BANZAI ENVIRONMENTAL

PALAEONTOLOGICAL DESKTOP ASSESSMENT

MOGOBE ELECTRICAL GRID INFRASTRUCTURE (EGI) NEAR KATHU IN THE NORTHERN CAPE PROVINCE

JUNE 2024

Compiled for Asha Consulting

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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SIGNATURE: 

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

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

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**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 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 – Methods and TOR	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Executive Summary and Section 8	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 4 Approach and Methodology	-
(f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Executive Summary and Section 8	

Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).		
Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**The relevant section in the report**	**Comment where not applicable.**
(g) An identification of any areas to be avoided, including buffers	Executive Summary and Section 8	
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Executive Summary and Section 8	
(k) Any mitigation measures for inclusion in the EMPr	Section 9	
(l) Any conditions for inclusion in the environmental authorisation	Executive Summary and Section 8	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Executive Summary and Section 8	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Executive Summary and Section 8	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities, or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Executive Summary and Section 8	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process was handled as part

Table 1: Checklist for Specialist studies conformance with Appendix 6 of the EIA Regulations of 2014 (as amended).		
Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**The relevant section in the report**	**Comment where not applicable.**
		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.
(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 ASHA Consulting to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Mogobe EGI near Kathu in the Northern Cape Province. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA 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 of the area.

The proposed Mogobe EGI Kathu is mantled by red to flesh-coloured aeolian sand of the Kalahari Group and at depth underlain by Precambrian bedrocks of the Transvaal Supergroup. The DFFE (Department of Forestry, Fisheries and the Environment) as well as the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database indicate that the Palaeontological Sensitivity of the study area is High (Almond et al, 2013; SAHRIS website, DFFE Website).

Recent palaeontological studies have indicated that the Kathu area is underlain by a thick layer of Plio-Pleistocene to Recent Kalahari Group sediments. The Kalahari Group is characterised by well-developed calcretes or surface limestones (Mokolanen Formation), which may be 30 m or more thick in the region, while superficial aeolian sands of the Gordonia Formation and rare near-surface gravel and alluvial deposits sediments are likely less than 1 m thick. The projected development will thus not have a direct impact on the underlying Precambrian bedrocks of the Transvaal Supergroup.

The fossil assemblages of this Kalahari Group are generally very low in diversity and occur over a wide range. It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils. It is considered that the development of the proposed development will not lead to detrimental impacts on the palaeontological resources of the area.

However, 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 Environmental Control Officer (ECO) in charge of these developments. These discoveries ought to be protected 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 can be carry out by a paleontologist. Preceding any collection of fossil material, the specialist would need to apply for collection permit from SAHRA. Fossil material must be housed in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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GLOSSARY OF TERMS

Fossil

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

Heritage

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

Heritage resources

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

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

Palaeontology

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

LIST OF ABBREVIATIONS

BA	Basic Assessment
BESS	Battery Energy Storage System
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
CA	National Competent Authority
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
HIA	Heritage Impact Assessment
Ma	Millions of years ago
MTS	Main Transmission Substation
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
OHPL	Over Head Power Line
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SEF	Solar Energy Facility
S&EIA	Scoping & Environmental Impact Assessment
ToR	Terms of Reference

1 INTRODUCTION

Mogobe EGI (Pty) Ltd ('the Applicant') is proposing the construction of up to 132 kV Electrical Grid Infrastructure (EGI) to support the Mogobe BESS project located on Portion 1 of the Farm Legoko 460, southeast of the town of Kathu within the Gamagara Local Municipality in the Northern Cape Province. The EGI will traverse Portion 1 of the Farm Legoko 460 and Farm Sekgame 461. The site is accessible via the existing farm access from the N14.

The Mogobe EGI will comprise of the following:

- A 132 kV double circuit monopole and/or lattice tower overhead power line, approximately 9.0 km in length and 30 m in height to connect to the Existing Eskom Ferrum Substation located within an approved corridor of approximately 200 m wide. The power line will be constructed within an approximately 31 m wide servitude.
- A service road of approximately 4 m wide below the power line.
- An on-site switching station, with an estimated footprint of 1.0 ha and up to 5 m in height, at the Mogobe BESS facility. This refers specifically to Eskom's section of the on-site substation, planned to be at 132 kV, which will be transferred from the IPP to Eskom. Lightning masts of up to 21 m will be installed within the substation yard, and
- Associated electrical infrastructure at the Eskom Ferrum Substation. This will include but not limited to a new feeder bay which comprises of the extension to the existing platform and busbars of the 132 kV yard inside Eskom Ferrum Substation.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This study has been conducted by Mrs Elize Butler. She has conducted approximately 750 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than thirty years. She has experience in locating, collecting, and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

