Appendix D11
Palaeontological Desktop Assessment of The Proposed Expansion of the Kareerand Tailings Storage Facility Near Stilfontein, North West Province
- PGS Heritage/Banzai Environmental, 2020

PALAEONTOLOGICAL DESKTOP ASSESSMENT OF THE PROPOSED EXPANSION OF THE KAREERAND TAILINGS STORAGE FACILITY NEAR STILFONTEIN, NORTH WEST PROVINCE

PGS Heritage

Date: 03-03-2019

Prepared by:

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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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ACKNOWLEDGMENT OF RECEIPT

Report Title	Palaeontological Desktop Assessment of the proposed Expansion of the Kareerand Tailings Storage Facility near Stilfontein, North West Province		
Control	**Name**	**Signature**	**Designation**
Author	Elize Butler		Palaeontologist
Reviewed			Principal Heritage Specialist
Client			

CLIENT:

CONTACT PERSON:

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-	
i. the specialist who prepared the report; and	Page ii of Report – Contact details and company and Appendix A
ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	
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
(cA) 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 alternatives;	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
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 11

k) any mitigation measures for inclusion in the EMPr;	Section 10
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- i. as to whether the proposed activity, activities or portions thereof should be authorized; (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 11
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 *gazetted* 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 (Pty) Ltd was appointed by PGS Heritage (Pty) Ltd to undertake a Palaeontological Impact assessment assessing the palaeontological impact of the planned expansion of the Kareerand Tailings storage facility, near Stilfontein, North West Province. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is essential to detect the presence of fossil material within the proposed development footprint. This assessment will evaluate the impact of the construction and operation of the proposed development on the palaeontological resources.

The proposed Kareerand expansion is situated on the farm Buffelsfontein 443 IP; Hartebeesfontein 422 IP; Wildebeestpan 442 IP, Kareerand 444IP; Kromdraai 420 IP and Megadam 574 IP in the City of Matlosana and Potchefstroom Local Municipalities, North West Province. The study site is underlain by the Hekpoort-; Daspoort and Strubenkop Formations of the Pretoria Group within the Transvaal Supergroup as well as the igneous intrusion, diabase. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Hekpoort Formation is moderate, Strubenkop Formation is Low, Daspoort Formation is High, while diabase is igneous rocks and thus unfossiliferous (Almond *et al*, 2013; Groenewald et al 2014; SAHRIS website). Since the area has already been disturbed with mining activities in the past the sensitivity is regarded as low.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Although fossils are rare in this biozone a single fossil can have a huge scientific importance as many fossil taxa are known from only one fossil.

In the unlikely event that fossil remains are discovered during any phase of construction, on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries ought to be protected (*in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (recording and collection) can be carry out.

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

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TERMINOLOGY AND ABBREVIATIONS

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

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2 500 000 years ago.

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.

Late Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

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

AIA	Archaeological Impact Assessment
ASAP	Association of South African Professional Archaeologists
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
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

1 INTRODUCTION

PGS Heritage has been appointed as the independent environmental consultant, to undertake the required EIA process for the development of the proposed expansion of the Kareerand Tailings Storage facility (TSF), near Stilfontein, North West Province (Fig. 1-2). The proposed new development is situated on the farm Buffelsfontein 443 IP; Hartebeesfontein 422 IP; Wildebeestpan 442 IP, Kareerand 444IP; Kromdraai 420 IP and Megadam 574 IP in the City of Matlosana and Potchefstroom Local Municipalities, North West Province (Fig. 3).

Mine Waste Solutions (MWS), also known as **Chemwes (Pty) Ltd (Chemwes)**, has been in business since 1964, and conducts its operations over a large area of land to the east of Klerksdorp, within the area of jurisdiction of the City of Matlosana and JB Marks Local Municipalities (LM), which fall within the Dr Kenneth Kaunda District Municipality (DM) in the North-West Province. The MWS Operations are located primarily to the south of the N12, east of the town of Stilfontein. The closest town is Khuma, located about 3km northwest of the facility, and other nearby towns include Stilfontein (10 km from facility) and Klerksdorp (19 km from facility)[1].

The operations at Mine Waste Solutions entail the collection and reprocessing of mine tailings that were previously deposited on **tailings storage facilities (TSFs)** in order to extract gold and uranium. High pressure water cannons are used to slurry the tailings on the Source TSFs, then slurry is pumped by a number of pump stations and pipelines to the **MWS Processing Plant** (indicated in dark green in Figure 1), and the residues from the Processing Plants are pumped to the **Kareerand TSF** (indicated in yellow in Figure 1). Once an old Source TSF has been completely recovered, it is cleaned-up and rehabilitated. See Figure 1 for an overview of the existing infrastructure used for this process[1].

