PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED KURUMAN GAMOHAAN SEVEN MILES 22KV POWERLINE ON THE REMAINING EXTENT OF THE FARM KURUMAN RESERVE 690, IN KURUMAN, NORTHERN CAPE PROVINCE

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Client:

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Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation.
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application.
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct.
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

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SIGNATURE: 

ACKNOWLEDGEMENT OF RECEIPT

Report Title	Palaeontological Desktop Assessment for a Proposed Kuruman Gamohaan Seven Miles 22kV Powerline on the Remaining Extent of the Farm Kuruman Reserve 690, in Kuruman, Northern Cape Province		
Control	**Name**	**Signature**	**Designation**
Author	**Elize Butler**		**Palaeontologist**
Reviewed	**Wouter Fourie**		Archaeologist/Heritage Specialist/Project Manager – PGS Heritage

CLIENT:

CONTACT PERSON:

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

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in 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 – 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 8	-
(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 9	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 6 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 alternatives;	Section 1 and 9	
(g) An identification of any areas to be avoided, including buffers	None Section 1 and 9	
(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 6.1 – 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 9	
(k) Any mitigation measures for inclusion in the EMPr	Section 1 and 9	
(l) Any conditions for inclusion in the environmental authorisation	Section 1 and 9	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 1 and 9	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 9	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 9	-
(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 will be

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
		conducted as part of the EIA and EMPr process.
(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	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 PGS Heritage (Pty) Ltd to conduct a Palaeontological Desktop Assessment (PDA) for the proposed Kuruman Gamohaan Seven Miles 22KV Powerline on the Remaining Extent of the Farm Kuruman Reserve 690, in Kuruman, Northern Cape Province. In compliance 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 development area and to evaluate the impact of the proposed development on the Palaeontological Heritage of the area.

The proposed development is underlain by Caenozoic deposits of the Kalahari Group, the Kuruman Formation (Asbestos Hills Subgroup) as well as the Kogelbeen Formation (Campbell Rand Subgroup) of the Ghaap Group (Transvaal Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Caenozoic Kalahari deposits is moderate, that of the Kuruman Formation is low while that of the Kogelbeen Formation is very high (Almond and Pether 2008, SAHRIS website).

However, the proposed development will include the installation of a wooden pole of approximately 30cm in diameter. A vertical drill will create a hole and the pole will be dropped in the hole by a crane. No cementing will be necessary. The impact of the project and technology used will thus limit the impact on the environment. It is thus expected that the project will have a Low significance in palaeontological terms and will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent.

BUT, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager 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 mitigation (recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

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TERMINOLOGY AND ABBREVIATIONS

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place.
- carrying out any works on or over or under a place.
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place.
- constructing or putting up for display signs or boards.
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralized bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 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 contains such fossilised remains or trace.

Table 2: Abbreviations

Abbreviations	**Description**
ASAP	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
ECO	Environmental Control Officer
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PDA	Palaeontological Desktop Assessment
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

1 INTRODUCTION AND PROJECT DESCIRPTION

Eskom proposes the construction of a new 22kV powerline from the existing Gamohaan substation towards Seven Miles where it will cross the Kuruman watercourse. This crossing of the Kuruman watercourse requires a General Authorisation (GA) registration and the the clearance of indigenous vegetation will require an EA prior to commencement.

The proposed new 22kV powerline route will run from the existing Gamohaan substation along the R31 provincial road toward Kuruman Town where the powerline will turn north at the Bathlaros intersection for 1,1km towards the community of Mamoratwe at which point the powerline will turn east towards Seven Miles where it will cross the Kuruman watercourse. The proposed crossing of the Kuruman watercourse requires will require a GA registration. The section of the proposed powerline that runs parallel to the R31 and then turns north towards Mamoratwe will require the removal of indigenous vegetation which will require an EA prior to commencement of the activity. The proposed development will include the installation of a wooden pole of about 30cm in diameter. A vertical drill will create a hole and the pole will be dropped in the hole by a crane. No cementing will be necessary. The impact of the project and technology used will thus limit the impact on the environment.The proposed powerline will be located on the remaining extent of the Farm Kuruman Reserve 690 (**Figure 1-2**). The start, middle and end coordinates of the proposed powerline are:

Start Point (Preferred): 27°22'45.905"S, 23°21'40.352"E;

Start Point (Alternative): 27°22'45.476"S, 23°21'40.622"E;

Middle Point (Preferred): 27°23'23.399"S, 23°22'55.254"E;

Middle Point (Alternative) 27°23'21.102"S, 23°22'51.856"E; and

End Point: 27°22'10.47"S, 23°24'11.682"E.

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, 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 Palaeontological Impact Assessments (PIA) since 2014.

