PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED TGME MINING PROJECT IN MPUMALANGA

Compiled for:

Transvaal Gold Mining Estates Limited

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Prepared by

Banzai Environmental

March 2022

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 consider, 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: 

The heritage impact assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1: 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 10	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1, 9 and 11	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure,	Section 1 and 11	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
inclusive of a site plan identifying site alternative;		
(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 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 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 11	
(k) Any mitigation measures for inclusion in the EMPr	Section 12	
(l) Any conditions for inclusion in the environmental authorisation	Section 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities, or portions thereof should be authorised, any avoidance, management and mitigation measures that should	Section 1 and 11	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
be included in the EMPr, and where applicable, the closure plan		
(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 to conduct the Palaeontological Impact Assessment assessing the proposed TGME underground Mining redevelopment Project in Mpumalanga. In accordance with the National Environmental Management Act 107 of 1998 (NEMA) and to comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PIA is necessary to confirm if fossil material could potentially be present in the planned development area, to evaluate the potential impact of the proposed development on the Palaeontological Heritage and to mitigate possible damage to fossil resources.

The proposed mining site is underlain by Quaternary alluvium and scree, diabase, and the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup) as well as the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Quaternary superficial sediments is low but locally High, the diabase is igneous in origin and has an insignificant Palaeontological Sensitivity while that of the Timeball Hill Formation is High and the Palaeontological Sensitivity of the Malmani Subgroup (Transvaal Supergroup) is Very High (Almond and Pether 2008, SAHRIS website).

A 2-day site-specific field survey of the development footprint was conducted on foot and by a motor vehicle on 24 to 25 February 2022. No visible evidence of fossiliferous outcrops was found in the development footprint and thus an overall medium palaeontological significance is allocated to the proposed development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area and construction of the development may be authorised in its whole extent. It should also be noted that the proposed surface infrastructure layout has been designed to be limited to previously disturbed areas where possible.

Recommendations:

- The Environmental Control Officer (ECO) for this project must be informed that the Palaeontological Sensitivity of the Timeball Hill Formation is High while that of the Malmani Subgroup (Transvaal Supergroup) is Very High.

- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources 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) so that mitigation (recording and collection) can be carried out.

- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the proposed mining redevelopment.

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1 INTRODUCTION

The following information was provided by TGME

Transvaal Gold Mining Estates Limited ("TGME"), a subsidiary of Theta Gold Mines Limited, is the holder of an existing mining right with Department of Mineral Resources and Energy ("DMRE") Reference Number: MP 30/5/1/2/2/83 MR ("83MR") with effective date 16 October 2013.

The 83MR mining area comprises Portions 1, 2, 3, 4, 5 and the Remaining Extent of the farm Frankfort 509KT, the farm Krugers Hoop 527KT, Portion 1 and the Remaining Extent of the farm Van Der Merwes Reef 526KT, Portions 1, 2 and the Remaining Extent of Portions of the farm 525KT, the farm Peach Tree 544KT, and Portions 18, 42, 43, 44 and the Remaining Extent of the farm Ponieskrans 543KT ("Mining Area") (**Figure1-2**).

TGME propose to re-operationalise its historical underground mines within the 83MR Mining Area which includes the Frankfort, Beta North and the Clewer, Dukes and Morgenson ("CDM") underground mines. The proposed project will **require additional surface infrastructure to support the underground working, the expansion of the current Tailings Disposal Facility ("TSF") and an upgrade of the old TGME process and beneficiation plant.**

To mitigate the risk of loss of Critical Biodiversity Areas ("CBA's"), sensitive floral communities, threatened ecosystems and floral Species of Conservation Concern (SCC's) a biodiversity verification and pre-feasibility assessment was conducted in May 2021 to identify environmental buffer zones. The assessment informed the engineering designs to ensure that the surface infrastructure layout is limited to previously disturbed areas where possible.

TGME is confident that the project will have a dramatic impact on the lives of our host communities by creating much needed jobs and downstream economic development; thereby assisting in accelerating the South African government's post-COVID economic recovery plan. Further, TGME's corporate presence in the region will result in a net positive benefit to the Blyde River catchment, safety and security of the host community and local tourism revenues, which would otherwise continue to deteriorate at the mercy of alien invasive vegetation and illegal miners.

Before TGME may commence with proposed project the following environmental authorisation and license applications must be approved in accordance with the relevant national legislation:

- An integrated application for Environmental Authorisation (EA) in terms of the National Environmental Management Act No. 107 of 1998 (NEMA) and for a Waste Management License (WML) in terms of the National Environmental Management: Waste Act No. 59 of 2008 (NEM:WA)

- Application for amendment to the current Environmental Management Programme ("EMPr") approved by the DMRE in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) on 16 October 2013.
- Application for a Water Use Licence (WUL) under the National Water Act No. 36 of 1998 (NWA) will be submitted for approval to the Department of Human Settlement, Water and Sanitation (DHSWS).
- Application for an Atmospheric Emission License (AEL) under the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM:AQA), required to operate the upgraded process and beneficiation plant.
- Heritage Permits in terms of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) from the South African Heritage Resources Agency (SAHRA); and
- Licenses in terms of the National Forest Act, 1998 (Act No. 84 of 1998).

TGME commissioned OMI Solutions (Pty) Ltd to commence with a Scoping and Environmental Impact Assessment (S&EIA) application for Environmental Authorisation (EA). As part of the Heritage Impact Assessment Banzai Environmental was appointed to conduct the Palaeontological Impact Assessment for the proposed project.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs. Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (*cum laude*) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has experience in locating, collecting, and curating fossils. She has been a member of the Palaeontological Society of South Africa (PSSA) since 2006 and has been conducting PIAs since 2014.

