



PGS HERITAGE

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED TBO's FREE STATE SOUTH 6 TSF RECLAMATION PUMP STATION AND SLURRY TRANSFER LINE

Issue Date: 28 October 2021
Revision No.: v0.1
Client:
PGS Project No: 555HIA

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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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ACKNOWLEDGEMENT OF RECEIPT

Report Title	PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED TBO's FREE STATE SOUTH 6 TSF RECLAMATION PUMP STATION AND SLURRY TRANSFER LINE		
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This PIA report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	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 vitae	Section 2 – refer to Appendix A	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – 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 9	-
(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 10	Desktop Study
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 10	-
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site	Section 5 – Geological and Palaeontological history	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
including areas to be avoided, including buffers;		
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	-
(k) Any mitigation measures for inclusion in the EMPr	Section 11	-
(l) Any conditions for inclusion in the environmental authorisation	Section 11	-
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11	-
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	-
(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 10	-
(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 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 the Palaeontological Desktop Assessment (PDA) to assess the proposed TBO's Free State South 6 Tsf Reclamation Pump Station and Slurry Transfer Line. 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 mining area and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed development is underlain by Quaternary red and grey aeolian dune sand as well as calcrete and surface limestone. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of Quaternary sediments is Low (Almond and Pether, 2009; Almond *et al.*, 2013). A Low significance has been allocated to the development site. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the mine may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must be informed. 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 mitigation can be carry out by a paleontologist.

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

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Appendix A CV

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
DEFF	Department of Environmental Department of Environment, Forestry and Fisheries
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NECSA	Nuclear Energy Corporation of South Africa
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
NGPM	Nkwe Garatau Platinum Mine
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

Harmony Gold Mining Company's TBO Saaiplaas Plant is planning to reclaim the Free State South (FSS) 6 TSF through the TBO Saaiplaas Plant. Final residue from Saaiplaas Plant tailings will be deposited on the St. Helena 123 TSF (**Figure 1-3**).

1.1 2. Project Description

The TBO Saaiplaas Plant plan to construct a new reclamation pump station at FSS 6 TSF and slurry transfer line from FSS6 TSF to to Brand A Pump Station to transport reclaimed slurry. Once at Brand A, the slurry will be pumped into a sump and transported to the Saaiplaas Plant via an existing pipeline. The reclamation pump station will be constructed adjacent to the footprint of FSS6 TSF and consist of offices, pumping and electrical infrastructure.

The technical specification of the proposed slurry pipeline is:

- Transport material – Slurry / Tailings
- Type – Steel (SABS 719 Grade B, with 10mm Cement Mortar Lining (CML)
- Construction – Flanged on plinths
- Flow Rate – 196 l/s
- Length – ± 5 900m
- Diameter – 0.45 m NB



Figure 1: Google Earth (2021) Image indicating the locality of the proposed new reclamation pump station at FSS 6 TSF and slurry transfer line from FSS6 TSF to Saaiplaas Plant. New transfer line is indicated in blue and existing line in green

