BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL PART 2 AMENDMENT

EXISTING GAMMA SUBSTATION AND ASSOCIATED POWERLINES, NORTHERN & WESTERN CAPE PROVINCES

2023

Compiled For

Nala Environmental (Pty) Ltd

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.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

Email: info@banzai-group.com

SIGNATURE:

This Palaeontological Impact Assessment (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.

Table 1: Checklist for Specialist studies in 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.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 3 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 3 – 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 5 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 6 – 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 11	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1;12	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**The relevant section in the report**	**Comment where not applicable.**
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 8 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;	Section 1;12 & 13	
(g) An identification of any areas to be avoided, including buffers	Section 1 & 12	
(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 6 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 8.1 – 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	Section 1 and 12	
(k) Any mitigation measures for inclusion in the EMPr	Section 13	
(l) Any conditions for inclusion in the environmental authorisation	Section 13	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 12	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**The relevant section in the report**	**Comment where not applicable.**
(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	Section 1 and 12	-
(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 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.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**The relevant section in the report**	**Comment where 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 4 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by Nala Environmental (Pty) Ltd to conduct the Palaeontological Assessment for the Part 2 Amendment Process for the proposed Construction of the 765kv Gamma Substation on the Farms Uit Vlugt Fontein No.265 and Schietkuil No.3 in the Pixely Ka Seme and Central Karoo District Municipalities; Western Cape Province and Northern Cape Province (DFFE Ref:. 12/12/20/873/Am2). 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 development is completely underlain by the Hoedemaker Member (Teekloof Formation, Adelaide Subgroup, Beaufort Group, Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of Adelaide Subgroup is Very High (Almond *et al*, 2013; SAHRIS website).

A two day-site-specific field survey of the development footprint was conducted on foot on 25 and 26 June 2022. Only isolated weathered, fossil fragments were identified in the substation footprint. The scarcity of fossil heritage in the study area indicates that the impact of the proposed development will be of a medium significance in palaeontological terms. Various electricity projects have been completed in a 30 km radius of the project. The Palaeontological Sensitivity of these projects will vary from Zero to Very High. However, it is important to note that the quality of preservation of these different sites will most probably vary and it is thus difficult to allocate a Cumulative Sensitivity to the projects. If all the mitigation measures are carried out, a conservative estimate of the Cumulative impacts on fossil Heritage will vary between Low and Medium.

It is thus considered that the proposed development is feasible and will not lead to detrimental impacts on the palaeontological reserves of the area. The construction of the development may thus be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA ((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 mitigation (recording and collection) can be carried out.

These recommendations must be incorporated into the Environmental Management Plan for the proposed project.

TABLE OF CONTENT

List of Figures

List of Tables

1 INTRODUCTION

1.1 Project Specific Information

PROPOSED CONSTRUCTION OF THE 765KV GAMMA SUBSTATION ON THE FARMS UIT VLUGT FONTEIN NO.265 AND SCHIETKUIL NO.3 IN THE PIXELY KA SEME AND CENTRAL KAROO DISTRICT MUNICIPALITIES; WESTERN CAPE PROVINCE AND NORTHERN CAPE PROVINCE (DFFE REF: 12/12/20/873)

An Application for Amendment of the Environmental Authorisation has been submitted to the DFFE for the following Amendments:

1) Addition of Conditions to the EA regarding the Updated Layout (April 2023)
2) Amendment to the project description on Page 3 of the Environmental authorisation related to the updated layout and co-ordinates of the 765kV Gamma Substation
3) Amendment to the Title of the Environmental Authorisation
4) Change the name of contact person and contact details for the Holder of the Environmental Authorisation

1.2 Background

Environmental Authorisation (EA) was issued for the construction of the complete Eskom Gamma Substation on Remainder of Schietkuil No.3 and Portion 1 of the Farm Uit Vlugt fontein No 265. The FEIR (August 2007), Page 4 indicates that "It should be noted that this EIA deals with the complete Gamma Sub-station, although the construction of individual components will be phased, as indicated by electricity demand over the next few years".

In this regard the first phase of the Gamma Substation commenced construction during the original validity period of the Environmental Authorisation and completed construction of these components in 2013. The holder of the EA now proposes to commence construction of the next phase of the authorised development, specifically the **development of a 132/400kV yard at the existing 765kV Gamma MTS and existing 400kV Overhead Lines (OHL) turn-ins**, as provided for in the current EA. The next phase of construction activities associated with the EA is directly linked to the increased demand for grid infrastructure which is linked to upcoming Renewable Energy projects in the Northern and Western Cape Provinces. Importantly, the 132kV/400kV yard and 400kV OHL turn-ins are needed to enable the connection of the authorised Umsinde Emoyeni Wind Farm (DFFE Ref: 14/12/16/3/3/2/686/AM2), which has been selected as a preferred bidder with a private off-taker, and has been registered as a Strategic Integrated Project (SIP).

The proposed 132kV/400kV yard and 400kV OHL turn-ins fall within the scope of the current EA. However – based on further technical analysis and design – it has been identified that the layout of the

authorised infrastructure will need to be updated to reflect the updated configuration proposed to be implemented. The updated layout falls within the scope and footprint of what was originally assessed in the original EIA process, however for the avoidance of doubt the holder wishes to have the updated layout approved by DFFE prior to implementation thereof.

In this regard, the following condition is requested to be included within the Environmental Authorisation:
"The layout titled "**Gamma Substation – April 2023 Layout Map**" submitted with the Part 2 Amendment Application dated April 2023 is hereby approved."

2) Amendment to the project description on Page 3 of the Environmental authorisation related to updated layout and co-ordinates of the 765kV Gamma Substation
From:
"for the construction of proposed 765kV Gamma Substation and associated infrastructure as described in the Scoping Report (SR), dated April 2007 and the Environmental Impact Report (EIR), dated August 2007.

At 31° 40' 38.802''S and 28° 24' 24.234" E and, portion 1 of Farm Uit Vlugt Fontein 265 and bordering Farm Schietkuil 3, which fall within the jurisdiction of Pixley Ka Seme Municipality of the Northern Cape Province and Central Karoo District Municipality in the Western Cape Province, hereafter referred to as "the property".
To:
"for the construction of proposed 765kV Gamma Substation and associated infrastructure as described in the Scoping Report (SR), dated April 2007, the Environmental Impact Report (EIR), dated August 2007 and layout titled "**Gamma Substation – April 2023 Layout Map**" submitted with the Part 2 Amendment Application April 2023".

At 31°40'47.37"S and 23°24'44.67"E, portion 1 of Farm Uit Vlugt Fontein 265 and bordering Farm Schietkuil 3, which fall within the jurisdiction of Pixley Ka Seme Municipality of the Northern Cape Province and Central Karoo District Municipality in the Western Cape Province, hereafter referred to as "the property".

3) Amendment to the Title of the Environmental Authorisation
The properties on the title page (Page 1) of the Environmental Authorisation are different to those described on Page 3 of the EA and all other references to these properties. The properties on Page 3 of the EA are correct and have been authorised as per those indicated in the FEIR 2007.
It is therefore requested that title of the Environmental Authorised be corrected as follows:
From:

"Proposed construction of the 765KV Gamma Substation on the Farms Uit Vlugt Fontein No.233 and Schietkuil No.3 in the Pixley Ka Seme and Central Karoo District Municipalities: Western Province and Northern Cape Province"

To:

"Proposed construction of the 765KV Gamma Substation on the Farms Uit Vlugt Fontein No.265 and Schietkuil No.3 in the Pixley Ka Seme and Central Karoo District Municipalities: Western Province and Northern Cape Province"

4) Change to the name of contact person and contact details for the Holder of the Environmental Authorisation

From:

"Ms C Streaton
Eskom Holdings Limited
P O Box 1091
Johannesburg
2000
Tel: (011) 800- 5411
Fax: (011) 800-3917"

To:

"Ms Martina Phiri
Eskom Holdings SOC Limited
P O Box 1091
Johannesburg
2000
Tel: 011 800 3550
Email: PhiriM@eskom.co.za"

Following submission of the Application the DFFE indicated that amendments related 1) and 2) i.e., reconfiguration and realignment of the 400kV Doërivier- Hydra No.2 400kV powerline to turn-in to the Gamma Substation yard would need to undertaken as a Part 2 Amendment Application following review of the EIAr dated August 2007. The EIAr dated August 2007 placed emphasis on the assessment of the Gamma Substation and has not been clear on a corridor or footprint that was assessed for the proposed future turn-in of the existing 400kV powerline infrastructure although mentioned within the report. The existing EA, read together with the EIAr, clearly contemplate and provide for the development of up to six 400kV OHL turn-ins within the assessment area, however it is noted that the EIAr (2007) does not describe or illustrate this with more specificity. Therefore, a Part 2 Amendment Application is to be undertaken to comparatively assess the impacts associated with the turn-in of the existing 400kV powerlines to the Gamma Substation yard and associated amendments as described below:

1) Addition of Conditions to the EA regarding the Updated Layout (April 2023)

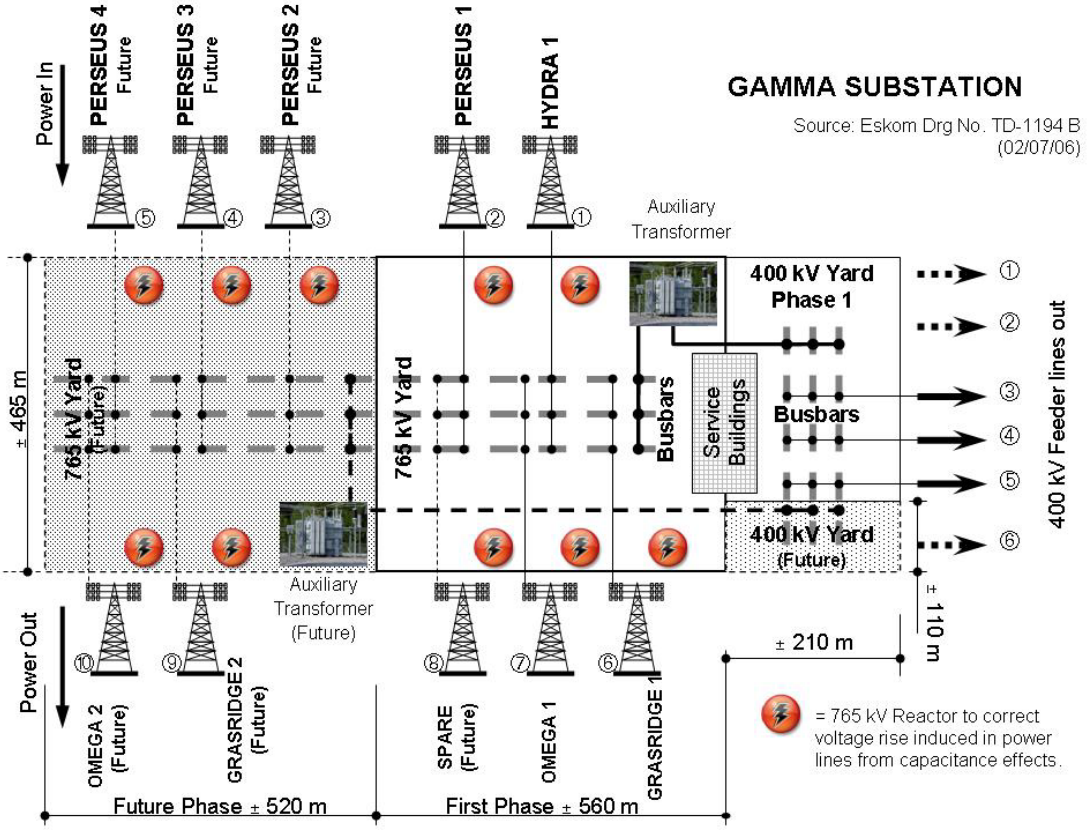
In 2007, an Environmental Authorisation was issued for the Gamma Substation located on Farm Uit Vlugt Fontein No. 265 and Farm Schietkuil No.3, Northern & Western Cape Province. As per the FEIR (2007), the project timeframes indicate that in order to meet the expected electricity demand, the Gamma Substation would be developed in phases as required by growth in electricity demand (Page 24 of the FEIR). The Environmental Authorisation for the Gamma Substation and associated infrastructure was issued by the Department of Environment and Tourism (now the Department of Forestry, Fisheries and the Environment) on the 19 November 2007 (Ref: 12/12/20/873) and layout as submitted with the FEIR (2007) approved.

Since the Environmental Authorisation was issued, the first phase of the authorised Gamma Substation commenced with construction within the validity period of the Environmental Authorisation and concluded construction on the first phase in 2013.

The holder of the EA now proposes to commence construction of the next phase of the authorised substation development, specifically the development of a 132/400kV yard at the MTS and 400kV OHL turn-ins. The phase of the Gamma MTS development that will now be implemented will consist of:

• A substation yard with a step-up voltage of 132kV/400kV on Farm Schietkuil 3 and Farm Uit Vlugt Fontein 265; and

• In addition, the existing Eskom 400kV overhead powerline that currently bypasses the existing Gamma Substation (i.e., the "Droerivier- Hydra No. 2" 400kV OHL) will be reconfigured to turn-in and turn-out of the new substation yard.