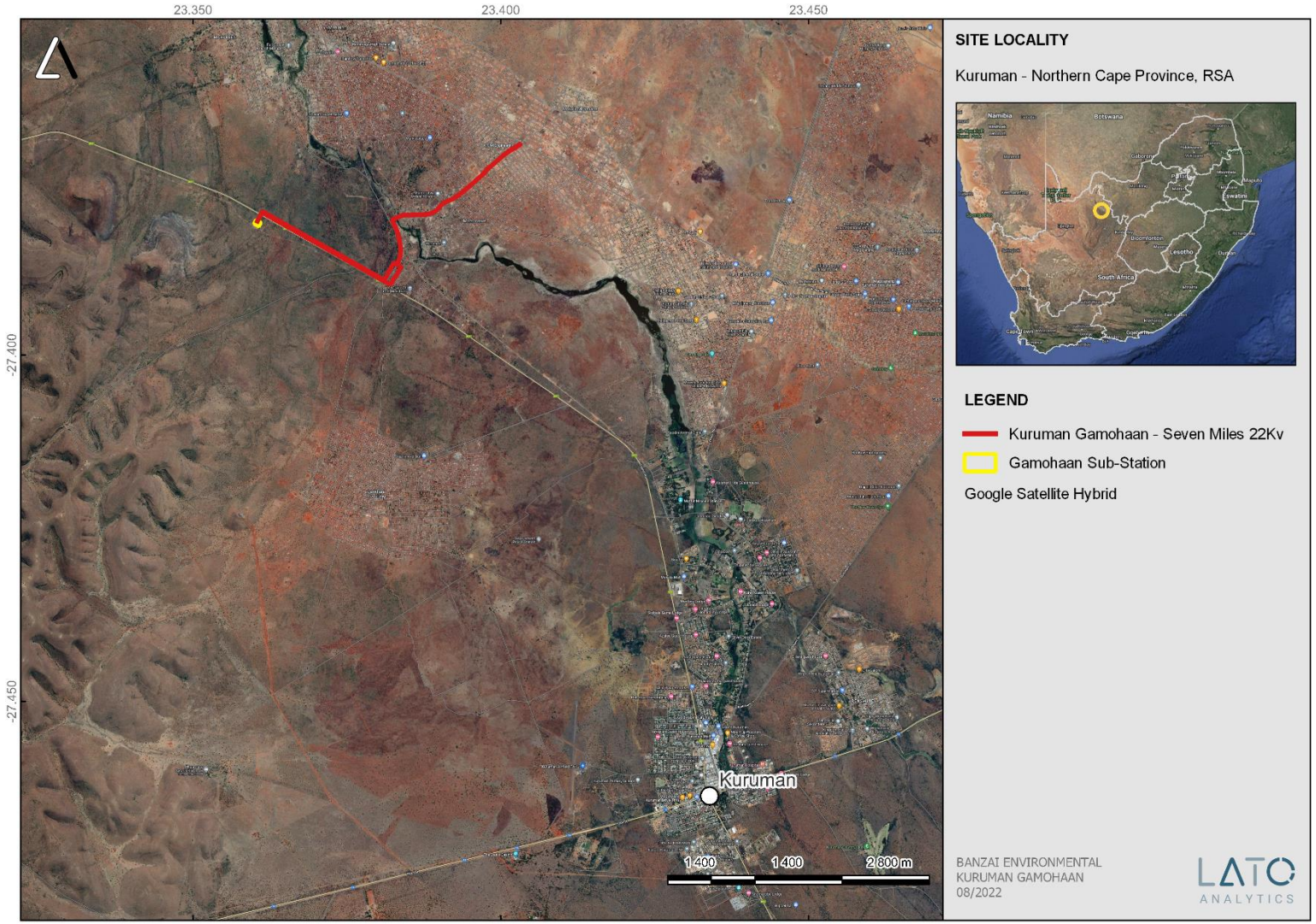


Figure 1: Google Earth (2021) Image of the proposed Kuruman Gamohaan – Seven miles 22kV Powerline on the Remaining Extent of the Farm Kuruman Reserve 690, in Kuruman, Northern Cape Province.

