PALAEONTOLOGICAL IMPACT ASSESSMENT

PAARDE VALLEY PV2 GRID CONNECTION TO VETLAAGTE MAIN TRANSMISSION SUBSTATION (MTS)

NORTHERN CAPE PROVINCE

2022

COMPILED FOR:

Holland & Associates

Environmental Consultants

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

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Email: info@banzai-group.com

SIGNATURE: 

This Palaeontological 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: NEMA Table

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 vita	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 – Objective
(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 10
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1 and 11
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology
(f) details of an assessment of the 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;	Section 1 and 11
(g) An identification of any areas to be avoided, including buffers	No buffers or areas of sensitivity identified 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

Table 1: NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – 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 11
(k) Any mitigation measures for inclusion in the EMPr	Section 12
(l) Any conditions for inclusion in the environmental authorisation	Section 12
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11
(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 11
(o) A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process. 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 Holland & Associates Environmental Consultants to conduct the Palaeontological Impact Assessment (PIA) to assess the proposed Paarde Valley Pv2 Grid Connection to Vetlaagte Main Transmission Substation (MTS), and Application for Amendment of the Environmental Authorisation for the Paarde Valley PV2 Photovoltaic Solar Energy Facility (DFFE Ref No.: 12/12/20/2500/AM5), near De Aar in the Northern Cape Province. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to verify 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 grid connection is underlain by the quaternary alluvium, Jurassic dolerite while the largest portion is underlian by the Tierberg Formation (Ecca Group, Karoo Supergroup). The most southern tip of the development is uderlain by the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) while the proposed MTS substation is located on Jurassic dolerite.

A 2-day site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 16-17 April 2022. Scattered petrified wood fragments and oolites have been uncovered in the south-eastern section of the proposed grid development. The proposed development is fairly small and in this area the Karoo Supergroup is deeply weathered and in places baked by Jurassic dolerite. Extensive excavations into deep bedrock during the construction phase is not anticipated and it is thus considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological reserves of the area. The construction of the development may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. Two technology alternatives are under consideration for this project, but from a palaeontological point of view there will be no difference between the impacts of these structures on the palaeontological resources of the area.

It is thus recommended that:

- The Environmental Control Officer (ECO), responsible for the development, should be aware of the possibility of finding fossils in the Adelaide Subgroup as well as in the Tierberg Formation (Ecca Group Karoo Supergroup). Quaternary fossil assemblages are normally rare and low in diversity and occur over a wide-ranging geographic area.
- If Palaeontological Heritage is 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 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 newly discovered fossils.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Environmental Authorisation (EA) for the 75 - 150 MW Paarde Valley PV2 was granted by the Department of Environmental Affairs (DEA) (now known as the Department of Forestry, Fisheries, and the Environment (DFFE)) on 7 September 2012, in terms of the NEMA EIA Regulations (2010). The authorised project includes the construction of a PV solar energy facility to generate approximately 75 – 150 MW on the aforementioned farm, as well as 132 kV / 220 kV overhead transmission lines and associated infrastructure (access roads, water supply infrastructure, stormwater infrastructure, internal access roads, buildings and fencing).

1.1 Proposed grid connection from Paarde Valley PV2 to Vetlaagte Main Transmission Substation

Paarde Valley PV2 (Pty) Ltd (hereafter referred to as the Applicant) proposes the construction of a 132 kV, double circuit, overhead powerline (OHPL) grid connection from the authorised on-site substation and switching station at Paarde Valley PV2 to Vetlaagte Main Transmission Station (MTS) (which is currently undergoing its own EA application process). The OHPL is proposed to be approximately 12.7 km in length, and is located in the Strategic Transmission Central Corridor[1]. A 200 m corridor (100 m of each side of the line) is to be assessed. The final OHPL servitude will be registered as 31 m but during the design development process a corridor of 200 meters is required to allow for minor tower position adjustments. The exact pylon locations will be determined by the outcome of the specialist's investigations, and engineering considerations. On average there will be 4 - 5 towers per km, so that the route will consist of an approximately 40 towers. The teams constructing the OHPL often use cranes and these will fit into an area with a maximum radius of approximately 30 m around the base of each tower, with the final footprint being relatively small. The line will have a capacity of 132kV and will make use of either steel monopole or steel lattice structure in line with Eskom required specifications.

A monopole self-supporting structure has a maximum base of 5 m in diameter above the ground. In some situations, the structures have stays. These would fall into the area with a maximum radius of 30 meters, but the stays themselves are hardly exposed at ground level, with only small steel rods protruding from the ground. Lattice towers have a bigger footprint as each has four legs that are a maximum of 15 m apart so that the final footprint would be approximately 15 m x 15 m. The height of either pylon structure will be up to 32 m.

The project will also include the switching station component of the authorised Paarde Valley PV2 on-site substation, with an approximate footprint area of 100 m x 100m, and a feeder bay at the Vetlaagte MTS with a capacity of 132 kV, as this needs to be handed over to Eskom with the grid connection self-build works once constructed.

In summary, the infrastructure associated with the proposed Grid Connection works for the Paarde Valley PV2 project (and to be handed back to Eskom following construction), includes the following:

[1]No. 113 of Government Gazette No. 41445 published 16 February 2018

- A 132kV, double circuit Overhead Power Line (OHPL) from the Switching Station connecting to the proposed Vetlaagte Main Transmission Substation (MTS)
- 132kV Feeder Bay at the Vetlaagte MTS
- On-site Switching Station (SWS), adjacent to the authorised IPP 132 kV substation. (Approximately 100 m x 100 m combined)

The technical details include:

Overhead Powerline:

- Height of pylons Up to 32m
- Type of poles/ pylons to be used. Double Circuit configuration. The alternatives under consideration and to be assessed include Steel lattice or Monopole structures in line with Eskom required specifications[2]
- Transmission line capacity 132kV
- OHPL Service Road (to lie within the OHPL servitude)
    - Length of OHPL service road(s) – Twin tracked service road following line route
    - Width of OHPL service road(s) 6 m

Switching Station:

- Footprint of approximately 50 m – 100 m x 100 m adjacent to IPP Substation
- Area occupied by buildings (Control building, relay room, generator, storage warehouse, water tanks, ablutions) +-1.0 Hectares
- Switching Station Access Road (separate access servitude from the nearest public road to the Switching Station yard)
    - Compacted gravel
    - Length of access road: +- 2.34 km
    - Width of access road: 8 m.
- Security fencing height: 2.4 m
- Type of fencing: Eskom palisade fencing + chain-link fencing for temporary works
- Capacity of on-site switching station 132kv

The OHPL and Switching station are required to connect the Paarde Valley PV2 Solar farm to the Eskom National Grid. The route selected follows boundary lines and / or existing OHPL routes so as to limit disruption to current farming activities as much as possible.