The above components are represented by the "400kV Yard Phase 1" and "400kV Feeder Lines" (turn-ins) shown in the schematic diagram below, extracted from the original fEIR (2007). The next phase of construction activities associated with the EA is directly linked to the increased demand for grid connection capacity which is linked to upcoming Renewable Energy projects in the Northern and Western Cape Provinces. Importantly, the 132kV/400kV yard and 400kV OHL turn-ins are needed to enable the connection of the authorised Umsinde Emoyeni Wind Farm (DFFE Ref: 14/12/16/3/3/2/686/AM2), which has been selected as a preferred bidder with a private off-taker, and has been registered as a Strategic Integrated Project (SIP).

The proposed 132kV/400kV yard and 400kV OHL turn-ins fall within the scope of the current EA. However – based on further technical analysis and design – it has been identified that the layout of the authorised infrastructure will need to be updated to accommodate the updated configuration/layout now proposed to be implemented. The updated layout falls within the scope and footprint of what was originally assessed in the original EIA process.

Following further Eskom planning related to future demand and upcoming renewable energy facilities set to come online in the near future, Eskom has considered an updated layout of the Gamma Substation to accommodate for the additional capacity. The updated layout falls within the assessed properties in the FEIR (2007) and related specialist studies and as authorised within the Environmental Authorisation (Ref:.12/12/20/873). The updated layout also falls within the existing servitude rights held by Eskom over the properties.

• The layout is located on Portion 1 of the Farm Uit Vlugt Fontein 265 and bordering Farm Schietkuil 3 and consists of a substation yard with a step-up voltage of 132kV/400kV, that borders Farm Schietkuil 3 and 400kV turn-in infrastructure.
• In addition, the existing Eskom 400kV overhead powerline that currently bypasses the existing Gamma Substation will be reconfigured to turn-in and turn-out of the new substation yard.

The FEIR (2007), Page 16, indicates that "there will also be turn in lines from the existing 400kV lines to the substation".

Currently there are no 400kV turn-in lines that have been constructed for the existing phase of the Gamma Substation, with only 765kV constructed.
The updated layout, will consist of the existing 400kV Hydra- Droerivier 2 overhead powerlines being reconfigured to turn-in to the new 400kV/132kV Gamma Substation yard. This is in compliance with the specifications of the FEIR (2007), and is schematically represented by the "400kV Feeder lines" shown in the above image.

Footprint of the Authorised Gamma Substation:

According to the FEIR (2007), Page 16, "When finally completed, the substation itself will cover about 1 290m x 465m (approximately 60ha) (when measured in terms of the outer perimeter lines of the terraces and security fence)."

The footprint of the already constructed first phase of the existing Gamma Substation is approximately 28 ha. The 132kV/400kV yard that will now be implemented is approximately 14ha, within the already authorised Gamma substation footprint.

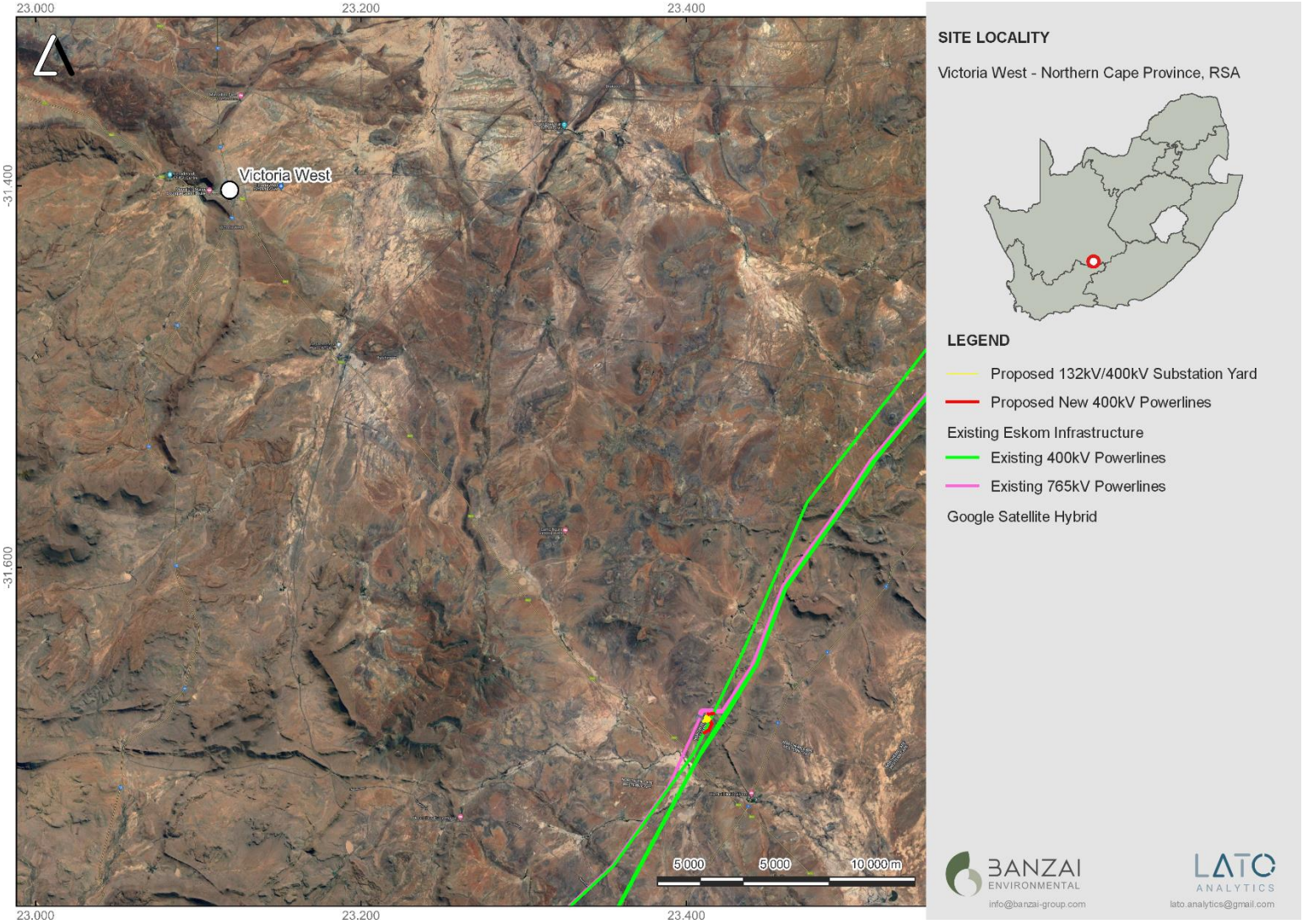


***Figure 1**: Regional locality of the 765kv Gamma Substation on the Farms Uit Vlugt Fontein No.265 And Schietkuil No.3 in the Pixely Ka Seme and Central Karoo District Municipalities; Western Cape Province and Northern Cape Province.*

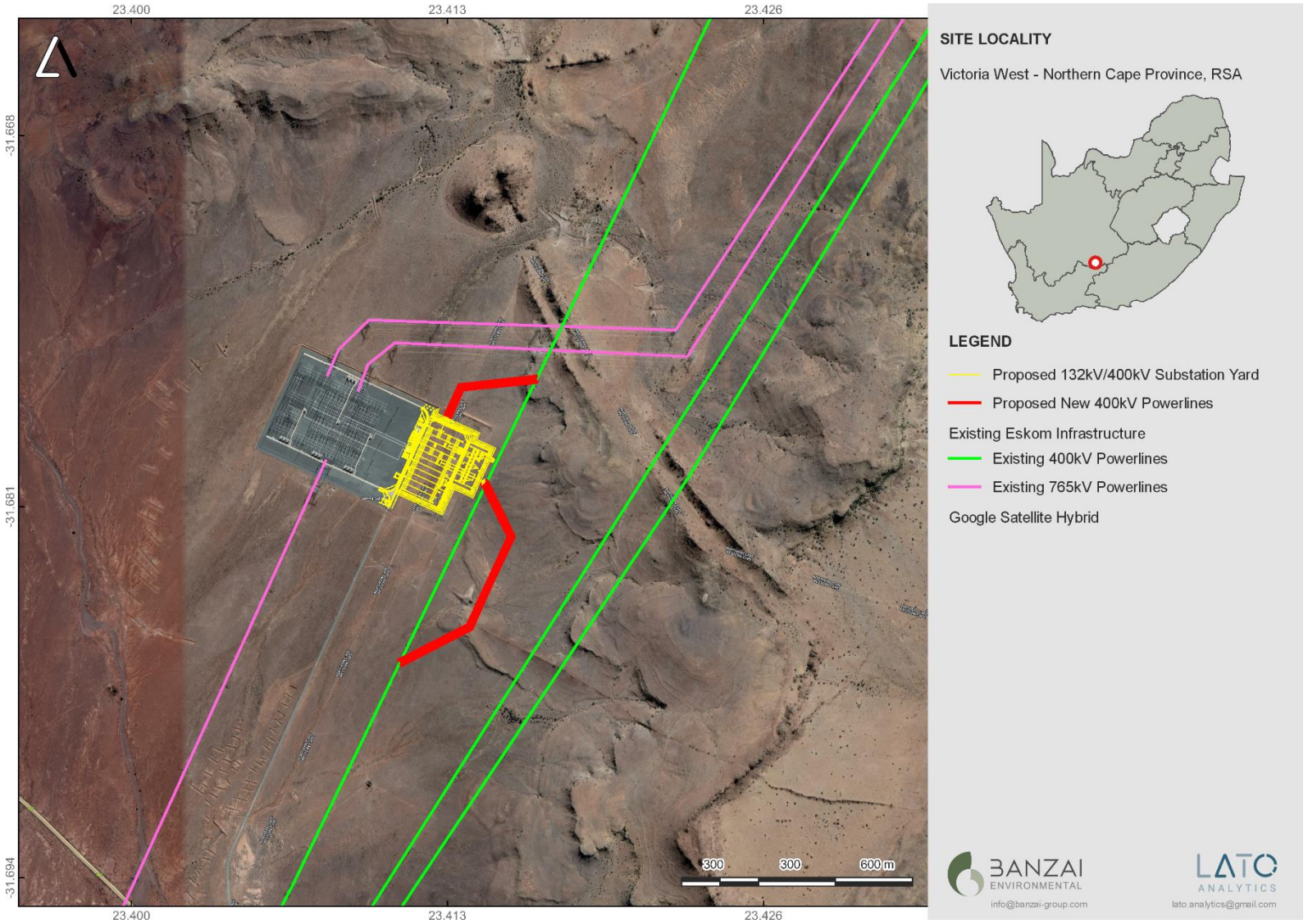


***Figure 2**: Detailed view of the proposed development.*

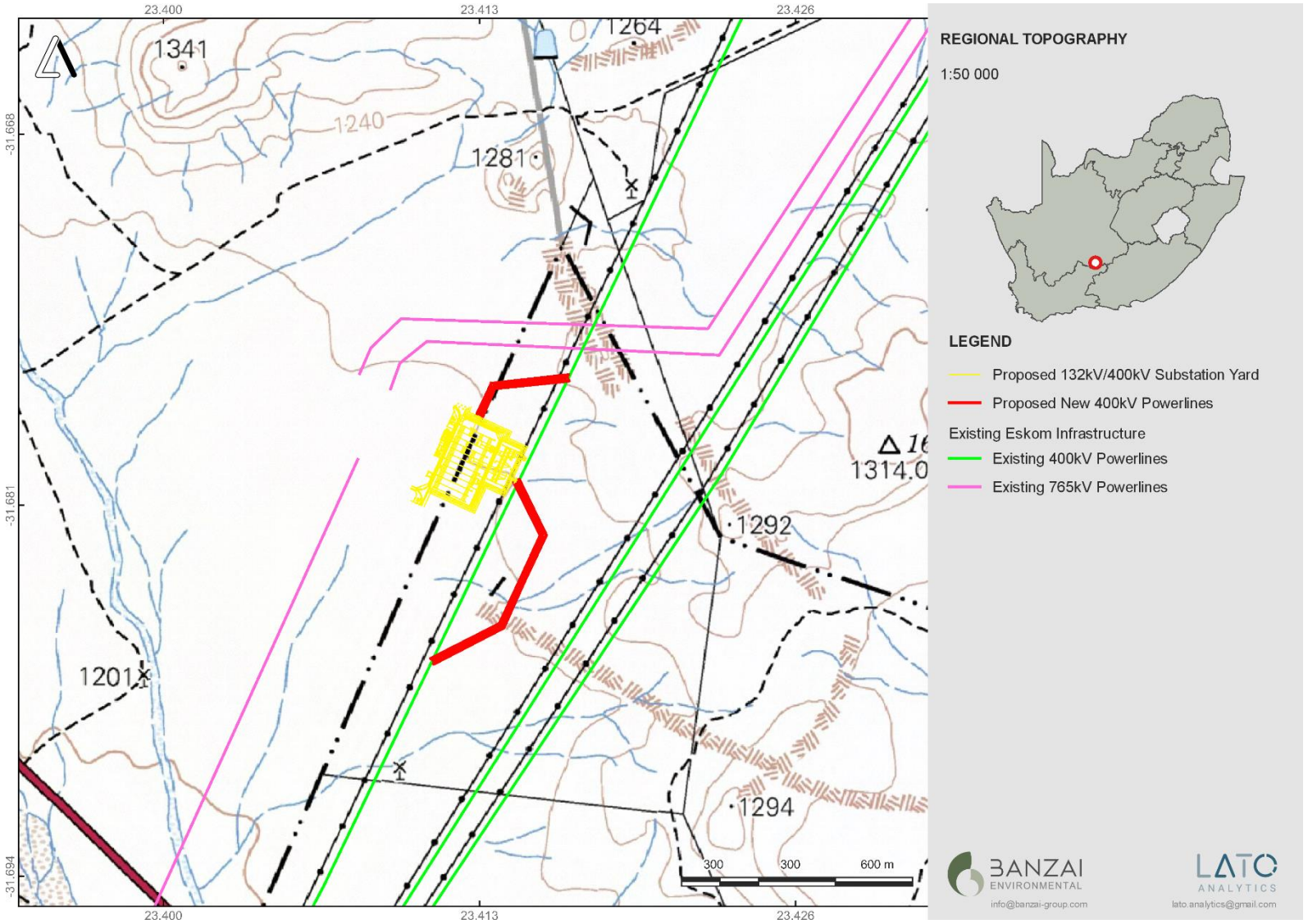


***Figure 3**: Locality Map of the proposed development.*

2 PREVIOUS STUDIES

The original studies for the authorised Eskom Gamma Substation on Remainder of Schietkuil No.3 and Portion 1 of the Farm Uit Vlugt fontein No 265 was conducted in 2007.