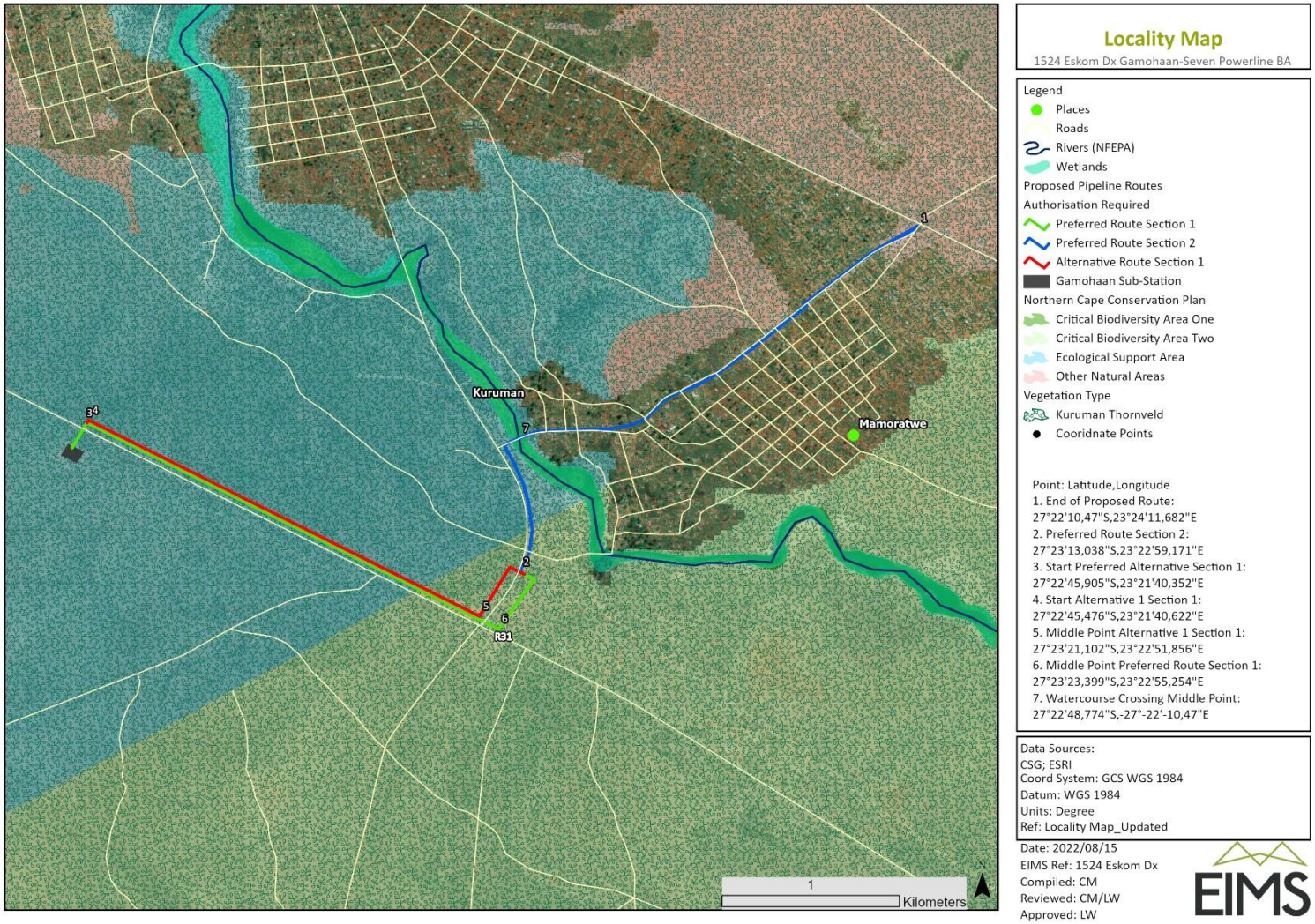


Figure 2: Locality Map of the proposed Kuruman Gamohaan – Seven miles 22kV Powerline on the Remaining Extent of the Farm Kuruman Reserve 690, in Kuruman, Northern Cape Province.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa 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 Environmental Management Program (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, Environmental Impact Assessment (EIA) rating standards as well as SAHRA policies the following comprehensive and legally compatible Palaeontological Desktop Assessment (PDA) 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 PDA forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

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

4 OBJECTIVE

The aim of a PDA is to assess the potential impact on palaeontological heritage resources and if required recommended further studies such as a PIA that will provide further guidelines on the management of palaeontological heritage resources and so decrease the effect of the development on potential fossils at the development site.

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the purpose of the PIA is: 1) to identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the

palaeontological magnitude of the formations; 3) to clarify the **impact** on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

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

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

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

The terms of reference of a PDA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kml's) in the proposed development.
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:

a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
c. Cumulative impacts result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.

- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The geology of the proposed 22KV Powerline on the Remaining Extent of farm Kuruman Reserve 690, in Kuruman, in the Northern Cape Province is shown on the 1:250 000 Kuruman 2722 Geological Map (1979) (Council of Geoscience, Pretoria) (**Figure 3;** Table 3). According to this map the development is underlain by the Campbell Group (Ghaapplato Formation) (Vgd, blue) as well as the Kuruman Member (Vak, brown) of the Asbestos Hills Formation (Griquatown Group).

Updated geological maps (**Figure 4**) indicates that the proposed development is underlain by the Kalahari Group as well as the Kogelbeen Formation (Campbell Rand Subgroup) and the Kuruman Formation (Asbestos Hill Subgroup), both of the Ghaap Group. The proposed development is underlain by sediments of the Transvaal Supergroup of the Griqualand West Basin. In Griqualand West the Ghaap Group is subdivided in the oldest Schmidtsdrif, middle Campbell Rand and youngest Asbestos Hills and Koegas Subgroups (**Figure 5**). The proposed development is located on the western border of the Kaapvaal Craton (McCarthy & Rubidge 2005, Eriksson et al. 2006).

The Campbell Rand Subgroup (**Figure 5-6**) 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 late Archaean Kogelbeen Formation is about 450m thick and comprise of limestone and chert with stromatolites and microbial horizons as well as dolomite. Within the stromatolitic horizons secondary chert replacement occurs. Almond (2018, 2019) described small exposures of the Kogelbeen Formation bedrocks on the western outskirts of Kuruman.

The Precambrian bedrocks are mantled by superficial deposits comprising of alluvial and colluvial gravels, cherty surface rubble as well as sediments of the Kalahari Group. Along river valley floors gravelly to sandy sediments is often calcretised. In some areas of Kuruman highly resistant, blocky-weathering siliceous breccia mantles caps the carbonate bedrocks. These silcrete-like breccia consists of angular clasts of laminated silicified carbonate and chert but no banded iron formations (BIF). This indicates that it was formed during a major explosive episode during the deposition of the Asbestos Hills deep marine succession. The upper surface of low-lying carbonate bedrocks has been karstified during the Caenozoic with common steep-sided solution hallows (sometimes infilled with ferruginised surface gravels and BIF forming underground drainage networks like the Eye of Kuruman as well as cave systems).

The fossil assemblages of the Kalahari (**Figure 7**) are represented by terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods, and trace fossils. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways. Amphibian and crocodile remains have been uncovered where the depositional settings in the past were wetter. Fossils are mostly associated with ancient lakes, pans, and river systems.

According to the PalaeoMap (**Figure 8**) on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Caenozoic Kalahari deposits is moderate, that of the Kuruman Formation is low while that of the Kogelbeen Formation is Very High (Almond and Pether 2008, SAHRIS website).