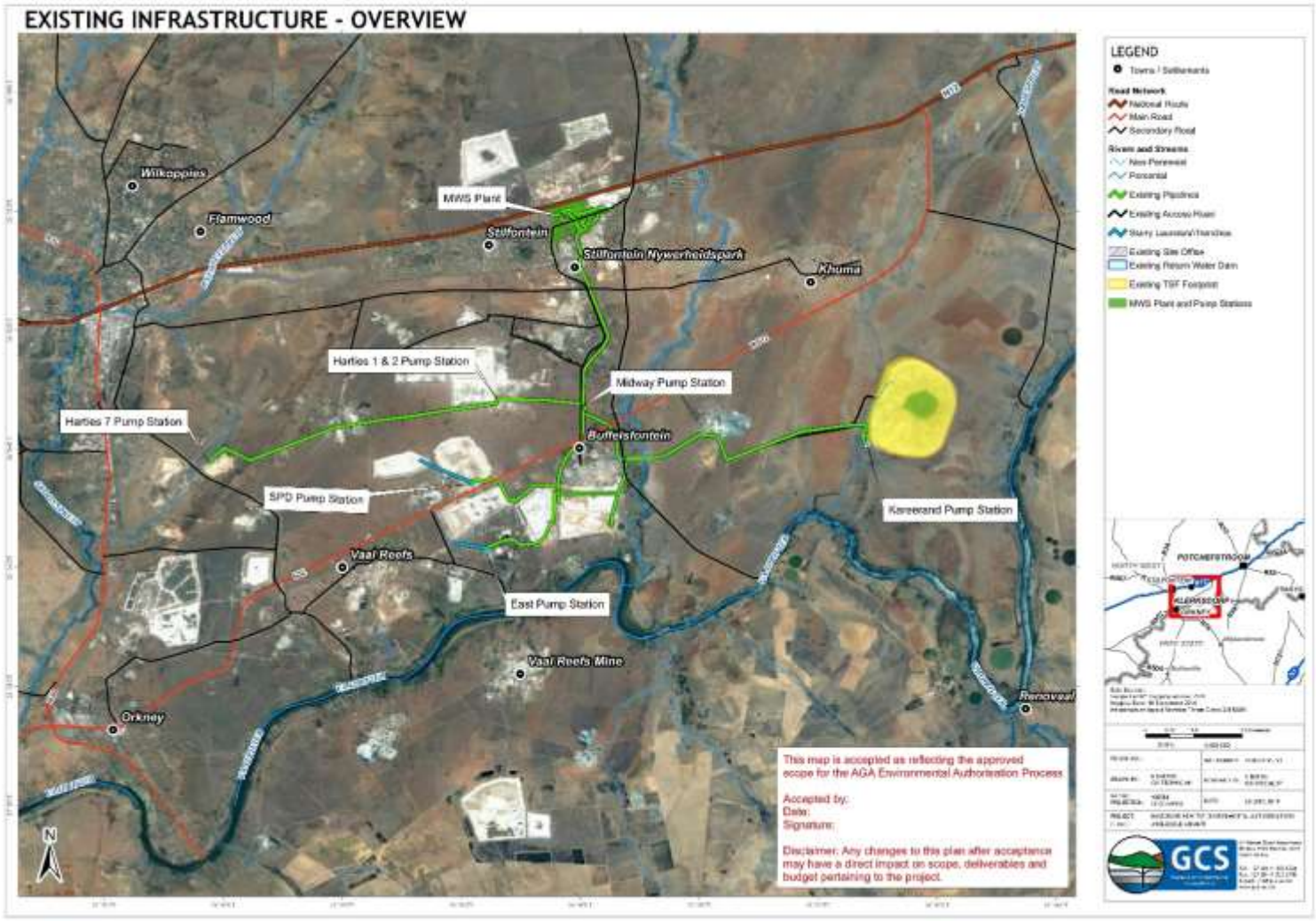

Figure 1 – Existing infrastructure.

1.1 Project Description

The proposed project will make use of the existing facilities as well as additional supporting infrastructure.

The details of the infrastructure which forms part of the expansion of the TSF are as follows:

- TSF expansion
    - TSF will be expanded by 380 ha
    - The expanded footprint will be lined as per requirements of the regulator
- Fences
    - 2.4 m high game fence with appropriate signage will be installed around the perimeter of the new TSF (length of new fence = 7 km)
    - This will tie into the existing fence and is the same type of fence
- New main access road and perimeter access road
    - 8 m wide gravel access road around perimeter of TSF, to the RWDs (return water dams), pump stations (western perimeter of TSF expansion) and offices
    - Total combined distance of new roads will be 11 km
    - Access ramps provide access onto tailings dam
- Topsoil bund wall
    - A bund wall will be constructed around the TSF, next to the access road
    - The wall will be 6 m at highest point and 2 m at lowest point, crest width is 8 m
    - The bund wall will also be used as access road on northern side of TSF
- Stormwater diversion channels
    - An trench on the northern side of the TSF, 6 km in length, to divert clean storm water running from the north, towards the east in the direction of the Vaal River
        - Trapezoidal in shape with side slopes of 1v:2h and base width varying from 4 m to 9m.
        - Designed to accommodate the 1:50 year storm event
        - Peak flow velocity will be 125 m^3/s during 1:50 year storm events
    - A second unlined trench next to the RWD will divert clean storm water runoff away from the RWD and solution trench and prevent it from mixing with the dirty water
    - Diversion channels will assist to minimise the water quality impact from the TSF[1]