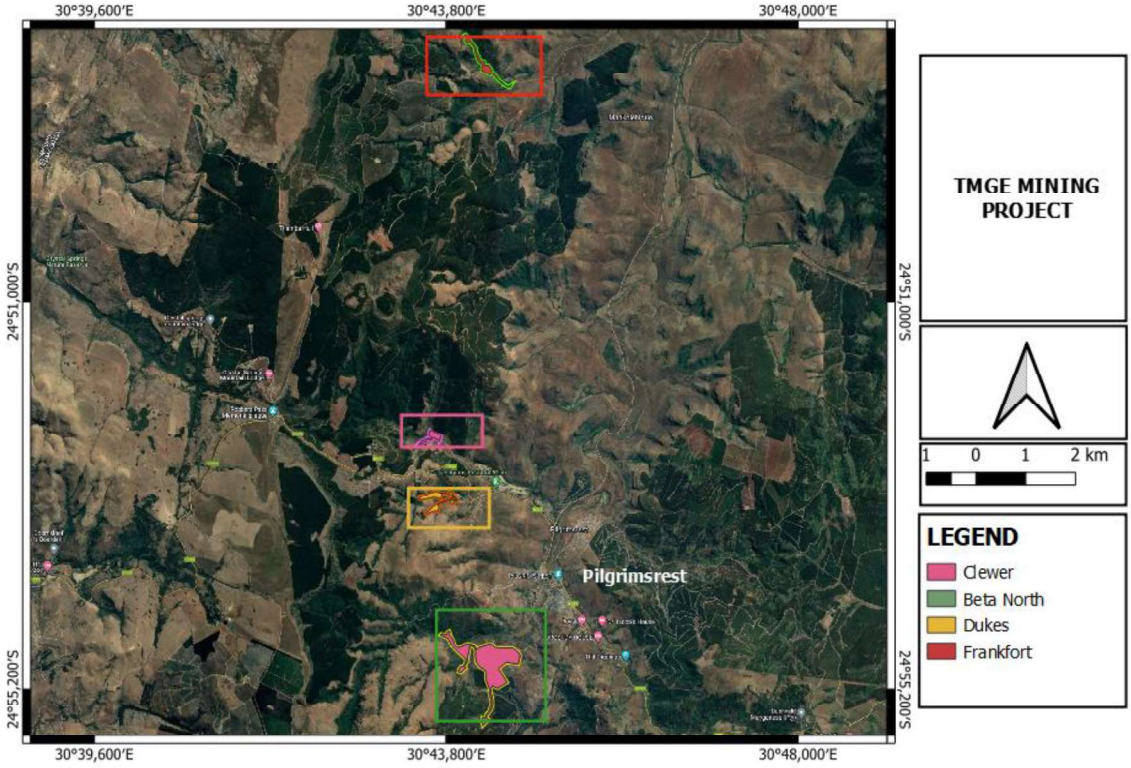


Figure 1: Google Earth Image (2020) indicating the location of the proposed TMGE Mining Projects.

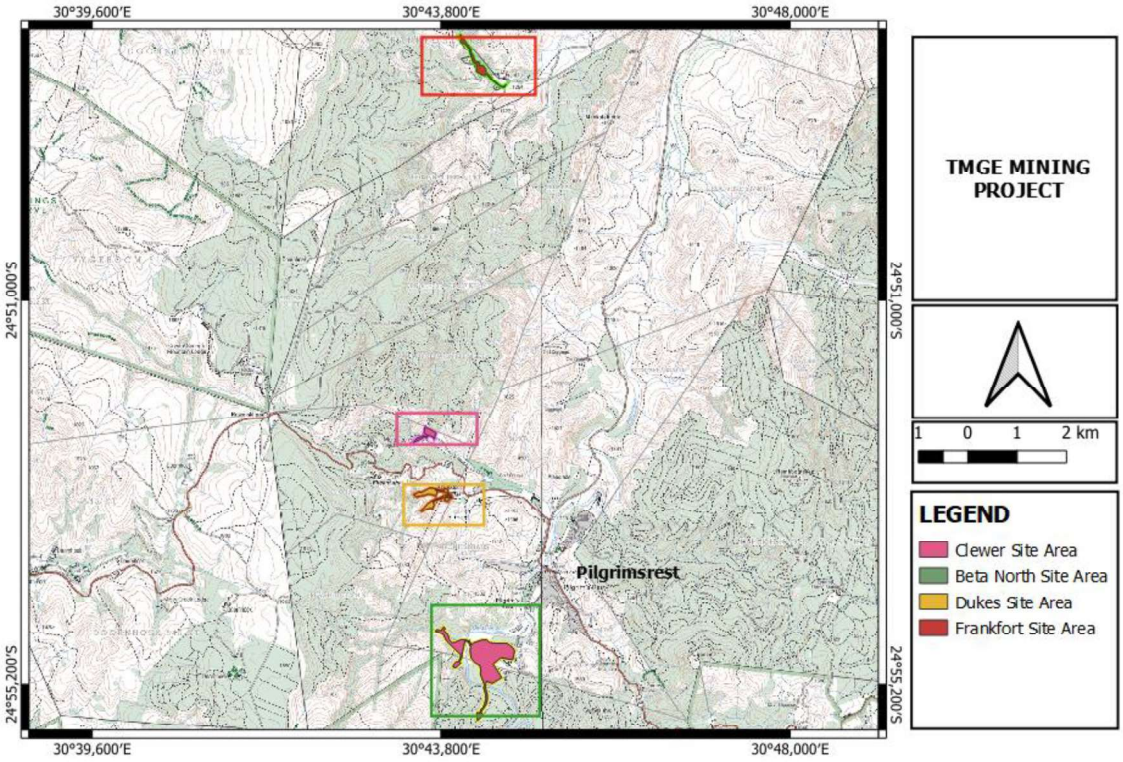


Figure 2: Location of the proposed TGME Mining Projects.

