



PGS HERITAGE

**PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE ESTABLISHMENT OF A
SUPER FINES STORAGE FACILITY AT GLORIA MINE, BLACK ROCK MINE
OPERATIONS, HOTAZEL, NORTHERN CAPE:**

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Client: EScience Associates on behalf of Assmang (Pty) Ltd, Black Rock
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PGS Project No: 401PIA



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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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Report Title	Establishment of a Super Fines Storage Facility at Gloria mine, Black Rock Mine Operations, Hotazel, Northern Cape		
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The heritage impact assessment report has been compiled taking into account 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.

NEMA Regs (2014) - Appendix 6	Relevant section in report
1. (1) A specialist report prepared in terms of these Regulations must contain-	
a) details of- <ul style="list-style-type: none"> i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae; 	Page ii of Report – Contact details and company and Appendix B
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 4 – Objective
(A) an indication of the quality and age of base data used for the specialist report;	Section 5 – Geological and Palaeontological history
(B) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9
d) the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A Desktop Study
e) a description of the methodology adopted in preparing the report or carrying out the specialized process inclusive of equipment and modeling used;	Section 7 Approach and Methodology
f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 1 and 9
g) an identification of any areas to be avoided, including buffers;	Not identified, Section 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

NEMA Regs (2014) - Appendix 6	Relevant section in report
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 10
k) any mitigation measures for inclusion in the EMPr;	Section 11
l) any conditions for inclusion in the environmental authorization;	N/A
m) any monitoring requirements for inclusion in the EMPr or environmental authorization;	N/A
n) a reasoned opinion- <ul style="list-style-type: none"> i. as to whether the proposed activity, activities or portions thereof should be authorized; <ul style="list-style-type: none"> (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; 	Section 10
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable.
q) any other information requested by the competent authority.	Not applicable.
2) Where a government notice <i>gazetted</i> 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** (DIA) to assess the proposed Super Fines Storage Facility near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Impact Assessment (PIA) is key to detect the presence of fossil material within the planned development footprint. This DIA is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The proposed Super Fines Storage Facility at the Assmang (Pty) Ltd Black Rock Mining Operations (BRMO), Hotazel, Northern Cape is completely underlain by the Cenozoic Kalahari Group as well underlying Griqualand West Basin rocks, Transvaal Supergroup. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Kalahari Group is low and the Griqualand West rocks of the Transvaal Supergroup is moderate.

It is therefore considered that the construction and operation of the Super Fines Storage Facility, is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the facility may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries ought to be secured (preferably *in situ*) and the ECO ought to alert SAHRA so that appropriate mitigation (e.g. documented and collection) can be undertaken by a professional palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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Appendix A: CV

TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artifacts, human and hominid remains, and artificial features and structures;
- rock art is any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures, and artifacts associated with a military history which are older than 75 years and the site on which they are found.

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;

Holocene

The most recent geological time period which commenced 10 000 years ago.

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.

Abbreviations	Description
ASAPA	Association of South African Professional Archaeologists
BRMO	Black Rock Mining operations
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DIA	Desktop Impact Assessment
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

Abbreviations	Description
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
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
SFSF	Super Fines Storage Facility

1 INTRODUCTION

Manganese ore is mined by Assmang (Pty) Ltd in the Black Rock area of the Kalahari. The ore is mined in the Northern Cape Province (Figure 1) from the Kalahari Manganese field.

In 1940, Assmang purchased a manganese ore outcrop on a small hill known as Black Rock. Numerous large properties underlain by ore were later found and purchased. Manganese ore mining operations were extended and presently include 3 underground mining complexes namely:

- Gloria Mine was commissioned in 1975 and produces medium grade carbonated ore
- Nchwaning II and Nchwaning III were commissioned in 1981 and 2004 respectively and produces high grade ore.

Ore is mined at Gloria using underground bord and pillar methods, using underground conveyer systems and trackless machines. The depth of the mined seams in combination with underground crushing does not warrant waste rock to be brought to the surface. The ore is crushed at the surface, divided into grades which are stockpiled for transport off the site. The ore is transported via rail and road. Gloria complex consist of several mining and mining related activities, and includes:

- Offices, administration, and support facilities
- Engineering services and facilities
- Underground mining access shafts, vent shafts and related infrastructure;
- Ore Processing Plant;
- Ore (including fines) storage and laydown areas;
- Stacking, reclaiming and loading facilities for transportation of ore;
- Current and historical tailings facilities;
- Contractor laydown areas;
- Waste storage and separation facilities;
- Historical and current tailings storage facilities;
- Salvage Yards;
- Potable water and process water storage and management facilities;
- A sewage treatment plant;
- Sub-stations and electrical works;
- Bulk fuel storage and refuelling station;
- Explosives magazines;
- Unpaved and paved roads connecting the above and other BRMO operations;
- Other ancillaries typical of such a mining operation.

Underground Activities Ore is blasted, drilled, and crushed underground before conveyed to the processing facilities on the surface. Operations underground consist primarily of:

- Blasting
- Drilling
- Crushing
- Loading and handling ore

Underground support facilities include:

- Engineering and support facilities
- Re-fuelling bays and Fuel storage facilities
- Water storage and reticulation systems

1.1 Scope of proposed activities

Manganese Ore is mechanically processed at BRMO. This includes crushing and screening, which inevitably generates ore fines which are deposited as both tailings and super fines to the relevant super fines storage facility. The fines are separated from other ore products during screening and washing. This fine material is transported hydraulically through suspension in process water to fines storage facilities. As technology improves the number of fines generated per tonne of product may improve, and in future the fines may be reclaimed for reprocessing.