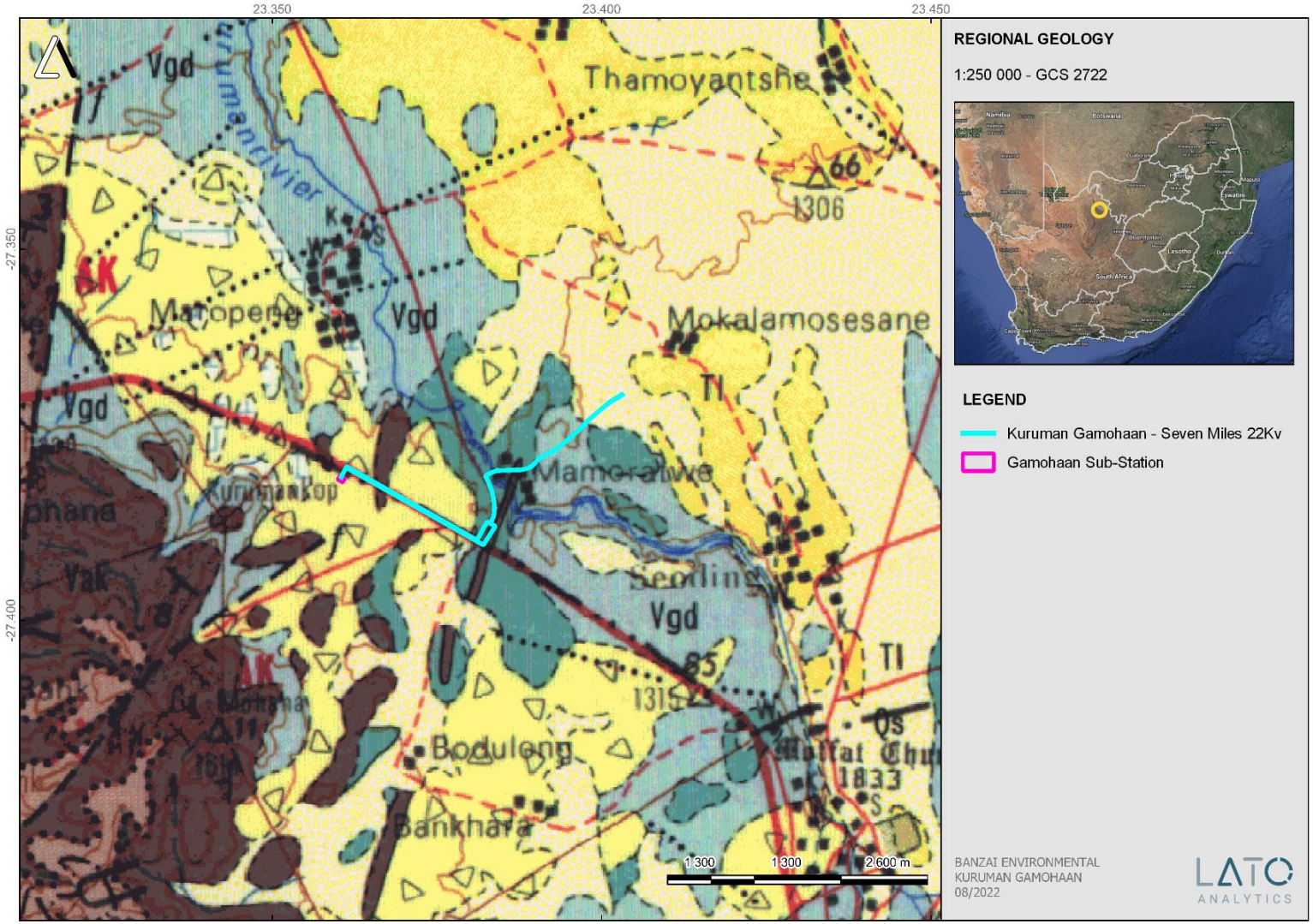
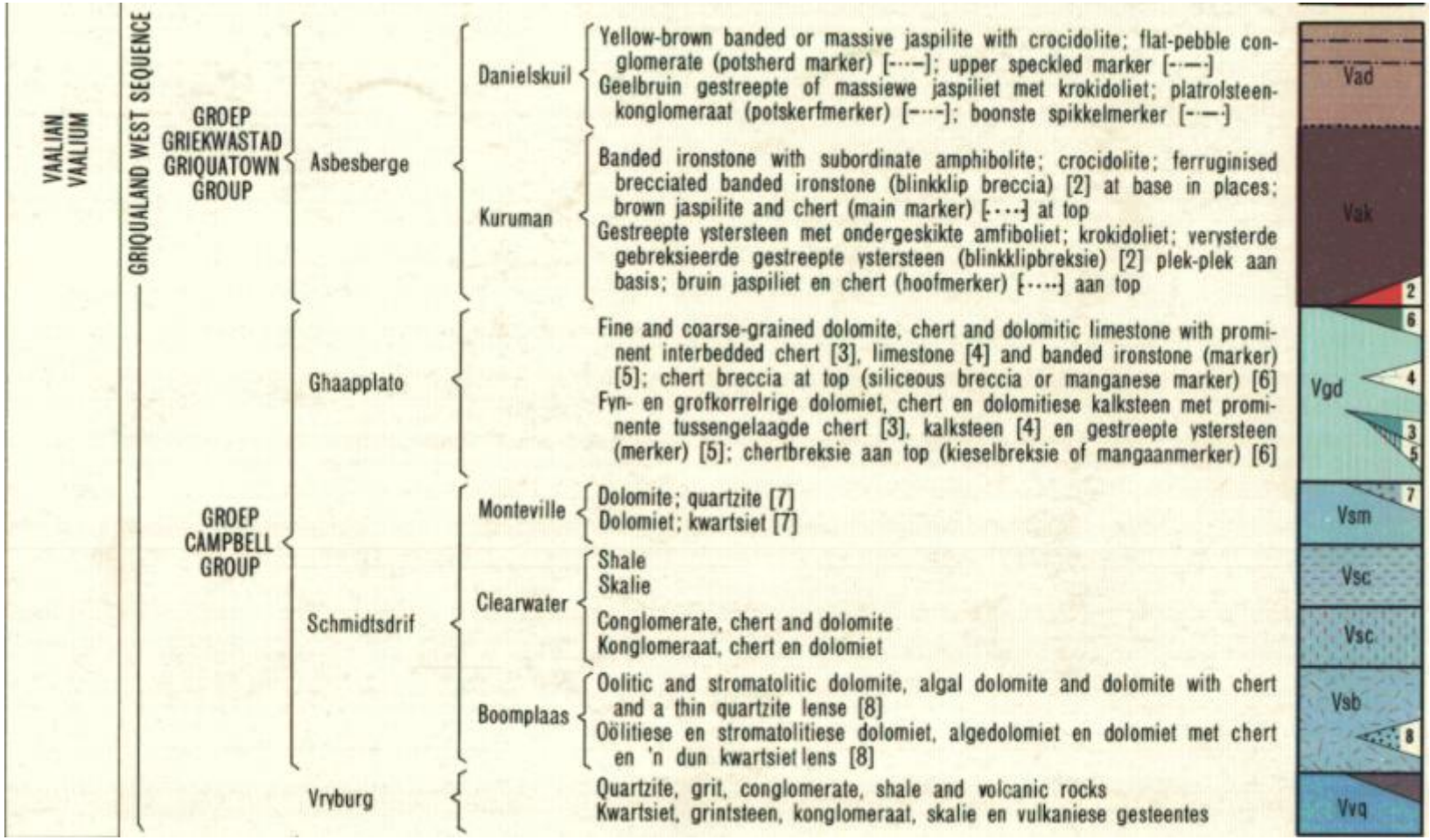