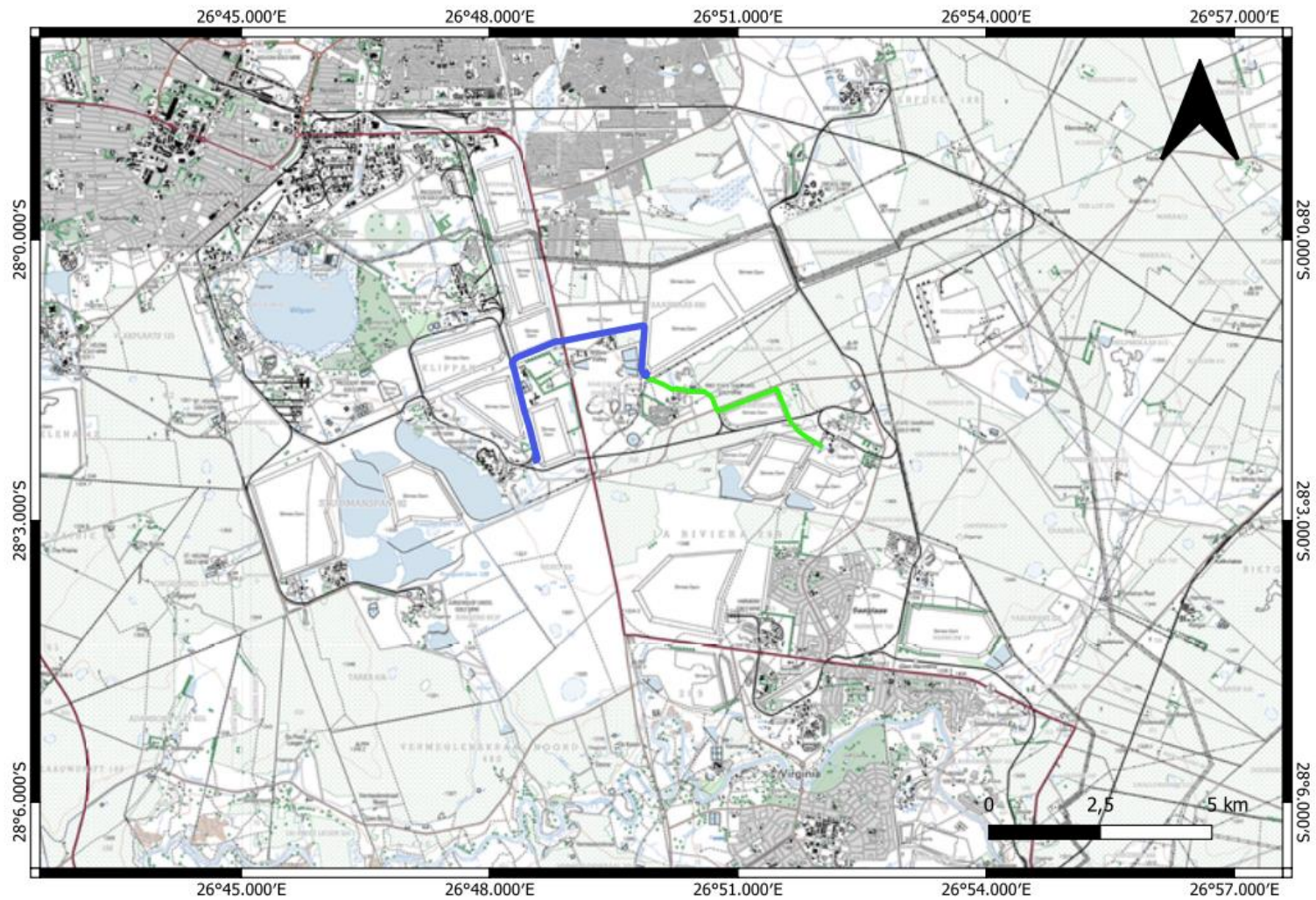


Figure 2 – Locality Map.



Figure 3: FSS 6 TSF Proposed Reclamation Pump Station

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 PIAs for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga Provinces. 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 PIAs since 2014.

3 LEGISLATION

3.1 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**”.

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

This Palaeontological Impact assessment forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 m² in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or

- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The aim of a PIA is to decrease the effect of the development on potential fossils at the development site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the purpose of the PIA are: 1) to **identify** the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to determine the **impact** on fossil heritage; and 4) to **recommend** how the property developer should guard against and lessen damage to fossil heritage.

The terms of reference of a PIA are as follows:

General Requirements:

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

- b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
- c. **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
 - Fair assessment of alternatives (infrastructure alternatives have been provided):
 - Recommend mitigation measures to minimise the impact of the proposed development; and
 - Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed development is depicted on the 1: 250 000 2826 Winburg (1978) Geological Map (Council for Geosciences, Pretoria). The proposed development is underlain by Quaternary red and grey aeolian dune sand as well as calcrete and surface limestone. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of Quaternary sediments is Low, but locally High, (Almond and Pether, 2009; Almond *et al.*, 2013) (**Figure 5**).

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

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

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Caenozoic

deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn cores, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells are also known from the Quaternary. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria and rhizoliths.

Table 3: Explanation of the symbols on the Geological Map surrounding the development (Johnson et al, 2006). SG- Supergroup; Fm-Formation

Symbol	Group/Formation (Fm)	Lithology	Palaeontological Sensitivity
Q	Quaternary	Alluvium, sand, calcrete	Low
Qc	Quaternary Calcrete	Calcrete	Low
Jd	Jurassic dykes	Intrusive Dolerite dykes	Zero
Pa	Adelaide Subgroup, Beaufort Group	Sandstone, Siltstone shale	Very High