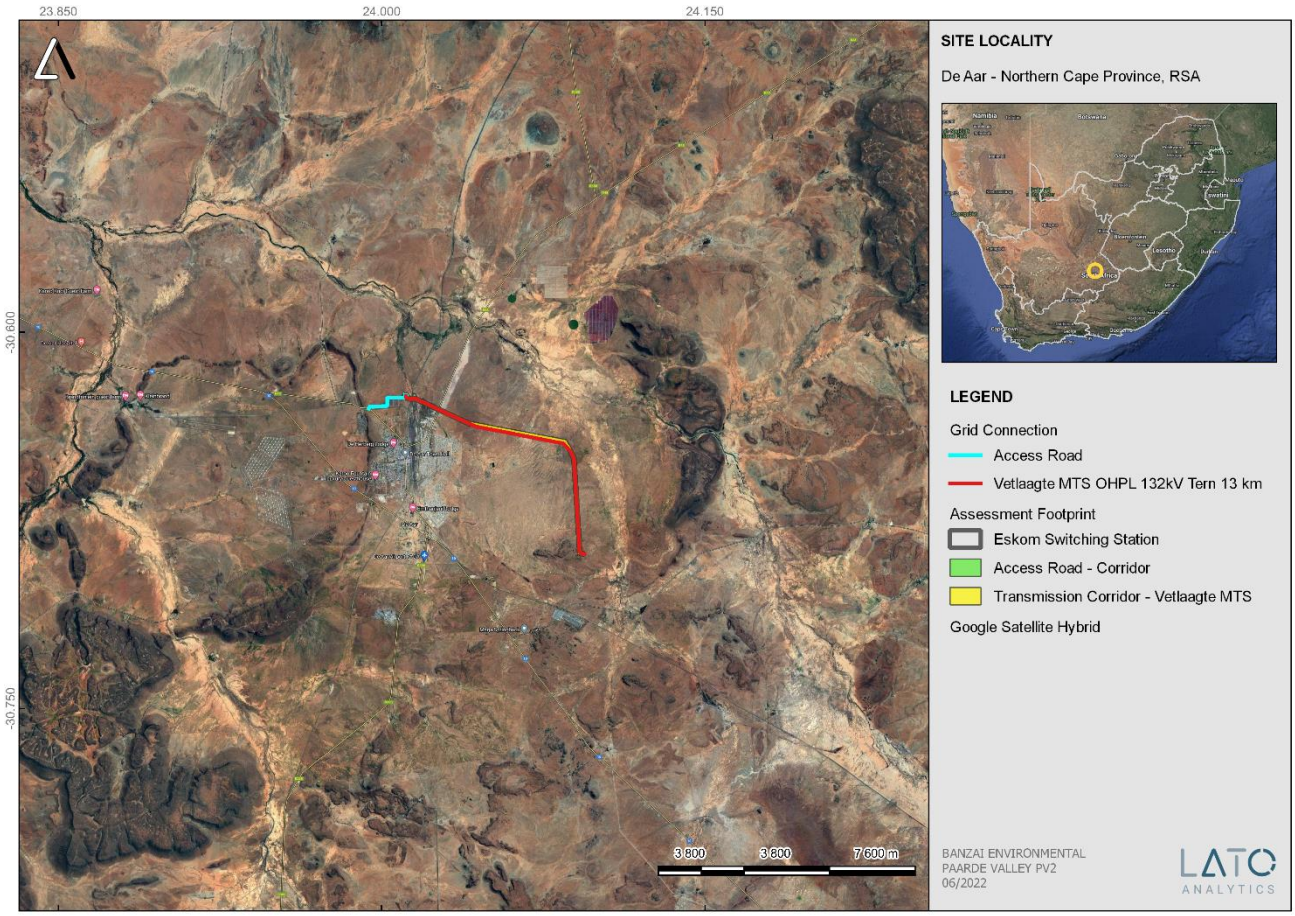


***Figure 1**: Regional locality for the proposed Paarde Valley PV2 Grid Connection to Vetlaagte MTS, near De Aar in the Northern Cape Province.*

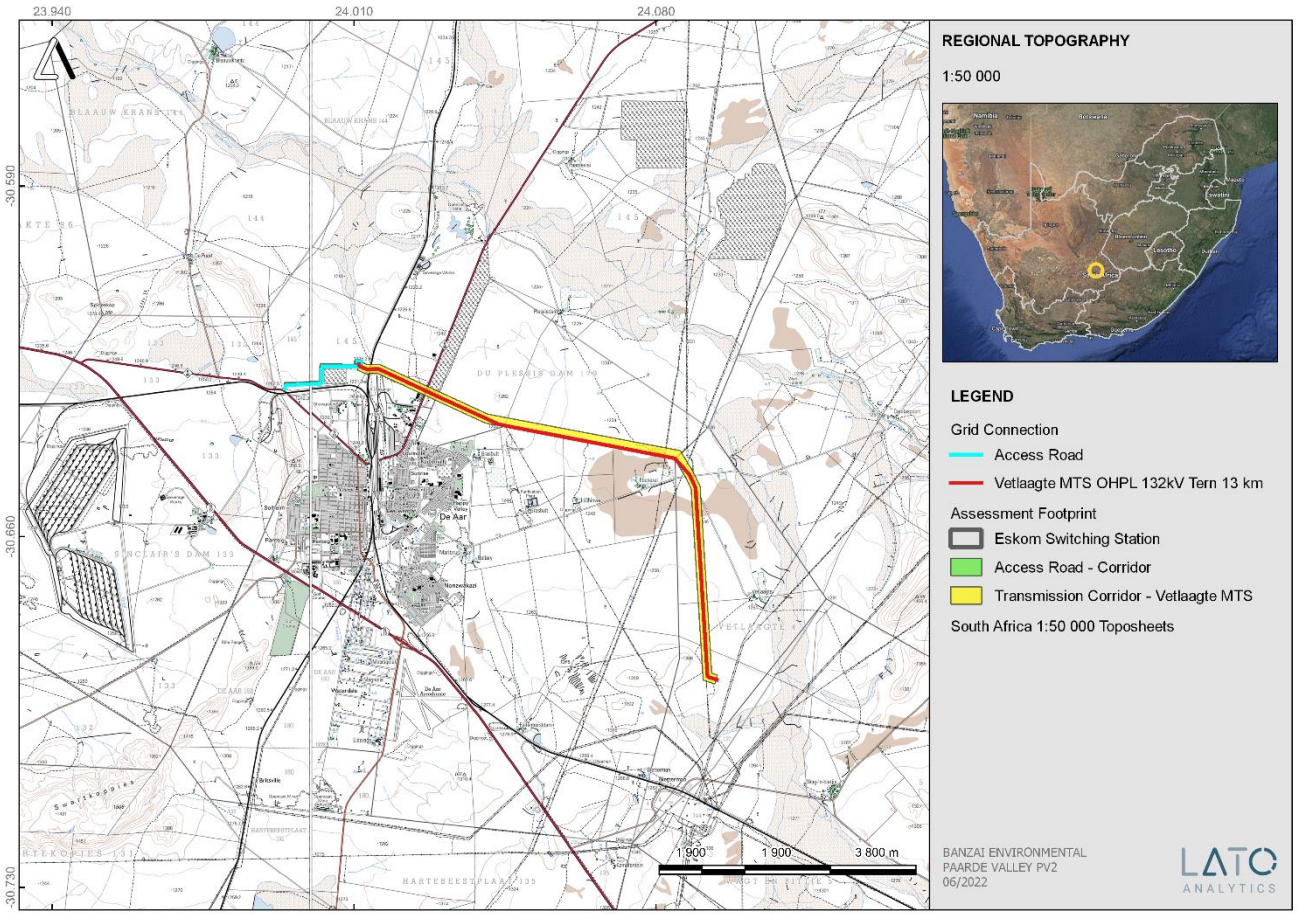


Figure 2: *Topography of the proposed Paarde Valley PV2 Grid Connection to Vetlaagte Main MTS, near De Aar in the Northern Cape Province.*

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 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-five years. She has experience in locating, collecting, and curating fossils. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, and 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 following section in each Act are 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 has been compiled.

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

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adheres 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 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) is to minimise the effect of the development on potential fossils at the development site and to determine the potential impact on palaeontological resources.

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 precedes 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 is 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 of 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).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the proposed Paarde Valley PV2 Grid Connection to Vetlaagte MTS, near De Aar in the Northern Cape Province is depicted on the 1:250 000 Colesberg 3024 (Le Roux, 1998) Geological map (Council of Geoscience, Pretoria) (**Figure 3-4**). According to this map the proposed grid connection is underlain by the quaternary alluvium in the far west (pale yellow; Quaternary), followed by a portion of Jurassic dolerite (Jd, red), while the largest portion is underlian by the Tierberg Formation (Pt, yellow-green; Ecca Group, Karoo Supergroup) in the east and south of the development. The most southern tip of the development is underlain by the Adelaide Subgroup (Pa, light green, Beaufort Group, Karoo Supergroup) while the MTS substation is located on Jurassic dolerite. Recent Shape files produced by the Council of Geosciences (Pretoria) indicate that the proposed Paarde Valley PV2 Grid Connection to Vetlaagte MTS are underlain by Jurassic dolerite as well as the Tierberg Formation of the Ecca Group, Karoo Supergroup (**Figure 5**).

The PalaeoMap of the South African Heritage Resources Information System indicates that the Palaeontological Sensitivity of the Quaternary alluvium is Moderate, while that of the Tierberg Formation is High and that of the Jurassic Dolerite is Zero/Insignificant. The Palaeontological Sensitivity of the Adelaide Subgroup is Very High (Almond and Pether, 2009; Almond *et al*., 2013) (**Figure 6**).