Figure 3: Extract of the 1:250 000 Kuruman 2722 Geological Map (1979) (Council of Geoscience, Pretoria) *indicating the geology of the proposed development in light blue.*

Table 3: Legend of the Kuruman 2722 Geological Map (1979) *(Council of Geoscience, Pretoria)*


VAALIAN
VAALIUM
GRIQUALAND WEST SEQUENCE
GROEP
GRIEKWASTAD
GRIQUATOWN
GROUP
GROEP
CAMPBELL
GROUP
Asbesberge
Ghaapplato
Schmidtsdrif
Vryburg
Danielskuil
Kuruman
Monteville
Clearwater
Boomplaas
Yellow-brown banded or massive jaspilite with crocidolite; flat-pebble conglomerate (potsherd marker) [----]; upper speckled marker [----]
Geelbruin gestreepte of massiewe jaspiliet met krokidoliet; platrolsteenkonglomeraat (potskerfmerker) [----]; boonste spikkelmerker [----]
Banded ironstone with subordinate amphibolite; crocidolite; ferruginised brecciated banded ironstone (blinkklip breccia) [2] at base in places; brown jaspilite and chert (main marker) [----] at top
Gestreepte ystersteen met ondergeskikte amfiboliet; krokidoliet; verysterde gebreksieerde gestreepte ystersteen (blinkklipbreksie) [2] plek-plek aan basis; bruin jaspiliet en chert (hoofmerker) [----] aan top
Fine and coarse-grained dolomite, chert and dolomitic limestone with prominent interbedded chert [3], limestone [4] and banded ironstone (marker) [5]; chert breccia at top (siliceous breccia or manganese marker) [6]
Fyn- en grofkorrelrige dolomiet, chert en dolomitiese kalksteen met prominente tussengelaagde chert [3], kalksteen [4] en gestreepte ystersteen (merker) [5]; chertbreksie aan top (kieselbreksie of mangaanmerker) [6]
Dolomite; quartzite [7]
Dolomiet; kwartsiet [7]
Shale
Skalie
Conglomerate, chert and dolomite
Konglomeraat, chert en dolomiet
Oolitic and stromatolitic dolomite, algal dolomite and dolomite with chert and a thin quartzite lense [8]
Oölitiese en stromatolitiese dolomiet, algedolomiet en dolomiet met chert en 'n dun kwartsietlens [8]
Quartzite, grit, conglomerate, shale and volcanic rocks
Kwartsiet, grintsteen, konglomeraat, skalie en vulkaniese gesteentes
Vad
Vak
2
6
Vgd
4
3
5
7
Vsm
Vsc
Vsc
Vsb
8
Vvq