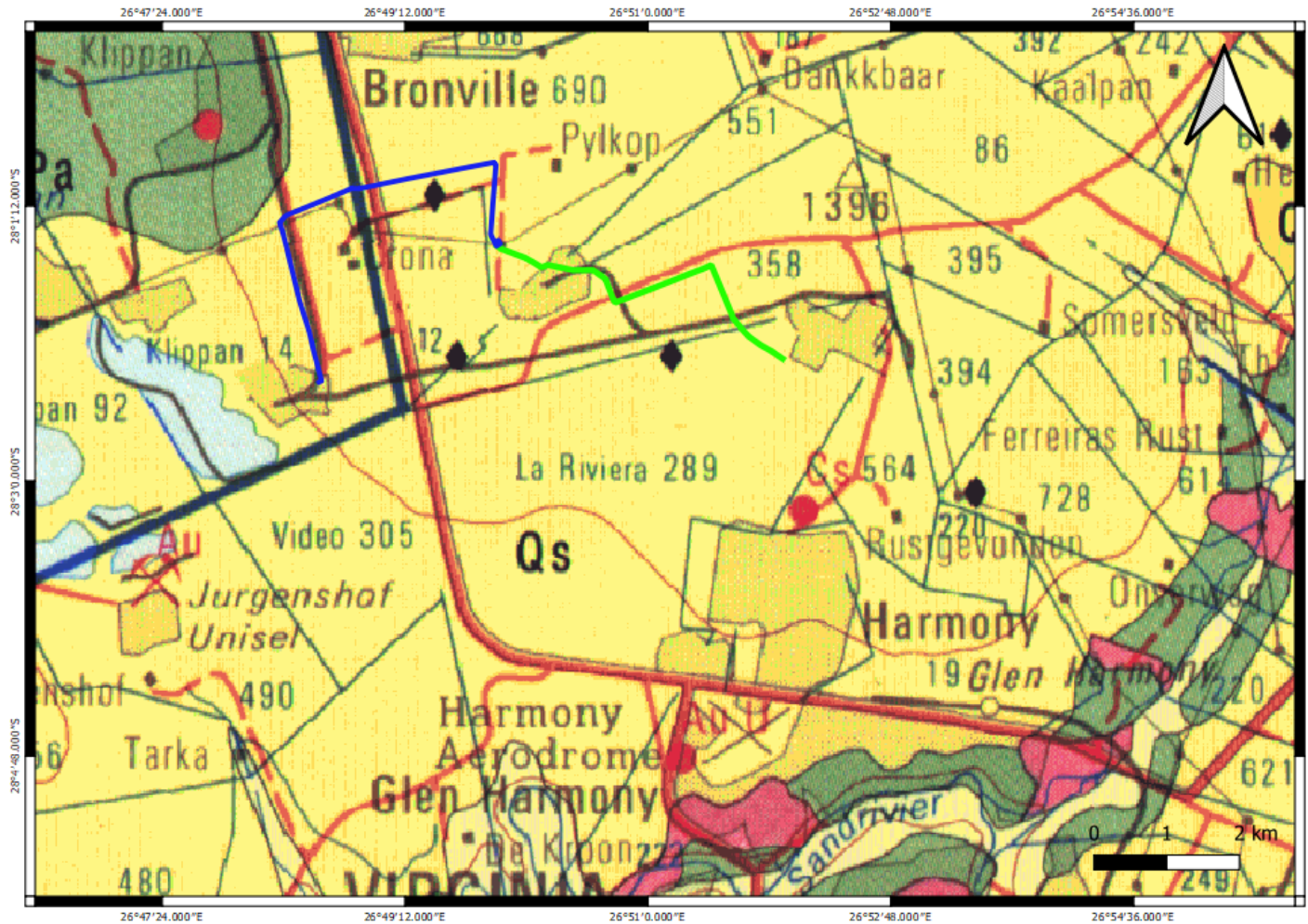
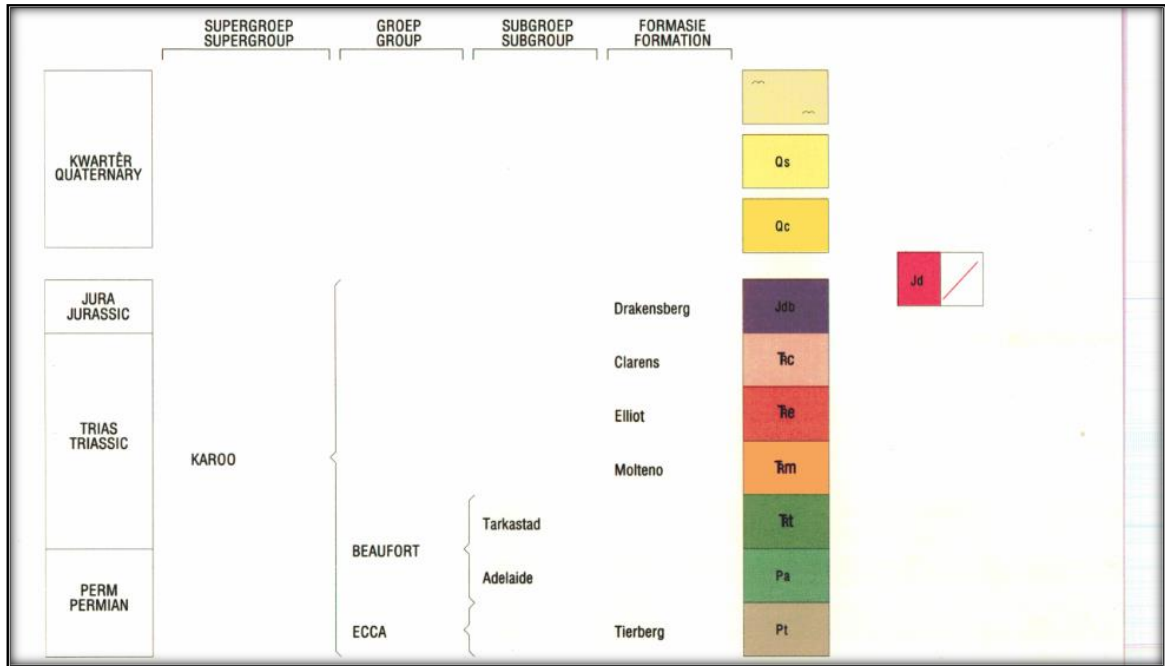