3 LEGISLATION

3.1 National Heritage Resources Act, 1999 (Act No 25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act, 1999 (Act No 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:

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

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

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

4 OBJECTIVE

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

According to the "SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports" the objective of the PIA is: 1) identifying the palaeontological importance of the rock formations in the development footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) explain the **impact** on fossil heritage; and 4) suggesting how fossil heritage might be protected.

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

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

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

The terms of reference of a PIA are as follows:

General Requirements:

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

c. **Cumulative impacts** result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.

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

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed TGME mining development in Mpumalanga is depicted on the 1:250 000 Pilgrim's Rest 2430 (1986) Geological map (Council of Geoscience, Pretoria). This map indicates that the mining site is underlain by small areas of Quaternary alluvium and scree (Q-yellow), diabase (Vdi-green) and sediments of the Timeball Hill Formation (Vt) (Pretoria Group, Transvaal Supergroup) as well as the Malmani Subgroup (Vmd) (Chuniespoort Group, Transvaal Supergroup) (**Figure 3-5**). According to the PalaeoMap of the South African Heritage Resources Information System, the Palaeontological Sensitivity of the Quaternary superficial sediments is low but locally High, the diabase is igneous in origin and has an insignificant Palaeontological Sensitivity while that of the Timeball Hill Formation is High and the Palaeontological Sensitivity of the Malmani Subgroup (Transvaal Supergroup) is Very High (Almond and Pether 2008, SAHRIS website).

Small patches of Quaternary sediments (alluvium and scree) are present in different areas of development (**Figure 3**). The Quaternary superficial deposits are the youngest geological deposits formed during the most recent geological period (approximately 2.6 million years ago to present). Most of the superficial deposits are unconsolidated sediments and consist of clay, gravel, sand, silt, that form relatively thin, discontinuous patches of sediments. These sediments comprise of channel, floodplain and stream deposits, talus gravels and glacial drift sediments.

The Quaternary deposits are very important due to the palaeoclimatic changes that are reflected in the different geological formations (Hunter et al., 2006). Most geomorphologic features in southern Africa were formed during the Cenozoic climate fluctuations (Maud, 2012). Barnosky (2005) indicated that various warming and cooling events occurred in the Cenozoic. These changes, especially those during the last 1.8 Ma, were the most drastic ever, being both drier and wetter than the present and caused changes in river flow patterns, sedimentation processes and vegetation variation (Tooth et al., 2004).

Quaternary alluvium (present in the development) may contain fossils assemblages, but these are generally rare, low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas.

In the past, palaeontologists did not focus on Caenozoic superficial deposits although they sometimes comprise of significant fossil deposits. These fossil assemblages resemble modern animals and may comprise of mammalian teeth, bones and horn corns, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusk shells are also known from Quaternary deposits. Plant material such as foliage, wood, pollens, and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

The diabase is igneous rocks and are thus considered to have no palaeontological significance. However, the existence of the diabase rocks would have had a thermal metamorphic effect on the adjoining Timeball Hill Formation and would decrease the chance of the fossil preservation in this formation.

The Transvaal Supergroup overlays the Archaean basement as well as the Witwatersrand and Ventersdorp Supergroups. The Precambrian Transvaal Supergroup is approximately 2550-2050 Ma years old (Bekker, et al. 2008; Catuneanu, et al 1999) (Late Archaean to Early Proterozoic) and is about 15 km thick. This Supergroup consists of sedimentary, volcanic and unmetamorphosed clastic rocks.