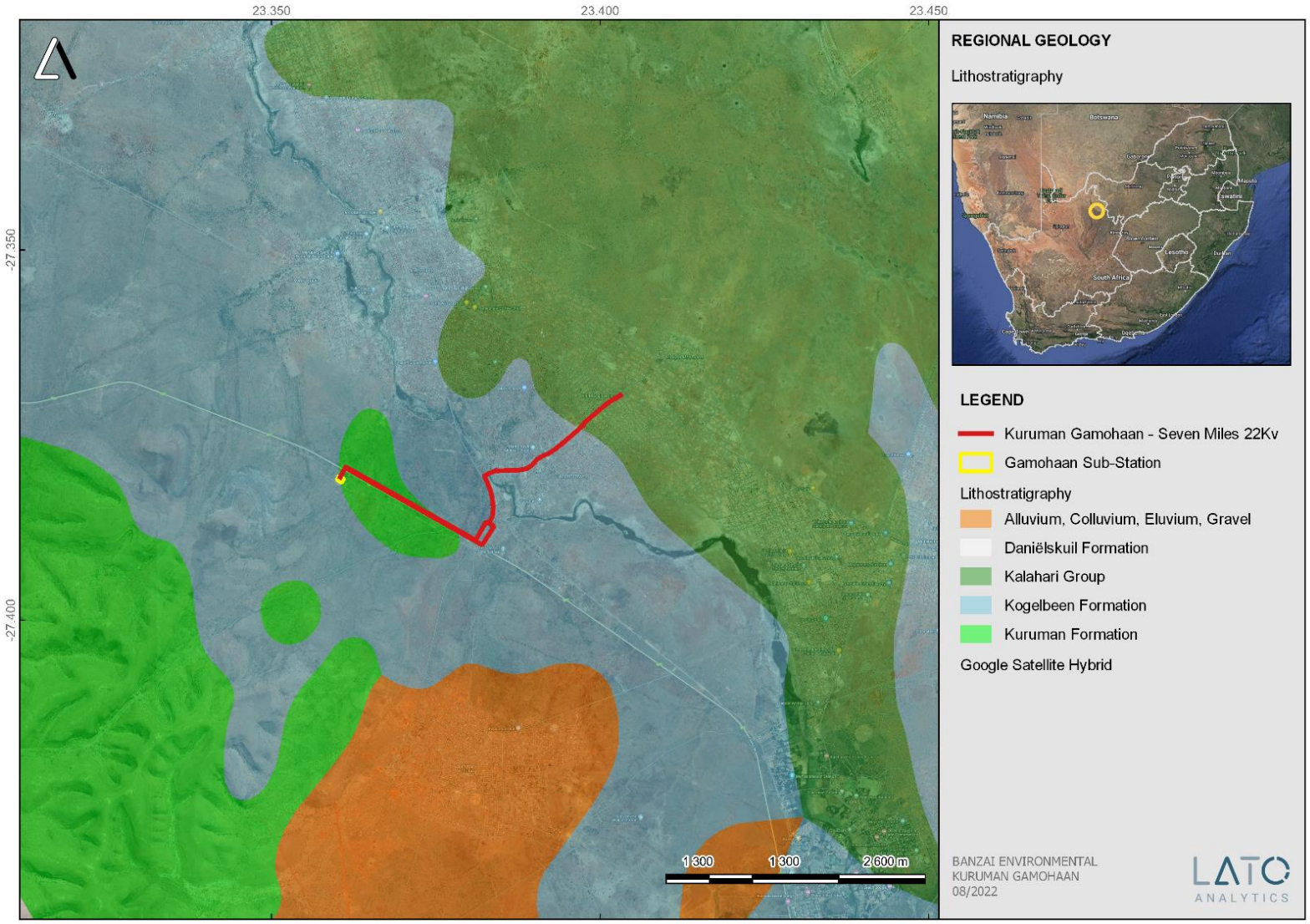


Figure 4: Updated geology (Council of Geosciences, Pretoria) indicates that the proposed development is underlain Vryheid Formation of the Ecca Group (Karoo Supergroup

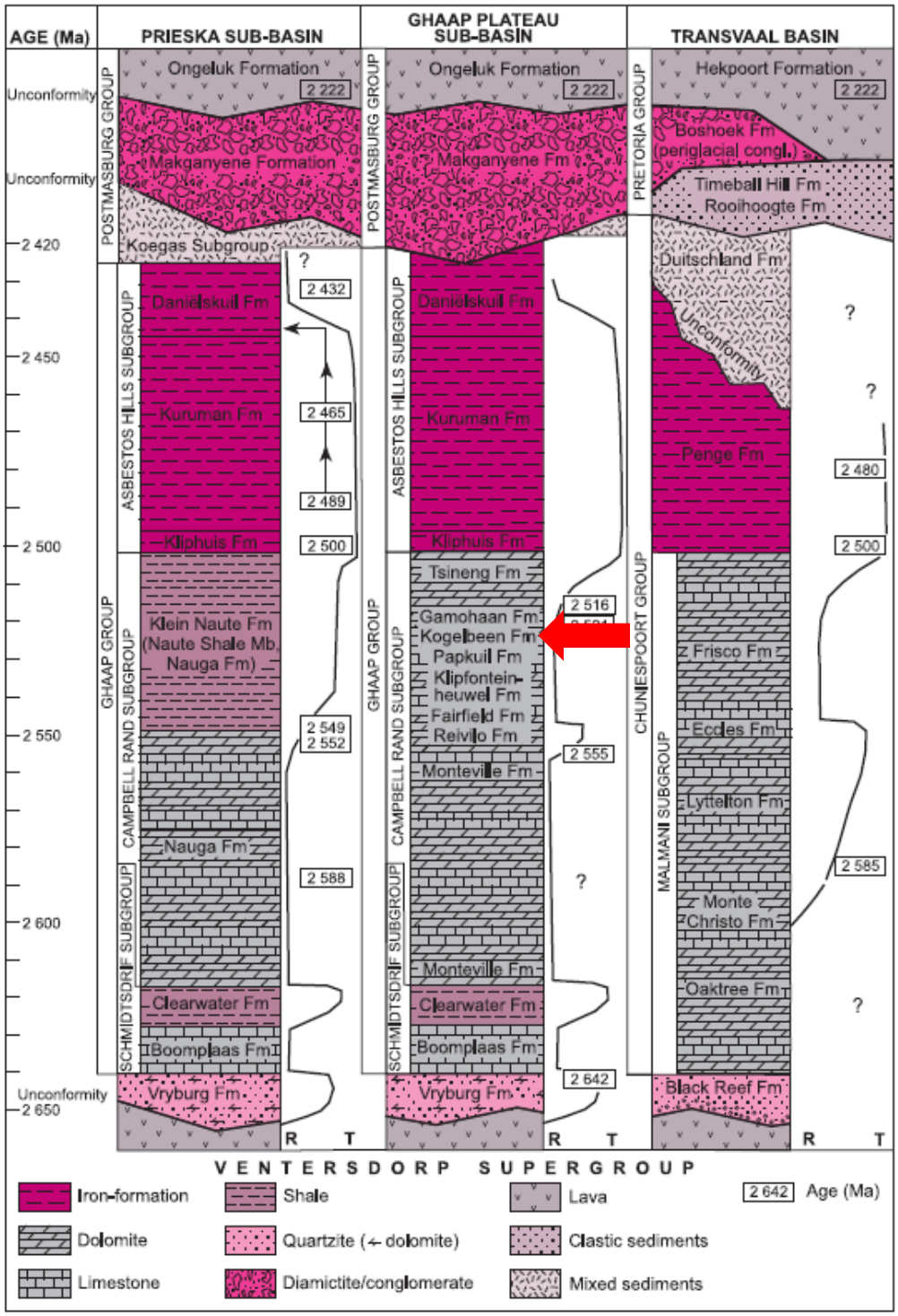


Figure 5: Stratigraphy of the Transvaal Supergroup (Ghaap Plateau Sub-basin, indicated in the middle column). Precambrian bedrock units represented in the study area is indicated by the red arrow (Modified from Eriksson et al. 2006).