The current tailings storage facilities (TSF) at the Gloria mine are approaching full capacity. In addition to this, various authorised upgrades are underway at the mine which will increase production capacity. Consequently, BRMO proposes to construct a new super fines storage facility (SFSF) at the Gloria Mine to augment current storage and cater for increased production in the future. The project will include the establishment of two or more storage cells making up the SFSF and required supplementary infrastructure, which includes:

- A return water dam,
- Fines and water conveyance infrastructure (pipelines, pumps et cetera and their related civil, mechanical, and electrical works),
- Access and maintenance roads,
- Fencing and access control,
- A contractor laydown area for the construction phase,

Topsoil and subsoil stockpiles from excavations.

1.1.1 Construction Phase

The construction phase will broadly consist of:

- Removal and relocation of protected plant species.
- Clearing of remaining vegetation and establishment of roads, contractor laydown area, and project service facilities.

- Excavation and stockpiling of topsoil.
- Excavation and stockpiling of subsoil.
- Site preparation (levelling, compaction, drainage layout etc.)
- Liner installations
- Installation of fines and water conveyance infrastructure (pipelines, pumps et cetera and their related civil, mechanical, and electrical works)
- Commissioning

1.1.2 Operational Phase

The operational phase will consist of:

- Deposition of super fines and reticulation of carrier water.
- General maintenance of the facility,
- Possible reclamation of fines (historical and recently deposited) for further processing.

1.1.3 Closure and Decommissioning Phase

The closure and decommissioning phase will broadly consist of:

- Shaping and capping of the storage facility,
- Removal of fines and water conveyance infrastructure, and any other structures (e.g. shelters for personnel, return water dam etc),
- Ripping and scarifying of roads, and other compacted footprints,
- Depositing of subsoil and topsoil, rehabilitation and aftercare¹¹

Two alternatives are currently investigated namely the preferred alternative (Figure 2) and one alternative (Figure 3-4). The layout may be further refined during the EIA phase based on findings of the environmental impact assessment process and more detailed designed information¹.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive 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 for 13 years. She has been conducting PIAs since 2014.

¹ 1 Information provided by EScience Associates (Pty) Ltd

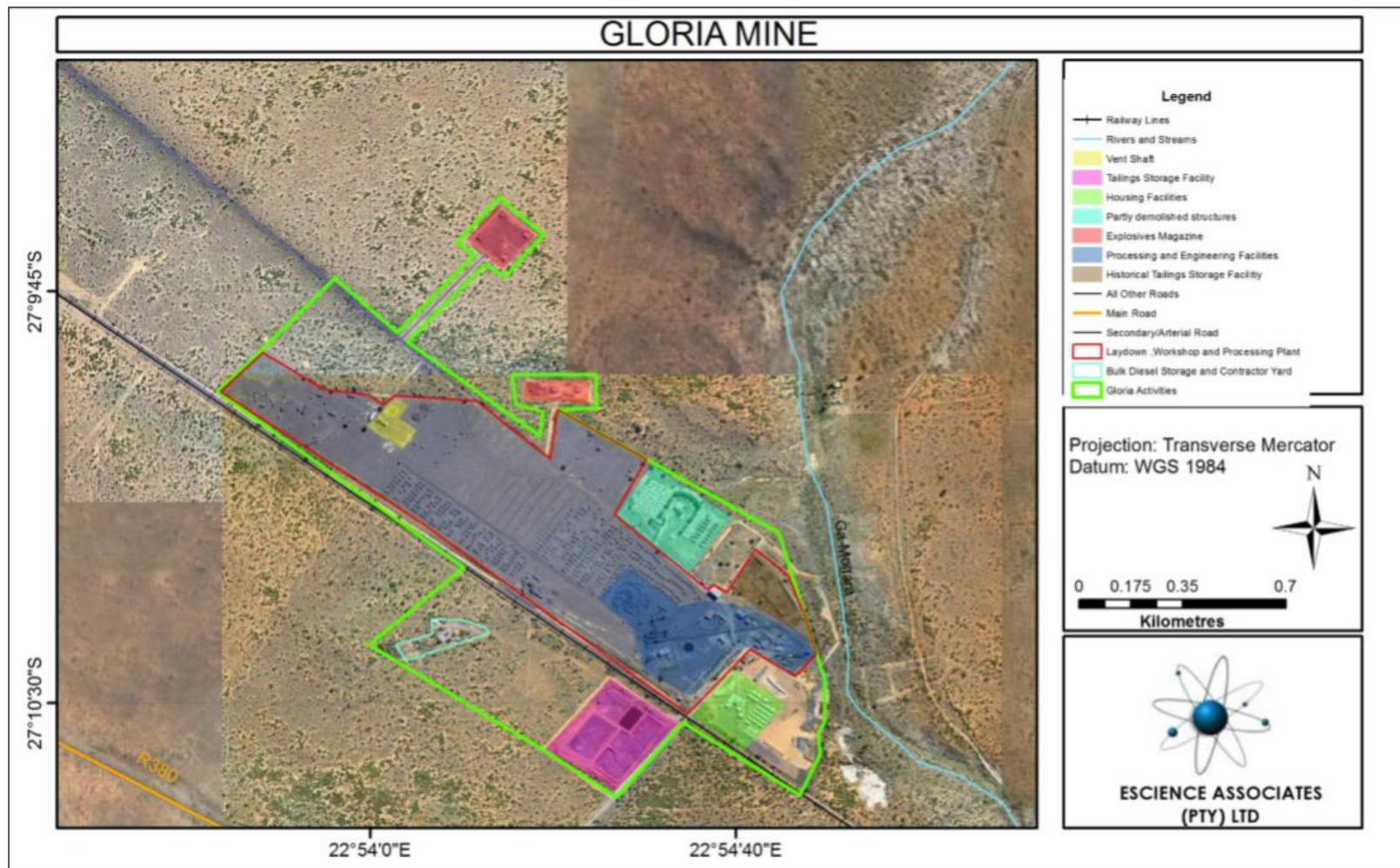


Figure 1: Current operations at Black Rock. Map provided by ESCIENCE Associates (Pty) Ltd.