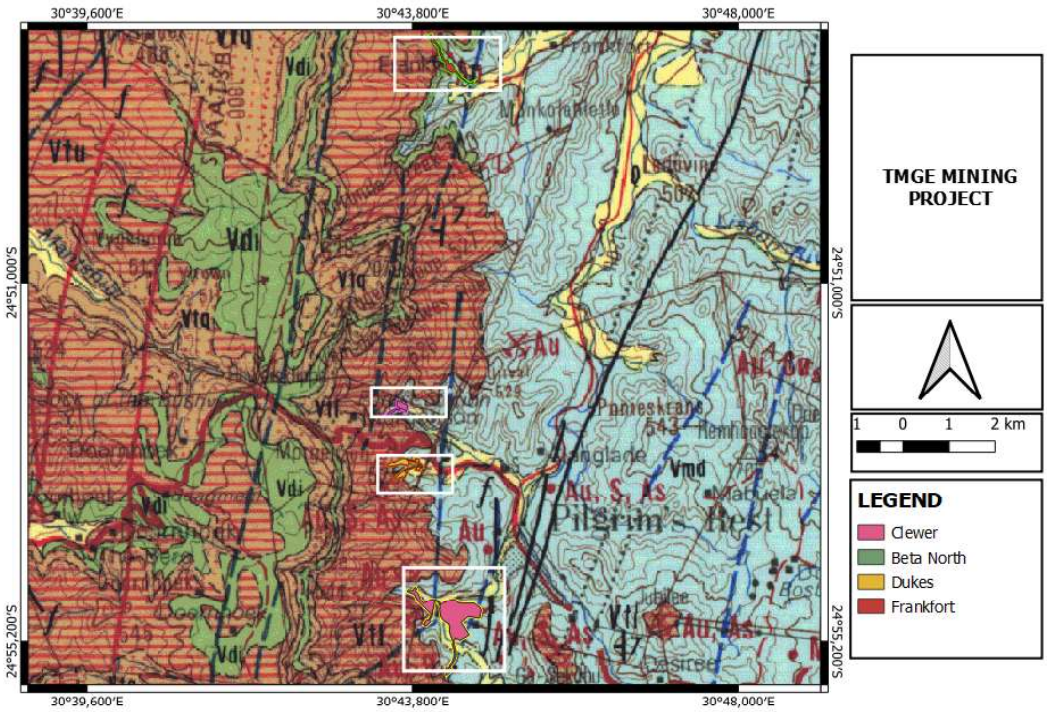


Figure 3: Extract of the 1:250 000 2430 Pilgrim's Rest (1986) Geological map (1976) (Council of Geoscience, Pretoria) indicating the proposed TGME Mining Project in Mpumalanga.

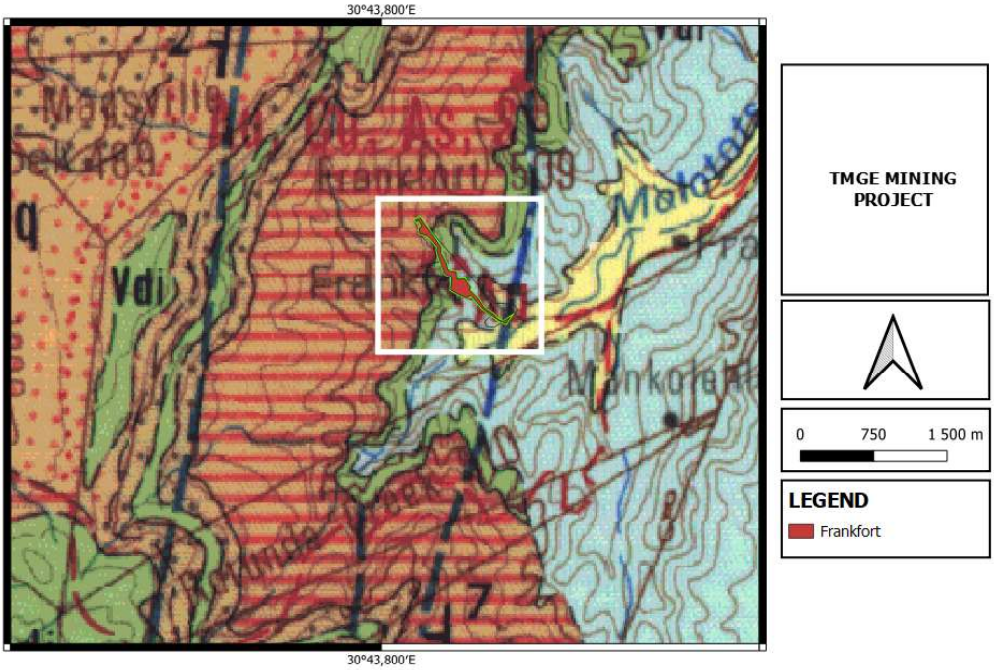


Figure 4: Extract of the 1:250 000 2430 Pilgrim's Rest (1986) Geological map (1976) (Council of Geoscience, Pretoria) indicating the proposed TGME Mining Project in Mpumalanga in pink. The mining site is underlain by Quaternary sediments, diabase, and sediments of the Transvaal Supergroup (Timeball Hill Formation of the Pretoria).