The Quaternary superficial deposits (yellow, single bird figure and scree) are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). 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 channel, floodplain and stream deposits, talus gravels and glacial drift sediments. The Quaternary deposits are very important because palaeoclimatic changes are reflected in the different geological formations (Hunter et al., 2006). During the climate fluctuations in the Cenozoic Era most geomorphologic features in southern Africa where formed (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Cenozoic but states that climatic changes during the Quaternary Period, specifically the last 1.8 Ma, were the most drastic climate changes relative to all climate variations in the past. Climate variations that occurred

in the Quaternary Period were both drier and wetter than the present and resulted in changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

Quaternary fossil assemblages are normally 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 superficial 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 deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts). Quaternary scree comprises of rubble and will not contain fossils.

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 of 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 considered to be 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 unfossiliferous.

The majority of the Tierberg Formation (Ecca Group; Karoo Supergroup) comprises of well-laminated, dark grey to black shale (Johnson et al 2006). Some yellowish tuffaceous beds up to 10cm thick occur in the lower part of the succession along the western and northern margins of the Basin. Calcareous concretions are common towards the top of the formation. Clastic rhythmites occur at various levels in the sequence (Cole, 2005). This formation is considered to be a deep-water deposit associated with event beds. The Tierberg formation is known for its rare trace fossils assemblages. Vascular plants (including petrified wood) and palynomorphs of Glossopteris flora have been found while crustaceans, shelly marine invertebrates, insects, and fish fossils as well as microfossils have been identified.

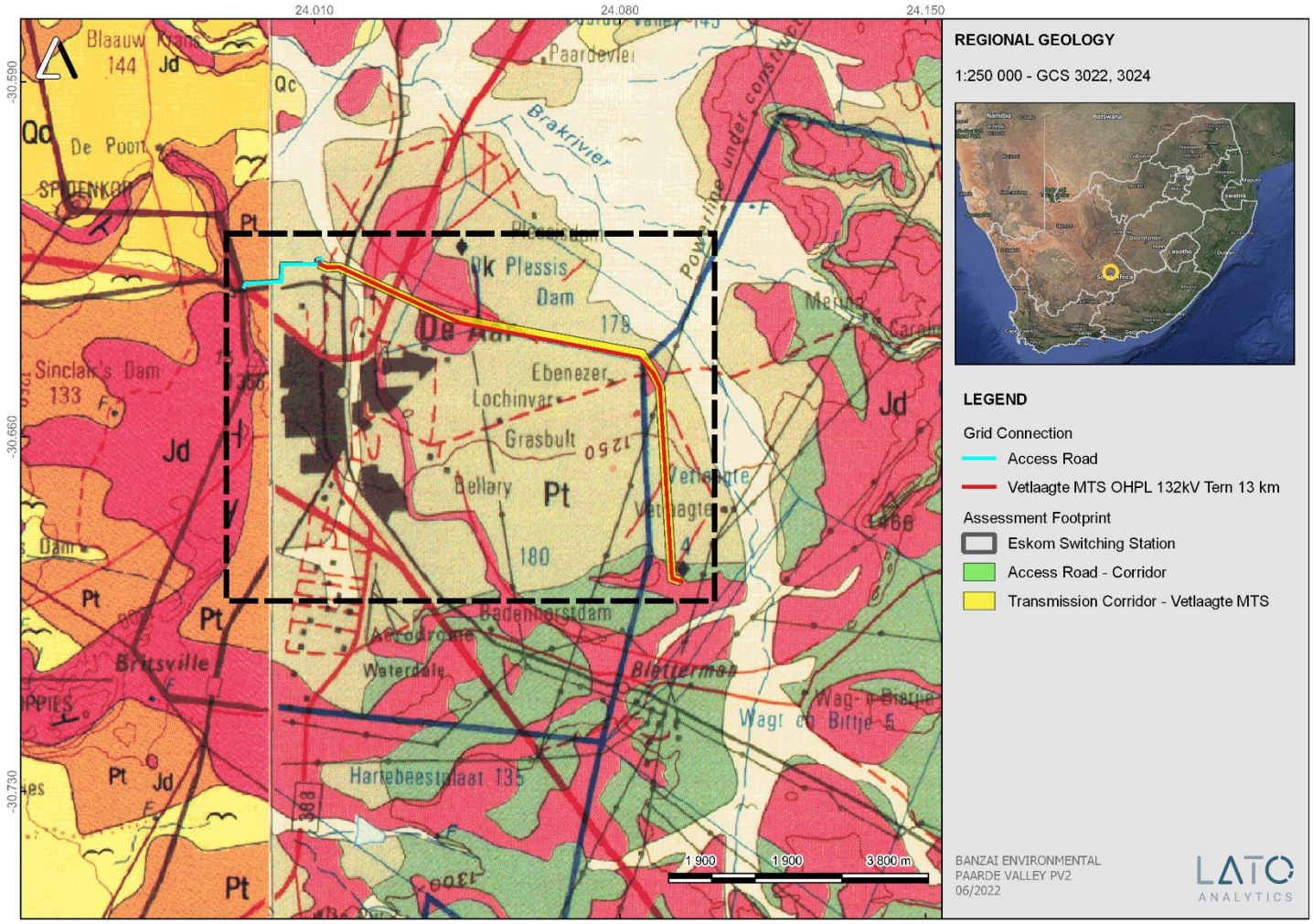


***Figure 3**: Extract of the 1:250 000 Colesberg 3024 (Le Roux, 1998) and 3022 Britstown (1992) Geological map (Council of Geoscience, Pretoria) indicating the proposed grid connection underlain by quaternary alluvium (pale yellow; Quaternary), Jurassic dolerite (Jd, red), Tierberg Formation (Pt, yellow-brown; Ecca Group, Karoo Supergroup) and Adelaide Subgroup (Pa, light green, Beaufort Group, Karoo Supergroup).*