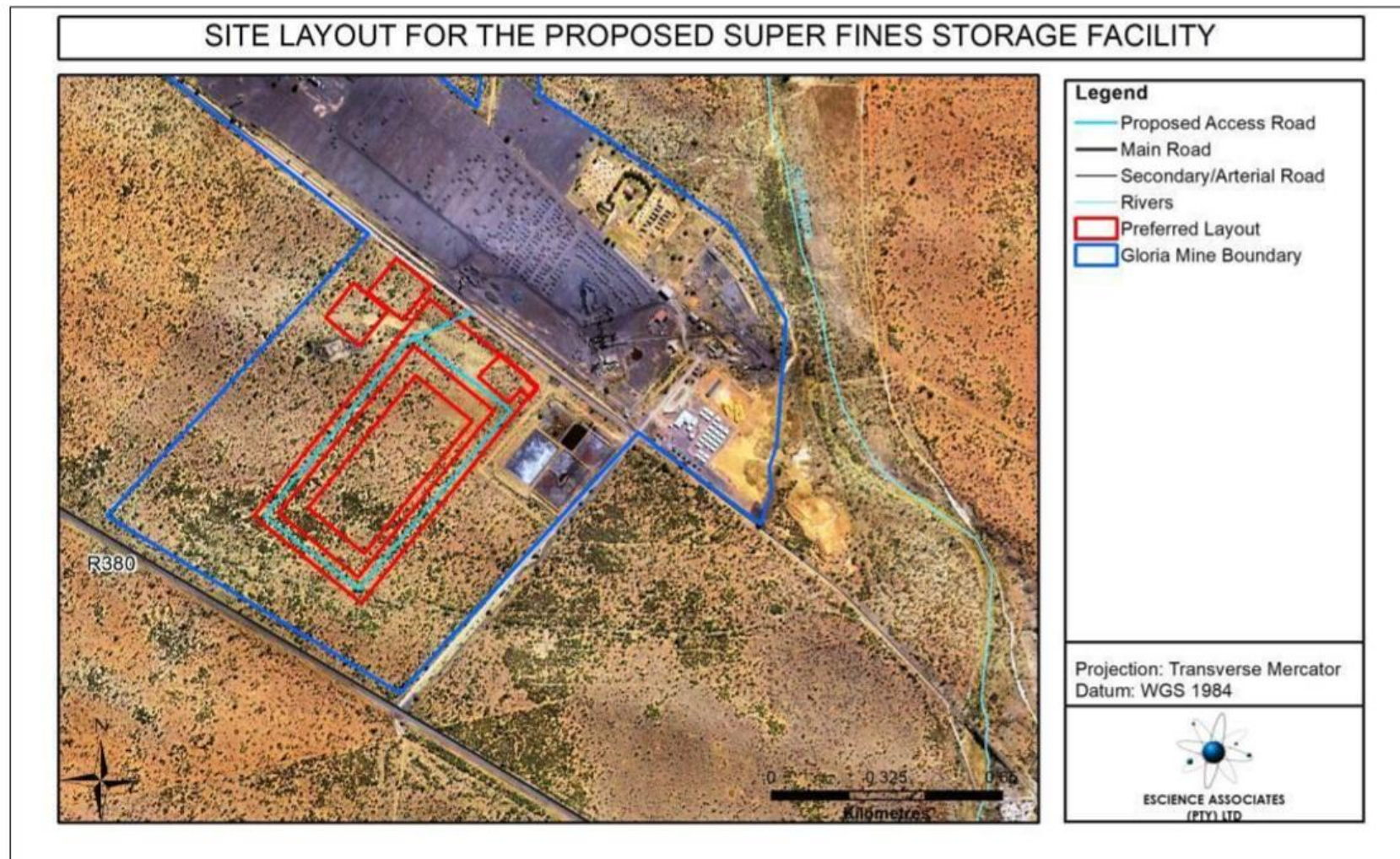


Figure 2: Proposed activities, Preferred Layout. Map provided by ESCIENCE Associates (Pty) Ltd.