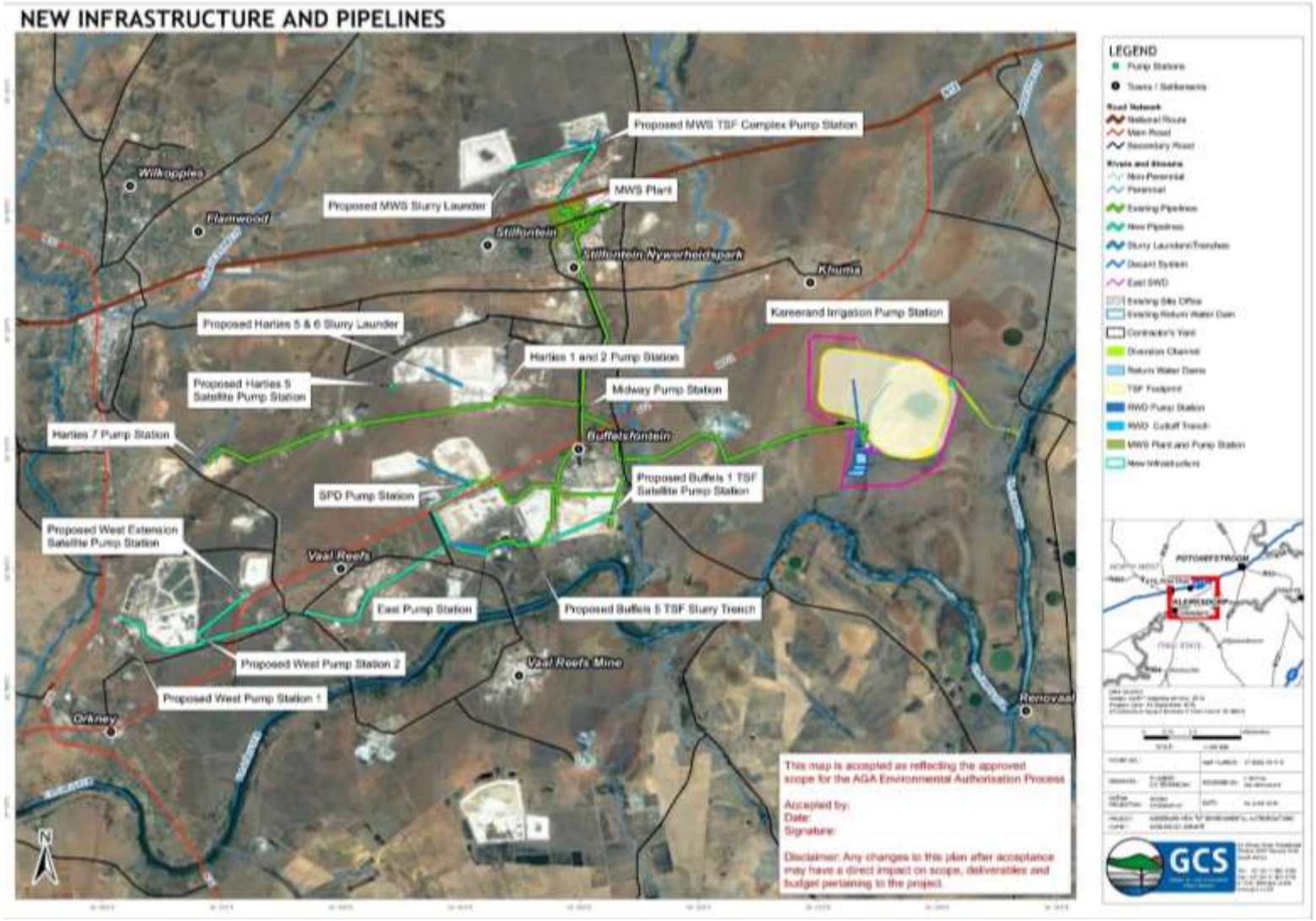

Figure 2 – New Infrastructure

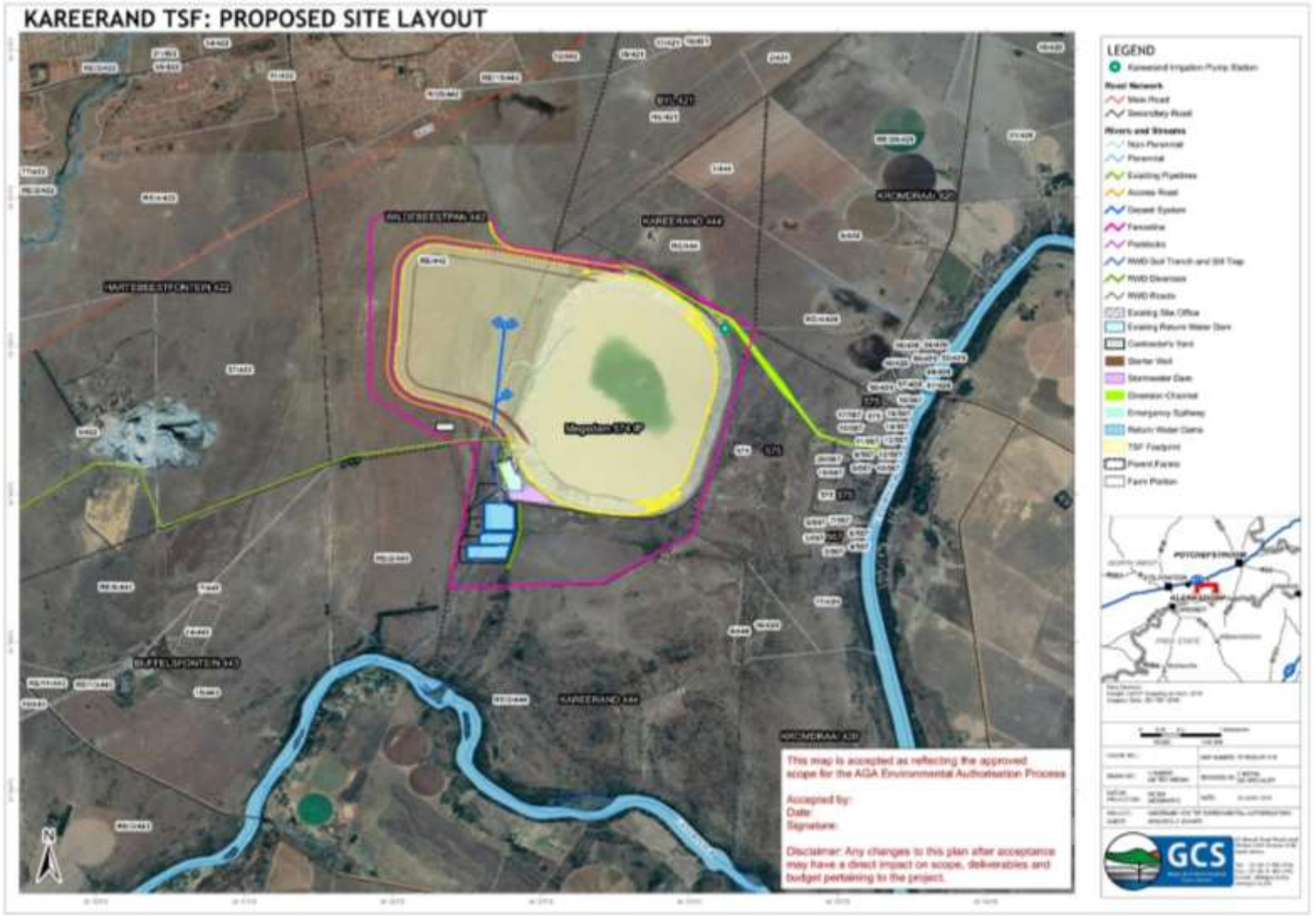

Figure 3 – TSF expansion site layout in detail, including associated infrastructure

- Delivery pipeline
    - Three steel 500 mm tailings delivery pipes located at the toe of the facility (western edge); 13.5 km in total length
    - Will deliver slurry to the northern, western and southern side of the TSF expansion
- Solution trench
    - Trench lined with 100 mm thick mesh reinforced concrete
    - Around northern, western and southern side of TSF
    - Will convey decant water and storm water from the side slopes, filter discharge (seepage water) from the outer drains and surface runoff from the side slopes to the RWD.
- Seepage and dirty water collector sump
    - Constructed on northern side of TSF
    - Will collect seepage water and dirty storm water running off the TSF walls from solution trench before it is pumped back to the north-western corner
- Catchment paddocks
    - Constructed around perimeter of facility at final outer wall toe location
    - Constructed using material from solution trench excavations and paddock basins; will be nominally compacted
    - Paddocks will be 50 m long and 20 m wide
    - Designed to contain run-off from a 1:50 year storm event
- Starter wall
    - The starter wall will contain tailings deposition during early development of TSF
    - Constructed using clay-based material from basin or other construction areas
- Drainage system
    - Under drainage system located within TSF footprint, consisting of toe, intermediate and central drains and drain outlets
    - Drain outlets constructed at approximately 50-100m intervals to collect seepage water from filter drains and convey it to solution trench
    - The existing drain outlets will connect to a collector drain system then discharge into the solution trench on the southern flank where the two facilities connect[1].
- Decant system
    - Gravity pipe decant system to ensure water does not accumulate on top of TSF
    - Includes permanent double intake structure and intermediate intake structures
    - Intermediate penstock intake structures positioned at different elevations along the penstock outlet pipeline
        - Ensure effective decanting of supernatant water during the development phase of TSF
        - Minimise delay in water returned to the reclamation sites
- Catwalk
    - Timber catwalk and floating walkway structure for access from pool wall to penstock intermediate and permanent intake structures respectively
- Silt trap