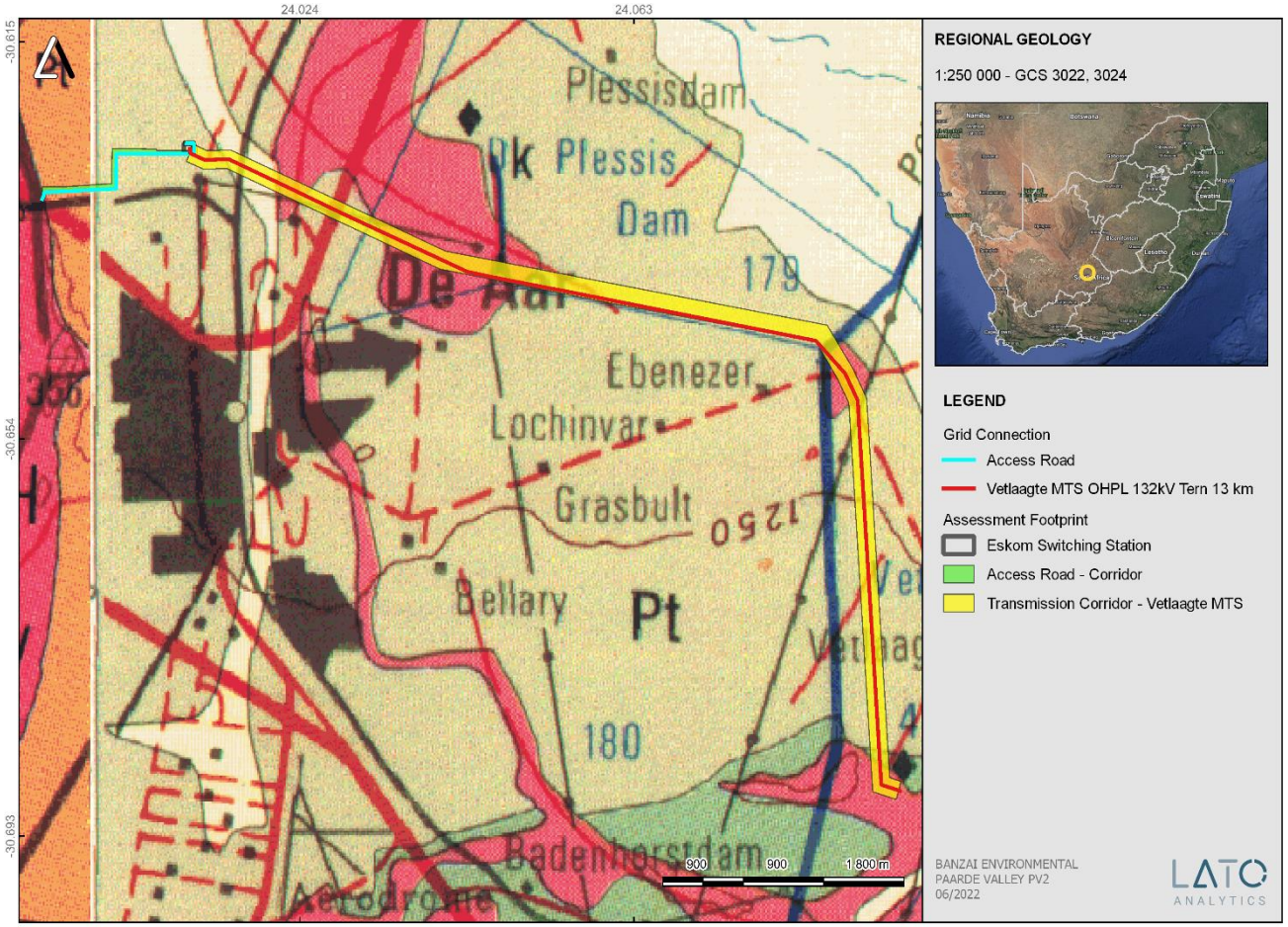
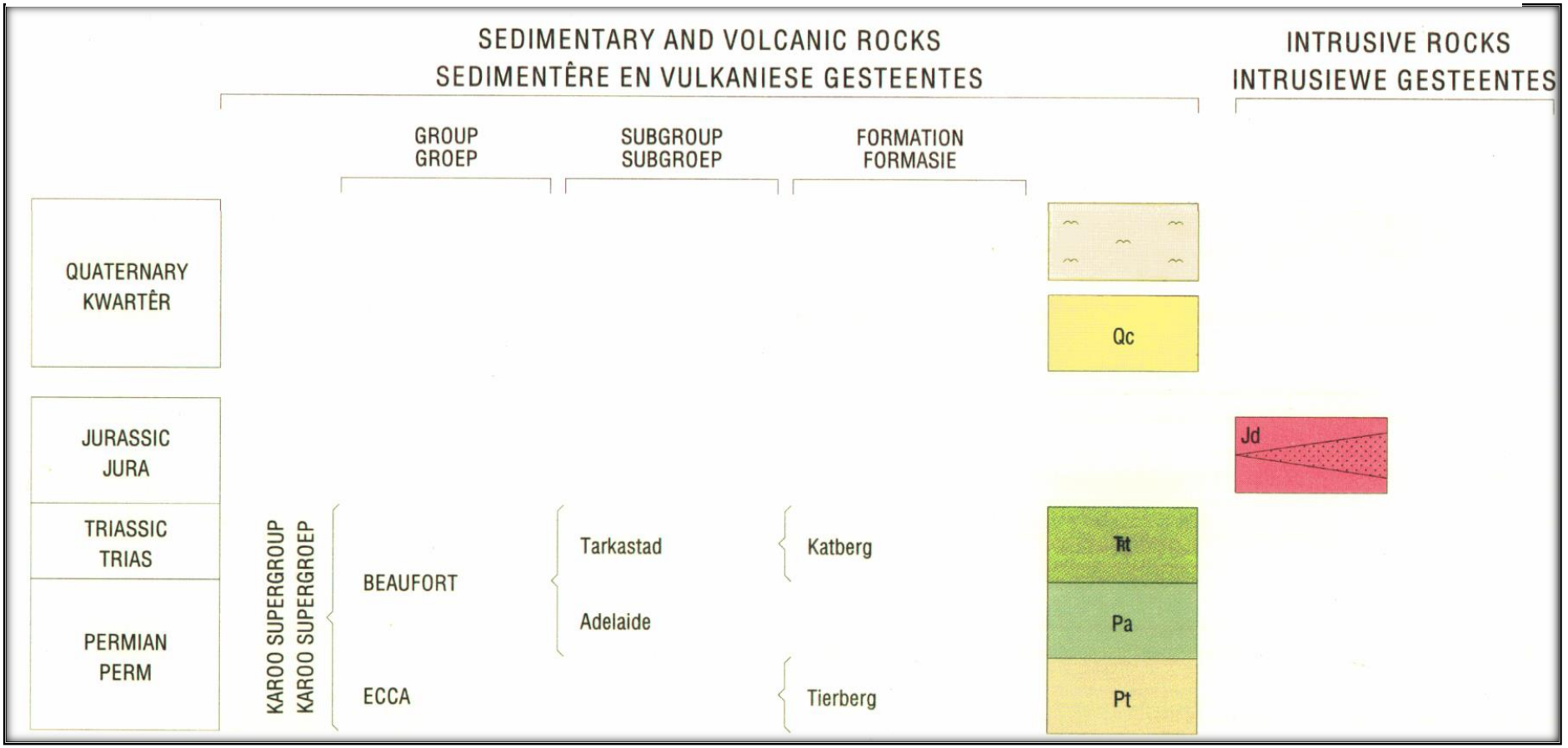
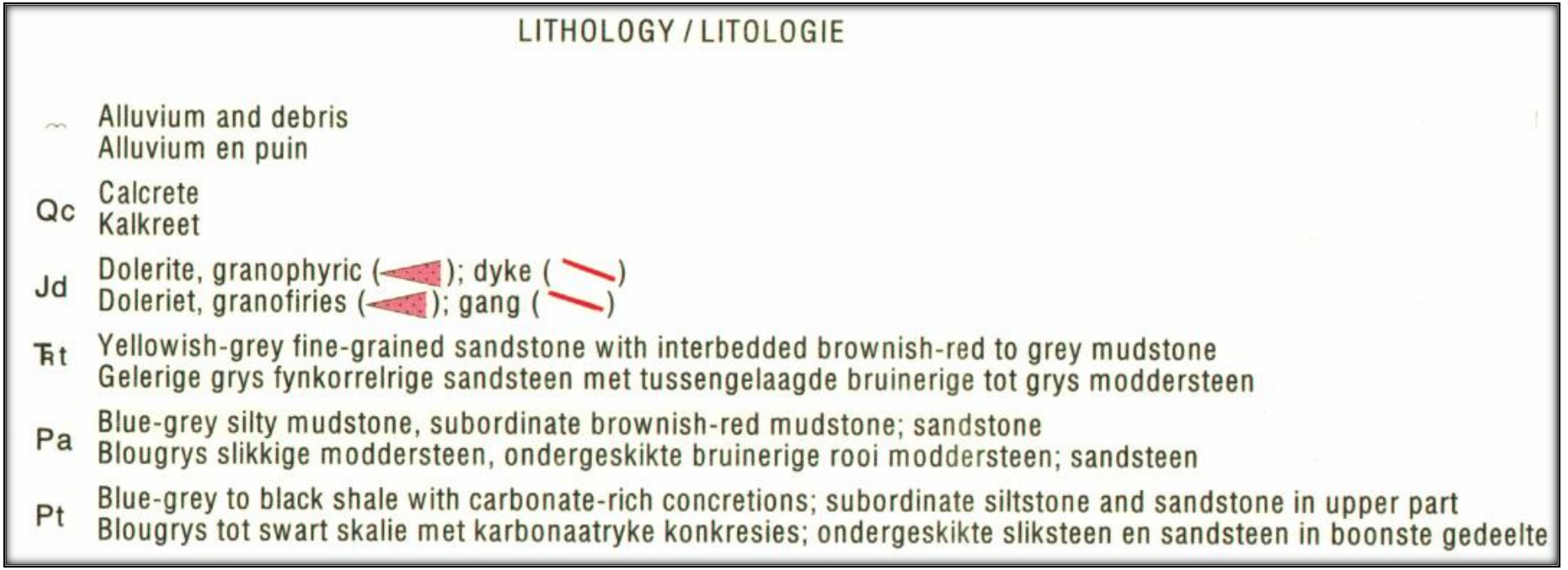