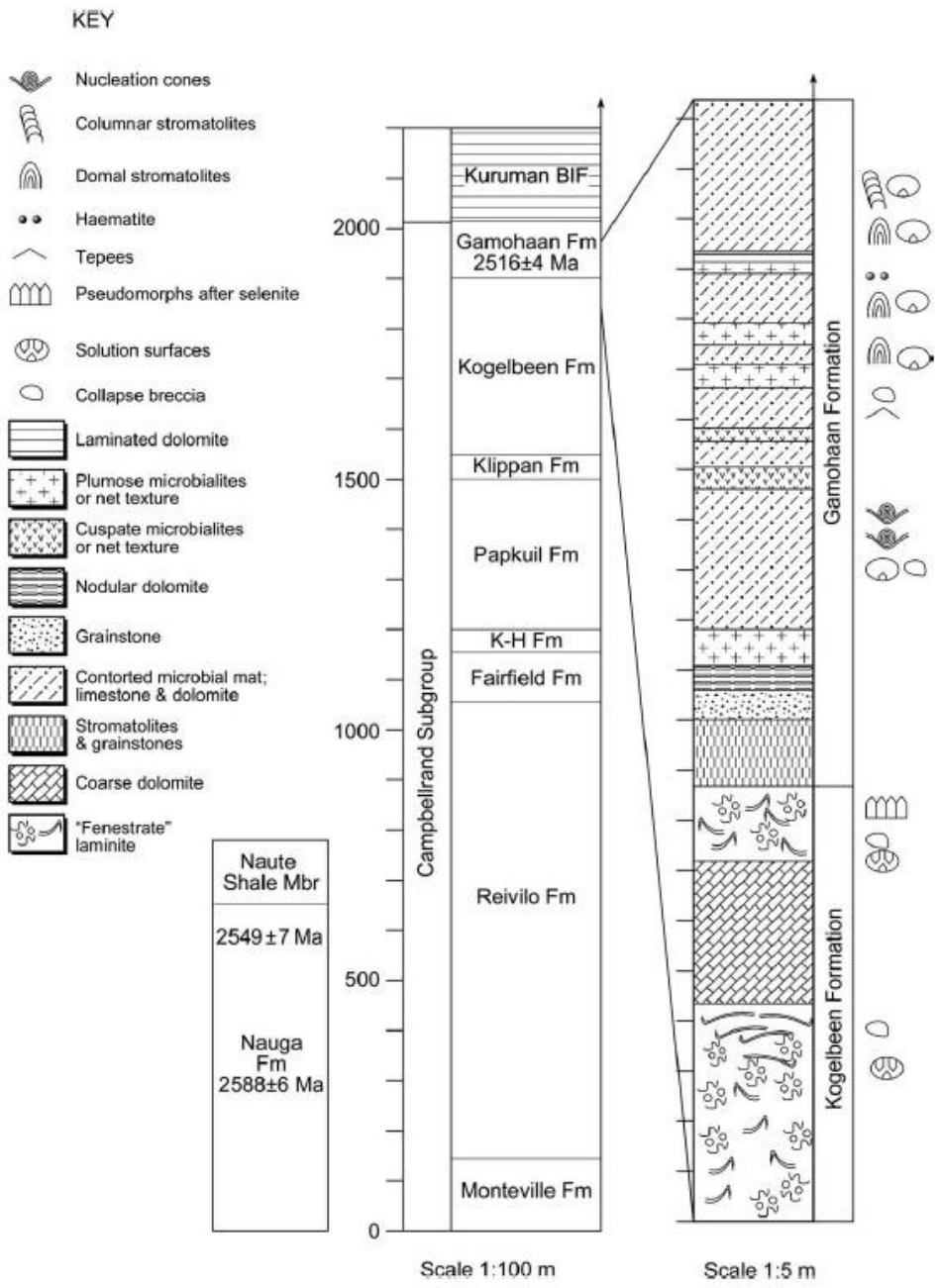


Figure 6: Stratigraphy of the Campbell Rand Supergroup indicating the main lithologies and sedimentary features (Taken from Gardine et al, 2005)

Table 4: Fossil Heritage probably present in the development footprint.

Table modified from Palaeotechnical Report (Almond and Pether 2009).

Subgroup/ sequence	Group	Formation	Fossil Heritage
Tertiary-Quaternary	Kalahari	-	Terrestrial organisms include trace fossils, ostracods, bivalves, gastropod shells, diatoms and trace fossils. Late Cenozoic calcrete may comprise of bones, horn corns as well as mammalian teeth. Tortoise remains have also been uncovered as well as trace fossils which includes termite and insect's burrows and mammalian trackways.
Griqualand West Super Group	Campbell Rand Subgroup	Ghaapplato	Stromatolites e.g., Cyanobacterial microfossils