Figure 4 - Extract of the 1: 250 000 2826 Winburg Geological Map (Council for Geosciences, Pretoria). The development is underlain by the Quaternary sand, calcrete and surface limestone.

Legend of 250 000 2826 Winburg Geological Map (Council for Geosciences, Pretoria)



Qs-Quaternary superficial sand red and grey aeolian dune sand

Qc-calcrete and surface limestone

Jd- Jurassic dolerite dyke

Pa-Adelaide Subgroup, Beaufort Group; very fine to coarse grained, buff white and white sandstone, blue grey mudstones and shale, subordinate conglomerate.



Figure 5 - Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in blue and the existing pipeline in red.

Table 4 - SAHRIS Palaeosensitivity ratings table. The relevant sensitivities are highlighted

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 5**) the proposed development is underlain by sediments with a Moderate (green) Palaeontological Sensitivity.

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

sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

6 GEOGRAPHICAL LOCATION OF THE SITE

The coordinates of the proposed development is:

Position	Latitude	Longitude
Southern point	-28.039270°S	26.809359°E
North Western point	28.021907°S	26.804531°E
North Eastern point	-28.015299°S	26.830991°E
South Eastern point	-28.023763°S	26.831498°E

7 METHODS

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

7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. The focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area that was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1: 250 000 2826 Winburg Geological Map (Council for Geosciences, Pretoria)
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.

9 IMPACT ASSESSMENT METHODOLOGY

9.1 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. In order 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 aforementioned criteria is given in **Table 5**.

Table 5 - 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.

9.2 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 6 - 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.

9.3 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 7 - 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.

9.4 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 8 8**.

Table 8 - 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.

9.5 Degree of Probability

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

Table 9 - 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

9.6 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 10**. 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 10 - 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.

9.7 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:

$$\text{Impact Risk} = \frac{\text{SIGNIFICANCE} + \text{Spatial} + \text{Temporal} \times \text{Probability}}{5}$$

5

An example of how this rating scale is applied is shown in **Table 11**.

Table 11 - Example of Rating Scale

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	-	2	1	5	3	
Impact on Paleontological Heritage Resources	Negative	Low	Study site	Permanent	Could happen	1.56

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2.6. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2.6 is then multiplied by the probability rating (0,6) to give the final rating of 0.6.

The impact risk is classified according to five classes as described in the **Table 12** below.

Table 12 - 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 1.56 will fall in the **Impact Class 2**, which will be considered to be a **Low Impact**.

9.8 Impact Assessment Table

Table 13 - Impact ratings for the proposed development

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	-	2	1	5	3	
Impact on Paleontological Heritage Resources	Negative	Low	Study site	Permanent	Could happen	1.56

9.9 SUMMARY OF IMPACT TABLES

The proposed development is underlain by Quaternary red and grey aeolian dune sand as well as calcrete and surface limestone. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of Quaternary sediments is Low, but locally High (Almond and Pether, 2009; Almond *et al.*, 2013).

The proposed development will have a LOW negative impact on Fossil Heritage. *Only the site will be affected by the proposed development.* The expected duration of the impact is assessed as potentially permanent to long term. The possibility that the impact could happen. The significance of the impact occurring will be LOW. As fossil heritage will be destroyed the impact is irreversible.

10 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by Quaternary red and grey aeolian dune sand as well as calcrete and surface limestone. According to the PalaeoMap of the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of Quaternary sediments is Low, but locally High (Almond and Pether, 2009; Almond *et al.*, 2013). A Low significance has been allocated to the development site. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the mine may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

However, if fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the Environmental Control Officer (ECO) in charge of these developments must be informed. 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 mitigation can be carry out by a paleontologist.

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

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