***Figure 4**: Regional geology of the proposed Paarde Valley PV2 Grid Connection to Vetlaagte MTS), near De Aar in the Northern Cape Province*

Table 2: Legend of the 1:250 000 Colesberg 3024 (1998) Geological map (Council of Geoscience, Pretoria)




LITHOLOGY / LITOLOGIE
Alluvium and debris
Alluvium en puin
Qc
Calcrete
Kalkreet
Jd
Dolerite, granophyric ( ); dyke ( )
Doleriet, granofiries ( ); gang ( )
Rt
Yellowish-grey fine-grained sandstone with interbedded brownish-red to grey mudstone
Gelerige grys fynkorrelrige sandsteen met tussengelaagde bruinerige tot grys moddersteen
Pa
Blue-grey silty mudstone, subordinate brownish-red mudstone; sandstone
Blougrys slikkige moddersteen, ondergeskikte bruinerige rooi moddersteen; sandsteen
Pt
Blue-grey to black shale with carbonate-rich concretions; subordinate siltstone and sandstone in upper part
Blougrys tot swart skalie met karbonaatryke konkresies; ondergeskikte sliksteen en sandsteen in boonste gedeelte

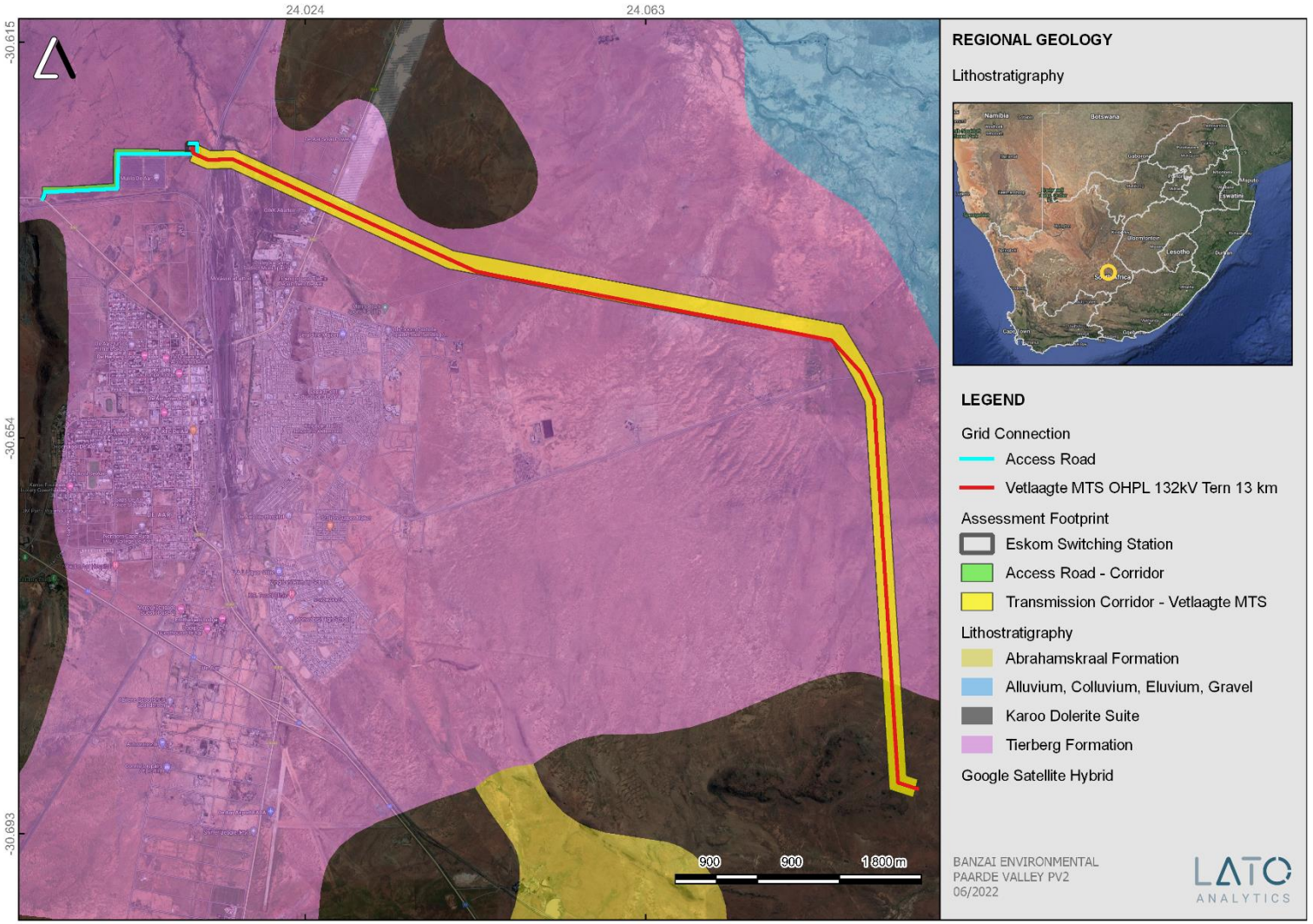


***Figure 5**: Geology of the proposed Paarde Valley PV2 Grid Connection to Vetlaagte MTS, near De Aar indicated by Shape Files (Council of Geosciences, Pretoria).*

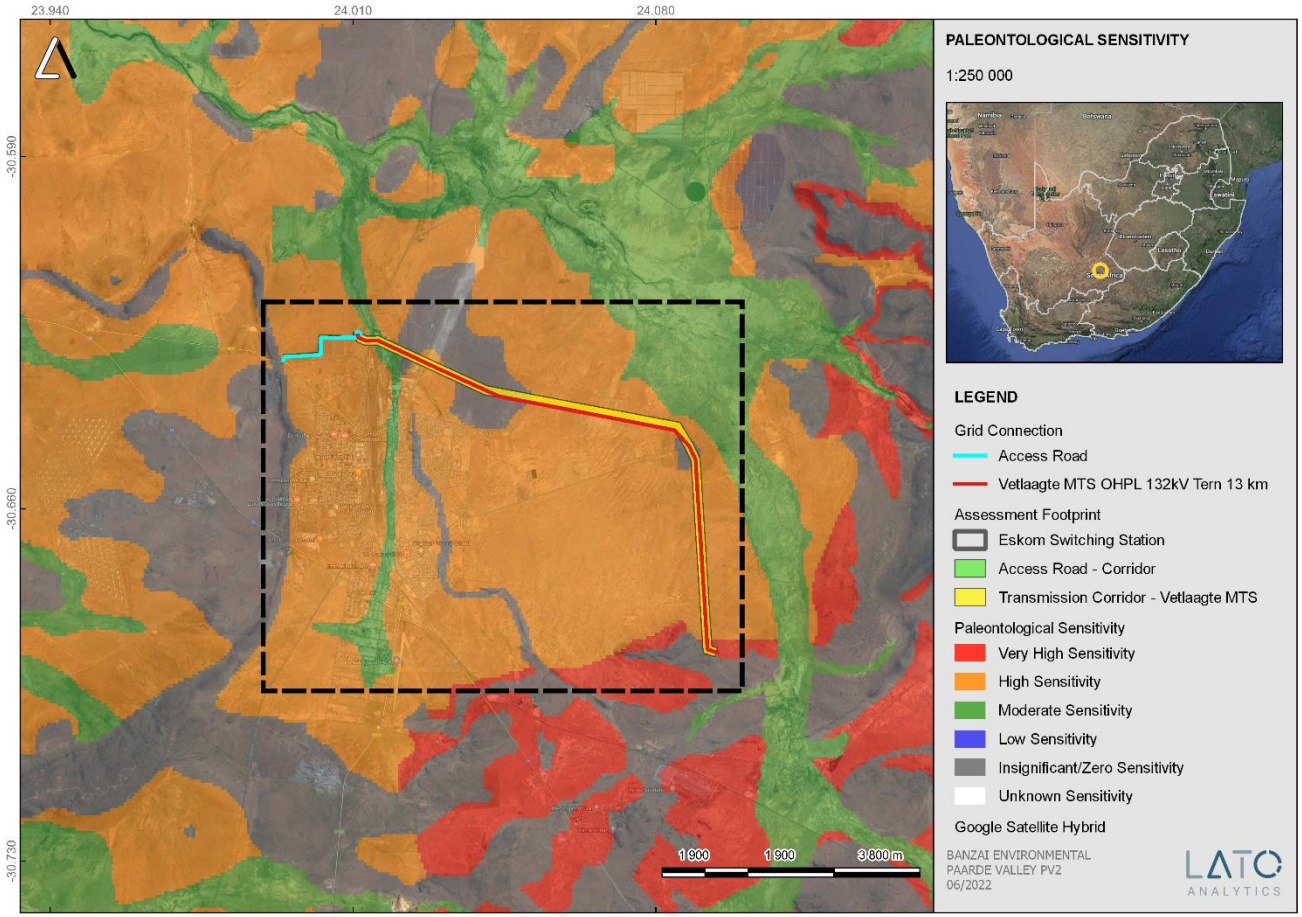


Figure 6: *Extract of the 1:250 000 SAHRIS PalaeoMap map (Council of Geosciences, Pretoria) indicating the proposed Paarde Valley PV2 Grid Connection to Vetlaagte MTS, near De Aar in the Northern Cape.*