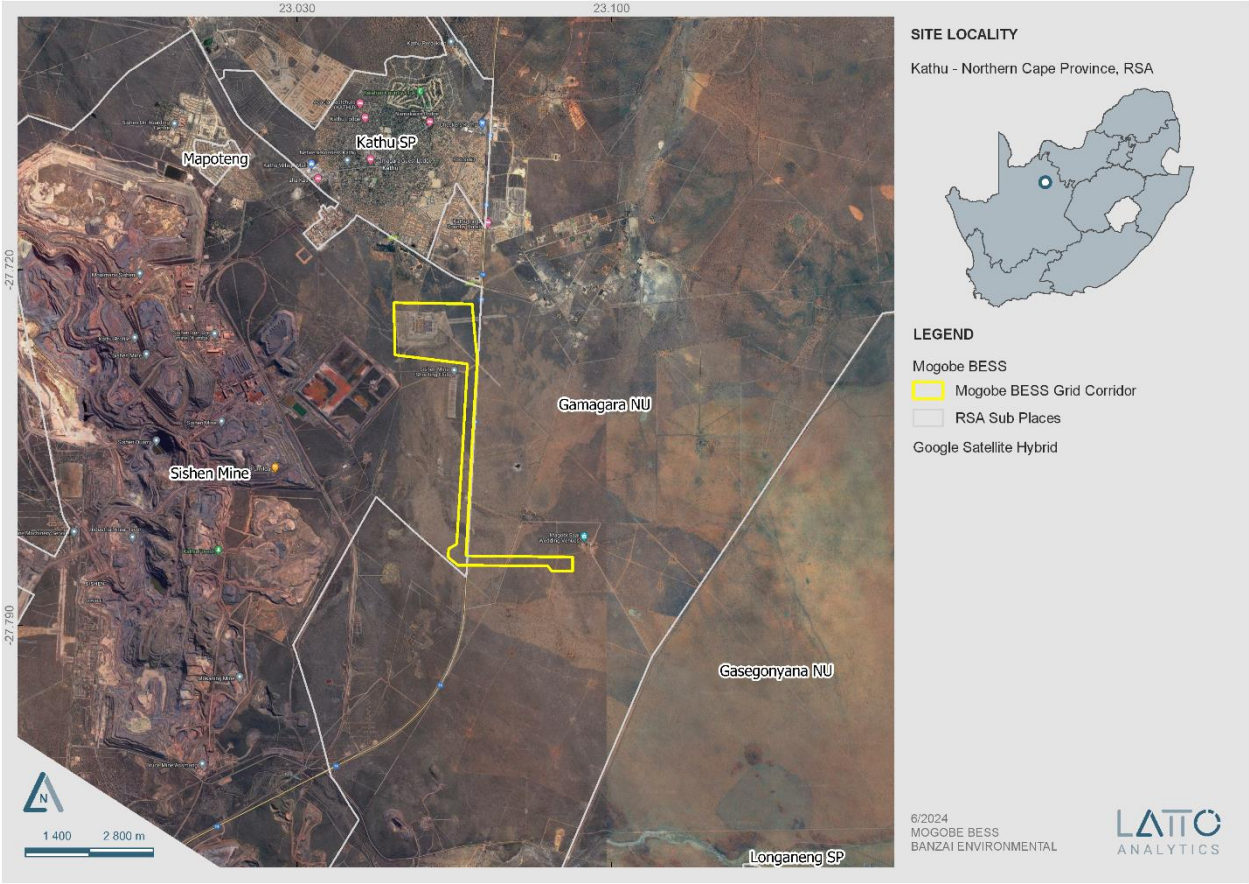


Figure 1: Regional locality of the proposed Mogobe EGI near Kathu in the Northern Cape Province.