Butler (2022) conducted a Palaeontological Impact Assessment for the proposed Power Line and Grid connection for the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities.
This study included the development of a 132kV powerline, 132kV on-site substations/ switching stations, extended development corridor that will enable the 132kV powerline to connect either to the south face of the Gamma substation yard or approach from the east, as well as new access/service tracks and watercourse crossing points associated with the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities

The author found that the development is underlain by Quaternary superficial deposits, Balfour and the Teekloof Formations of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) with large areas of the development footprint underlain by Jurassic dolerite. (See **Figure 4**). The Gamma substation and associated powerline connections is underlain by the Hoedemaker Member (Teekloof Formation, Adelaide Subgroup Karoo Supergroup) while the grid connection is partially underlain by Jurassic Dolerite as well (**Figure 5**).

Butler (2022) found that no Palaeontological Impact assessment was conducted for the Eskom Gamma Substation in 2007.

And thus, this study has been commissioned for the Phase 2 Amendment,

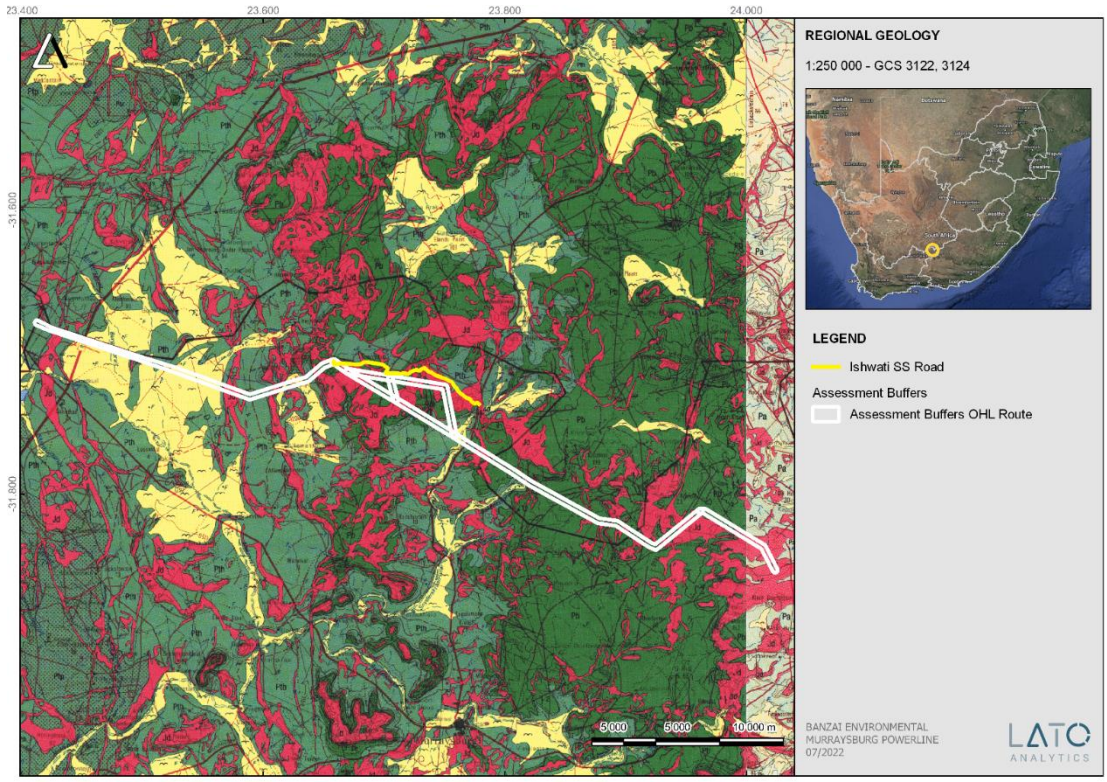


Figure 4: Extract of the 1:250 000 Victoria West 3122 (1989) and 3124 Middelburg (1997) Geological map (Council of Geoscience, Pretoria) indicating the surface geology of the proposed development (Image taken from Butler, 2022)

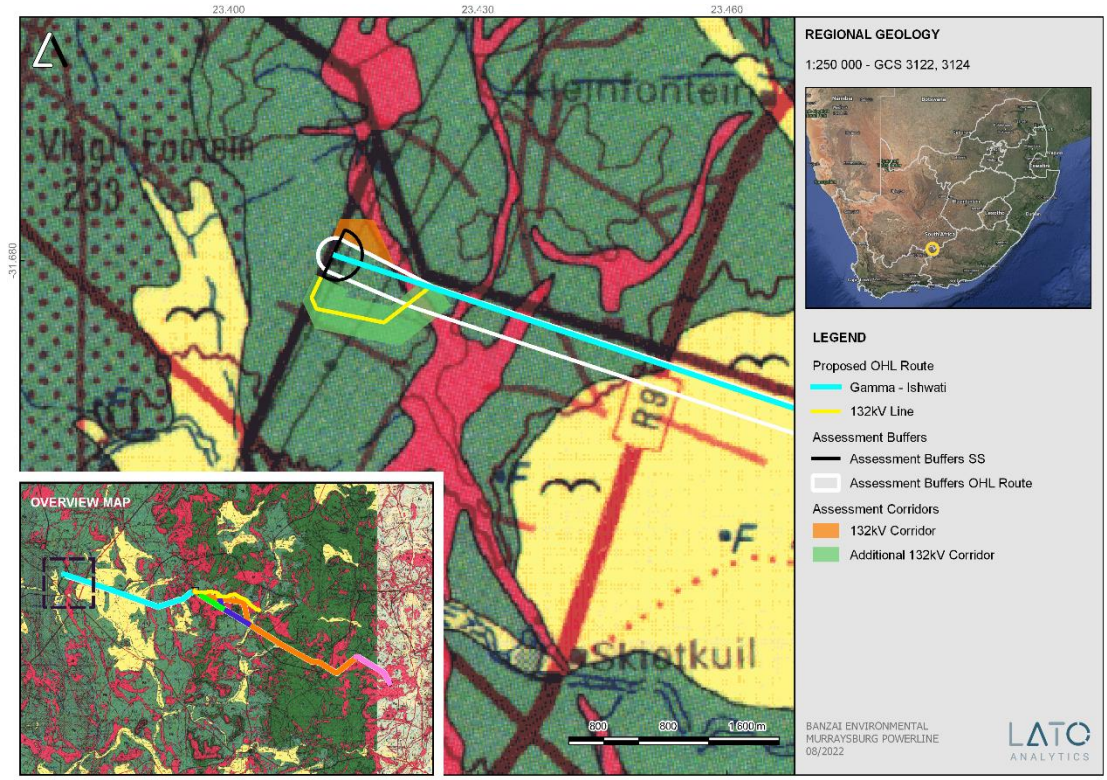


***Figure 5**: Extract of the 1:250 000 Victoria West 3122 (1989) Geological map (Council of Geoscience, Pretoria) indicating the Gamma substation and western margin of the proposed development underlain by Jurassic dolerite (red, Jd), Quaternary superficial deposits (yellow, single bird figure), and Teekloof (Pto/Pth, dark green) Formation of the Adelaide Subgroup (Image taken from Butler,2022)*

A site investigation was conducted for the entire development (which assessed a corridor that included the proposed Gamma Substation yard and proposed 400kV turn-in footprint). A few weathered, isolated fossils were identified in the Gamma Substation development and an overall medium palaeontological significance was allocated to the whole development project.

3 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 400 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, 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 twenty-eight 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.

4 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 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 m^2 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 m^2 in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

5 OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to decrease the effect of the development on potential fossils at the development site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to clarify the **impact** on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

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.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of 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 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
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

6 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The Gamma Substation development is indicated on the 1:250 000 Victoria West 3122 (1989) Geological Map (Council for Geosciences, Pretoria) (**Figure 6**). The development is completely underlain by the Hoedemaker Member (Pth, green) (Teekloof Formation, of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup (**Figure 6; Table 2**). Jurassic dolerite underlies the area on the most western portion of the 400kv Powerline. These sediments are mantled by Quaternary deposits as elsewhere in the country, but this is not indicated on the 1: 250 000 Geological Map.

This part of the basin is extensively intruded by dolerite (Jd, red) dykes and sills and the surrounding Beaufort Group sediments have been baked thus compromising the fossil heritage of the area through thermal metamorphism (**Figure 7**). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of Adelaide Subgroup is Very High, while that of the Jurassic dolerite is Zero (Almond *et al*, 2013; SAHRIS website).

The Quaternary superficial deposits are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). The rocks and sediments are found at or near the Earth's surface. Pre-Quaternary deposits are known as bedrock. Most of the superficial deposits are unconsolidated sediments and consist of clay, gravel, sand, silt, that form relatively thin, discontinuous patches of sediments or larger spreads onshore. These sediments comprise of beach sand, channel, floodplain and stream deposits, talus gravels and glacial drift sediments.

The Quaternary deposits reveal palaeoclimatic changes in the different geological formations (Hunter et al., 2006). The climatic fluctuations in the Cenozoic Era were responsible for the formation of most geomorphologic features in southern Africa (Maud, 2012). Various warming and cooling events occurred in the Cenozoic but climatic changes during the Quaternary, specifically the last 1.8 Ma, were the most drastic relative to all climate variations in the past (Barnosky, 2005). Climate in the Quaternary were drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Caenozoic deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from Quaternary. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria and rhizoliths.

As already mentioned, the area is extensively intruded by dolerite dikes and sills (Jd, red) of the Karoo Igneous Province and the area is known for its dolerite koppies. The Karoo Igneous Province in southern

Africa is a classic continental flood basalt province that was formed during the Early Jurassic Period. This province occurs over a comprehensive area in southern Africa and comprises a widespread system well developed igneous bodies (dykes, sills) that invaded the sediments of the Main Karoo Basin. Flood basalts do not typically form any visible volcanic structures, but with a series of outbursts form a suite of fissures of sub-horizontal lava flows that may vary in thickness. The Karoo is an old flood basalt province and is preserved today as erosional remnants of a more extensive lava cap that covered much of southern Africa in the geological past. This Suite is entirely unfossiliferous.

The flood plains of the Beaufort Group (Karoo Supergroup) are internationally renowned for the early diversification of land vertebrates and provide the worlds' most complete transition from early "reptiles" to mammals. The Beaufort Group is subdivided into a series of biostratigraphic units based on its faunal content (Kitching 1977; Keyser *et al*, 1977; Rubidge 1995; Smith *et al*, 2020; Viglietti 2020). The proposed development is underlain by the Hoedemaker Member of the Teekloof Formation. The stratigraphically younger Poortjie Formation is biostratigraphically represented by the Endothiodon Assemblage Zone (AZ). This biozone is subdivided by the *Tropidostoma-Gorgonops and* the *Lycosuchus-Eunotosaurus* Subzones (**Table 2**), while the *Abrahamskraal* Formation is represented by the *Tapinocephalus* and upper Eodicynodon AZ.

Day and Smith (2020) proposed a subdivision of the Endothiodon AZ in the *lower Lycosuchus - Eunotosaurus* Subzone and the upper *Tropidostoma - Gorgonops* Subzone. The contact between these subzones is represented by the first appearance of Tropidostoma dubium. The first appearance of *Aulacephalodon bainii* terminates the Endothiodon AZ

The *Endothiodon* AZ is comparable with much of the Middleton Formation (east of 24°E) as well as the lower Teekloof Formation (west of 24°E). Day *et al* (2015) found that the *Endothiodon* Assemblage Zone West of 24°E is present in the upper two thirds of the Poortjie Member (Day *et al*., 2015) overlying the Hoedemaker Member except in the upper strata. Near Victoria West the lithostratigraphy may vary due to thinning of lithostratigraphic units (Day and Rubidge, 2019) (Day and Rubidge, 2019).