According to the SAHRIS Palaeosensitivity map (**Figure 6)** the proposed development is underlain by sediments of Very High (red), High (orange) and Moderate (green) and Zero (grey) Palaeontological Sensitivity.

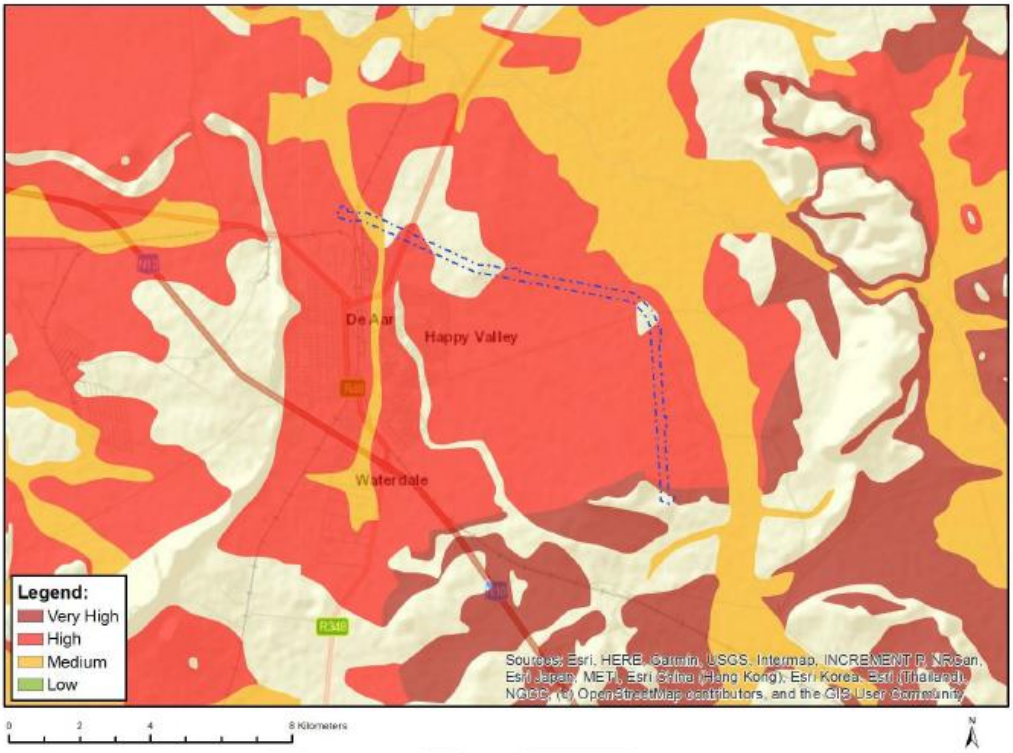
Table 3:Palaeontological Significance

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

The PalaeoMap thus follows the geology of the 1:250 000 Colesberg 3024 (Le Roux, 1998) Geological map (Council of Geoscience, Pretoria).

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

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

***Figure 7**: Environmental Screening Report*

The Environmental Screening Tool indicates that the Palaeontological Sensitivity of the proposed Paarde Valley PV2 Grid Connection to Vetlaagte MTS, near De Aar is Very High, High, Medium, and Low. This is in contrast to that of the Palaeosensitivity Map.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed Paarde Valley PV2 grid connection is approximately 12,8 km long and extends to the north, east and south-east of the town of De Aar, in the Northern Cape.

Table 4: Project locality

	Latitude (S)	Longitude (E)
Paarde Valley PV2 Substation	30°37'32.04"S	24° 0'39.33"E
Southern corner of PV farm	30°37'55.09"S	24° 1'45.00"E
North eastern bend	30°38'41.93"S	24° 5'2.64"E
Proposed MTS	30°41'20.62"S	24° 5'42.56"E

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes Palaeontological impact assessment reports in the same area, aerial photos, and Google Earth images, topographical as well as geological maps.

7.1 Assumptions and Limitations

- When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area, and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. 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. Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint**.**

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984).

- A Google Earth map with polygons of the proposed development was obtained Holland and Associates Environmental Consultants
- 1:250 000 Colesberg 3024 (Le Roux, 1998) Geological map (Council of Geoscience, Pretoria). Shape files produced by the Council of Geosciences (Pretoria).
- Various other renewable Energy facilities have been developed in the area (Almond, J.E. 2010a; Almond, J.E. 2010b.; Almond, J.E. 2010c; Almond, J.E. 2012a; Almond, J.E. 2012b; Almond, J.E. 2012c.

9 SITE VISIT

A 2-day site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 16 and 17 April 2022. Fragmented and scattered petrified tree fossils as well as well-preserved oolites were recovered from the eastern section of the Grid connection.

***Figure 8**: View over the Paarde Valley PV2 solar farm*

***Figure 9**:Scattered weathered mudstones of the Tierberg Formation.*

***Figure 10**: Existing Power lines in the south-west of the proposed Grid development corridor.*

***Figure 11**: Scattered green-grey Tierberg sediments.*

***Figure 12**: Flat topography mantled by tall grass with isolated patches of soil*

***Figure 13**:* Well-joined d*olerite* outcrop *next to the proposed MTS site. Surrounding sediments of the Ecca Group and Adelaide Subgroup have been baked*.

***Figure 14** Weathered to well-preserved oolite outcrop*

:

***Figure 15**: Proposed MTS development area covered by vegetation with sandy outcrops in places*

Figure 16: *Fragments of petrified wood.*

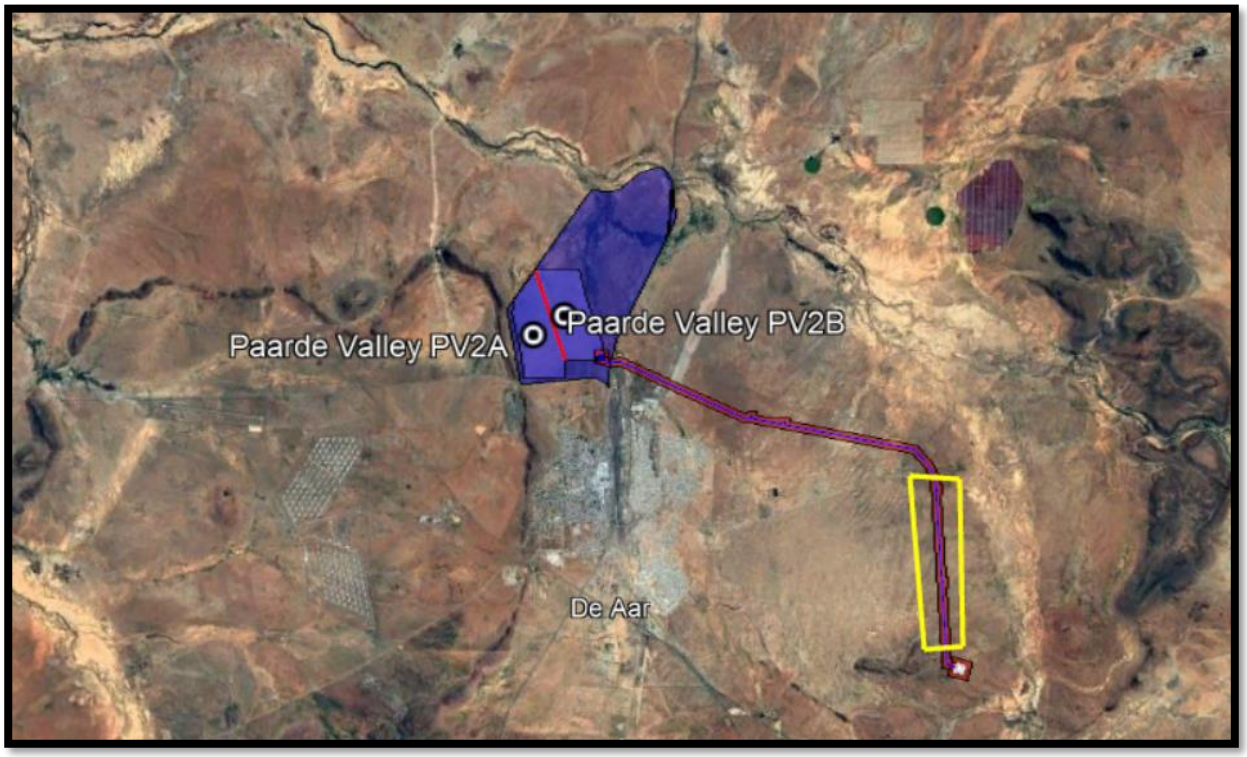


Figure 17: *Locality of tree fossils and oolites.*

10 ASSESSMENT METHOLOGY AND IMPACT ASSESSMENT FORMAT

The proposed OHPL and Switching station are required to connect the Paarde Valley PV2 Solar farm to the Eskom National Grid. The route selected follows boundary lines and / or existing OHPL routes so as to limit disruption to current farming activities as much as possible.

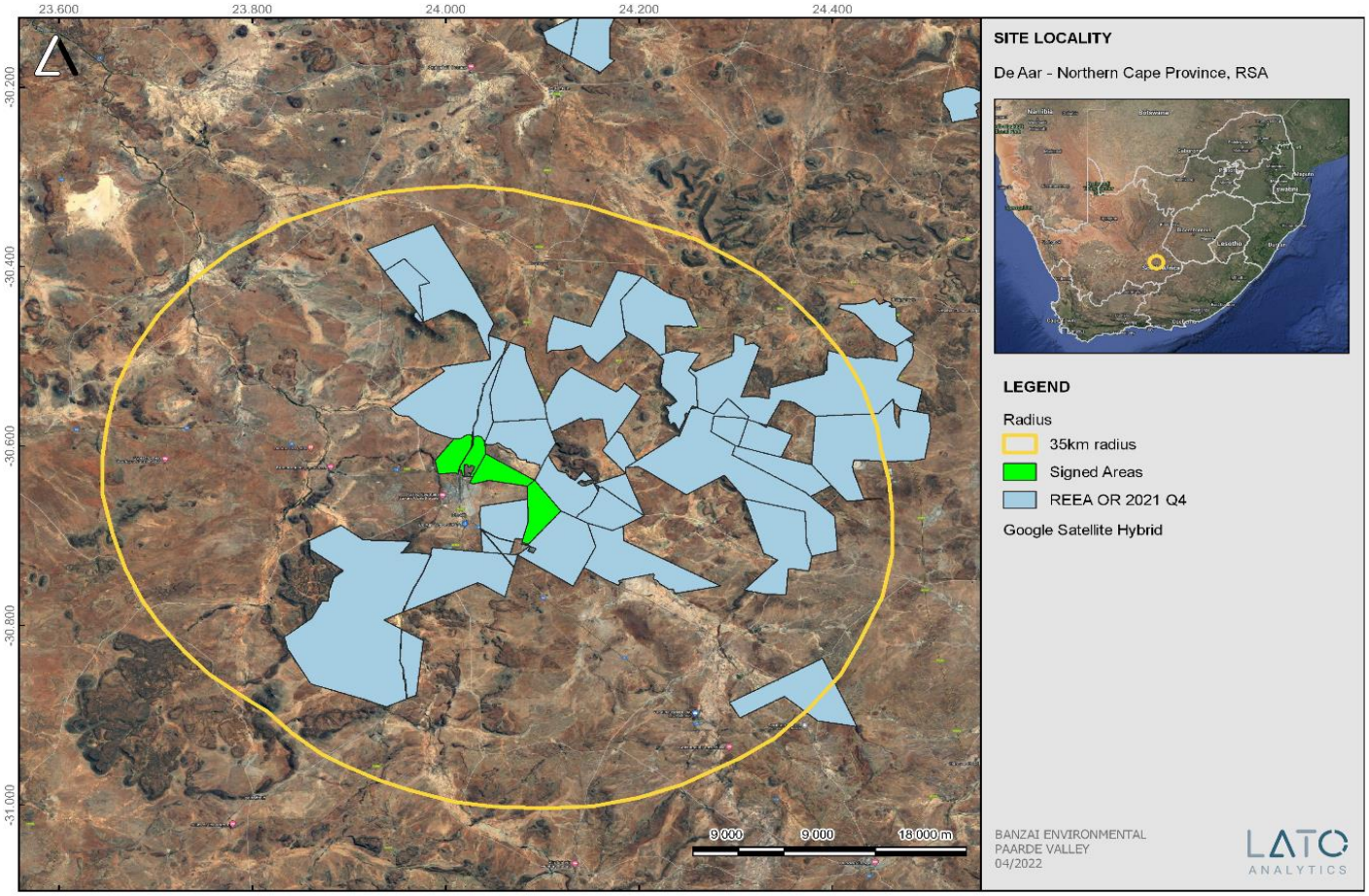


***Figure 18**: Wind and Solar developments in a radius of 35 km around the proposed development. Cumulative Impacts.*

Although, many other renewable energy facilities have been developed in the area, the overall Palaeontological significance has been low and remains allocated as low.

Please Note: Only the construction phase of the proposed development will affect the destruction of Fossil Heritage and there will be no impact on the Operational and Decommissioning Phases

The complete Assessment Methodology is attached in Appendix 2.

10.1 IMPACT ASSESSMENT TABLES:

Impact on fossil heritage will include damage or destruction of fossils on or below the surface. Impacts will only occur during the construction phase at or below the ground surface

Table 5:Impacts during Construction

	Proposed project		**"No go"**	
	Without Mitigation	**With mitigation**	**Without Mitigation**	**With mitigation**
Nature	**Negative**	**Positive**	Neutral	Neutral
Extent	**Site specific**	**Site specific**	Zero	Zero
Magnitude	**High**	**Low**	Zero	Zero
Duration	**Long Term**	**Long Term**	None	None
Consequence	**Moderately beneficial/ detrimental**	**Slightly beneficial/ detrimental**	Zero	Zero
Significance	**Very-Low**	**Negligible**	Zero	Zero
Probability	**Probable**	**Unlikely**	None	None
Confidence	**Medium**	**Medium**	None	None
Reversibility	Zero	Zero	n/a	n/a
Irreplaceable loss of resources	High	High	n/a	n/a
Cumulative Impact	**Low**	**Low**	Zero	
Degree to which the impact can be avoided	High		Neutral	
Degree to which the impact can be managed	High		Neutral	
Degree to which the impact can be mitigated	High		Neutral	

Table 6:Impacts during Operational				
	Proposed project		**"No go"**	
	Without Mitigation	**With mitigation**	**Without Mitigation**	**With mitigation**
Nature	n/a			
Extent	n/a			
Magnitude	n/a			
Duration	n/a			
Consequence	n/a			
Significance	n/a			
Probability	n/a			
Confidence	n/a			
Reversibility	n/a			
Irreplaceable loss of resources	n/a			
Cumulative Impact	n/a			
Degree to which the impact can be avoided	n/a			
Degree to which the impact can be managed	n/a			
Degree to which the impact can be mitigated	n/a			