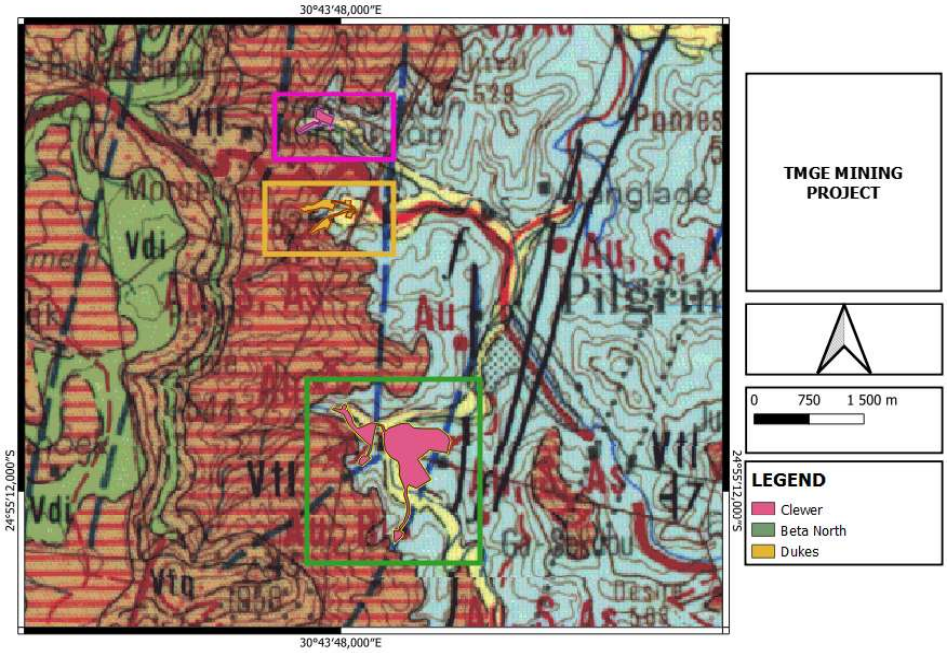


Figure 5: Extract of the 1:250 000 2430 Pilgrim's Rest Geological map (1986) (Council of Geoscience, Pretoria) indicating the proposed TMGE Mining Project (Clewer Site in green; Dukes Site in orange and Beta Site in grey) in Mpumalanga. Surface geology indicates that the development footprint is underlain by Quaternary superficial sediments, diabase, and the Timeball Hill Formation of the Pretoria Group (Transvaal Supergroup) as well as the Malmani Subgroup; Chuniespoort Group, Transvaal Supergroup.

Legend to Map and short explanation (Modified from the 1: 2430 Pilgrim's Rest Geological map (1986) (Council of Geoscience, Pretoria)).

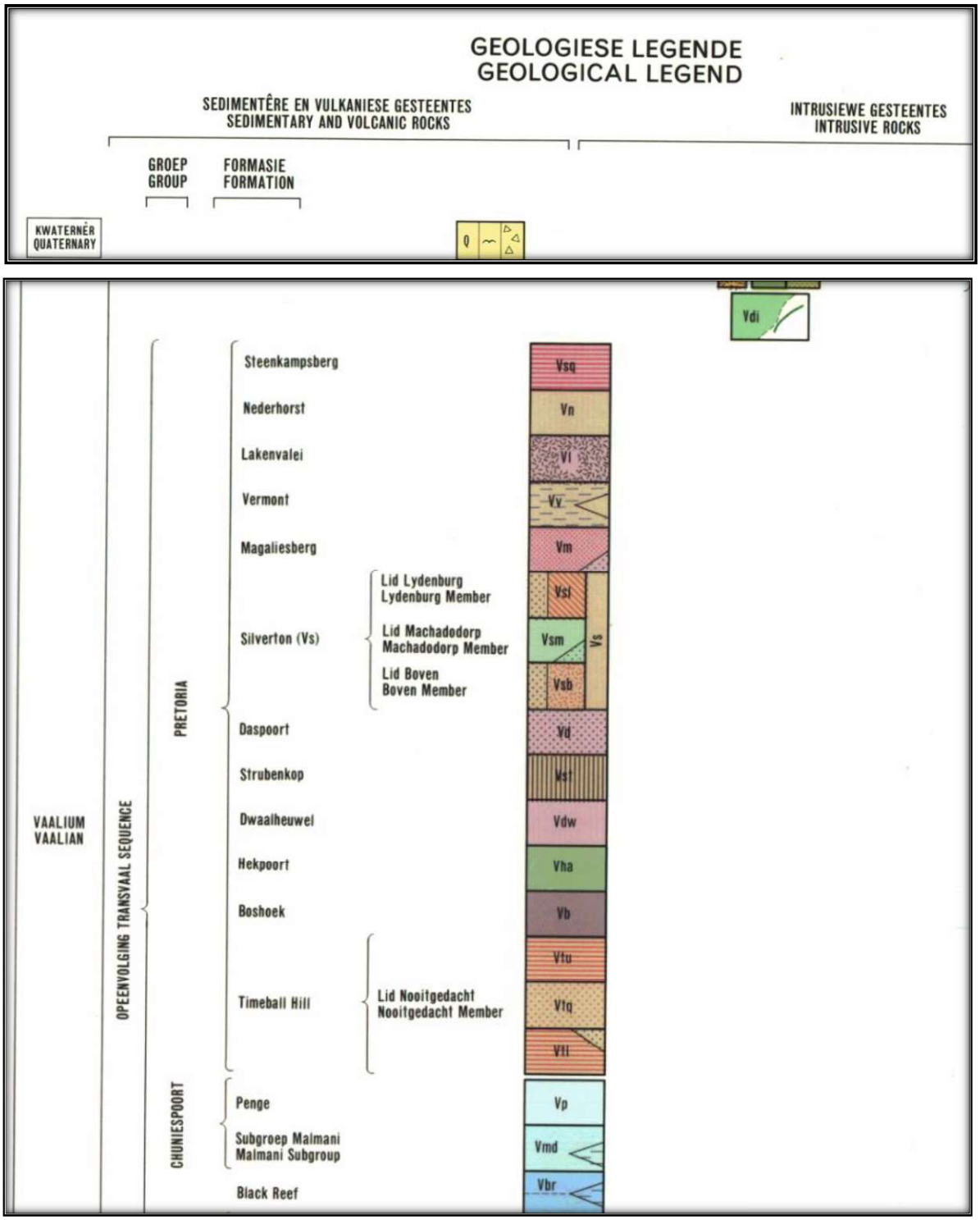
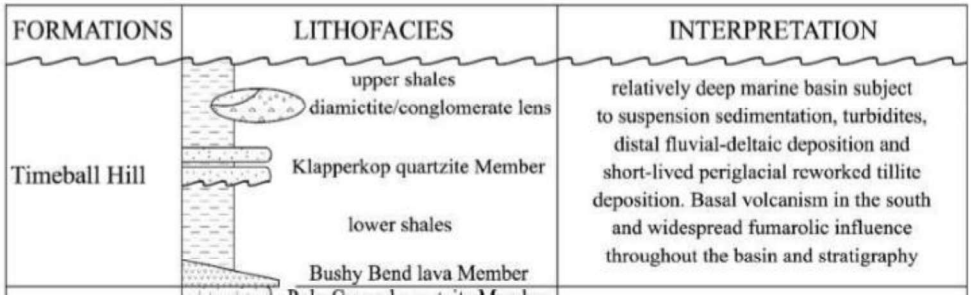


Table 2: Geology of development footprint.