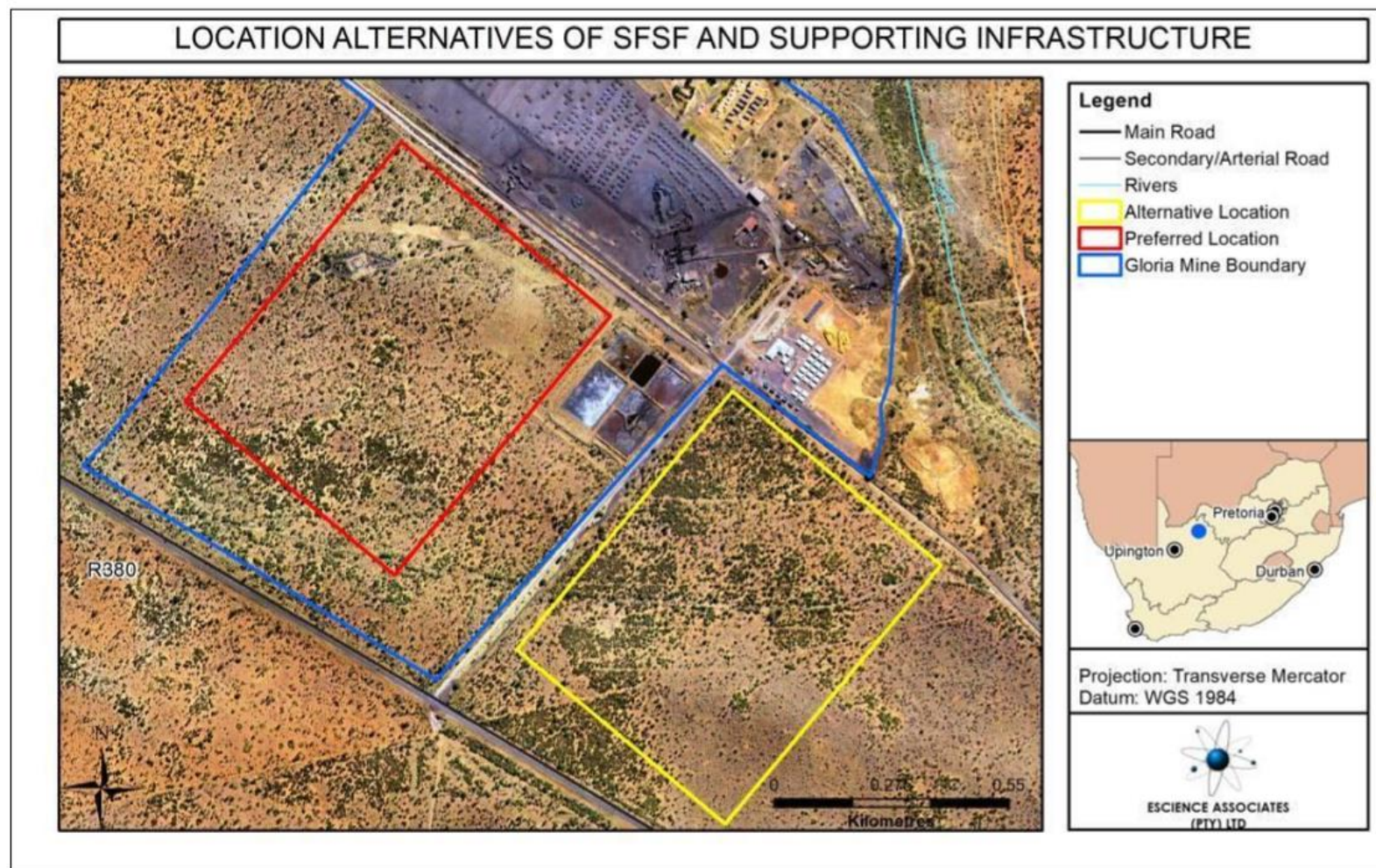


Figure 3. Proposed Location alternatives. Map provided by ESCIENCE Associates (Pty) Ltd.

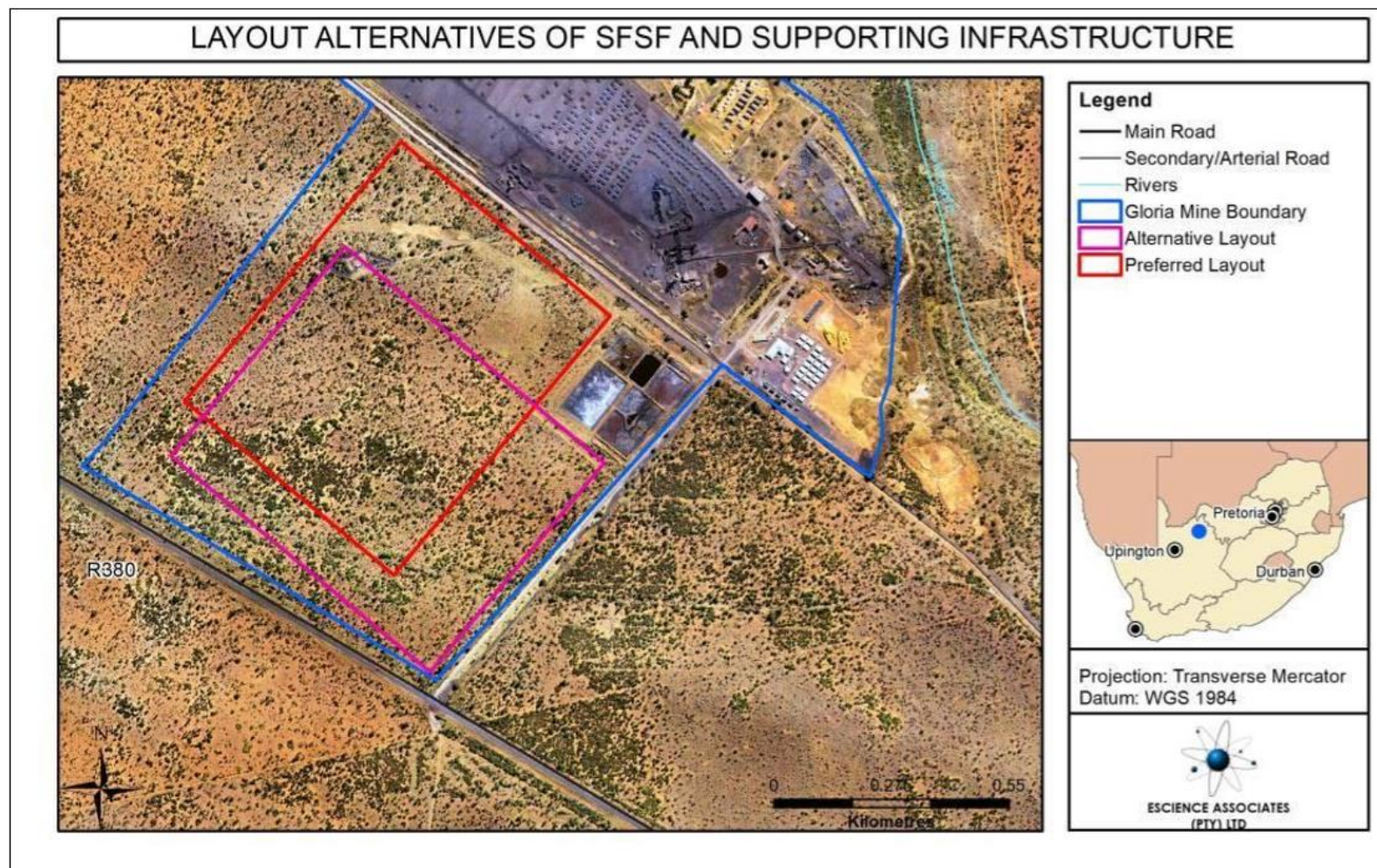


Figure 4: Proposed layout alternatives. Map provided by ESCIENCE Associates (Pty) Ltd.