Table 7:Impacts during Decommissioning

	Proposed project		"No go"	
	Without Mitigation	**With mitigation**	**Without Mitigation**	**With mitigation**
Nature	n/a			
Extent	n/a			
Magnitude	n/a			
Duration	n/a			
Consequence	n/a			
Significance	n/a			
Probability	n/a			
Confidence	n/a			
Reversibility	n/a			
Irreplaceable loss of resources	n/a			
Cumulative Impact	n/a			
Degree to which the impact can be avoided	n/a			
Degree to which the impact can be managed	n/a			
Degree to which the impact can be mitigated	n/a			

Table 8:Impact Management						
Impact management outcome: *Potential impact on Palaeontological Heritage*						
Impact Management Actions	**Implementation**			**Monitoring**		
	Responsible person	Method of implementation	Timeframe for implementation	Responsible person	Frequency	Evidence of compliance
Pre-Construction, Construction Phase						
– *Prevent loss of fossil heritage*	*Project Manager/ECO*	*Chance finds Protocol*	*Preconstruction phase and construction*	*ECO*	*Ongoing during construction*	*Records of fossil finds*

11 FINDINGS AND RECOMMENDATIONS

The proposed grid connection is underlain by the quaternary alluvium, Jurassic dolerite while the largest portion is underlian by the Tierberg Formation (Ecca Group, Karoo Supergroup). The most southern tip of the development is uderlain by the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) while the proposed MTS substation is located on Jurassic dolerite.

A 2-day site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 16-17 April 2022. Scattered petrified wood fragments and oolites have been uncovered in the south-eastern section of the proposed grid development. The proposed development is fairly small and in this area the Karoo Supergroup is deeply weathered and in places baked by Jurassic dolerite. Extensive excavations into deep bedrock during the construction phase is not anticipated and it is thus considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological reserves of the area. The construction of the development may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources. Two technology alternatives are under consideration for this project, but from a palaeontological point of view there will be no difference between the impacts of these structures on the palaeontological resources of the area.

It is thus recommended that:

- The Environmental Control Officer (ECO), responsible for the development, should be aware of the possibility of finding fossils in the Adelaide Subgroup as well as in the Tierberg Formation (Ecca Group Karoo Supergroup). Quaternary fossil assemblages are normally rare and low in diversity and occur over a wide-ranging geographic area.
- If Palaeontological Heritage is 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 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 newly discovered fossils.

12 CHANCE FINDS PROTOCOL

The following procedure will only need to be followed if fossils are uncovered during excavation.

12.1 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 is 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.

12.2 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 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.

12.3 Chance Find Protocol

- 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 1: -CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist

YEARS' EXPERIENCE: 29 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. Zoology (*Cum laude*), 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–currently

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ANNEXURE 2: Assessment Methodology and Impact Assessment Format Table

For each impact, the **nature** (positive/negative), **extent** (spatial scale), **magnitude/intensity** (intensity scale), **duration** (time scale), **consequence** (calculated numerically) and **probability** of occurrence is ranked and described. These criteria would be used to ascertain the **significance** of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place.

The tables below show the rankings of these variables, and defines each of the rating categories.

Table 2: Assessment criteria for the evaluation of impacts

CRITERIA	RANK	DESCRIPTION
Nature	**Positive (+)**	The environment will be positively affected.
	Negative (-)	The environment will be negatively affected.
Extent or spatial influence of impact	**National (4)**	Beyond provincial boundaries, but within national boundaries.
	Regional (3)	Beyond a 10 km radius of the proposed activities, but within provincial boundaries.
	Local (2)	Within a 10 km radius of the proposed activities.
	Site specific (1)	On site or within 100 m of the proposed activities.
	Zero (0)	Zero extent.
Magnitude/ intensity of impact (at the indicated spatial scale)	**High (3)**	Natural and/ or social functions and/ or processes are *severely* altered.
	Medium (2)	Natural and/ or social functions and/ or processes are *notably* altered.

	Low (1)	Natural and/ or social functions and/ or processes are *slightly* altered.
	Zero (0)	Natural and/ or social functions and/ or processes remain *unaltered.*
Duration of impact	**Long Term (3)**	More than 10 years, but impact ceases after the operational phase.
	Medium Term (2)	Between 3 – 10 years.
	Short Term (1)	Construction period (up to 3 years).
	None (0)	Zero duration.
Consequence **(Nature x (Extent + Magnitude/ Intensity + Duration))**	**Extremely beneficial/ detrimental** **(10 – 11) (+/-)**	The impact is *extremely* beneficial/ detrimental.
	Highly beneficial/ detrimental **(8 – 9) (+/-)**	The impact is *highly* beneficial/ detrimental.
	Moderately beneficial/ detrimental **(6 – 7) (+/-)**	The impact is *moderately* beneficial/ detrimental.
	Slightly beneficial/ detrimental **(4 – 5) (+/-)**	The impact is *slightly* beneficial/ detrimental.
	Negligibly beneficial/ detrimental **(1 – 3) (+/-)**	The impact is *negligibly* beneficial/ detrimental.
	Zero consequence **(0) (+/-)**	The impact has zero consequence.
Probability of occurrence	**Definite (4)**	Estimated at a greater than 95% chance of the impact occurring.

	Probable (3)	Estimated 50 – 95% chance of the impact occurring.
	Possible (2)	Estimated 6 – 49% chance of the impact occurring.
	Unlikely (1)	Estimated less than 5% chance of the impact occurring.
	None (0)	Estimated no chance of impact occurring.

The **significance** of an impact is derived by taking into account the **consequence** (nature of the impact and its extent, magnitude/intensity and duration) of the impact and the **probability** of this impact occurring through the use of the following formula:

Significance Score = Consequence x Probability

The means of arriving at a significance rating is explained in Table 3.

Table 3: Definition of significance ratings

SIGNIFICANCE SCORE	SIGNIFICANCE RATINGS	
32 – 40	**High (+)**	**High (-)**
25 – 31	**Medium (+)**	**Medium (-)**
19 – 24	**Low (+)**	**Low (-)**
10 – 18	**Very-Low (+)**	**Very-Low (-)**
1 – 9	**Negligible**	

Once the significance of an impact has been determined, the **confidence** in the assessment of the impact, as well as the degree of **reversibility** of the impact and **irreplaceable loss of resources** would be determined using the rating systems outlined in Table 4, 5 and 6 respectively. Lastly, the **cumulative impact** is ranked and described as outlined in Table 7.

Table 4: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
High	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Medium	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Low	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Table 5: Degree of reversibility

REVERSABILITY OF IMPACT	CRITERIA
High	High potential for reversibility.
Medium	Medium potential for reversibility.
Low	Low potential for reversibility.
Zero	Zero potential for reversibility.

Table 6: Degree of irreplaceability

IRREPLACEABLE LOSS OF RESOURCES	CRITERIA
High	Definite loss of irreplaceable resources.
Medium	Medium potential for loss of irreplaceable resources.
Low	Low potential for loss of irreplaceable resources.
Zero	Zero potential for loss of irreplaceable resources.

Table 7: Cumulative Impact on the environment

CUMULATIVE IMPACTS	CRITERIA
High	The activity is one of *several* similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the geographical, physical, biological, social, economic and cultural aspects of the environment.
Medium	The activity is one of a *few* similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the geographical, physical, biological, social, economic and cultural aspects of the environment.
Low	The activity is localised and might have a negligible cumulative impact.
Zero	No cumulative impact on the environment.

EXAMPLE TEMPLATE FOR IMPACT TABLES:

Construction phase impact:

	Proposed project		**"No go"**	
	Without Mitigation	**With mitigation**	**Without Mitigation**	**With mitigation**
Nature				
Extent				
Magnitude				
Duration				
Consequence				
Significance				
Probability				
Confidence				
Reversibility				

Irreplaceable loss of resources				
Cumulative Impact				
Degree to which the impact can be avoided				
Degree to which the impact can be managed				
Degree to which the impact can be mitigated				

Operational phase impact:

	Proposed project		"No go"	
	Without Mitigation	**With mitigation**	**Without Mitigation**	**With mitigation**
Nature				
Extent				
Magnitude				
Duration				
Consequence				
Significance				
Probability				
Confidence				
Reversibility				
Irreplaceable loss of resources				
Cumulative Impact				
Degree to which the impact can be avoided				
Degree to which the impact can be managed				
Degree to which the impact can be mitigated				