    - Concrete-lined silt trap with twin compartments between penstock outlet and RWD
    - Should reduce volume of suspended solids flowing into RWD
- Storm water dam
    - Storm water dam will be located between TSF and RWDs and will contain dirty water running off the TSF
    - Capacity will be 155 000 m^3 and will cover 6.6 Ha
- RWD and related infrastructure
    - New RWDs with a combined capacity of 837 000 m^3 (area of 60 Ha), south of the TSF and existing RWD complex
    - RWD will have three compartments (one for operation, the other two for dirty water containment)
    - Will be lined with double HDPE liner system and leakage-detection material (Hi-drain); double liner will consist of 2 mm geomembrane and 1.5 HDPE geomembrane
- Contractors yard
    - Contractor's yard will be located on the south western side of the TSF extent on the right of the access road travelling south.
    - Contractor's yard will include the following infrastructure: site office, workshop, fuel storage facilities, wash bays, change houses, septic tanks.

The additional infrastructure required across the operational footprint will include new pump stations, new satellite pump stations, slurry launders and connecting slurry and process water pipelines. As indicated in Figure 2, in the centre of operations, existing infrastructure (pump stations and main slurry and process water pipelines) will be utilised to process adjacent resources. Buffels 5 TSF will be connected to the East Complex Pump Station via a new slurry trench and Buffels 1 TSF will be pumped via a satellite pump station to the Buffels 5 TSF slurry trench feed. At the Harties 1 & 2 Pump Station, located centre to north of Figure 2, Harties 5 & 6 TSF will be directed via a slurry launder to the pump station and may require, at a later date, a satellite pump station to aid in reclamation of tailings that cannot be gravity fed. In the west, three new pump stations (West Pump Station 1, West Pump Station 2 and a satellite pump station) will be constructed, with main slurry and process water pipelines extended from the existing SPD and East Complex Pump Stations in the east to the west, allowing for the use of the SPD and East Complex Pump Stations as booster pump stations. In the north, the MWS 4 & 5 TSF's will be reclaimed and directed to a new pump station via slurry launders. New process water and slurry piping will be installed between the MWS 4 & 5 Pump Station and the MWS plant. In total, three new main pump stations and three new satellite pump stations will be built[1].

The details of the supporting infrastructure for the TSF expansion are as follows:

- Pump Stations
    - Three main pump stations: one at the MWS complex, two at the outlying western TSFs
    - Three satellite pump stations: one at the Harties TSFs (probably at a later stage), one at the outlying western TSFs and one at the Buffels TSFs
- Process water pipelines

    - Extended from the existing SPD and East Complex pump stations to the western outlying TSFs
    - Connecting MWS TSFs and MWS plant
- Slurry pipelines
    - Extended from the existing SPD and East Complex pump stations to the western outlying TSFs
    - Connecting MWS TSFs and MWS plant
- Slurry launders
    - Connecting the Buffels TSF to the East Complex pump station
    - Connecting Harties TSFs with the Harties 1 & 2 pump station
    - Connecting MWS TSFs to the proposed MWS pump station[1]

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Conclusion

The expansion of the existing TSF will enable the reclamation of tailings dams and deposition of the tailings in a new facility complete with appropriate seepage mitigation measures and resultantly reduce the total seepage into the Vaal River.

The project will support concurrent rehabilitation of the existing TSF and the expansion TSF, thereby reducing the risk of windborne dust and storm water management. Removing and consolidating the tailings in the KOSH area on a single mega tailings storage facility will in the long term, positively impact the surrounding environment and Vaal River[1].

Specialist studies have been commissioned to assess the impacts of the TSF expansion on identified aspects of biophysical and socio-economic receptors within the area. Mitigation, management, and rehabilitation designs are informed by a team of specialists and engineers.

[1]Information provided by GSC Water and Environmental Consultants

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 12 years. She has been conducting PIAs since 2014.

2 LEGISLATION

2.1 National Heritage Resources Act (25 of 1999)

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

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

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

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

3 OBJECTIVE

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

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

The terms of reference of a PIA are as follows:

General Requirements:

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

Implications of specialist findings for the proposed development (such as permits, licenses etc).

4 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Kareerand expansion is situated on the farm Buffelsfontein 443 IP; Hartebeesfontein 422 IP; Wildebeestpan 442 IP, Kareerand 444IP; Kromdraai 420 IP and Megadam 574 IP in the City of Matlosana and Potchefstroom Local Municipalities, North West Province. The study site is indicated on the 1:250 000 2626 West Rand Geological Map (Council for Geosciences, Pretoria) and is underlain by the Hekpoort-; Daspoort and Strubenkop Formations of the Pretoria Group within the Transvaal Supergroup as well as the igneous intrusion diabase. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Hekpoort Formation is moderate, Strubenkop Formation is Low, Daspoort Formation is High, while diabase is igneous rocks and thus unfossiliferous (Almond *et al*, 2013; Groenewald et al 2014; SAHRIS website).

Symbol	**Group/Formation**	**Lithology**	**Fossils**
Vd	Daspoort	Alluvial, fluvial and deltaic sandstones mudrocks, marine sediments in east	Stromatolites
Vh	Hekpoort	Basalts, pyroclastics with minor lacustrine shales	None recorded
Vs	Strubenkop	Lacustrine mudrocks with minor sandstone	None recorded
Vdi	Diabase	Igneous intrusion	None recorded

Table 1: Explanation of symbols for the geological map, lithology and possible fossils (Eriksson *et a*l 2006; Groenewald et al 2014).

There is a possibility that stromatolite as well as microfossils are present in the Daspoort Formation (Pretoria Group, Transvaal Supergroup), while Groenewald et al (2014) did not record any fossils from the other formations.

Figure 4: Example of a well-preserved stromatolite from the Archaean Era.