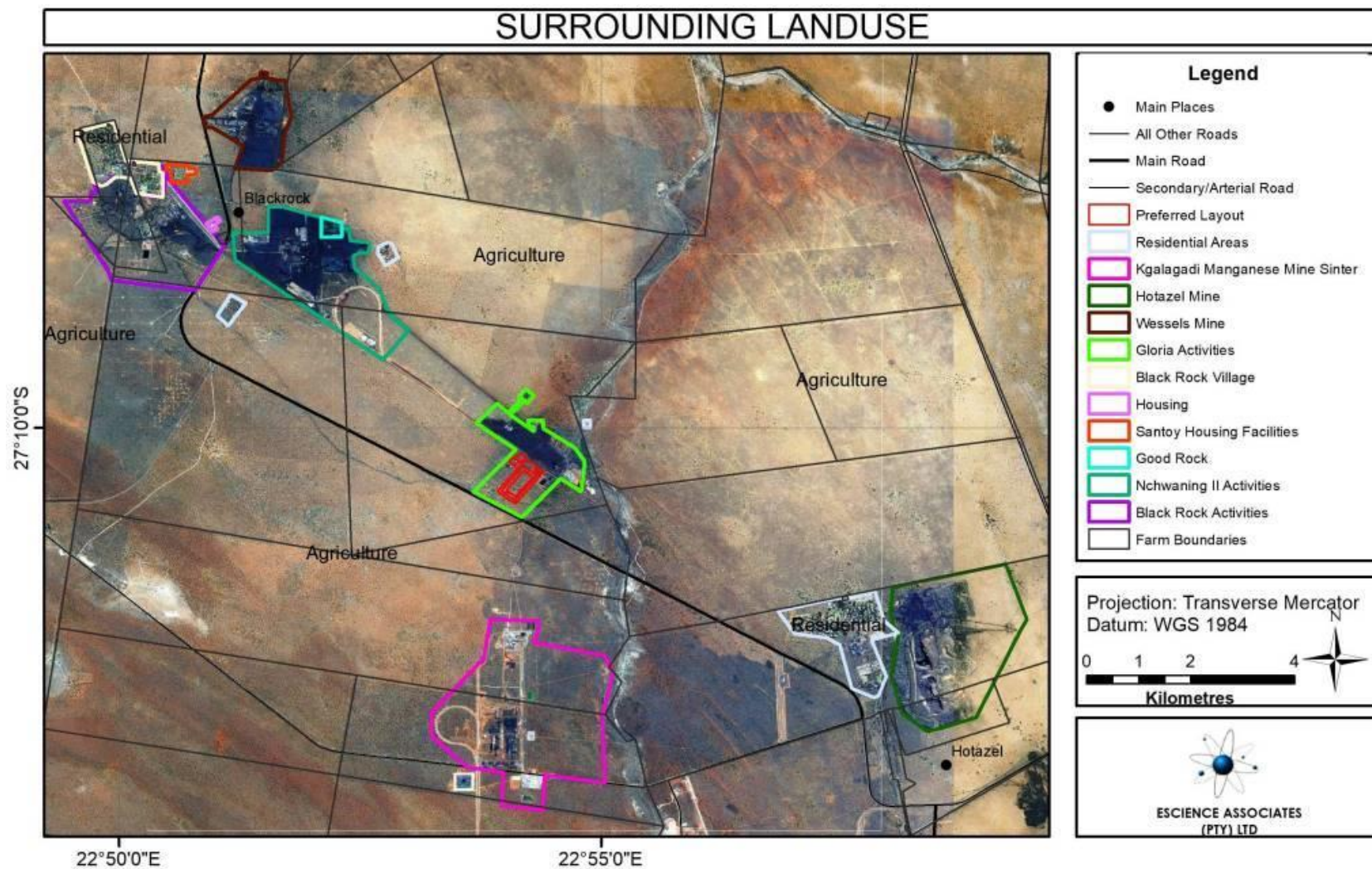


Figure 5: Surrounding Land use. Map provided by ESCIENCE Associates (Pty) Ltd.

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 unique 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 DIA 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 objective of a Palaeontological Desktop Assessment is to determine the impact of the development on potential palaeontological material at the site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed as well as rock formations just below the surface

in the development footprint 2) to assess the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage, and 4) to **recommend** how the developer ought to protect or mitigate damage to fossil heritage.

When a palaeontologist compiles a desktop study, the potentially fossiliferous rocks present within the development are established from 1:250 000 geological maps. The topography of the development is identified by 1:50 000 topography maps and Google Earth Images. Previous palaeontological impact studies in the same region, the PalaeoMap from SAHRIS; and databases of various institutions which identify fossils found in close proximity to the development is used to identify the fossil heritage within each rock. The palaeontological status of each rock component is calculated and the possible impact of the development on fossil heritage is determined by a) the palaeontological importance of the rocks, b) the quantity of bedrock removed and c) the type of development.

When it is determined that the development footprint has a **moderate to high sensitivity, a field-based assessment** by a palaeontologist is necessary. By using the desktop and the field survey of the exposed rock the impact significance of the planned development is calculated and recommendations for any further studies or mitigation are made. Usually, destructive impacts on palaeontological heritage only occur during the construction phase and the excavations will change the current topography and may 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 precede construction or even better occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. It is important that preceding the excavation of any fossil heritage 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

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Super Fines Storage Facility development is underlain by the Cretaceous to Tertiary Kalahari Formation (Qs) and underlying Griqualand West Basin rocks, Transvaal Supergroup of Vaalian age (Figure 6 - 7).