Figure 7:Archaeon stromatolites

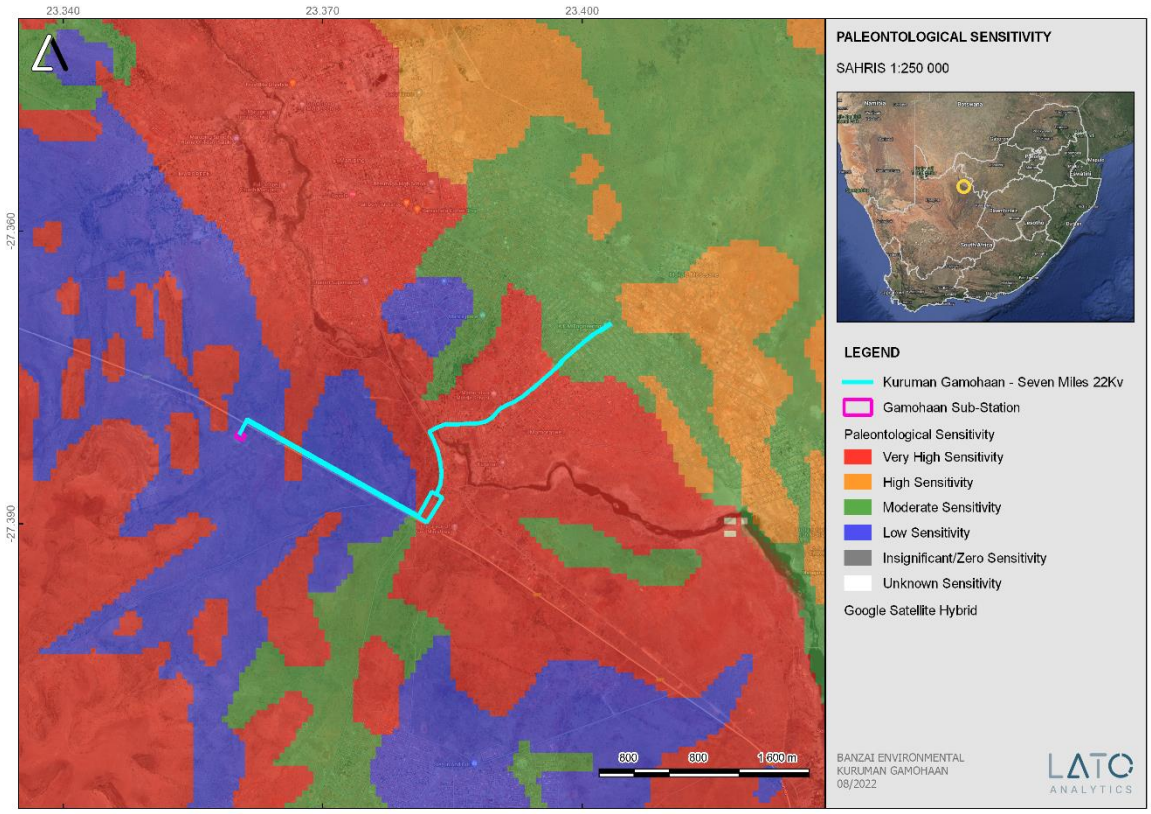


Figure 8: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in light blue.

Table 5:Palaeontological Sensitivity

Colour	Sensitivity	Required Action
RED	**VERY HIGH**	**field assessment and protocol for finds is required**
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	**MODERATE**	**desktop study is required**
BLUE	**LOW**	**no palaeontological studies are required however a protocol for finds is required**
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

According to the SAHRIS Palaeosensitivity map (**Figure 8**) the proposed development is underlain by sediments with a Very High (red), Moderate (green) a Low (blue) Palaeontological Sensitivity.

6 METHODS

The aim of this 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.

6.1 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.

7 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)
- 1:250 000 Kuruman 2722 Geological Map (1979) (Council of Geoscience, Pretoria)
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.
- Various PIAs conducted by Almond (see references)

8 IMPACT ASSESSMENT METHODOLOGY

8.1 Introduction

PLEASE NOTE:

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. To ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the criteria is given below.

Table 6: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	Proposed site	Incidental
2	LOW	Study area	Short-term
3	MODERATE	Local	Medium/High-term
4	HIGH	Regional / Provincial	Long-term
5	VERY HIGH	Global / National	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

8.2 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 km2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given below.

Table 7: Description of the significance rating scale

RATING		DESCRIPTION
5	Very high	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	High	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	Moderate	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	Very low	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	No impact	There is no impact at all - not even a very low impact on a party or system.

8.3 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail below**.**

Table 8: Description of the significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Site	The impact will affect an area not exceeding the Eskom property.
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

8.4 Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table below.

Table 9: Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium/High term	The environmental impact identified will operate for the duration of life of facility.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

8.5 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown below.

Table 10: Description of the degree of probability of an impact occurring.

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely

3	Could happen
4	Very Likely
5	It's going to happen / has occurred

8.6 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in **Table 11**. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 11: Description of the degree of certainty rating scale

RATING	**DESCRIPTION**
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

8.7 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus, the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

Impact Risk = (SIGNIFICANCE (5)**+** *Spatial* (2)**+** Temporal(5)) X Probability(4)
5

Table 12: Impact ratings for the proposed development

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	Very High	Site	Permanent	Could Happen	
Impact	5	2	5	4	3.2

Note: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (4) is divided by 5 to give a probability rating of 0,8. The criteria rating of 4 is then multiplied by the probability rating (0,8) to give the final rating of 3.2.

The impact risk is classified according to five classes as described below.

Table 13: Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	**Very Low**
1.1 – 2.0	2	**Low**
2.1 – 3.0	3	**Moderate**
3.1 – 4.0	4	**High**
4.1 – 5.0	5	**Very High**

Therefore, with reference to the example above, an impact rating of 3.2 will fall in the **Impact Class 4,** which will be a **high impact**.

8.8 SUMMARY OF IMPACT TABLES

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Pre-mitigation	Negative	Very High (5)	Study site (2)	Permanent (5)	Very Likely (4)	3.2
Post-mitigation	Neutral	Very High (5)	Study site (2)	Permanent (5)	Could Happen (3)	2.4

Pre-mitigation: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (4) is divided by 5 to give a probability rating of 0,8. The criteria rating of 4 is then multiplied by the probability rating (0,8) to give the final rating of 3.2. (HIGH IMPACT +IMPACT CLASS 4).

Post-mitigation: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 4 is then multiplied by the probability rating (0,6) to give the final rating of 2.4. (MODERATE IMPACT =IMPACT CLASS 3)

9 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Caenozoic deposits of the Kalahari Group, the Kuruman Formation (Asbestos Hills Subgroup) as well as the Kogelbeen Formation (Campbell Rand Subgroup) of the Ghaap Group (Transvaal Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Caenozoic Kalahari deposits is moderate, that of the Kuruman Formation is low while that of the Kogelbeen Formation is Very High (Almond and Pether 2008, SAHRIS website).

However, the proposed development will include the installation of a wooden pole of about 30cm in diameter. A vertical drill will create a hole and the pole will be dropped in the hole by a crane. No cementing will be necessary. The impact of the project and technology used will thus limit the impact on the environment. It is thus expected that the project will have a Low significance in palaeontological terms and will not lead to damaging impacts on the palaeontological resources of the area. The construction of the development may thus be permitted in its whole extent.

Nevertheless, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO/site manager in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO/site manager 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 mitigation (recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

9.1 CHANCE FINDS PROTOCOL

The following procedure will only be followed if fossils are uncovered during the excavation phase of the development.

9.2 Legislation

Cultural Heritage in South Africa (includes 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**".

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

9.3 Background

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

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

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

9.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African

Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.

- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.
- Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.
- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- If the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO. Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization, the developer may continue with the development on the affected area.

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APPENDIX A

ELIZE BUTLER

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
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	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

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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
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