Stromatolites are layered mounds, columns and sheet-like sedimentary rocks (Fig 4). 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 today was generated by numerous cyanobacteria photosynthesizing during the Archaean and Proterozoic Era.

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

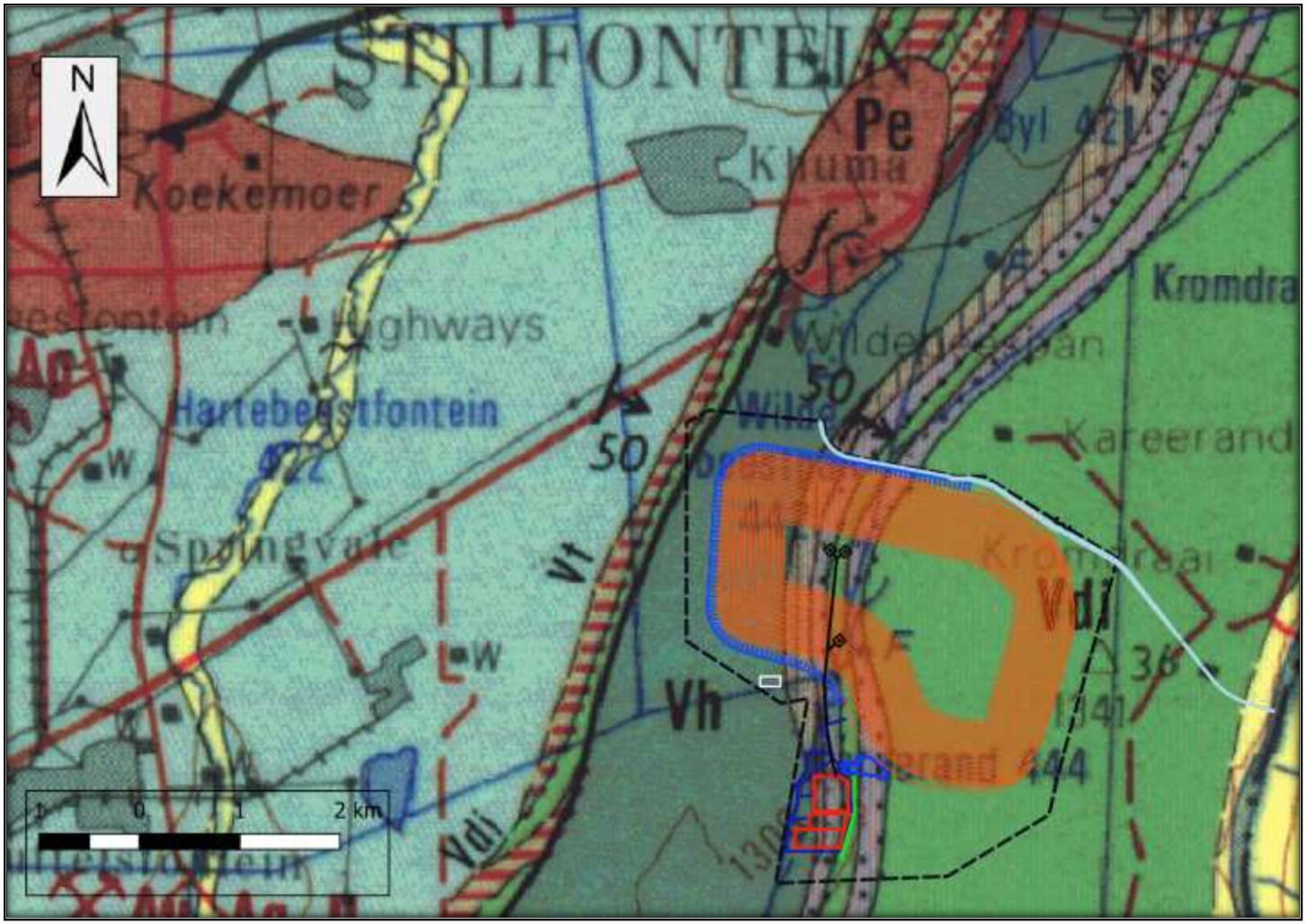
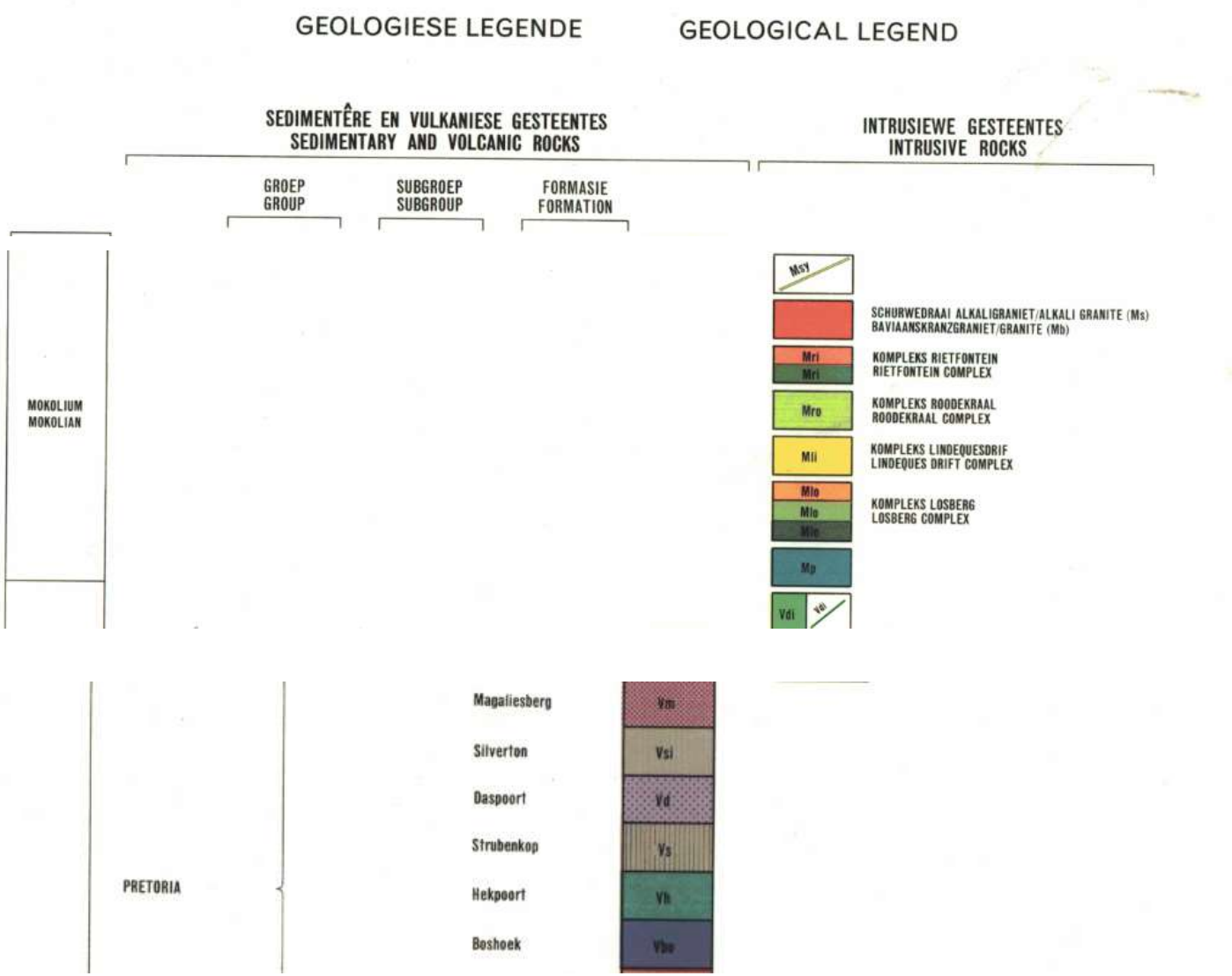