Table 1: Generalised Stratigraphic Column and Associated Geology

Stratigraphy			Lithology	
Kalahari Formation (Qs and Q)			Clay, limestone and sand	
Transvaal Supergroup	Postmansburg Group	Voelwater Subgroup	Hotazel Formation	Iron Formation
				Upper Mn ore body
				Middle Mn ore body
				Iron Formation
				Lower Mn ore body
				Mn-rich iron formation
				Iron Formation
			Ongeluk Formation	Basaltic lava

The **Kalahari deposits** is approximately c. 65 – 2.5 million years old (Ma).

The Cenozoic Kalahari Group is the most widespread body of terrestrial sediments in southern Africa. The Cenozoic sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge *et al.*, 2006). The youngest formation of the Kalahari group is the Gordonia Formation which is generally termed Kalahari sand and comprises of red aeolian sands that covers most of the Kalahari Group sediments. The pan sediments of the area originated from the Gordonia Formation and contains white to brown fine grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows seasonal effects of shallow saline groundwaters. Quaternary alluvium, aeolian sands, surface limestone, silcrete, and terrace gravels are also included in the Kalahari Group (Kent 1980).

The fossil assemblages of the Kalahari are generally very low in diversity, and occur over a wide range and thus the palaeontological diversity of this Group is low. These fossils represent terrestrial plants and animals with a close resemblance to living forms (see Table 2). Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils.

Hotazel is located in the **Griqualand West Basin**, Northern Cape Province which consists of clastic sediments as well as volcanic rocks, diamictites and banded iron formations. Manganese deposits is present in the Hotazel Formation, upper Postmasburg Group (approximately 2 222 Ma). The Vryburg Formation is the basal unit and overlies unconformably the granite and rocks of the Ventersdorp Supergroup. The Campbell Group overlies the Vryburg Formation and consists of the Schmidtsdrif Formation and the upper Ghaap Plateau Formation. The Griquatown Group is divided into two formations namely the Asbestos Hills and Koegas Formations. The Gamagara Formation follows and is positioned on the Maremane Anticline, and is overlain by the Makganyene Formation. The Cox Group comprises of the lower Ongeluk Formation and the upper Voëlwater Formation. The Ongeluk Formation was deposited under water and reaches a thickness of between 400 and 900 m. This Formation is basal and is mainly volcanic (Visser 1989). Manganese is present in the

upper Voëlwater Formation (Snyman 1996). According to Kent (1980) and Snyman (1996) Griqualand West Basin attains a maximum thickness of 4500 m.

Algal growth structures, also known as “Stromatolites”, are fossil structures described from the dolomites of the Transvaal Supergroup. 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.

Table 2: Table modified from Palaeotechnical Report (Almond & Pether 2009).

Subgroup/ sequence	Group	Formation	Fossil Heritage	Comment
Tertiary- Quaternary	Kalahari	-	Terrestrial organisms	Trace fossils, ostracods, bivalves, gastropod shells, diatoms
Griqualand West Super Group	Campbell	Ghaapplato (Vgh)	Stromatolites	Cyanobacterial microfossils are present
-	Griquastad	Asbestos Hills	Stromatolites	Cynanobacterial microfossils are present



Figure 6: Example of a well-preserved stromatolite from the Archaean Era.

Almond & Pether 2008, allocated a low significance to the Kalahari Group because fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. In the past palaeontologists did not focus on Cenozoic superficial deposits although they sometimes comprise of significant fossil biotas.