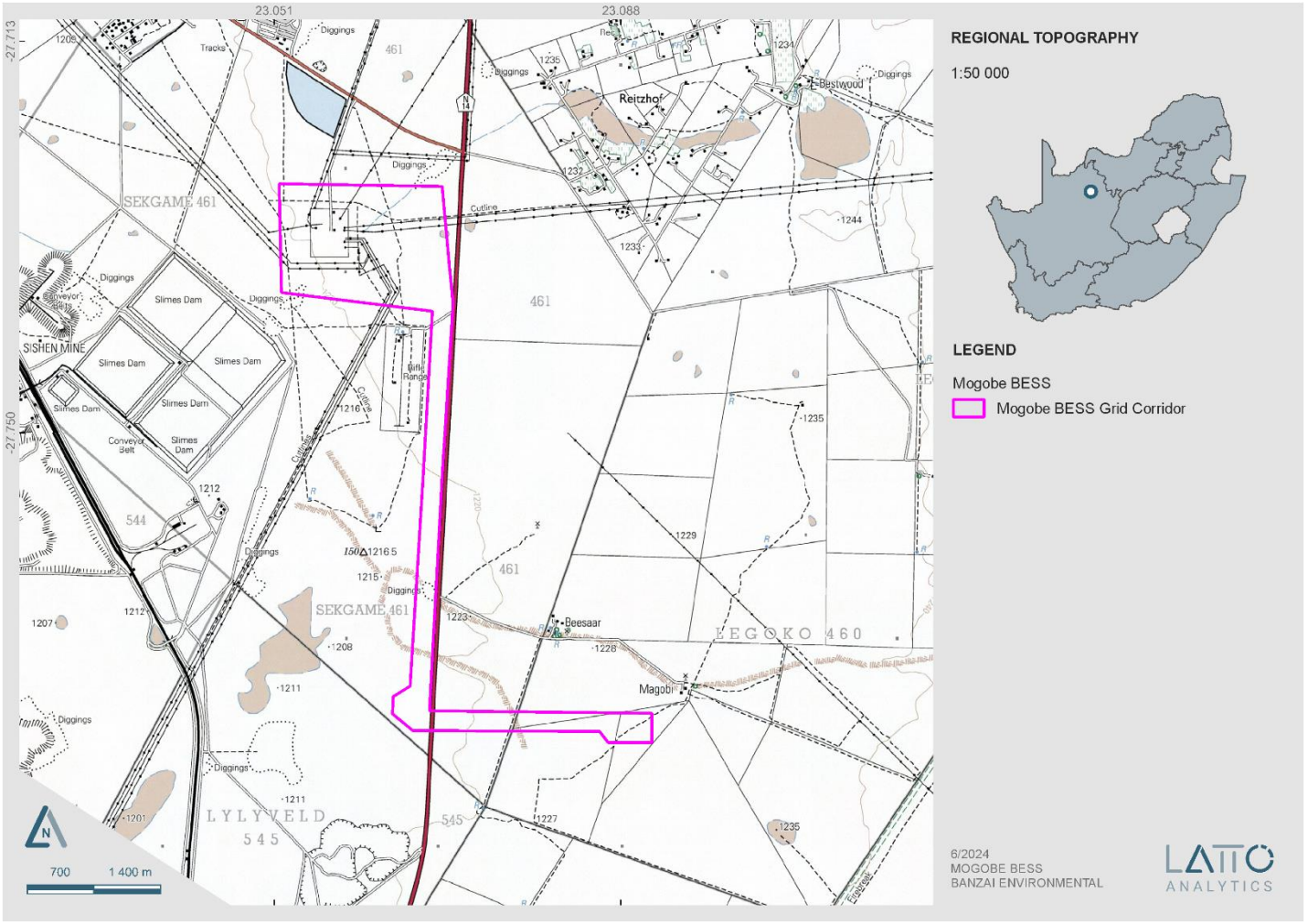


Figure 2: Locality Map of proposed Mogobe EGI near Kathu in the Northern Cape Province.

3 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 m² in extent.
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 METHODS AND TERMS OF REFERENCE

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

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

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

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

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

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

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

The terms of reference of a PIA are as follows:

General Requirements:

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

4.1 Assumptions and Limitations

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

Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological

formations are used for Desktop studies, it is commonly assumed that exposed fossil exists within the footprint. As a result, a field assessment will improve the accuracy of the desktop evaluation.

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Mogobe EGI near Kathu in the Northern Cape Province is depicted on the 1:250 000 Kuruman 2722 (1979) Geological Map (Council for Geosciences, Pretoria). This map indicates that the study area is mantled by red to flesh-coloured aeolian sand (Qs) and Surface limestone (Tl) (Figure 3, Table 2). According to the PalaeoMap (Figure 4, Table 3) on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of study area is High (orange) and Moderate (green) (Almond et al, 2013; SAHRIS website). The updated Geology (2014, Council for Geosciences, Pretoria) (Figure 5) indicates that the study area is entirely underlain by the Kalahari Formation. The National Environmental Web-bases Screening Tool indicates that the development has a High (red) Palaeontological Sensitivity (Figure 6).

Kathu is about 1200–1300 metres above sea level, and situated in the semi-arid, flat landscape of the Northern Cape, between the Langberge mountain range to the west and the low-lying Kurumanheuwels to the east. The Ga-Mogara River, which flows into the Kuruman River north of Hotazel, drains this region. The study site is situated on flat-lying Kalahari terrain south of the town of Kathu. The N14 trunk road, located east of the study area, leads to Kuruman. Scatterings of thorn trees are present on the open terrain and is visible on satellite pictures. A few kilometres east are low hills comprising of Precambrian banded ironstones (Asbestos Hills Subgroup, Ghaap Group).

The geological map indicates that the study area is mantled by potentially fossiliferous Pleistocene to Recent aeolian sands of the Gordonia Formation as well as calcretes (surface limestones) of the Mokolanen Formation (Kalahari Group). These superficial sediments mantle Precambrian sedimentary bedrocks of the Transvaal Supergroup at depth. Some other Kalahari Group sediments is also present in the Kathu area but not mapped on the 1:250 000 scale.

