mines. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the Lephalale coal and power project, Lephalale, Limpopo Province, Republic of South Africa. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a 132KV powerline from the Tweespruit distribution substation (in the Mantsopa local municipality) to the Driedorp rural substation (within the Naledi local municipality), Free State province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of the new coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of a Photovoltaic Solar Power station near Collett substation, Middelburg, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment for the proposed township establishment of 2000 residential sites with supporting amenities on a portion of farm 826 in Botshabelo West, Mangaung Metro, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed prospecting right project without bulk sampling, in the Koa Valley, Northern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

Butler, E. 2017. PIA site visit and report of the proposed Galla Hills Quarry on the remainder of the farm Roode Krantz 203, in the Lukhanji Municipality, division of Queenstown, Eastern Cape Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of Tina Falls Hydropower and associated power lines near Cumbu, Mthlontlo Local Municipality, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of the Mangaung Gariep Water Augmentation Project. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed Belvoir aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed construction of the Melkspruit-Rouxville 132KV Power line. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed development of a railway siding on a Portion of portion 41 of the farm Rustfontein 109 is, Govan Mbeki local municipality, Gert Sibande district municipality, Mpumalanga Province. Bloemfontein.



- Butler, E. 2017. Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed extension of the Kareerand Tailings Storage Facility, associated borrow pits as well as a storm water drainage channel in the Vaal River near Stilfontein, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed of the Lephallale Coal and Power Project, Lephallale, Limpopo Province, Republic of South Africa. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Overvaal Trust PV Facility, Buffelspoort, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed development of the H₂ Energy Power Station and associated infrastructure on Portions 21; 22 And 23 of the farm Hartebeestspruit in the Thembisile Hani Local Municipality, Nkangala District near Kwamhlanga, Mpumalanga Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.
- Butler, E. 2017. Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.
- Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.
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