GEOLOGY FOR HOTAZEL/BLACK ROCK REGION

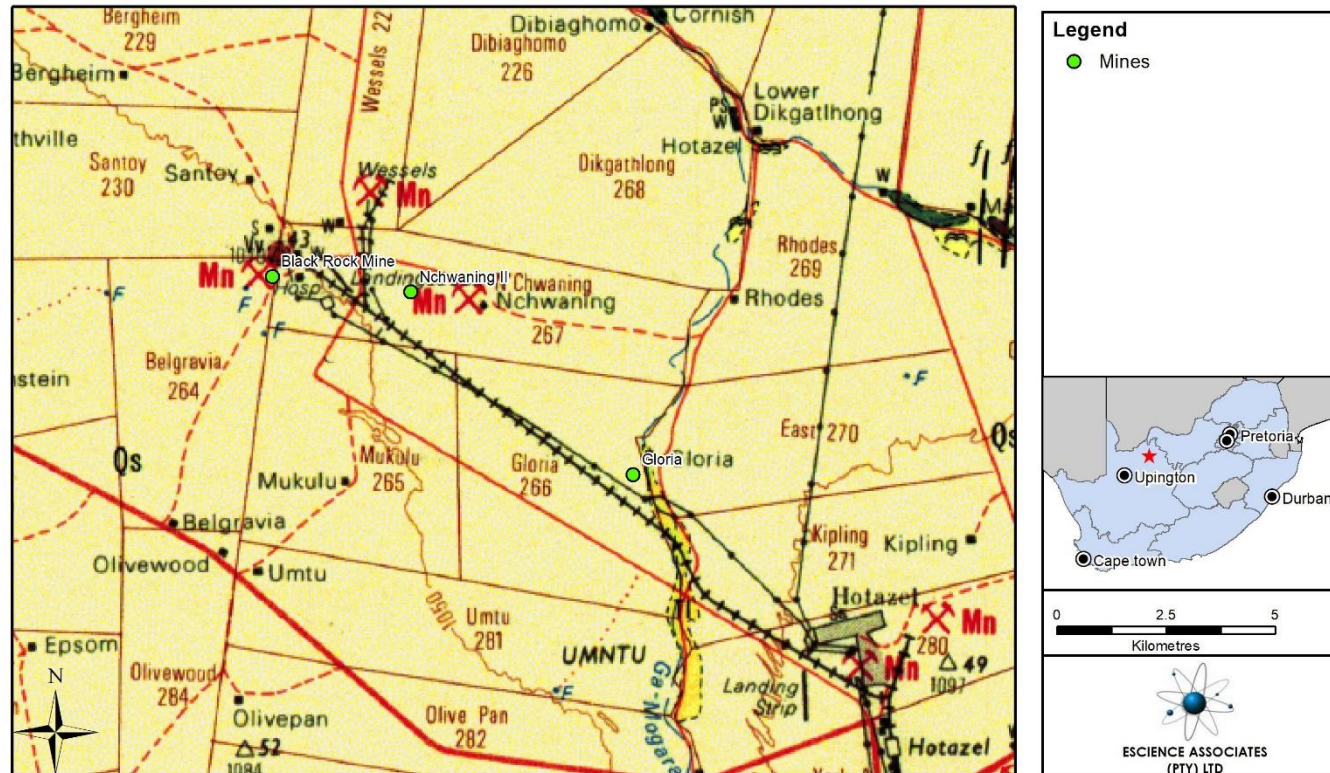


Figure 7: Extract of the 1:250 000 2722 Kuruman Geological Map (Council of Geosciences, Pretoria) of the Black Rock Mining Operations, of which the SFSF is located at Gloria Mine (indicated in green) near Hotazel in the John Taolo Gaetsewe District Municipality in the Northern Cape.). Map provided by ESCIENCE Associates (Pty) Ltd.

Legend to Map and short explanation.

Qs – Red to flesh-coloured wind-blown sand (beige). Kalahari Group. Quaternary.

TI – Surface limestone (yellow). Kalahari Group.

Vo – Amygdaloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper (green). Ongeluk Formation, Olifantshoek Group, Transvaal Supergroup.

Vad – Yellow-brown banded or massive jaspilite and crocitolite (purple). Danielskuil Formation, Asbesberge Subgroup, Griqualand West Group, Transvaal Supergroup.

---f--- – (black) Fault.

..... – Lineament.

□ – Approximate position of property East 270.

F- Figure numbers.

Mining Activities

AK – Crocitolite

Ki – Kieselguhr

Mn – Manganese.

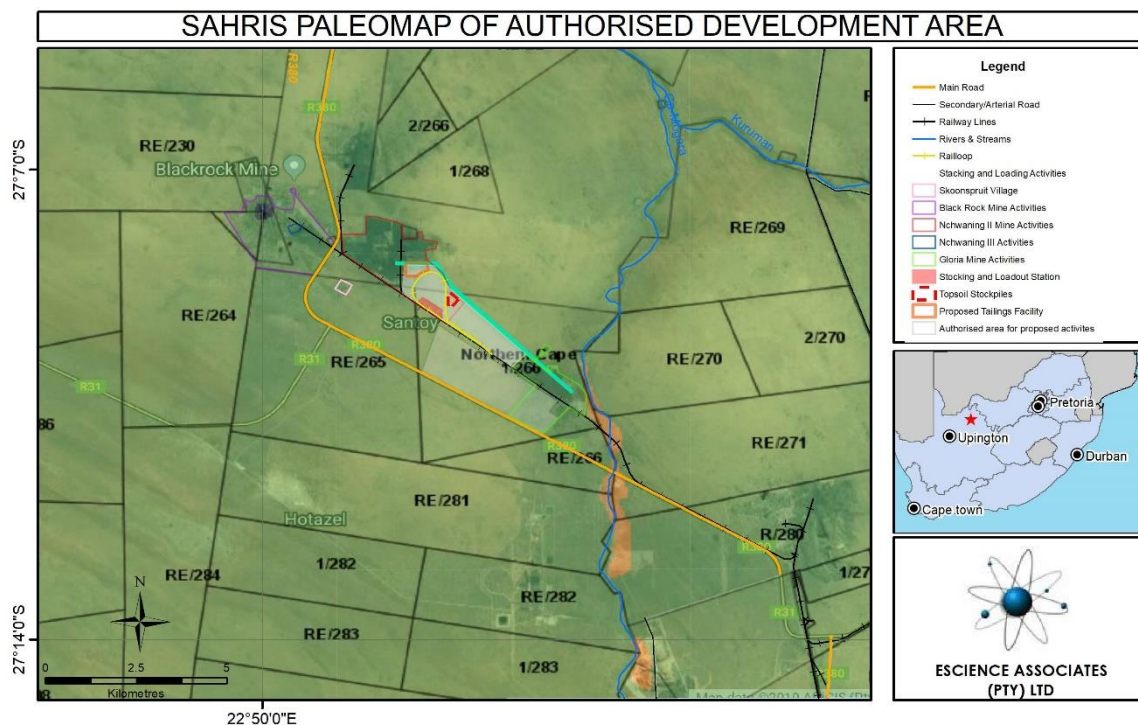


Figure 8: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences). Map provided by ESCIENCE Associates (Pty) Ltd.

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) there is very little chance of finding fossils in this area.

6 GEOGRAPHICAL LOCATION OF THE SITE

The ASGN Tailings Facility at BRMO is located at Santoy in the Northern Cape Province almost 80 km north-west of the town of Kuruman and 12 kilometres north-west of Hotazel. BRMO falls within the jurisdiction of the Joe Morolong Local Municipality and the John Taolo Gaetsewe District Municipality.

7 METHODS

A desktop study was assembled to evaluate the possible risk to palaeontological heritage (this includes fossils as well as trace fossils) in the proposed development area. In compiling the desktop report aerial photos, Google Earth 2018, topographical and geological maps and other reports from the same area as well as the author's experience were used to assess the proposed development footprint.