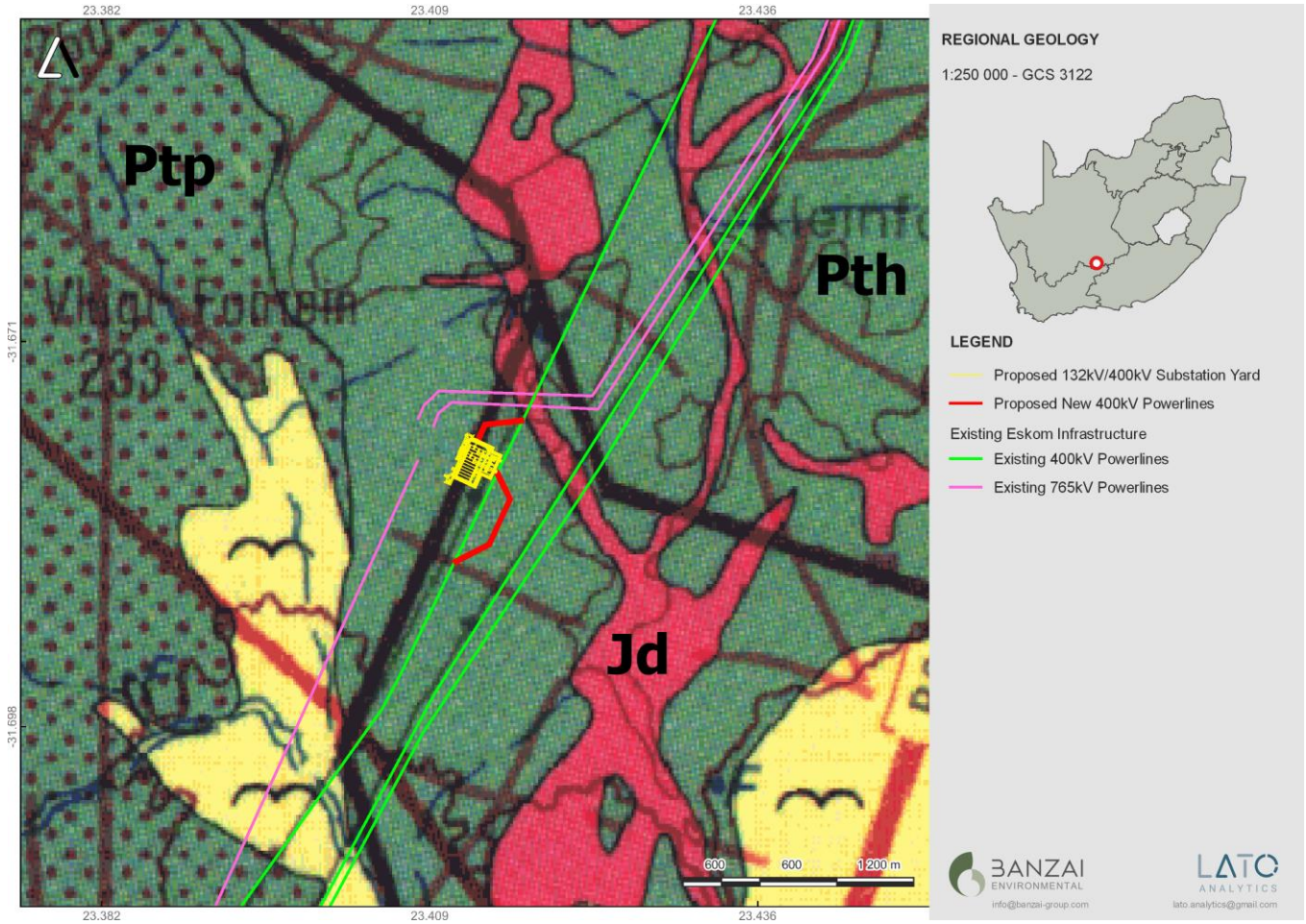
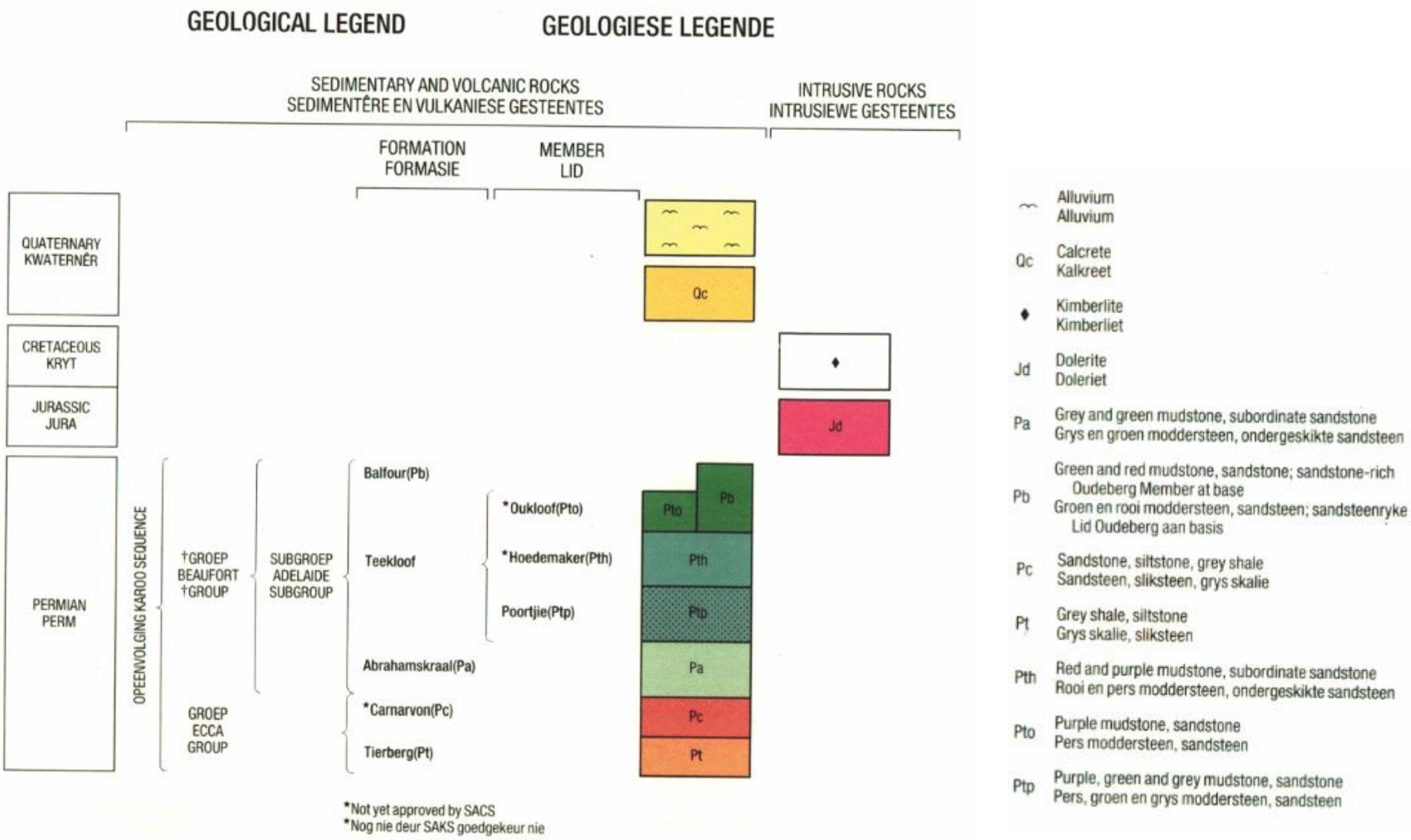


***Figure 6**. Extract of the 1:250 000 Victoria West 3122 (1989) Geological Map (Council for Geosciences, Pretoria) indicating the geology of the 765kv Gamma Substation. The substation development is completely underlain by the Hoedemaker Member (Pth, green) (Teekloof Formation) of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup while some of the power lines is underlain by Jurassic Dolerite (Jd, red).*

Table 2: Legend of the 1:250 000 Victoria West 3122 (1989) Geological Map (Council for Geosciences, Pretoria)



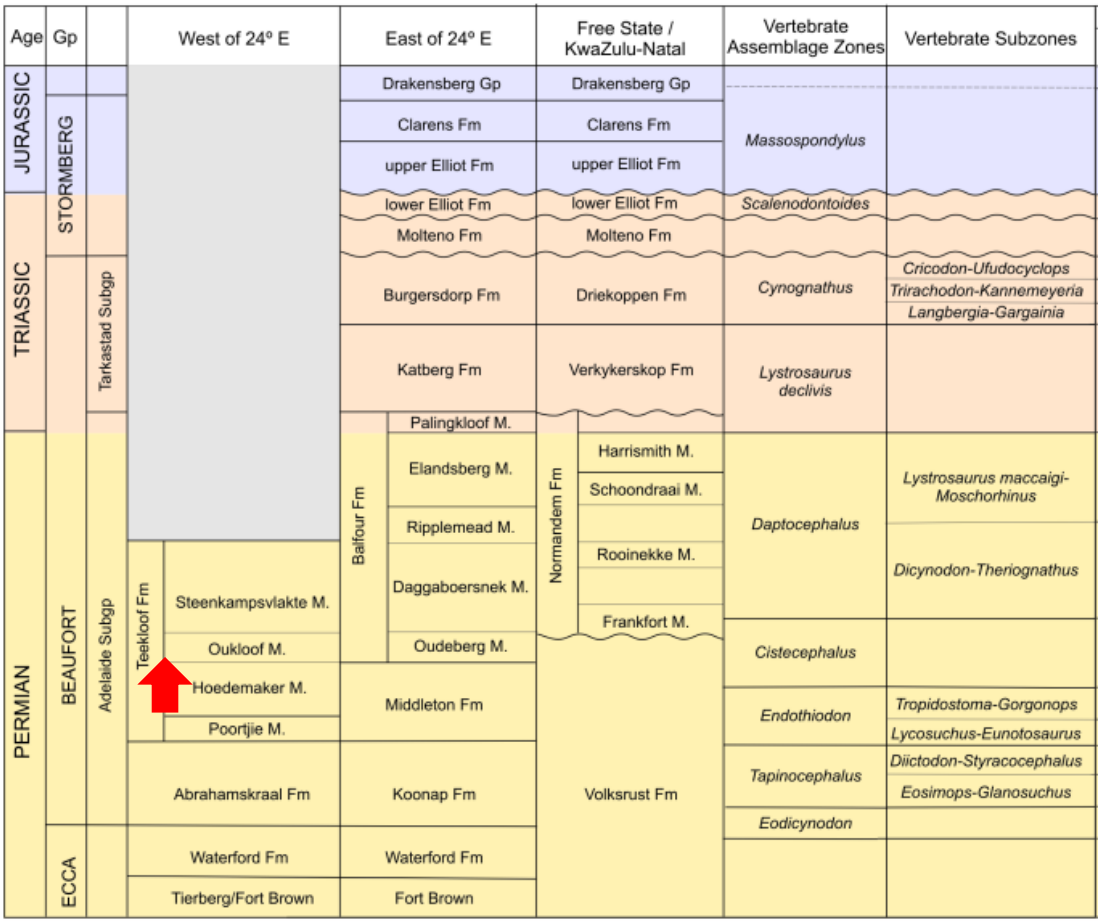


***Figure 7**: Vertebrate biozonation range chart for the Main Karoo Basin of South Africa. Solid lines indicate known ranges, dotted lines indicate suspected but not confirmed ranges, single dot represents the stratigraphic position of the taxa that have only been recovered from a single bed. Wavy lines indicate unconformities. (PLYCSR=Pelycosauria and MAMMFMES+Mammaliaformes. Gp=group, Subgp-Supbroup, Fm=Formation, M=Member. The proposed cemetery development is indication by the red arrow*

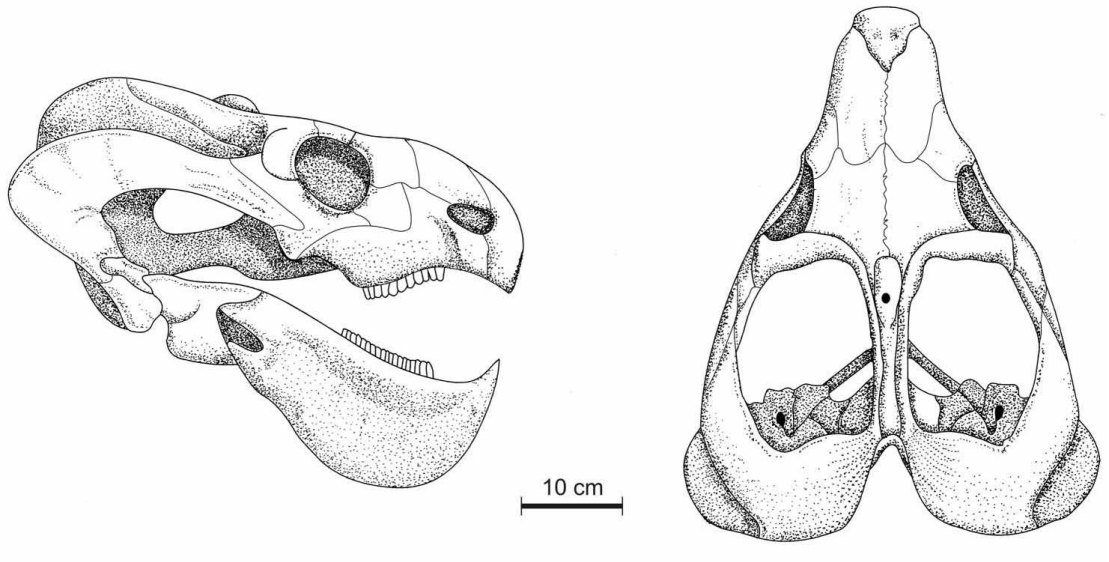


***Figure 8**: Endothiodon bathystoma, in lateral and dorsal views is the biozone defining fossil of the Endothiodon Assemblage Zone*

The dicynodont genera *Endothiodon* (**Figure 8**), *Emydops, Diictodon, Pristerodon* and the gorgonopsian Gorgonops characterizes the *Endothiodon* AZ. In South Africa, *Endothiodon* is most probably represented by the single species *Endothiodon bathystoma* (Brink, 1986; Cox and Angielczyk, 2015; Maharaj, 2018) that becomes abundant after the Capitanian mass extinction. Endothiodon is very rarely recovered from other intervals.