Borehole data indicates subsurface dolomite overlain by banded iron formation (Almond 2015). These Precambrian bedrocks is present deep beneath the study area and will not be impacted on by the proposed development. The Campbell Rand Subgroup consists of a thick (1,6 to 2,5 km) carbonate platform succession of cherts with minor tuffs and siliciclastic rocks as well as dolomitic limestones and dolostones. These sediments were deposited about 2,6 to 2,5 Ga (billion years ago) on the shallow submerged shelf of the Kaapvaal Craton. Frequent changes in sea level were caused by changing depositional cycles in shallow water facies. Stromatolitic limestones and dolostones, oolites, laminated

calcilutites, cherts, with subordinate siliclastics (shales, siltstones) and minor tuffs (Beukes 1980, Beukes 1986, Sumner 2002, Eriksson *et al.* 2006, Sumner & Beukes 2006) are present in this area.

The pedogenic limestones, studied by Haddon (2005) and Truter et al. (1938), are a reflection of the region's seasonal arid climates over the last five million years. The Kalahari Group's late Caenozoic calcretes (Tl - Tertiary Limestone Figure 3, Table 2) and aeolian sands are composed of exotic pebbles and locally conglomeratic clasts of reworked calcrete. They may have a thickness of exceeding 20–30 m, but are typically thinner. Secondary silicified limestones may include deposits of the underlying Precambrian carbonate rocks.

Surface calcretes are not mapped at surface in the present study area but are most probably present. Calcretes present in the Mokalanen Formation have formed in several sediments e.g., colluvium, windblown sands as well as ephemeral streams and pans. Sometimes these calcretes may attain considerable thickness and represents polyphase development during the last 5Ma (late Miocene/Pliocene). The calcretes are overlain by red aeolian sands (Gordonia Formation) of the Kalahari. Calcrete deposits may accumulate in pans beneath the aeolian sands. Radiometric dating could thus far not establish a precise boundary between the Quaternary and Tertiary (Kent,1980). The Gordonia Formation (Kalahari Group) are dated as Late Pliocene/Early Pleistocene to Recent times by the Middle to Later Stone Age stone tools recovered from them (Dingle et al, 1983).

In the Sishen Iron Ore Mine, southwest of the research area, Haddon (2005) discovered that the sediments of the Kalahari Group, which cover the Precambrian bedrock, have a thickness of roughly 80 metres. The low-lying beds were identified as belonging to the Budin Formation (lacustrine calcareous clays with scarce suspended pebbles associated with palaeodrainage systems) and Wessels Formation (basal debris flow gravels linked with local faults).

The upper 15 m of the Kalahari sequence in the area consists of well-indurated calcretised siltstones, clays and pebbly horizons, with solution hollows developing along joint surfaces within 10 m of the surface. Calcretised silcretes with in situ brecciation are also recognised near the surface. It is also noted that the rocks of the Kalahari Group exhibit significant, rapid horizontal variation, hinting that the succession underpinning the current study region is unlikely to be the same.

Recent field study associated with the manganese ore railway line (Sishen New Loop) records a thick (> several metres) pale pinkish in colour, karstified calcrete hardpan at surface partially mantled by a thin layer of downwasted surfaced gravels (calcrete rubble) and orange-brown Kalahari sands (Almond 2013a). Stormwater trenches in the area also exhibit a variety of calcrete facies, including brecciated, honeycomb, gravelly, pelleted, and silicified forms.

Various authors, Butzer 1984, Klein 1988, Beaumont 1990, Partridge & Scott 2000, Beaumont 2004,

have reported on an important succession of stratified, unconsolidated, fossiliferous Quaternary to Holocene sediments of solution hollows (sinkholes / dolines) within a thick calcrete hardpan at Kathu Pan about 5.5 km northwest of Kathu. Porat *et al.* (2010) reported that boreholes within the pan area identified a Kalahari Group succession of over 70 m thick, as well as 30 m of clays, gravels, and sands that is probably represented by the Wessels, Budin and possibly also Eden Formations. These Formations is overlain by over 40 m of calcrete of the Mokalanen Formation and unconsolidated superficial sediments of the Gordonia Formation aeolian sands. Some of the doline infill successions comprise an assortment of Mid to Late Pleistocene and Holocene calcareous silty sands, gravels, and peat horizons while several spring eyes were identified. Sterile basal layers overlie the karstified calcrete surface and are associated with a series of stone artefact assemblages ranging from Early Acheulean to Middle Stone Age to Later Stone Age.