Figure 5: Extract of the 1: 250 000 2626 West Rand Geological Map (Council of Geosciences, Pretoria). The site is underlain by the Hekpoort-; Daspoort and Strubenkop Formations of the Pretoria Group within the Transvaal Supergroup as well as diabase.


GEOLOGIESE LEGENDE
GEOLOGICAL LEGEND
SEDIMENTÊRE EN VULKANIESE GESTEENTES
SEDIMENTARY AND VOLCANIC ROCKS
INTRUSIEWE GESTEENTES
INTRUSIVE ROCKS
GROEP
GROUP
SUBGROEP
SUBGROUP
FORMASIE
FORMATION
MOKOLIUM
MOKOLIAN
Msy
SCHURWEDRAAI ALKALIGRANIET/ALKALI GRANITE (Ms)
BAVIAANSKRANZGRANIET/GRANITE (Mb)
Mri
Mri
KOMPLEKS RIETFONTEIN
RIETFONTEIN COMPLEX
Mro
KOMPLEKS ROODEKRAAL
ROODEKRAAL COMPLEX
Mli
KOMPLEKS LINDEQUESDRIF
LINDEQUES DRIFT COMPLEX
Mlo
Mlo
Mlo
KOMPLEKS LOSBERG
LOSBERG COMPLEX
Mp
Vdi
Vsi
PRETORIA
Magaliesberg
Silverton
Daspoort
Strubenkop
Hekpoort
Boshoek
Vm
Vsi
Vd
Vs
Vh
Vbo

LEGEND

Vd–Daspoort Formation; Pretoria Group; Transvaal Supergroup

Vh–Hekpoort Formation; Pretoria Group; Transvaal Supergroup

Vs–Strubenkop Formation Pretoria Group; Transvaal Supergroup

Vdi –Diabase

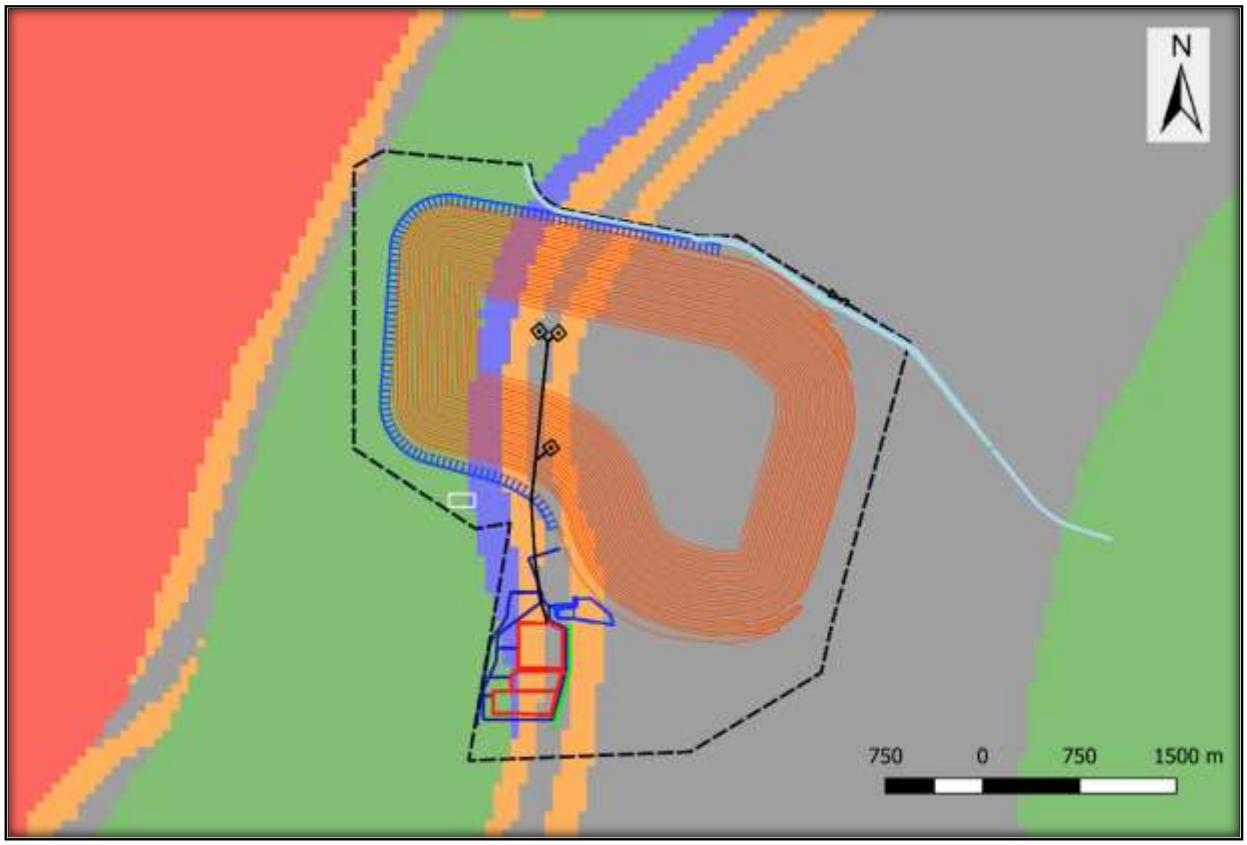


Figure 6 - Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences). Approximate location of the proposed development is indicated in red.