Characterizing taxa of the *Lycosuchus – Eunotosaurus* Subzone is *Eunotosaurus africanus* and the lycosuchid theroceohalian *Lycosuchus vanderrieti* that co-occur with Endothiodon (**Figure 9**). This Subzone represents the first stage of ecological recovery after the Capitanian mass extinction. (Day *et al*., 2013; Kammerer *et al*., 2015) and records the stratigraphically lowest occurrence of large gorgonopsians and bauroid therocephalians. Basal therocephalians include the scylacosaurid *Glanosuchus macrops* while the small gorgonopsian *Eriphostoma microdon* is also present in this Subzone. This Subzone mostly corresponds with the arenaceous Poortjie Member with a sandstone mudrock ratio of 1:2. A sudden increase of sandstone bodies is present at the base of this member and the change from single-storied to multi-storied channel sandstone geometries. Mudrocks are represented by subordinate dark-reddish brown mudstone and greenish-grey siltstone. Roussouw and De Villiers [1952) describes calcareous nodular horizons that weathers to a brown colour as well as thin sheets of pink-weathering silicified siltstone.

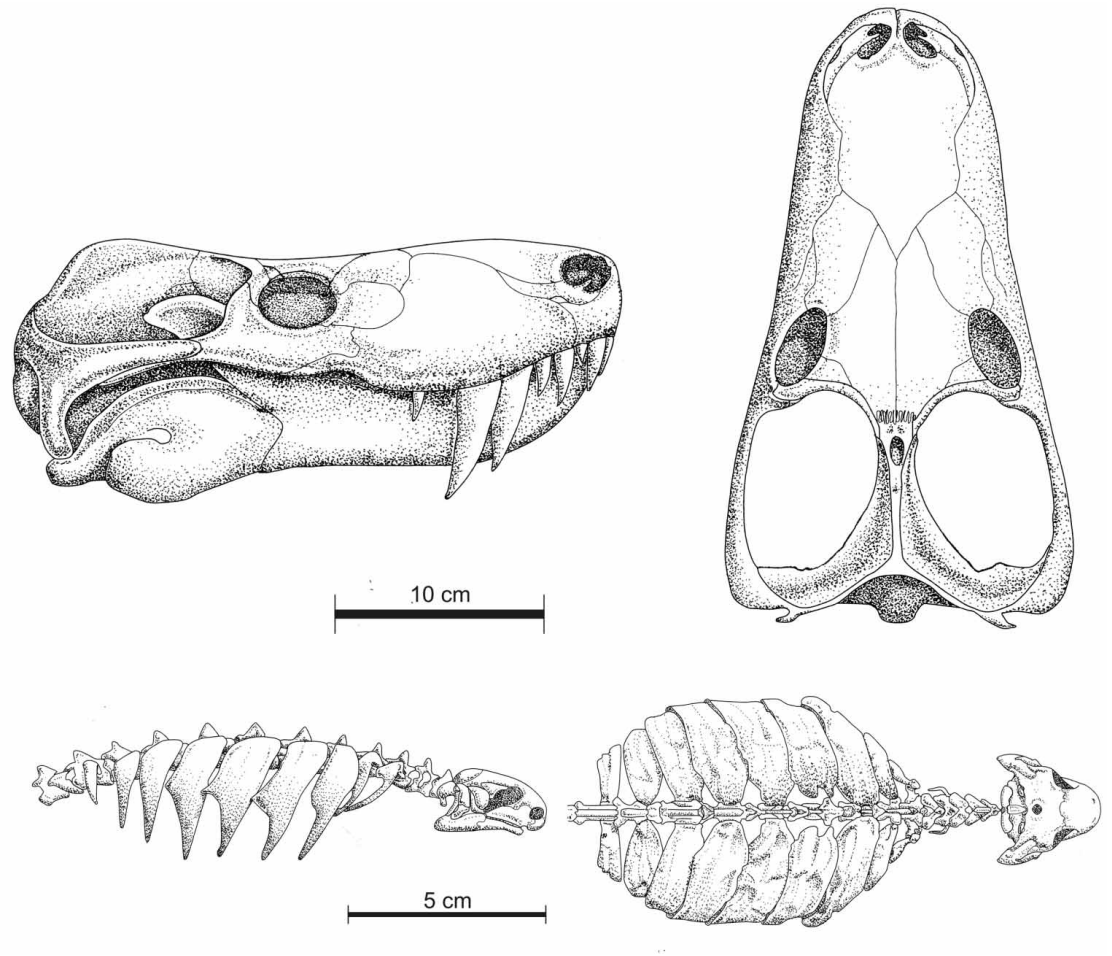


***Figure 9**: Lateral and dorsal views of Lycosuchus vanderrieti (top), and Eunotosaurus africanus (bottom), the biozone defining taxa of the Lycosuchus – Eunotosaurus Subzone (Taken from Day and Smith, 2020)*

A renewed uplift in the Gondwanides (about 260 Mya) caused a variety of sand-dominated braided streams flowing northeasterly and crossing the southern Karoo alluvial plains in the direction of an intracontinental sea (Rubidge, 2005). The arenaceous Poortjie Member preserves these channels. Renewed tectonism is indicated by the presence of various laterally continuous thin sheets of silicified mudrocks (Rossouw and De Villiers, 1952). These sediments are rich in in volcanic ash (Ho Tun, 1979). The *Abrahamskraa*l and *Teekloof* Formations contains these tuffaceous horizons. Radiometric dates indicate that the base of the Poortjie Member is about 260 260 My while the upper boundary is about 259 and 258 Ma (Day *et al*., 2015, Lucas and Shen, 2018).

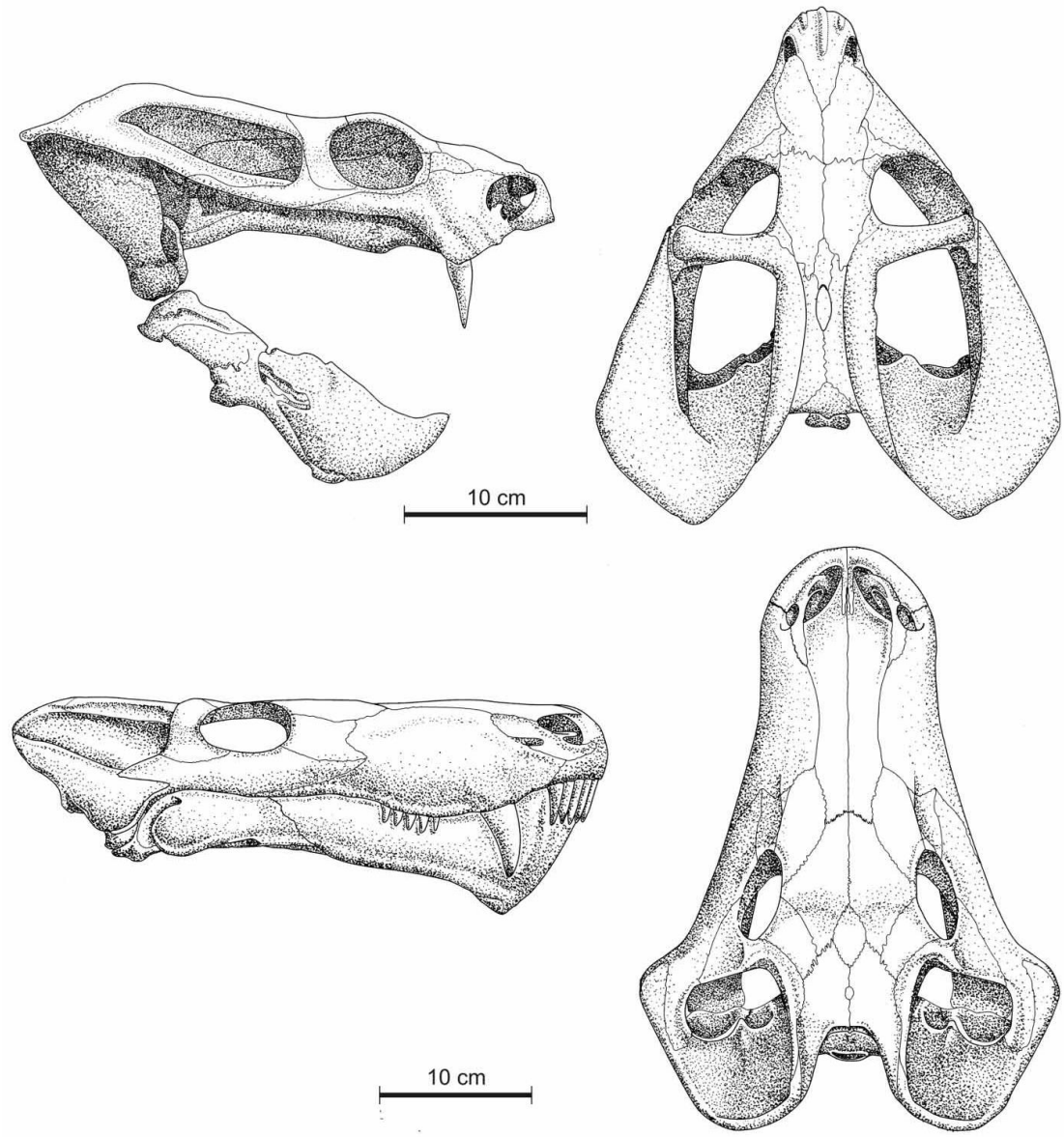


***Figure 10**: Lateral and dorsal views of the index taxa of the Tropidostoma – Gorgonops Subzone namely (top) Tropidostoma dubium, (bottom) Gorgonops torvus*

The predominantly mudrock *Tropidostoma-Gorgonops* Subzone is a sequence of fluvio-lacustrine strata. Vertebrate fossils are mostly found in massively bedded thick greenish-grey siltstone with minor mudstone intercalations occurring between the main channel sandstones. These sediments are thick coarsening upwards sequences of between 5 to 10m thick and is understood to be prograding crevasse splay complexes. The latter was deposited by repeated overbank flood events originating from the channel banks and accumulating in lowland flood basins. Scattered oblate pedogenic carbonate nodules forming horizons is present in massive siltstones. This is interpreted to be calcic vertisols that were deposited under a seasonally dry humid-temperate climate (Smith, 1993) at the base of meanderbelt slopes.

The *Tropidostoma - Gorgonops* Subzone has a greater abundance of taxons than the *Lycosuchus - Eunotosaurus* Subzone (**Figure 10**). This Subzone is characterised by the presence of rare basal cynodonts. large gorgonopsians,

basal baurioid therocephalians, cryptodont dicynodonts, and small pareiasaurs. Fossils in this Subzone is predominately found in overbank facies

Fossils of the *Tropidostoma-Gorgonops* Subzone are mainly found in the overbank facies — particularly in the fine-grained sandstone and massive siltstone sheets of the proximal floodplain facies (Smith, 1993). This subzone is known for its dense cluster of *Diictodon* skulls that are found in a patch of 20 to 50m. *Diictodon* (Smith, 1993) and *Youngina* (Smith and Evans, 1995) juvenile aggregations has been described in the literature.

Fossils are usually disarticulated unweathered, well-preserved specimens while fully articulated specimens are usually intercurled paired skeletons. Fossils bones are usually enclosed in smooth-surfaced calcareous pedogenic nodular material. Rare burrow casts accredited to the digging activity of dicynodonts is present in the in the lower part of the subzone but absent in the upper section. Coprolites comprising of bones has also been recovered. The *Tropidostoma - Gorgonops* Subzone reaches a thickness of between 130 and 150m along the Nuweveld escarpment and becomes thinner in the north (Day and Rubidge, 2019).

6.1 Layout Comparison

As mentioned, in section 2 of this report, the original studies for the authorised Eskom Gamma Substation on Remainder of Schietkuil No.3 and Portion 1 of the Farm Uit Vlugt fontein No 265 was conducted in 2007. **However, No Palaeontological study was conducted for the development**. The study conducted by Butler (2022) was thus used as the basis of the layout for the present report. When comparing the layout of the substation and grid connection of the 2022 study (which assessed a corridor that included the proposed Gamma Substation yard and proposed 400kV turn-in footprint) (**Figure 4-5**) with the present study (**Figure 7**) it is evident that both layouts are underlain by the Hoedemaker Member as well as Jurassic Dolerite.