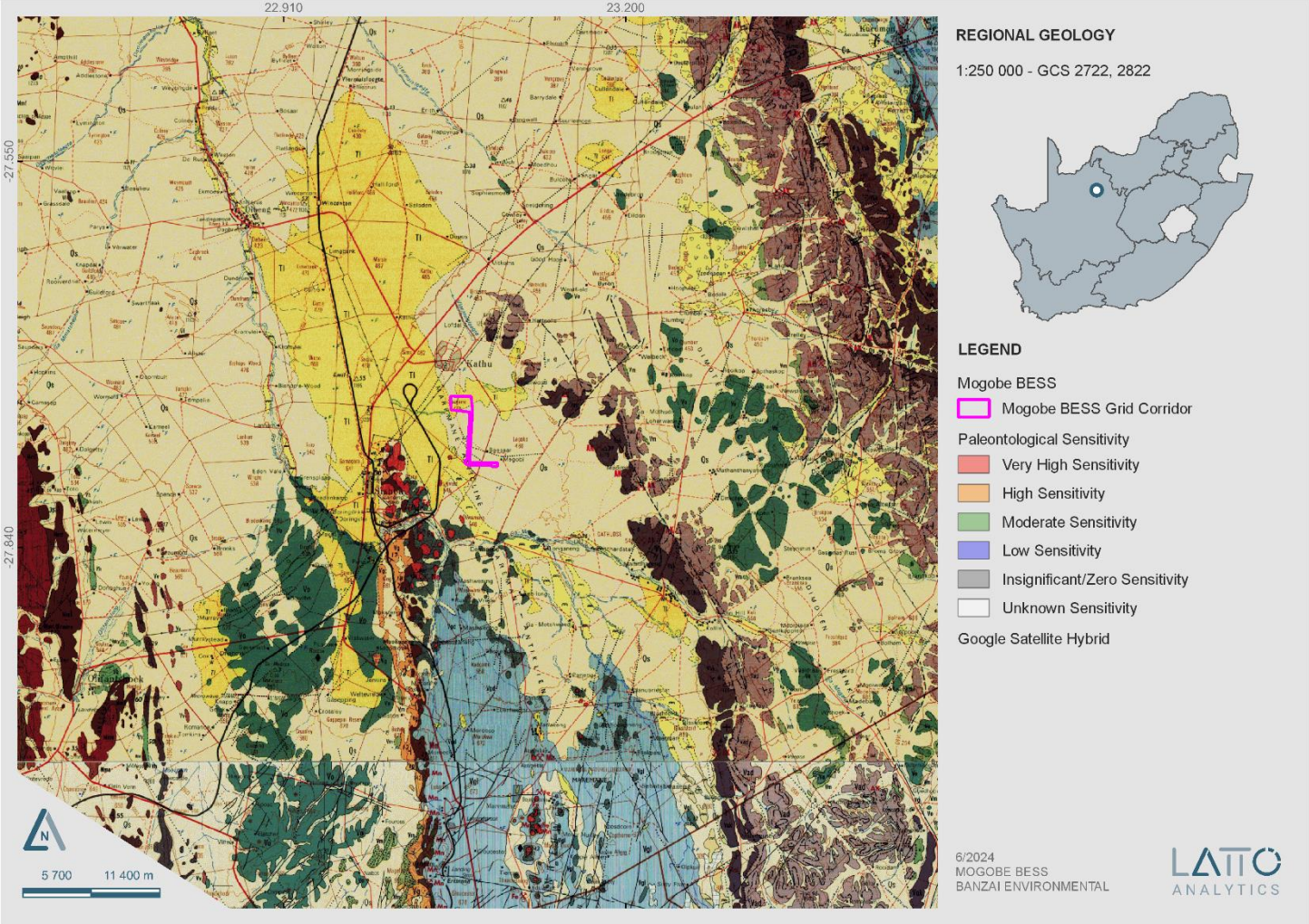


Figure 3. Extract of the 1:250 000 Kuruman 2722 (1979) Geological Map (Council for Geosciences, Pretoria) indicating that the study area is underlain by Quaternary wind-blown sands (Qs) as well as surface limestone (Tl).

Table 2:Legend of the 1:250 000 Kuruman 2722 (1979) Geological Map (Council for Geosciences, Pretoria).