Sediments present in the development is indicated in bold.

Map abbrev.	Supergroup/Group/Suite	Formation/ Subgroup	Lithology	Fossil Heritage
Q Surface deposits including alluvium and scree	**Quaternary sediments**		Surface deposits including alluvium and scree	Mammalian teeth, bones, horn corns, reptile skeletons, ostrich egg fragments. Microfossils, non-marine mollusk shells, foliage, wood, pollens, ,peats, trace fossils e.g. vertebrate tracks, burrows, termitaria and rhizoliths (root casts
Vdi	**Diabase**			Unfossiliferous
Mg	Transvaal Supergroup; Pretoria Group	Magaliesberg Fm	Sandstones and mudstones of coastal origin	Microbial mat structures/trace fossils
Vsi		Silverton Fm	Volcanic rocks, marine mudrocks with carbonates	Stromatolites
Vdq		Daspoort	Fluvial and Alluvial, deltaic sandstones and mudrocks, in east is marine sediments	Stromatolites
Vt	**Transvaal Supergroup; Pretoria Group**	**Timeball Hill Formation**	Quartzite, siltstone, shale, conglomerate, Fluvio-deltaic and lacustrine mudrocks with diamictite, quartzite, minor lavas.	Stromatolites
Vmd	**Transvaal Supergroup; Chuniespoort Group, Malmani Subgroup**		Minor secondary mudrocks, cherts, containing carbonaceous shale, stromatolitic carbonates (limestones / dolomites),	Stromatolites Shallow marine to intertidal stromatolites organic-walled microfossils

Table 3: Stratigraphy and depositional settings if the Timeball Hill Formation at the base of the Pretoria succession (Catuneanu and Eriksson 2002).



The Timeball Hill Formation is known to contain stromatolites and are associated with thin carbonate interbeds within turbidite sequences in the lower part of the formation (Catuneanu & Eriksson 2002). Stromatolites have not been recorded from the overlying fluvio-deltaic Klapperkop Quartzite Member. Other subunits in the Pretoria Group containing stromatolites possibly also

contain organic-walled microfossils. Stromatolites are layered mounds, columns and sheet-like sedimentary rocks. These structures were originally formed by the growth of layer upon layer of cyanobacteria, a single-celled photosynthesizing microbe. Cyanobacteria are prokaryotic cells (simplest form of modern carbon-bases life). Stromatolites are first found in Precambrian rocks and are known as the earliest known fossils. The oxygen atmosphere that we depend on was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.

The Malmani Subgroup platform carbonates of the Transvaal Basin comprise of an assortment of stromatolites (microbial laminites), ranging from supratidal mats to intertidal columns and large subtidal domes (Eriksson *et al.* 2006). This Subgroup is approximately 2 km-thick and consists of a series of formations of stromatolitic and oolitic carbonates (limestones and dolomites), minor secondary cherts and black carbonaceous shales.

Stromatolites and oolites from the Transvaal Supergroup have been described by various authors (Eriksson and Altermann, 1998). Detailed descriptions of South African Archaean stromatolites are available in the literature (Altermann, 1995; Altermann 2001; Buick, 2001; and Schopf, 2006).

Periodic palaeoplacer gold was mined from the Black Reef Formation in the past (e.g., Söhnge, 1986). In a study conducted in 1988, Meyer found that the Sabi-Pilgrim's Rest goldfield in Mpumalanga Province produced almost 185 Mt ore at an average grade of *c.* 8 g/t