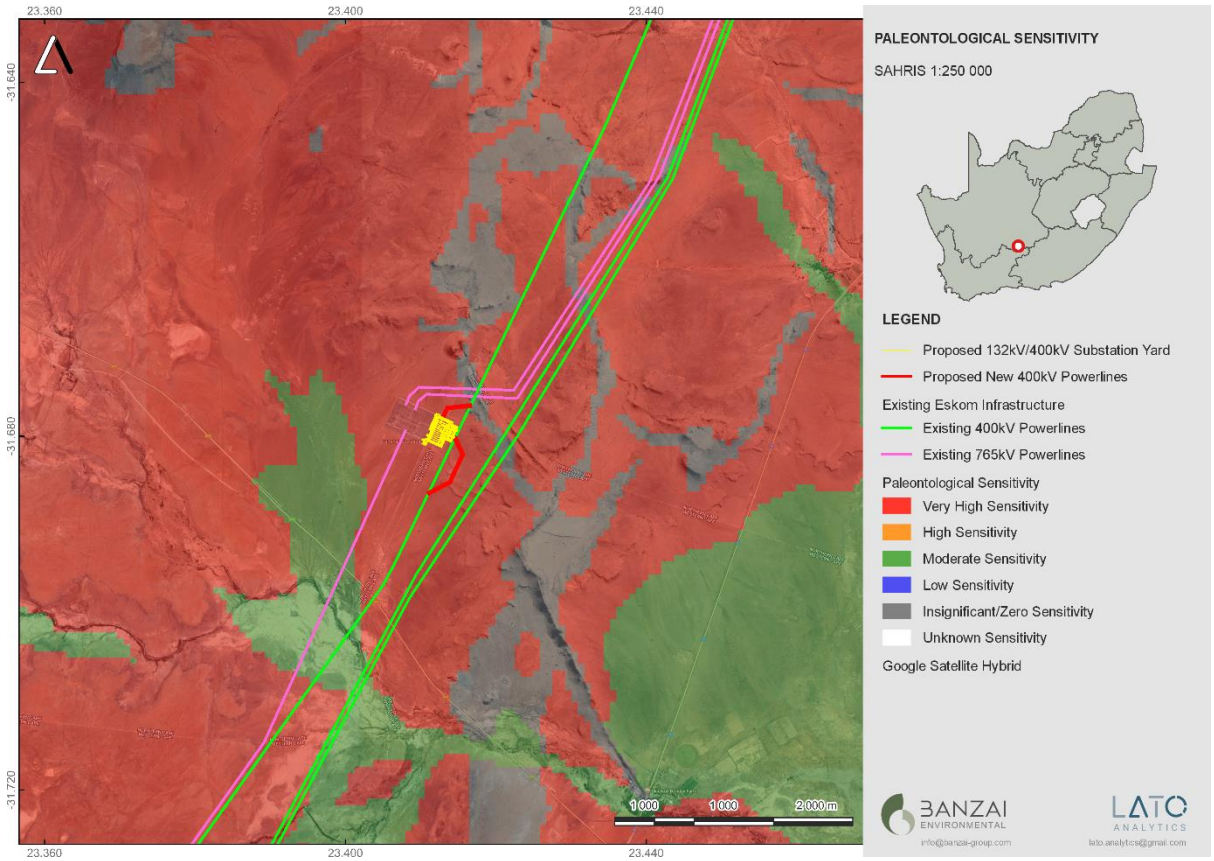


***Figure 11**: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the development in yellow.*

According to the SAHRIS Palaeosensitivity map (**Figure 11**) the development is underlain by sediments with a Very High (red), 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.

The colors on the PalaeoMap indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

7 GEOGRAPHICAL LOCATION OF THE SITE

The proposed 765kv Gamma Substation is located on the Farms Uit Vlugt Fontein No.265 and Schietkuil No.3 in the Pixely Ka Seme and Central Karoo District Municipalities; Western Cape Province and Northern Cape Province

8 METHODS

The aim of a desktop study is to evaluate the possible risk to palaeontological heritage in the proposed development. This includes all trace fossils as well as all fossils in the proposed footprint. All possible information is consulted to compile a desktop study, and this includes the following: all Palaeontological Impact Assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

8.1 Assumptions and Limitations

The focal point of geological maps is the geology of the area and the sheet explanations of the Geological Maps were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Areas with similar Assemblage Zones in other areas is also used to provide information on the existence of fossils in an area which has not documented in the past. When using similar Assemblage Zones and geological formations for Desktop studies it is generally **assumed** that exposed fossil heritage is present within the footprint. A field-assessment will thus improve the accuracy of the desktop assessment.

As previously stated: The original studies for the authorised Eskom Gamma Substation on Remainder of Schietkuil No.3 and Portion 1 of the Farm Uit Vlugt fontein No 265 was conducted in 2007. **No Palaeontological Impact Assessment was conducted during the 2007 EIA. Butler 2022) conducted a PIA for the proposed Power Line and Grid connection for the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities. This study and layout were thus utilized as the basis for the current study.**

9 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)
- Palaeontological Sensitivity Map on SAHRIS
- A Google Earth kmz files of the proposed development was obtained from Nala Environmental as well as background information.
- Topographic maps (1:50 000) of the 3122 Victoria West area.
- 1:250 000 Victoria West 3122 (1998) Geological Map (Council for Geosciences, Pretoria)
- eThembeni Cultural Heritage. 2007.Heritage Impact Assessment of Gamma Grassridge Power Lines and Substation, Eastern, Western, and Northern Cape Provinces, South Africa.

10 SITE VISIT

A site-specific field survey of the development footprint was conducted on foot on 25-26 June 2022. Only two fragmented loose fossils were identified in the Gamma Substation and associated grid connection footprint.

Figure 12: View over Gamma Substation

Figure 13*:Western margin of the proposed development indicates low vegetation mantled by Quaternary sediments*

Figure 14:Isolated loose fossil fragments found to the west of the Gamma substation

11 ASSESSMENT METHODOLOGY

Direct, indirect and cumulative impacts of the impacts identified above will be assessed according to the following standard methodology:

- The **nature** which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent** wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The **duration** wherein it will be indicated whether:
    - The lifetime of the impact will be of very short duration (0 - 1 years) – assigned a score of 1;
    - The lifetime of the impact will be of short duration (2 - 5 years) – assigned a score of 2;
    - Medium-term (5 - 15 years) – assigned a score of 3;
    - Long-term (> 15 years) – assigned a score of 4; or
    - Permanent – assigned a score of 5.
- The **magnitude** quantified on a scale from 0 - 10 where 0 is small and will have no effect on the environment, 2 is minor and will result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease) and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1 - 5 where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but of low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **significance** which shall be determined through a syntheses of the characteristics described above and can be assessed as low, medium or high; and
- The **status**, which is described as positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources.
- The degree to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:

$S = (E + D + M) \times P$

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area);
- 30 – 60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated); and
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Table 4: Impact table of the construction phase of 765kv Gamma Substation and associated grid connection

	Without mitigation	**With mitigation**
Extent	Local (3)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Low (20)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes o	Yes
Can impacts be mitigated?	Yes	

Mitigation 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.

The EO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan

Residual Risk: *Loss of Fossil Heritage*

Assessment of Cumulative Impacts

As per DEA's requirements, specialists are required to assess the cumulative impacts. In this regard, please refer to the methodology below that will need to be used for the assessment of Cumulative Impacts.

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities1.

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section should address whether the construction of the proposed development will result in:

» Unacceptable risk

» Unacceptable loss

Complete or whole-scale changes to the environment or sense of place

» Unacceptable increase in impact

The specialist is required to conclude if the proposed development will result in any unacceptable loss or impact considering all the projects proposed

in the area.

Table 5: Cumulative impact table:

Nature: Loss of Fossil Heritage		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (3)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	High (8)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (48)**	**Low (20)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes o	Yes
Can impacts be mitigated?	Yes	Local (1)
Confidence in findings: High.		
Mitigation:		

- 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. The EO will close off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan

Table 6: Recommendations Concerning Fossil Heritage Management During the Construction Phase

OBJECTIVE: Prevent the loss of Palaeontological Heritage

Project component/s	*Damaging impacts on palaeontological heritage occur during the **construction** phase which will modify the existing topography. The proposed development consists of the construction of the 765kv Gamma Substation and associated grid connection*		
Potential Impact	Destroy or permanently close-in fossils at or below the ground surface that are then no longer available for research.		
Activity/risk source	• Activities associated with the construction of the project.		
Mitigation: Target/Objective	Protection of identified fossils uncovered during the construction phase.		
Mitigation: Action/control		**Responsibility**	**Timeframe**
Mitigation comprises of the collection and recording of fossils as well as obtaining data of the surrounding sedimentary matrix within the proposed development footprint by a palaeontologist. This should take place after the preliminary vegetation removal but *before* the ground is levelled for construction. Excavation of this fossil heritage will require a permit from the South African Heritage Resource Agency (SAHRA) and the material must be housed in a permitted institution. All fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA. These recommendations should be incorporated into the Environmental Management Programme for the Photovoltaic Solar Energy Facilities.		Environmental Manager or EO and specialist	Construction phase

12 FINDINGS AND RECOMMENDATIONS

No Palaeontological Impact Assessment was conducted during the original Gamma Station EIA in 2007. Butler (2022) conducted a PIA for the proposed Power Line and Grid connection for the authorised Umsinde Emoyeni and Khangela Emoyeni Wind Energy Facilities. This study and layout were thus utilized as the basis for the current study.

The development is completely underlain by the Hoedemaker Member (Teekloof Formation, Adelaide Subgroup, Beaufort Group, Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of Adelaide Subgroup is Very High (Almond *et al*, 2013; SAHRIS website).

A two day-site-specific field survey of the development footprint was conducted on foot on 25 and 26 June 2022. Only isolated weathered, fossil fragments were identified in the substation footprint. The scarcity of fossil heritage in the study area indicates that the impact of the proposed development will be of a medium significance in palaeontological terms. Various electricity projects have been completed in a 30 km radius of the project. The Palaeontological Sensitivity of these projects will vary from Zero to Very High. However, it is important to note that the quality of preservation of these different sites will most probably vary and it is thus difficult to allocate a Cumulative Sensitivity to the projects. If all the mitigation measures are carried out, a conservative estimate of the Cumulative impacts on fossil Heritage will vary between Low and Medium.

It is thus considered that the proposed development is feasible and will not lead to detrimental impacts on the palaeontological reserves of the area. The construction of the development may thus be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO or site manager in charge of these developments. Fossil discoveries ought to be protected and the ECO/site manager must report to SAHRA ((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 mitigation (recording and collection) can be carried out.

These recommendations must be incorporated into the Environmental Management Plan for the proposed project.

13 CHANCE FINDS PROTOCOL

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

13.1 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.

13.2 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.

This informational document is intended for workmen and foremen on construction sites. 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.

13.3 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 Environmental official employed by the developer 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 coordinates.
- 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 the 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

ELIZE BUTLER

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, 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

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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.
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Butler. E., 2022. Palaeontological Impact Assessment for the Proposed Power Line as part of the Paleso Solar Power Plant near Viljoenskroon in the Free State
Butler. E., 2022. Palaeontological Impact Assessment for the Thakadu Solar Plant which near Viljoenskroon in the Free State
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Butler. E., 2022. Palaeontological Impact Assessment for the proposed Harvard 1 Solar Photovoltaic (PV) facility on Portion 5 of Farm Spes Bona no 2355, Mangaung Metropolitan Municipality in the Free State.
Butler. E., 2022. Palaeontological Impact Assessment for proposed Harvard 2 Solar Photovoltaic (PV) facility on Portion 8 of Farm Spes Bona No 2355, Mangaung Metropolitan Municipality in the Free State.
Butler. E., 2022. Palaeontological Impact Assessment for the proposed Doornrivier Solar 1, southwest of Matjhabeng (formerly Virginia) in the Free State
Butler. E., 2022. Palaeontological Desktop Assessment for the proposed Leeuwbosch PV solar photovoltaic (PV) plant and associated infrastructure on Portion 37 of the Farm Leeuwbosch No. 44 near Leeudoringstad within the Maquassi Hills Local Municipality in the Dr Kenneth Kaunda District Municipality in the North West Province.

APPENDIX 3: SITE SENSITIVITY VERIFICATION

CONTENTS

1 INTRODUCTION

The construction of the Eskom Gamma Substation was authorised by the Department of Environmental Affairs in 2007. The approval was for constructing the complete Gamma substation. However, it was noted that individual components would be constructed in a phased approach as determined by the electricity demand over several years.

As such, the first construction phase of the Gamma substation commenced during the original validity period of the EA and was completed in 2013 (**Figure S1**).