7.1 Assumptions and Limitations

The accuracy of DIA is reduced by several factors which may include the following: the databases of institutions are not always up to date and relevant locality and geological information were not accurately documented in the past. Various remote areas of South Africa have not been assessed by palaeontologists and data is based on aerial photographs alone. Geological maps concentrate on the geology of an area and the sheet explanations were never intended to focus on palaeontological heritage.

Similar Assemblage Zones, but in different areas is used to provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations and Assemblage Zones generally **assume** that exposed fossil heritage is present within the development area. The accuracy of the Palaeontological Impact Assessment is thus improved considerably by conducting a field-assessment.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- The Palaeosensitivity Map from the SAHRIS website.
- 2722 BB Topographical map
- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- Geological Map 1: 250 000 2722 Kuruman, (Moen 1979).
- A Google Earth map with polygons of the proposed development was obtained from *EScience Associates*.
- Other Impact Studies in the same area is listed in the references and include Almond 2010; 2012a,b; 2013a,b; 2016; Bamford, 2017; Fourie, 2018, Groenewald 2013, 2014.
- Draft Scoping Report for the establishment of a Super Fines Storage Facility at Gloria Mine: Assmang (Pty) Ltd Black Rock Mine Operations, Santoy, Northern Cape.

9 IMPACT ASSESSMENT METHODOLOGY

An assessment of the impact significance of the proposed Super Fines Storage Facility on local fossil heritage is presented here:

9.1 Methodology for Impact Assessment

In order to ensure uniformity, a standard impact assessment methodology has been utilised so that a wide range of impacts can be compared. 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 aforementioned 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 3.

Table 3: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	<i>Isolated site/ proposed corridor</i>	<u>Incidental</u>
2	LOW	<i>Study area</i>	<u>Short-term</u>
3	MODERATE	<i>Local</i>	<u>Medium-term</u>
4	HIGH	<i>Regional / Provincial</i>	<u>Long-term</u>
5	VERY HIGH	<i>Global / National</i>	<u>Permanent</u>

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

9.2 Significance Assessment

The 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 an area affected by atmospheric pollution may be extremely large (1000 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 in Table 4: below.

Table 4: 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 in the Table 5 below.

Table 5: Description of the Spatial 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 possible impacts, and will be felt at a regional scale (District Municipality to Provincial Level). The impact will affect an area up to 50 km from the proposed site.
3	Local	The impact will affect an area up to 5 km from the proposed site.

2	Study Area	The impact will affect an area not exceeding the boundary of the study area.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the site.

9.4 Temporal/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 or duration scale is rated according to criteria set out in Table 6:

Table 6: 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-term	The environmental impact identified will operate for the duration of life of the project.
4	Long-term	The environmental impact identified will operate beyond the life of operation of the project.
5	Permanent	The environmental impact will be permanent.

9.5 Degree of Probability

The probability, or likelihood, of an impact occurring will be described as shown in Table 7: Table 7 below.

Table 7: 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 8. 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 8: 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.

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:

$$\text{Impact Risk} = \frac{(\text{Significance (3)} + \text{Spatial (2)} + \text{Temporal (5)})}{3} * \frac{\text{Probability}}{5}$$

An example of how this rating scale is applied is shown below within Table 9:

Table 9: Example of Rating Scale

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	Moderate	Study area	Permanent	Could Happen	LOW
Impact on heritage sites	3	2	5	2	1.3

Note: The significance, spatial and temporal scales are added to give a total of 10, which is divided by 3 to give a criterion rating of 3.3. The probability (2) is divided by 5 to give a probability rating of 0.4. The criteria rating of 3.3 is then multiplied by the probability rating (0.4) to give the final rating of 1.3.

The impact risk is classified according to 5 classes as described in the table below.

Table 10: 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
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An impact rating of 1.04 will fall in the Impact Class 2, which will be considered to be a low impact.

9.8 Summary of Impact Tables

The development footprint is completely underlain by the Kalahari Formation. The Palaeontological Sensitivity of this formation is rated as Low. The expected duration of the impact is assessed as potentially permanent to long term. 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**. Impacts on palaeontological heritage during the construction phase could potentially occur but are regarded as having a moderate possibility.

The significance, spatial and temporal scales are added to give a total of 10, which is divided by 3 to give a criterion rating of 3.3. The probability (2) is divided by 5 to give a probability rating of 0.4. The criteria rating of 3.3 is then multiplied by the probability rating (0,4) to give the final rating of 1,3 and falls Impact Class 2 .

10 FINDINGS AND RECOMMENDATIONS

The proposed construction of the Super Fines Storage Facility at the Assmang (Pty) Ltd, Black Rock Mining Operations at Hotazel, Northern Cape is completely underlain by the Cenozoic Kalahari Group as well underlying Griqualand West Basin rocks, Transvaal Supergroup. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Kalahari Group is low and the Griqualand West rocks of the Transvaal Supergroup as moderate.

It is therefore considered that the construction and operation of the Super Fines Storage Facility upgrade is deemed appropriate and feasible, and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction and operation of the facility may be authorised as the whole extent of the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries ought to be secured (preferably *in situ*) and the ECO ought to alert SAHRA so that appropriate mitigation (e.g. documented and collection) can be undertaken by a professional palaeontologist.

The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

11 CHANCE FINDS PROTOCOL

A following procedure will only be followed in the event that fossils are uncovered during excavation.

11.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) are protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”.

Palaeontological heritage are unique and non-renewable, and are 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.

11.2 Background

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

11.3 Introduction

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 Control Officer (ECO) 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 ECO, 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.

11.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work 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 ECO or site manager. The ECO 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 ECO (site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ECO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development.

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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

Registered as a PhD fellow at the Zoology Department of the UFS

2013 to current

Dissertation title: A new gorgonopsian from the uppermost *Daptocephalus Assemblage Zone*, in the Karoo Basin of South Africa

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
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Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently
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