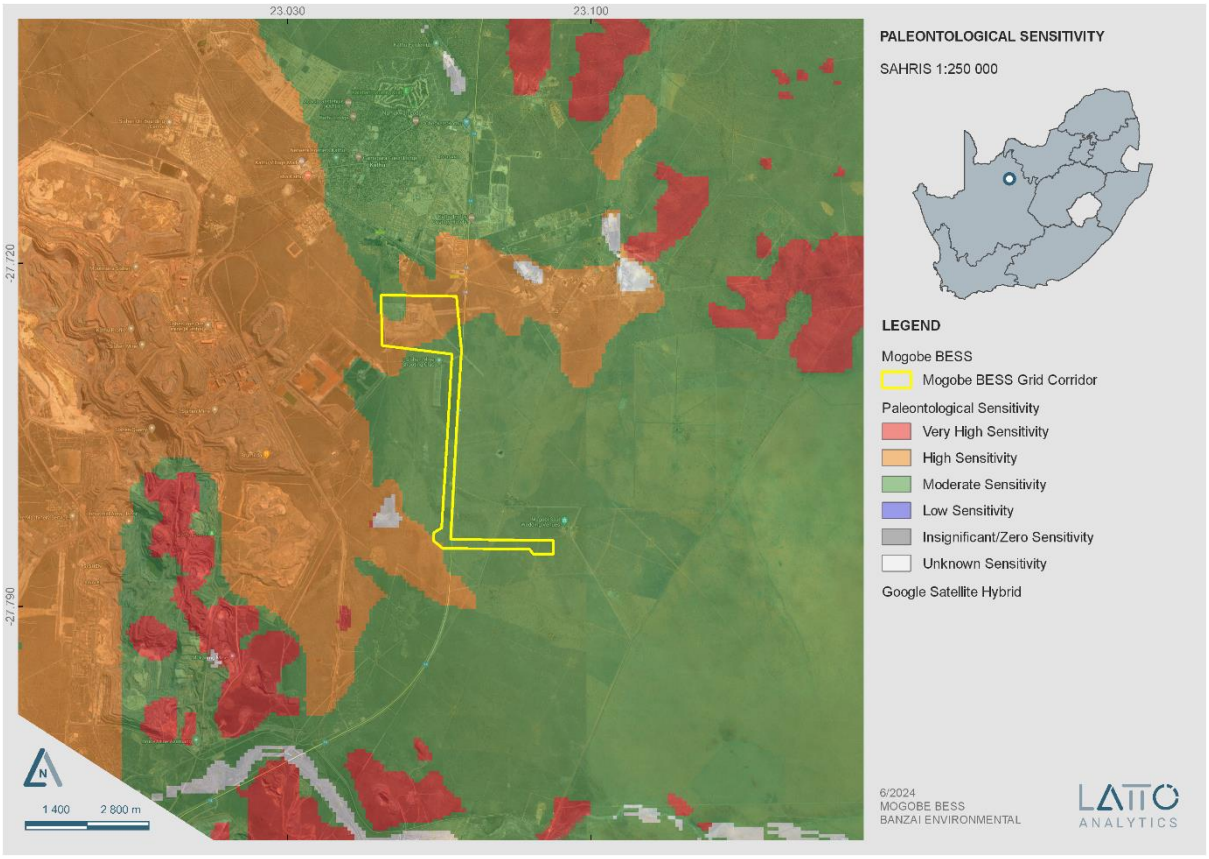


Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicates that the development is underlain by sediments with a High (orange) and Moderate (green) Palaeontological Sensitivity.

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.