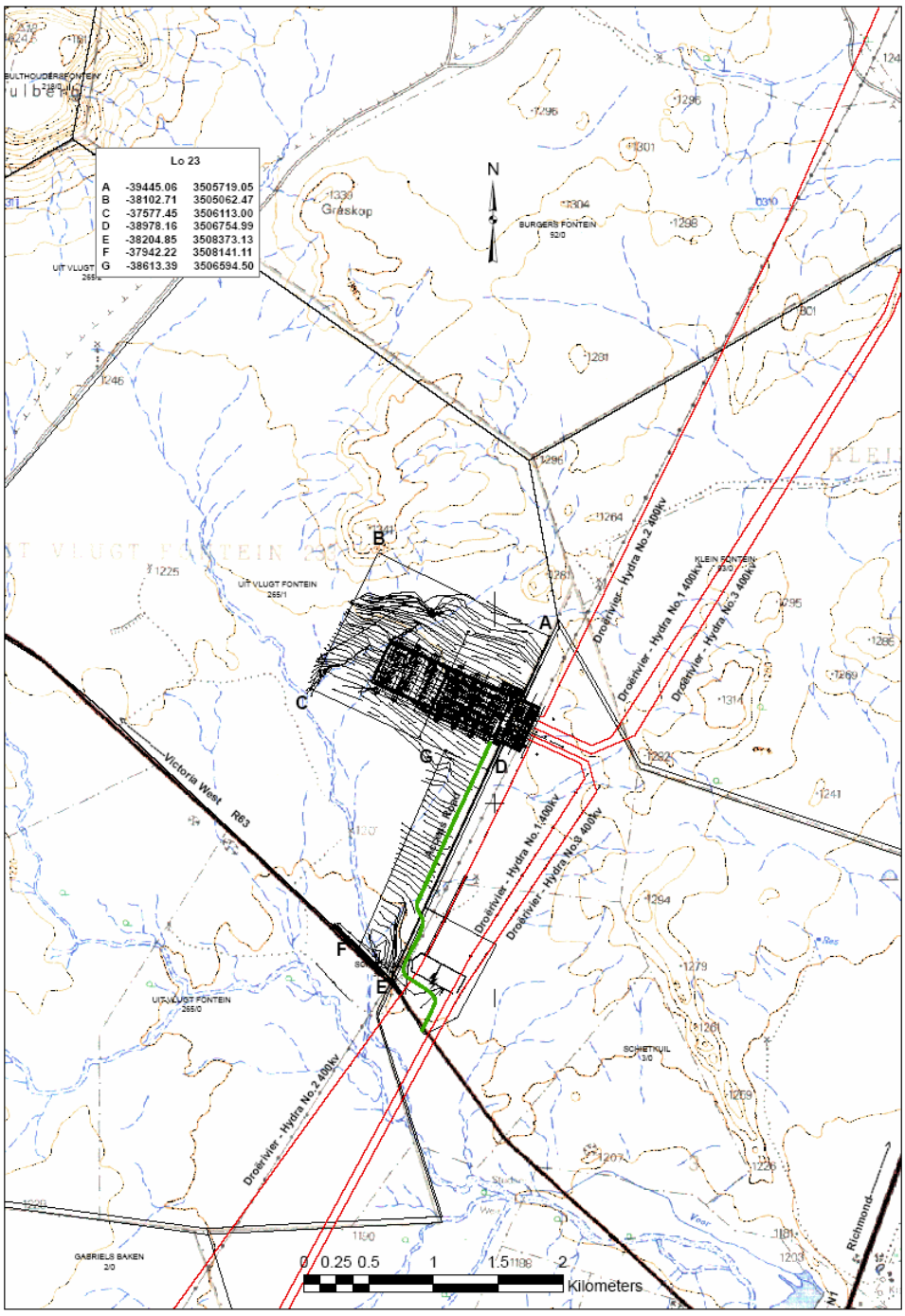


***Figure S1**: As per the Final Environmental Impact Report (FEIR) (2007) indicating the layout of the 765kV Gamma Substation as authorised.*

1.1 Proposed Second Phase

The holder of the EA proposes to commence construction of the second phase of the authorised substation development, specifically the development of a 132/400kV yard at the existing MTS and OHL turn-in of the existing 400kV Droer-Hydra 2 Overhead Powerline into the substation yard, as provided for in the current EA.

The next phase of construction activities associated with the EA is directly linked to the increased demand for grid infrastructure which is linked to upcoming Renewable Energy projects in the Northern and Western Cape Provinces. Notably, the 132kV/400kV yard and 400kV OHL turn-ins are needed to enable the connection of the authorised Umsinde Emoyeni Wind Farm (DFFE Ref: 14/12/16/3/3/2/686) with has been registered as Strategic Integrated Project (SIP).

The proposed 132kV/400kV yard and 400kV OHL turn-ins fall within the scope of the current EA. However – based on further technical analysis and design – it has been identified that the layout of the authorised infrastructure will need to be updated to reflect the updated configuration proposed (i.e., the 132kV/400kV substation yard and 400kV turn-in) to be implemented. The updated layout falls within the scope and footprint of what was originally assessed in the original EIA process, however for the avoidance of doubt the holder wishes to have the updated layout approved by DFFE prior to implementation thereof.

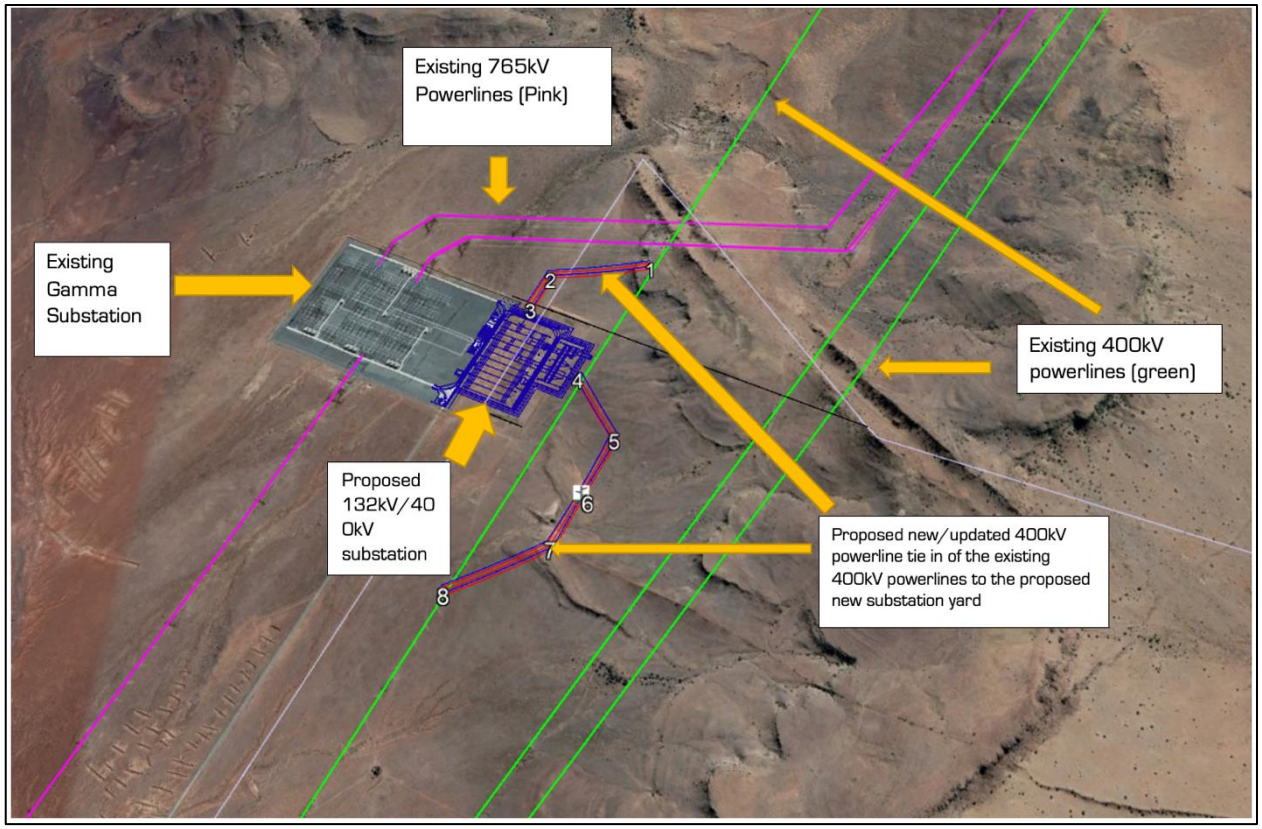


***Figure S2**: Proposed Updated Layout depicting the existing Gamma Substation with the next phase of the authorised development now proposed for implementation (new proposed 132kV/400kV Substation yard and new reconfigured turn-in and turn-out of the existing 400kV powerline).*

A Part 2 amendment application is proposed to be undertaken for the proposed update to the layout to the existing 765kV Gamma Substation and associated powerline turn-in infrastructure. The next phase of the Gamma MTS development that will now be implemented will consist of:

- A substation yard with a step-up voltage of 132kV/400kV on Farm Schietkuil 3 and Farm Uit Vlugt Fontein 265; and
- In addition, the existing Eskom 400kV overhead powerline that currently bypasses the existing Gamma Substation (i.e. the "Droerivier- Hydra No. 2" 400kV OHL) will be reconfigured to turn-in and turn-out of the new substation yard.

Table 1: Location of proposed new/updated 400kV powerline tie in and of the existing 400kV powerlines

Gamma Substation and associated grid connection		
Power line	**GPS Coordinates**	
	Latitude	**Longitude**
1	31°40'35.34"S	23°24'59.90"E
2	31°40'36.32"S	23°24'48.50"E
3	31°40'40.41"S	23°24'46.74"E
4	31°40'48.73"S	23°24'52.25"E
5	31°40'55.48"S	23°24'56.16"E
6	31°41'1.32"S	23°24'52.97"E
7	31°41'6.80"S	23°24'49.91"E
8	31°41'11.22"S	23°24'39.75"E

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations [4 December 2014, Government Notice (GN) R982, R983, R984 and R985, as amended], various aspects of the proposed developments may have an impact on the environment and are considered to be listed activities. These activities require authorisation from the National Competent Authority (CA), namely the Department of Forestry, Fisheries and the Environment (DFFE), prior to the commencement thereof. Further to this as per GN R. 2313 : **Adoptions of the standard for the development and expansion of powerlines and substation with identified geographical areas and the exclusion of this infrastructure from the requirements to obtain Environmental Authorisation** , the Standard was adopted in terms of section 24(10)(a) of the Act for the purpose of excluding the activities contemplated in paragraph 5.1 and 5.2 of the Schedule from the requirement to obtain environmental authorisation prior to commencement. In terms of the procedural requirement set out in the standard, screening tool reports have been undertaken for the grid corridor and associated infrastructure and site sensitivity verifications have been undertaken by the relevant specialists in accordance with the sensitivity themes. As per 6.1. of the GNR .2313, "Where any part of the infrastructure occurs on an area for which the environmental sensitivity for any environmental theme is identified as being very high or high by the national web based environmental screening tool and confirmed to be such through the application of the procedures set out in the Standard", the site sensitivity verifications have been performed as per the procedural requirements set out.

In accordance with GN 320 and GN 1150 (20 March 2020)[1] of the NEMA EIA Regulations of 2014 (as amended), prior to commencing with a specialist assessment, a site sensitivity verification must be undertaken to confirm the current land use and environmental sensitivity of the proposed project areas as identified by the National Web-Based Environmental Screening Tool (i.e., Screening Tool). Elize Butler, as palaeontology specialist, have been commissioned to verify the sensitivity of the project sites under these specialist protocols.

The scope of this report is for the proposed 132kV/400kV yard and 400kV OHL turn-ins that fall within the scope of the current EA. However – based on further technical analysis and design – it has been identified that the layout of the authorised infrastructure will need to be updated to reflect the updated configuration proposed (i.e., the 132kV/400kV substation yard and 400kV turn-in) to be implemented. The updated layout falls within the scope and footprint of what was originally assessed in the original EIA process, however for the avoidance of doubt the holder wishes to have the updated layout approved by DFFE prior to implementation thereof.

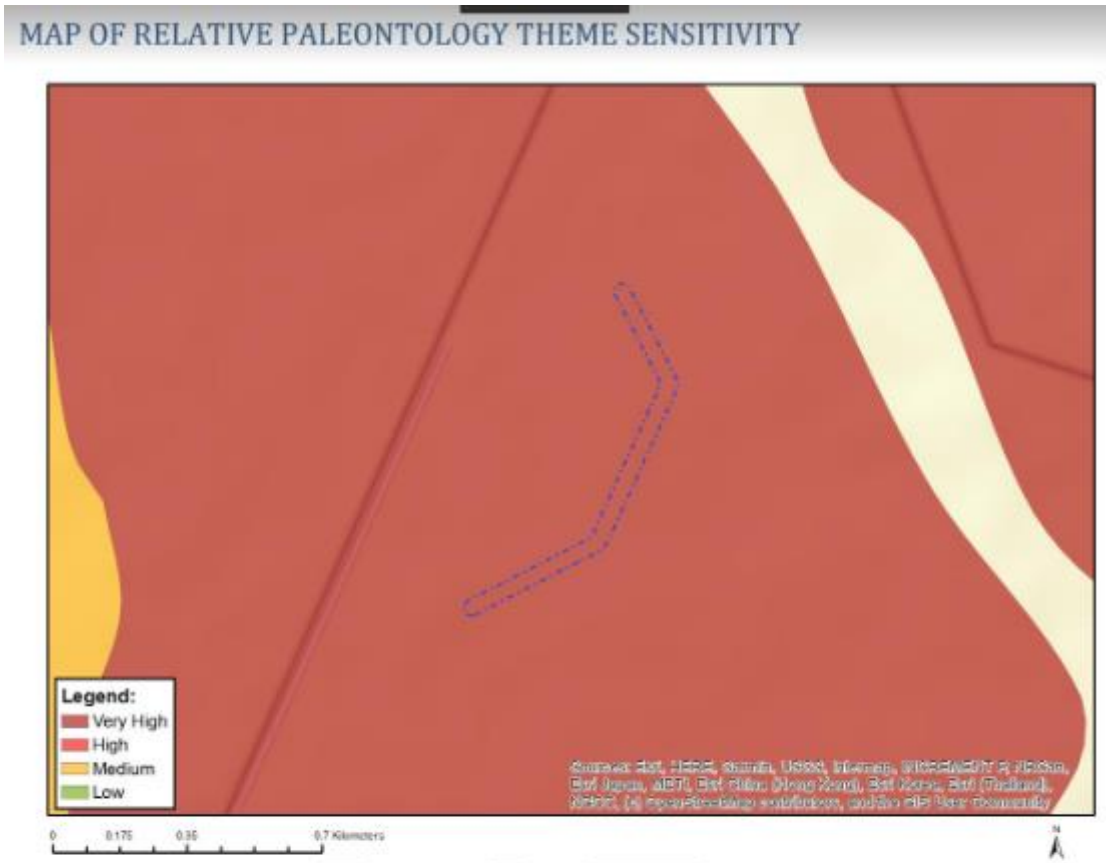
2 SITE SENSITIVITY VERIFICATION METHODOLOGY