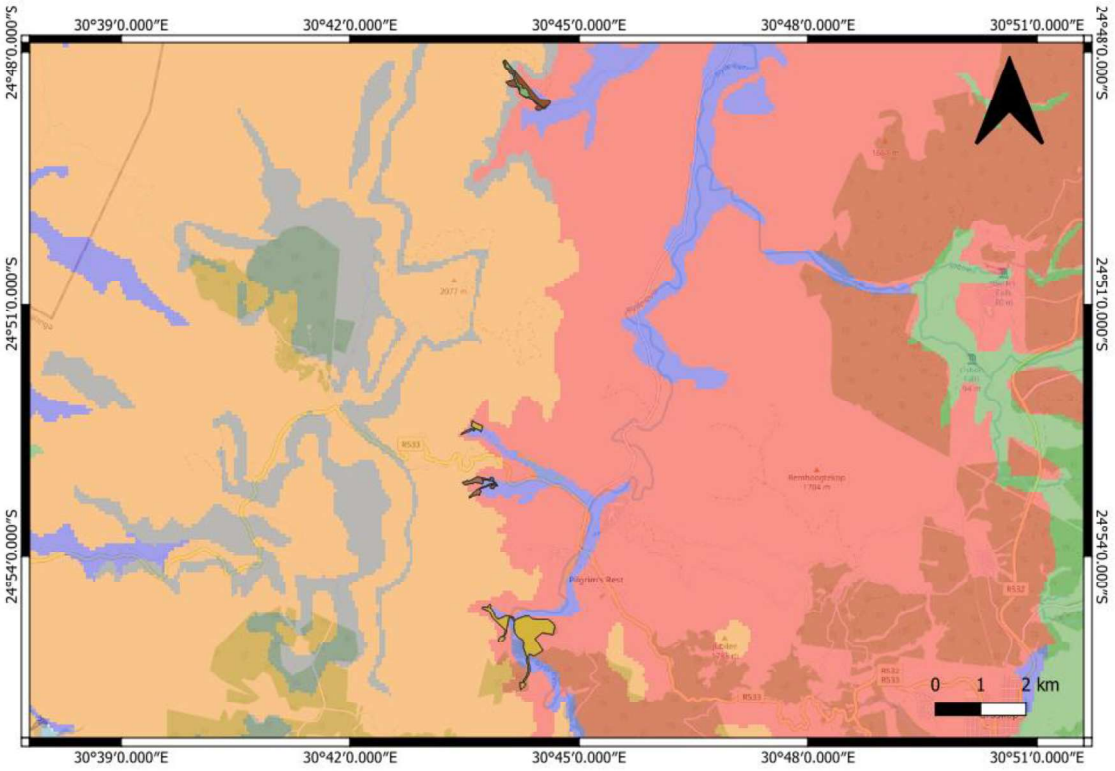


Figure 6: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences). Location of the proposed development is indicated in brown.

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 6**) the proposed development is underlain by sediments with a Low (blue), Moderate (green),High (orange) and Very High Sensitivity (red).

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.

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6 GEOGRAPHICAL LOCATION OF THE SITE

The 83MR mining area is located on Portions 1, 2, 3, 4, 5 and the Remaining Extent of the farm Frankfort 509KT, the farm Krugers Hoop 527KT, Portion 1 and the Remaining Extent of the farm Van Der Merwes Reef 526KT, Portions 1, 2 and the Remaining Extent of Portions of the farm Morgeson 525KT, the farm Peach Tree 544KT, and Portions 18, 42, 43, 44 and the Remaining Extent of the farm Ponieskrans 543KT ("Mining Area") (**Figure1-2**).

7 METHODS

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

7.1 Assumptions and Limitations

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 never been reviewed by palaeontologists and data is generally based on aerial photographs alone. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

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

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 Pilgrim's Rest 2430 (1986) Geological map (Council of Geoscience, Pretoria).

- A Google Earth map with polygons of the proposed development was obtained from TGME.
- PIA's of areas around Pilgrim's Rest.

9 SITE VISIT

Dr Heidi Fourie conducted the 2-day site-specific field survey of the development footprint. The site visit was conducted on foot and by motor vehicle on 24 to 25 February 2022. No visible evidence of fossiliferous outcrops was found in the development footprint. Neels Kruger (site photographs) as well as Christine Rowe (TGME; examples of stromatolites in the surrounding area) are thanked for the photographs they provided.

It is very Important to note that TGME plans to re-operationalise its historical underground mines, but the proposed project will "**require additional surface infrastructure to support the underground workings, the expansion of the current Tailings Disposal Facility ("TSF") and an upgrade of the old TGME process and beneficiation plant."**

Photographs indicates examples of the existing structures

Figure 7: Access Road to Beta North

Figure 8: Adit at Beta North

Figure 9:Illegal mining at Beta North

Figure 10: Waste Rock Dump on Beta Mine.

Figure 11:Access Road to Dukes Mine

Figure 12:Illegal mining on Dukes Mine

Figure 13:Adit at Dukes Mine

Figure 14: Processed waste material at Dukes Mine

Figure 15: Vent shaft at Dukes mine.

Figure 16:-Frankfort Mine access Road

Figure 17:Frankfort Mine entrance

Figure 18: Neglected Frankfort mine Offices

Figure 19: Site of the old DMS (Dense Medium Separation) plant at Frankfort Mine. No fossiliferous outcrops are present.

Figure 20: Access Road to Morgenson Mine

Figure 21: Morgenson mine Adit

Figure 22: Neglected site of the Morgenson - mining Offices

Figure 23: Neglected site of the Morgenson site infrastructure.