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) there is a moderate to low chance of finding fossils in this area.

5 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is in the western portion of the Witwatersrand Basin approximately 160 km from Johannesburg. Stilfontein on the R502 and approximately 35 km from Potchefstoom. The study area is located near Stilfontein approximately 8 km East of Klerksdorp and 15 km north-east of Orkney. The project is situated in the City of Matlosana and JB Marks Local Municipalities, in the Dr Kenneth Kaunda District Municipality within the North-West Province

6 METHODS

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

6.1 Assumptions and Limitations

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

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

7 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- The Palaeosensitivity Map from the SAHRIS website.
- 2626 DD Topographical map
- A Google Earth map with polygons of the proposed development was obtained from PGS Heritage.

8 IMPACT ASSESSMENT METHODOLOGY

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 1.

Table 1: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	*Isolated corridor / proposed corridor*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	***Local on the study area***	***Medium-term***
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	**Permanent**

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

8.1 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.

The proposed Kareerand expansion is situated on the farm Buffelsfontein 443 IP; Hartebeesfontein 422 IP; Wildebeestpan 442 IP, Kareerand 444IP; Kromdraai 420 IP and Megadam 574 IP in the City of Matlosana and Potchefstroom Local Municipalities, North West Province. The study site is underlain by the Hekpoort-; Daspoort and Strubenkop Formations of the Pretoria Group within the Transvaal Supergroup as well as the igneous intrusion, diabase. There is a possibility that stromatolite as well as microfossils are present in the Daspoort Formation (Pretoria Group, Transvaal Supergroup) while no known fossils are recorded in the other formations.

The Daspoort Formation of the development footprint is in an area where the palaeontological sensitivity is high but due to the fact that the area has already been disturbed with mining activities the sensitivity is regarded as low.

A more detailed description of the impact significance rating scale is given in Table 2.

Table 2: 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 is 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	There is no impact at all - not even a very low impact on a party or system.

8.1.1 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 Table 3.

The impact on fossil materials and thus palaeontological heritage will be limited to the construction phase when new excavations into fresh potentially fossiliferous bedrock take place. The extent of the area of potential impact is thus restricted to the project site and therefore categorised as **local**.

Table 3: 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 / corridor.
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.

8.1.2 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 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.

The temporal or duration scale is rated according to criteria set out in Table 4.

Table 4: 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.**

8.1.3 Degree of Probability

The probability or likelihood of an impact occurring, will be outlined in Table 5 below.

Stromatolite may be present within the development site. By taking a preventive approach, an insignificant loss of fossil resources is expected.

Table 5: Description of the degree of probability of an impact occurring

RATING	DESCRIPTION
1	Practically impossible
2	**Unlikely**
3	Could happen
4	Very likely
5	It's going to happen / has occurred

8.1.4 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 6. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making.

Table 6: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% su 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.

8.1.5 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:

$$\textbf{\textit{Impact Risk}} = \frac{(\text{SIGNIFICANCE} + \textit{Spatial} + \text{Temporal})}{3} \times \frac{\text{Probability}}{5}$$

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

Table 7: Example of Rating Scale

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	Low	Local	Long Term	Could Happen	**Moderate**
Impact on palaeontological deposits	2	3	5	3	**1.98**

Note: The significance(2), spatial (3) and temporal scales (5) are added to give a total of 10, which is divided by 3 to give a criterion rating of 3.3. The probability (3) is divided by 5 to give a probability rating of 0.6. The criteria rating of 3.3 is then multiplied by the probability rating (0.6) to give the final rating of 1.98.

The impact risk is classified according to five classes as described in Table 8 below.

Table 8: Impact Risk Classes

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

Therefore, with reference to the example used for heritage structures above, an impact rating of 1.2 will fall in the Impact Class 3, which will be considered to be a moderate impact.

Table 9: Final Impact Evaluation Summary

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Impact on palaeontological deposits					
No mitigation	Low	Local	Permanent	Could happen	
	2	2	5	3	**1.98**
With mitigation	Low	Local	Permanent	Could happen	
	1	2	5	2	1.06

The significance of the proposed development is Low and therefor likely to have little real effect on the development. The impact will only affect the study area although the impact will have a permanent effect on the environment. But it will be unlikely that the impact will occur as the area has been highly disturbed by pervious activities and fossil heritage in this sedimentary rock is scarce. The impact can thus be described as a moderate impact.

9 CHANCE FINDS PROTOCOL

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

9.1 Legislation

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

9.2 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.

9.3 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.

9.4 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.

10 FINDINGS AND RECOMMENDATIONS

The proposed Kareerand expansion is situated on the farm Buffelsfontein 443 IP; Hartebeesfontein 422 IP; Wildebeestpan 442 IP, Kareerand 444IP; Kromdraai 420 IP and Megadam 574 IP in the City of Matlosana and Potchefstroom Local Municipalities, North West Province. The study site is underlain by the Hekpoort-; Daspoort and Strubenkop Formations of the Pretoria Group within the Transvaal Supergroup as well as the igneous intrusion, diabase. According to the PalaeoMap of SAHRIS the Palaeontological Sensitivity of the Hekpoort Formation is moderate, Strubenkop

Formation is Low, Daspoort Formation is high, while diabase is igneous rocks and thus unfossiliferous (Almond *et al*, 2013; Groenewald et al 2014; SAHRIS website).

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Although fossils are rare in this biozone a single fossil can have a huge scientific importance as many fossil taxa are known from only one fossil.

If fossil remains are discovered during any phase of construction, on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries ought to be protected (*in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (recording and collection) can be carry out.