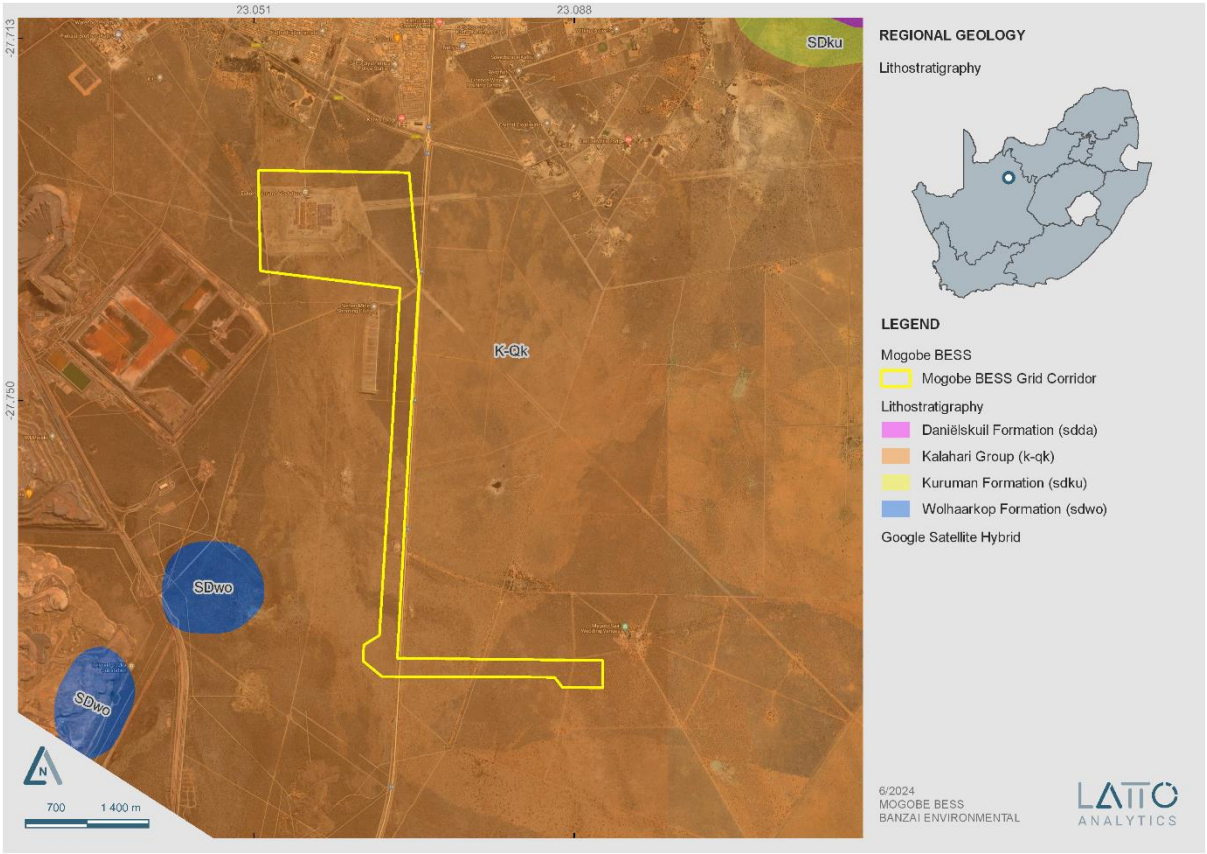
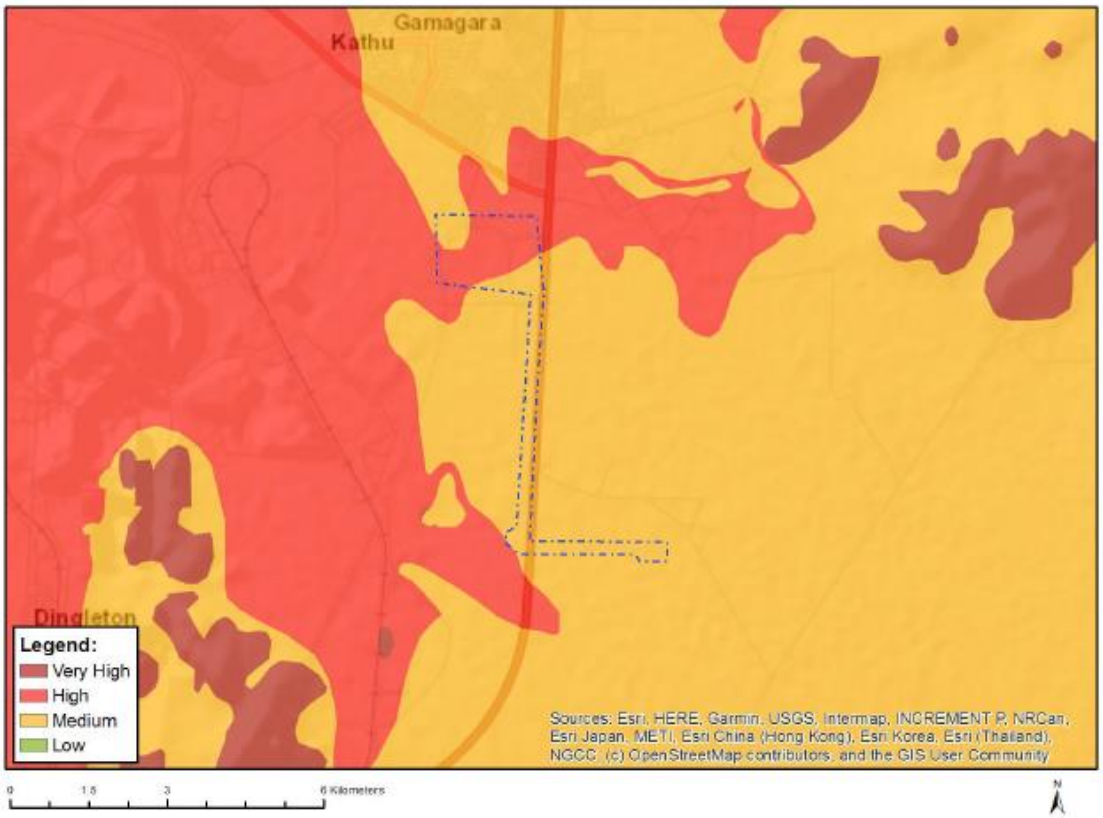


Figure 5: Updated geology (2014, Council for Geosciences, Pretoria) indicates that the proposed Mogobe EGI development near Kathu in the Northern Cape is underlain by the Kalahari Group (k-qk).

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

Figure 6: Palaeontological Sensitivity of Study site by the National Environmental Web-bases Screening Tool.

The National Environmental Web-based Screening Tool indicates that the Palaeontological Sensitivity of the development is High (red), while areas with a Medium (yellow) Palaeontological Sensitivity is also crossed.

6 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- Google Earth© satellite imagery.
- Palaeosensitivity map on SAHRIS (South African Heritage Resources Information System) website
- National Environmental Web-bases Screening Tool
- PIAs in the area include that of Almond 2013a, 2014 (see references)
- 1:250 000 Kuruman 2722 (1979) Geological Map *(Council for Geosciences, Pretoria)*

7 ASSESSMENT METHODOLOGY

7.1 Method of Environmental Assessment

Impact assessment must take account of the nature, scale, and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the following project phases:

- Construction.
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

Table 4: The rating system

NATURE		
The Nature of the Impact is the possible destruction of fossil heritage		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		

This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).