Figure 24: Mine Vent shaft

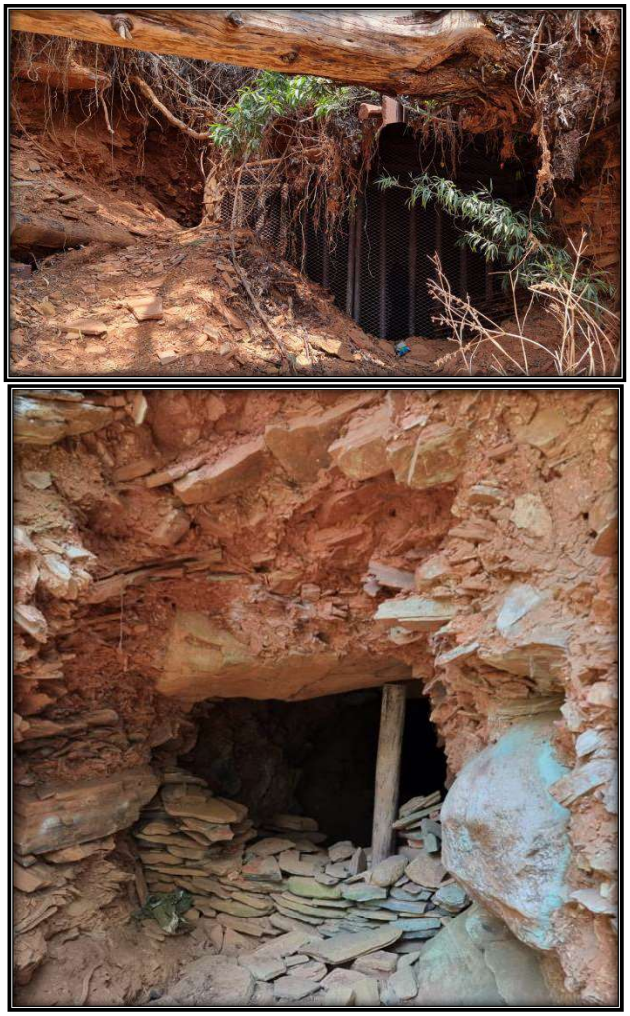

Figure 25: Morgenson Mine Vent shaft

Figure 26: Some of the dolomite showing the vein quartz that will be mined, the gold is a black colour and only deposited in this vein

Figure 27: Return Water Dam within dolomite bedrock.

10 IMPACT ASSESSMENT METHODOLOGY

Probability: This describes the likelihood of the impact actually occurring.	
Improbable	The possibility of the impact occurring is very low, due to the circumstances, design or experience.
Probable	There is a probability that the impact will occur to the extent that provision must be made therefore.
Highly Probable	It is most likely that the impact will occur at some stage of the development.
Definite	The impact will take place regardless of any prevention plans, and there can only be relied on mitigatory actions or contingency plans to contain the effect.
Duration: The lifetime of the impact	
Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
Medium term	The impact will last up to the end of the phases, where after it will be negated.
Long term	The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.

Permanent	Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.
Scale: The physical and spatial size of the impact	
Local	The impacted area extends only as far as the activity, e.g. footprint
Site	The impact could affect the whole, or a measurable portion of the above-mentioned properties.
Regional	The impact could affect the area including the neighboring residential areas.
Magnitude/ Severity: Does the impact destroy the environment or alter its function.	
Low	The impact alters the affected environment in such a way that natural processes are not affected.
Medium	The affected environment is altered, but functions and processes continue in a modified way.
High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Significance: This 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.	
Negligible	The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
Low	The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
Moderate	The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
High	The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

Mitigation Effect: Degree to which the impact can be managed following mitigation	
Can be reversed	Can be avoided, managed or mitigated in such a way that natural processes are not affected and returned to natural state
Can be avoided, managed or mitigated	Can be avoided, managed or mitigated to the degree that functions and processes continue in a modified way)
May cause irreplaceable loss of resources	Irreversible impact (may cause irreplaceable loss of resources). Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Positive
Negative

10.1 Summary of Impact Tables

It is highly probable that impact will occur. The duration of the impact will be permanent. Only the sites which will be remined, will be affected by the proposed development. The magnitude of the impact occurring will be High. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent and irreversible. The significance of the impact occurring will be High pre-mitigation and moderate post- mitigation. A negative impact on the palaeontological heritage can be reduced by the application of adequate damage mitigation procedures. If mitigation measures are implemented the impact on fossil Heritage could be positive.

Impact	Probability	Duration	Scale	Significance	Mitigation Effect
Pre-Mitigation	Highly Probable	Permanent	Site	High	
Post-mitigation	Probable	Permanent	Site	Moderate	Can be avoided, managed, or mitigated

11 FINDINGS AND RECOMMENDATIONS

The proposed mining site is underlain by Quaternary alluvium and scree, diabase, and the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup) as well as the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Quaternary superficial sediments is low but locally High, the diabase is igneous in origin and has an insignificant Palaeontological Sensitivity while that of the Timeball Hill Formation is High and the Palaeontological Sensitivity of the Malmani Subgroup (Transvaal Supergroup) is Very High (Almond and Pether 2008, SAHRIS website).

The proposed mining site is underlain by Quaternary alluvium and scree, diabase, and the Timeball Hill Formation (Pretoria Group, Transvaal Supergroup) as well as the Malmani Subgroup (Chuniespoort Group, Transvaal Supergroup). According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Quaternary superficial sediments is low but locally High, the diabase is igneous in origin and has an insignificant Palaeontological Sensitivity while that of the Timeball Hill Formation is High and the

Palaeontological Sensitivity of the Malmani Subgroup (Transvaal Supergroup) is Very High (Almond and Pether 2008, SAHRIS website).

A 2-day site-specific field survey of the development footprint was conducted on foot and by a motor vehicle on 24 to 25 February 2022. No visible evidence of fossiliferous outcrops were found in the development footprint and thus an overall medium palaeontological significance is allocated to the development footprint. It is therefore considered that the proposed development will not lead to detrimental impacts on the palaeontological reserves of the area and construction of the development may be authorised in its whole extent.

Recommendations:

- The ECO for this project must be informed that the Palaeontological Sensitivity of the Timeball Hill Formation is High while that of the Malmani Subgroup (Transvaal Supergroup) is Very High.

- If Palaeontological Heritage is uncovered during surface clearing and excavations the **Chance find Protocol** attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources 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) so that mitigation (recording and collection) can be carried out.

- Before any fossil material can be collected from the development site the specialist involved would need to apply for a collection permit from SAHRA. Fossil material must be housed in an official collection (museum or university), while all reports and fieldwork should meet the minimum standards for palaeontological impact studies proposed by SAHRA (2012).
- These recommendations should be incorporated into the Environmental Management Plan for the proposed mining Development.

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Appendix A – Elize Butler CV

CURRICULUM VITAE
ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	26 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–currently

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