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

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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	National Museum, Bloemfontein

and Collection Manager	1998–currently

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1. **Butler, E. 2014.** Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.
2. **Butler, E. 2014.** Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.
3. **Butler, E. 2015.** Palaeontological impact assessment of the proposed consolidation, re-division and development of 250 serviced erven in Nieu-Bethesda, Camdeboo local municipality, Eastern Cape. Bloemfontein.
4. **Butler, E. 2015.** Palaeontological impact assessment of the proposed mixed land developments at Rooikraal 454, Vrede, Free State. Bloemfontein.
5. **Butler, E. 2015.** Palaeontological exemption report of the proposed truck stop development at Palmiet 585, Vrede, Free State. Bloemfontein.
6. **Butler, E. 2015.** Palaeontological impact assessment of the proposed Orange Grove 3500 residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape. Bloemfontein.
7. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Gonubie residential development, Buffalo City Metropolitan Municipality East London, Eastern Cape Province. Bloemfontein.
8. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Ficksburg raw water pipeline. Bloemfontein.
9. **Butler, E. 2015.** Palaeontological Heritage Impact Assessment report on the establishment of the 65 mw Majuba Solar Photovoltaic facility and associated infrastructure on portion 1, 2 and 6 of the farm Witkoppies 81 HS, Mpumalanga Province. Bloemfontein.
10. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed township establishment on the remainder of portion 6 and 7 of the farm Sunnyside 2620, Bloemfontein, Mangaung metropolitan municipality, Free State, Bloemfontein.
11. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 1 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse729, near Vryburg, North West Province. Bloemfontein.
12. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Woodhouse 2 photovoltaic solar energy facilities and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
13. **Butler, E. 2015.**Palaeontological Impact Assessment of the proposed Orkney solar energy farm and associated infrastructure on the remaining extent of Portions 7 and 21 of the farm Wolvehuis 114, near Orkney, North West Province. Bloemfontein.
14. **Butler, E. 2015.** Palaeontological Impact Assessment of the proposed Spectra foods broiler houses and abattoir on the farm Maiden Manor 170 and Ashby Manor 171, Lukhanji Municipality, Queenstown, Eastern Cape Province. Bloemfontein.

15. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed construction of the 150 MW Noupoort concentrated solar power facility and associated infrastructure on portion 1 and 4 of the farm Carolus Poort 167 and the remainder of Farm 207, near Noupoort, Northern Cape. Prepared for Savannah Environmental. Bloemfontein.
16. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 1 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
17. **Butler, E. 2016.** Palaeontological Impact Assessment of the proposed Woodhouse 2 Photovoltaic Solar Energy facility and associated infrastructure on the farm Woodhouse 729, near Vryburg, North West Province. Bloemfontein.
18. **Butler, E. 2016.** Proposed 132kV overhead power line and switchyard station for the authorised Solis Power 1 CSP project near Upington, Northern Cape. Bloemfontein.
19. **Butler, E. 2016.** Palaeontological Impact Assessment of of the proposed Senqu Pedestrian Bridges in Ward 5 of Senqu Local Municipality, Eastern Cape Province. Bloemfontein.
20. **Butler, E. 2016.** Recommendation from further Palaeontological Studies: Proposed Construction of the Modderfontein Filling Station on Erf 28 Portion 30, Founders Hill, City Of Johannesburg, Gauteng Province. Bloemfontein.
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25. **Butler, E. 2016.** Chris Hani District Municipality Cluster 9 water backlog project phases 3a and 3b: Palaeontology inspection at Tsomo WTW. Bloemfontein.
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39. **Butler, E. 2017.** Palaeontological Impact Assessment Of The Proposed Development Of The New Open Cast Mining Operations On The Remaining Portions Of 6, 7, 8 And 10 Of The Farm Kwaggafontein 8 In The Carolina Magisterial District, Mpumalanga Province. Bloemfontein.
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55. **Butler, E. 2017.** Palaeontological Desktop Assessment of the construction of the proposed Viljoenskroon Munic 132 KV line, Vierfontein substation and related projects. Bloemfontein.
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63. **Butler, E. 2017.** Palaeontological Desktop Assessment for the proposed Aroams prospecting right project, without bulk sampling, near Aggeneys, Northern Cape Province. Bloemfontein.
64. **Butler, E. 2017.** Palaeontological Impact Assessment of the proposed Belvior aggregate quarry II on portion 7 of the farm Maidenhead 169, Enoch Mgijima Municipality, division of Queenstown, Eastern Cape. Bloemfontein.
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176. Palaeontological field Assessment for the proposed Rietfontein Housing Project as part of the Rapid Land Release Programme, Gauteng Province Department of Human Settlements, City of Johannesburg Metropolitan Municipality

177. Palaeontological Desktop Assessment for the Proposed Choje Wind Farm between Grahamstown and Somerset East, Eastern Cape
178. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial, General & In Kimberlite), Combined with A Waste License Application, Registration Division: Gordonia And Kenhardt, Northern Cape Province
179. Palaeontological Impact Assessment for the Proposed Clayville Truck Yard, Ablution Blocks and Wash Bay to be Situated on Portion 55 And 56 Of Erf 1015, Clayville X11, Ekurhuleni Metropolitan Municipality, Gauteng Province
180. Palaeontological Desktop Assessment for the Proposed Hartebeesthoek Residential Development
181. Palaeontological Desktop Assessment for the Proposed Mooiplaats Educational Facility, Gauteng Province
182. Palaeontological Impact Assessment for the Proposed Monument Park Student Housing Establishment
183. Palaeontological Field Assessment for the Proposed Standerton X10 Residential and Mixed-Use Developments, Lekwa Local Municipality Standerton, Mpumalanga Province
184. Palaeontological Field Assessment for the Rezoning and Subdivision of Portion 6 Of Farm 743, East London
185. Palaeontological Field Assessment for the Proposed Matla Power Station Reverse Osmosis Plant, Mpumalanga Province

CONFERENCE CONTRIBUTIONS
NATIONAL

PRESENTATION

Butler, E., Botha-Brink, J., and F. Abdala. A new gorgonopsian from the uppermost *Dicynodon Assemblage Zone*, Karoo Basin of South Africa.18 the Biennial conference of the PSSA 2014.Wits, Johannesburg, South Africa.

INTERNATIONAL

Attended the Society of Vertebrate Palaeontology 73th Conference in Los Angeles, America. October 2012.

CONFERENCES: POSTER PRESENTATION

NATIONAL

Butler, E., and J. Botha-Brink. Cranial skeleton of *Galesaurus planiceps*, implications for biology and lifestyle. University of the Free State Seminar Day, Bloemfontein. South Africa. November 2007.

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Butler, E., and J. Botha-Brink. The biology of the South African non-mammaliaform cynodont *Galesaurus planiceps*.15th Conference of the PSSA, Howick, South Africa. August 2008.

INTERNATIONAL VISITS

Natural History Museum, London July 2008

Paleontological Institute, Russian Academy of Science, Moscow November 2014