The following information sources were consulted to compile this report:
The Palaeontology Sensitivity Verification was undertaken by the following methodology:

- The site sensitivity is established through the National Environmental Web-Based Screening Tool
- The Site is mapped on the relevant Geological Map to determine the underlying geology of the development
- Then the site is mapped on the South African Heritage Resources Information System (SAHRIS) PalaeoMap, and the Sensitivity of the proposed development established.
- Other information is obtained by using satellite imagery and
- Palaeontological Impact Assessments and Desktop Assessments of projects in the same area are studied.
- A site investigation was conducted for this project

[1] GN 320 (20 March 2020): Procedures for The Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation

3 OUTCOME OF SITE SENSITIVITY VERIFICATION



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

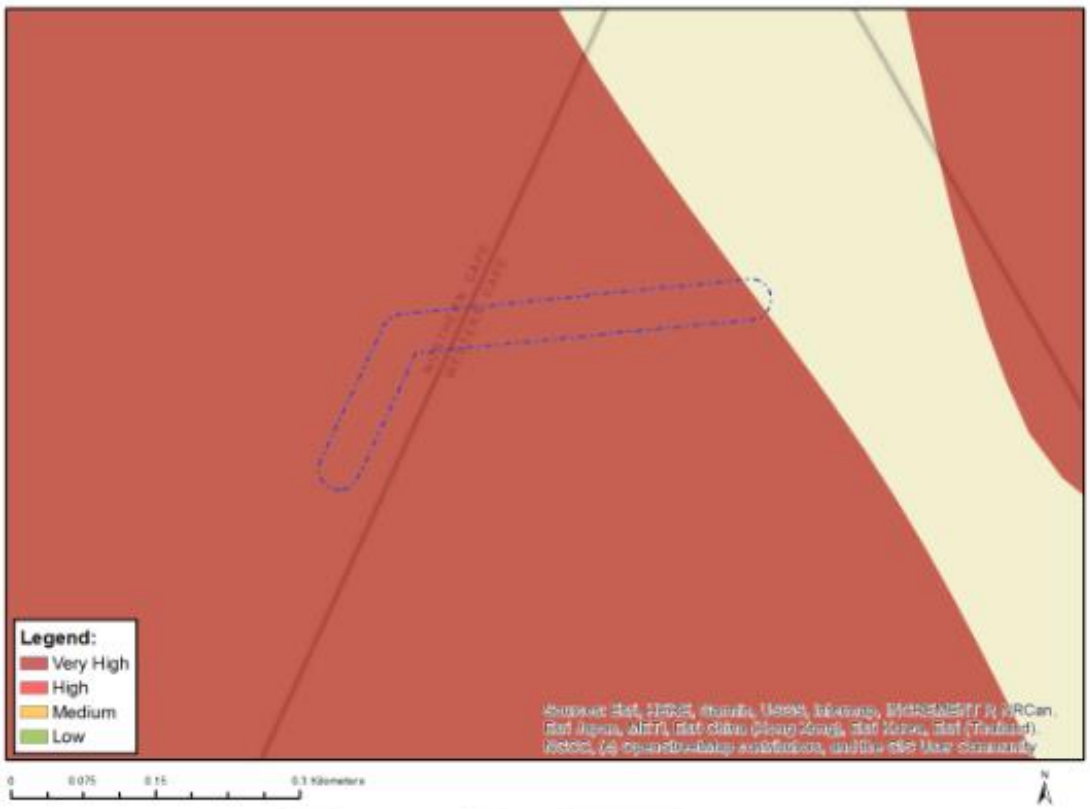
Sensitivity Features:

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

Figure S3: Palaeontological Sensitivity of the 400kV Droër- Hydra 2 Turn-in points 4-8 generated by the National Environmental Web-bases Screening Tool.

According to the screening tool the proposed development has a Very High (dark red) Palaeontological Sensitivity.

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 S3: Palaeontological Sensitivity of the Droër -Hydra 2 Turn Points 1-3 generated by the National Environmental Web-bases Screening Tool.

According to the screening tool the proposed turn points is underlain by sediment with a Very High (dark red), and white (unknown) Palaeontological Sensitivity.

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 S4**: Palaeontological Sensitivity of the existing Gamma Substation Gamma Substation Yard -Part 2 Amendment Application.* This map was *generated by the National Environmental Web-bases Screening Tool.*

According to the screening tool the proposed turn points is underlain by sediment with a Very High (dark red), Palaeontological Sensitivity.

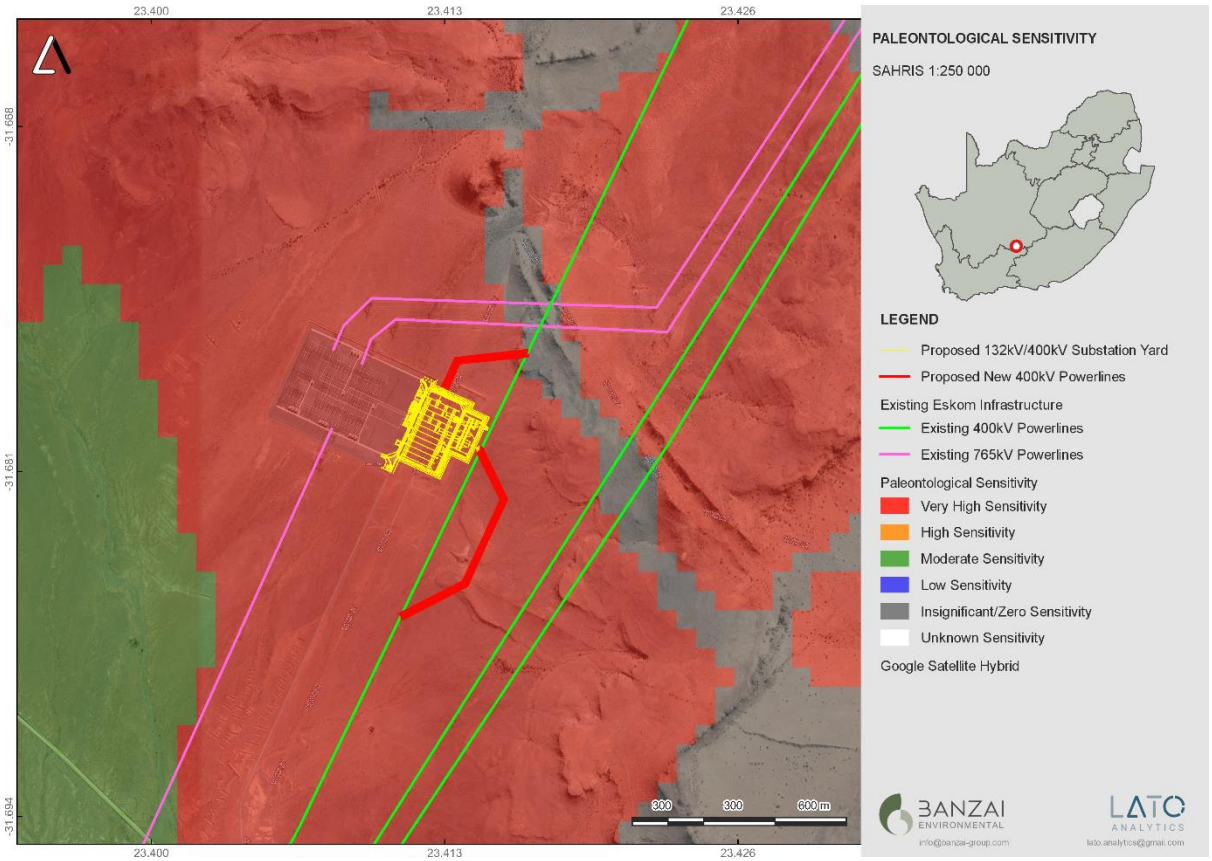


Figure S5: Extract of the SAHRIS Palaeomap (Council of Geosciences, Pretoria) indicating the Palaeontological study area.

According to the SAHRIS Palaeomap the proposed development is underlain by sediments with a Very High (red), and Zero (grey) Palaeontological Sensitivity.

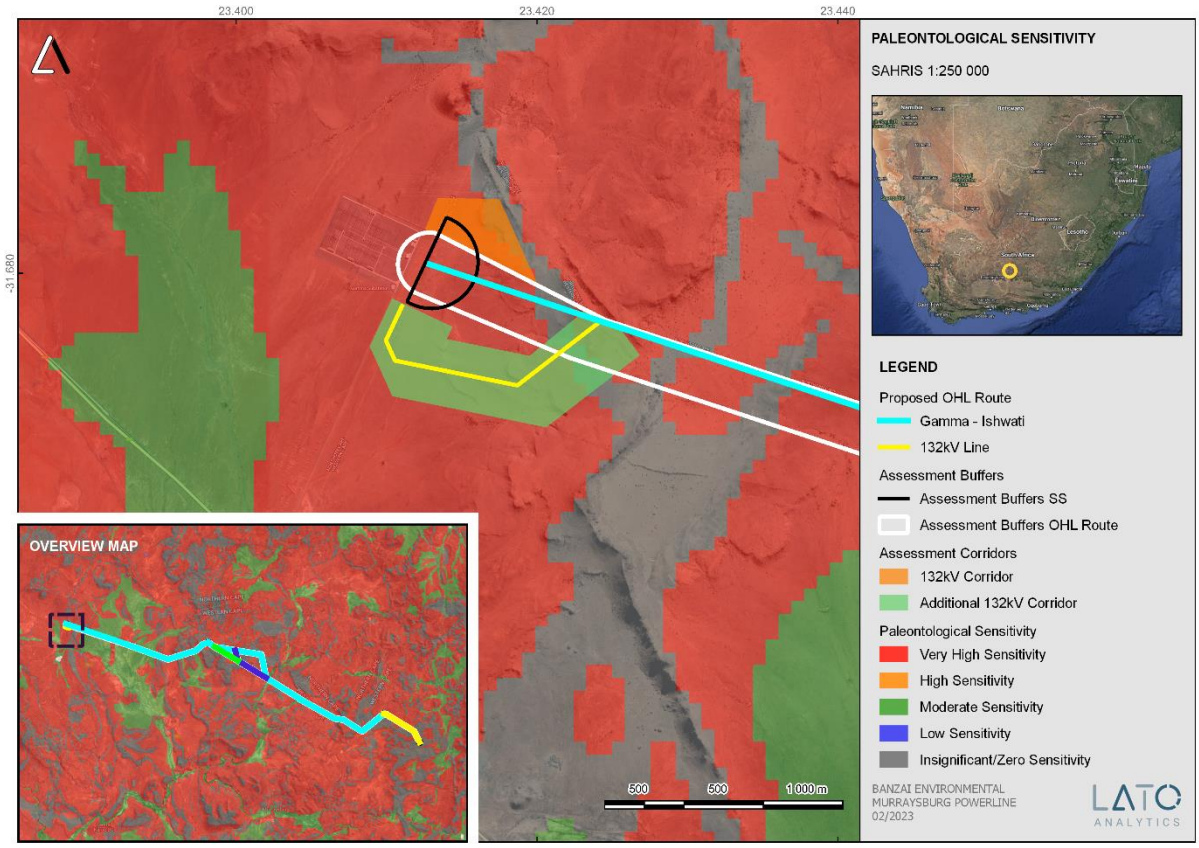


***Figure S6**: Close-up view of the SAHRIS PalaeoMap indicating the substation and grid connections of the 2020 study*

According to the SAHRIS Palaeomap the proposed layout in 2020 is underlain by sediments with a Very High (red), and Zero (grey) Palaeontological Sensitivity.

4 CONCLUSION

When comparing the layout of the substation and grid connection of the 2022 study with the present study it is evident that both layouts are underlain by the Hoedemaker Member as well as Jurassic Dolerite. The substation and most of the grid connection is underlain by potentially fossiliferous Lower Beaufort sedimentary rocks while a small portion of the grid connection is underlain by unfossiliferous Jurassic Dolerite. A few weathered loose vertebrate fossils were uncovered during the 2022 winter walkdown of the development footprints. These fossil finds were expected as the surrounding area of the developments are known to be highly fossiliferous as almost 2000 fossils have been collected by research teams in the past. This classification is thus confirmed to be accurate (National Environmental Web-bases Screening Tool and SAHRIS) as far as the impact of the proposed powerline, substation and associated infrastructure is concerned, based on actual conditions recorded on the ground during the site visit in the winter months of 2022.