3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.

3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity = X.** **The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.**		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive

7.2 Summary of Impact Tables

Loss of fossil heritage will be a negative impact. Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent. In the absence of mitigation procedures, the damage or destruction of any palaeontological materials will be permanent. Impacts on palaeontological heritage during the construction phase could potentially occur and are

regarded as having a medium probability. As fossil heritage will be destroyed the impact is irreversible. The significance of the impact occurring will be medium pre-mitigation and low post-mitigation.

Table 5: **Summary of Impact Tables**

	Site	Probability	Duration	Magnitude	Reversibility	Irreplicable Loss	Cumulative Effect	Significance
Pre-Mitigation	1	2	4	2	4	4	2	17
Post mitigation	1	2	4	2	4	4	2	17

8 FINDINGS AND RECOMMENDATIONS

The proposed Mogobe EGI Kathu is mantled by red to flesh-coloured aeolian sand of the Kalahari Group and at depth underlain by Precambruim bedrocks of the Transvaal Supergroup. The DFFE (Department of Forestry, Fisheries and the Environment) as well as the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database indicate that the Palaeontological Sensitivity of the study area is High (Almond et al, 2013; SAHRIS website, DFFE Website).

Recent palaeontological studies have indicated that the Kathu area is underlain by a thick layer of Plio-Pleistocene to Recent Kalahari Group sediments. The Kalahari Group is characterised by well-developed calcretes or surface limestones (Mokolanen Formation), which may be 30 m or more thick in the region, while superficial aeolian sands of the Gordonia Formation and rare near-surface gravel and alluvial deposits sediments are likely less than 1 m thick. The projected development will thus not have a direct impact on the underlying Precambrian bedrocks of the Transvaal Supergroup.

The fossil assemblages of this Kalahari Group are generally very low in diversity and occur over a wide range. It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required pending the discovery of newly discovered fossils. It is considered that the development of the proposed development will not lead to detrimental impacts on the palaeontological resources of the area.

However, 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 Environmental Control

Officer (ECO) in charge of these developments. These discoveries ought to be protected 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 can be carry out by a paleontologist. Preceding any collection of fossil material, the specialist would need to apply for collection permit from SAHRA. Fossil material must be housed in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

9 MITIGATION AND EMPR REQUIREMENTS

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

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

It is the responsibility of the project's Environmental Control Officer (ECO) or site manager to train the workers and foremen on what to do if a fossil is accidentally discovered. In the absence of the ESO, a member of staff must be designated to be accountable for the effective application of the chance discovery protocol so that the conservation of fossil material is not jeopardised.

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

9.1 Legislation

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

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

9.2 Chance Find Procedure

- If a chance find is made, the person responsible for the find must immediately stop working, and all work in the immediate vicinity of the find must stop as well.
- The individual who discovered the item must immediately notify his or her direct supervisor, who must then notify his or her management and the ECO or site manager. The ECO or site manager must notify the relevant Heritage Agency (South African Heritage Resources Agency, SAHRA) of the discovery. (Contact information: SAHRA, 111 Harrington Street, Cape Town, South Africa. PO Box 4637, Cape Town 8000, South Africa. Fax: +27 (0)21 462 4509. Tel: 021 462 4502. Web address: www.sahra.org.za). Photographs of the find from various perspectives, as well as GPS coordinates, must be submitted to the Heritage Agency.
- Within 24 hours of the discovery, a preliminary report must be sent to the Heritage Agency, which must include the following: 1) the date of finding; 2) a description of the discovery; and 3) a description of the fossil and its context (depth and position of the fossil), as well as GPS coordinates.
- Photographs of the discovery (the more the merrier) must be of high quality, in focus, and accompanied by a scale. Photographs of the vertical part (side) where the fossil was discovered are also required.
- Upon receipt of the preliminary report, the Heritage Agency will notify the ECO (or site manager) whether a palaeontologist rescue excavation or collection is required.
- The place must be guarded to prevent future damage. There should be no attempt to remove material from their environment. Stabilize the exposed items and cover them with a plastic sheet or sand bags. The Heritage organization will also be able to advise on the best way to protect the find.
- If the fossil cannot be stabilized, the ECO (site manager) may carefully collect the fossil.
- Once the Heritage Agency has received the written authorization, the mine may continue with the mining activity in the affected area.
- Fossil finds must be placed in tissue paper and in an appropriate box while necessary care must be taken to remove any fossil material from the rescue site.

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APPENDIX 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. 2018. Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.
Butler, E. 2018. Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.
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Butler, E. 2018. Palaeontological field assessment of the proposed development of the Wildealskloof mixed use development near Bloemfontein, Free State Province. Bloemfontein.
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