ANGLO AFRICAN METALS ZERO WASTE RECOVERY PLANT, MPUMALANGA PROVINCE

Heritage Impact Assessment

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Declaration of Independence

I, Wouter Fourie, declare that –

General declaration:

- I act as the independent heritage practitioner 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 favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting heritage 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 favourable 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 from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence 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;

HERITAGE CONSULTANT: PGS Heritage (Pty) Ltd
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SIGNATURE: _____

ACKNOWLEDGEMENT OF RECEIPT

Report Title	*ZERO-WASTE RECOVERY PLANT, MPUMALANGA PROVINCE – HERITAGE IMPACT ASSESSMENT*		
Control	**Name**	**Signature**	**Designation**
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Reviewed	**Gideon Raath**		**Savannah Environmental (Pty) Ltd**

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SIGNATURE: _____

EXECUTIVE SUMMARY

PGS Heritage (Pty) Ltd (PGS) was appointed by Savannah Environmental (Pty) Ltd (Savannah) to undertake a Heritage Impact Assessment (HIA) which will serve to inform the Environmental Impact Assessment Process (EIA) and Environmental Management Programme (EMPr) for the proposed Zero Waste Recovery Plant is located on Highveld Industrial Park No 1230 JS, eMalahleni LM within the Nkangala District Municipality (DM) in Mpumalanga.

This HIA has shown that the proposed Zero Waste Recovery Plant will have a projected minimal impact on heritage resources within the project area due to the extensive disturbance of the footprint by industrial activity.

The SAHRIS palaeontological sensitivity map rates the study as underlain by geological strata with a Very High palaeontological significance. However, the palaeontological desktop assessment has considered the potential impact and due to the disturbed nature of the site has concluded that no further fieldwork will be required but that a chance finds protocol must be implemented as provided in the palaeontological desktop assessment (Butler, 2021).

It is the author's considered opinion that the overall impact on heritage resources will be Low. Provided that the recommended mitigation measures are implemented, the impact would be acceptably Low or could be totally mitigated to the degree that the project could be approved from a heritage perspective.

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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 artefacts, human and hominid remains and artificial features and structures;
- rock art, being 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; and
- features, structures and artefacts associated with 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 influence 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 3 300 000 years ago.

Fossil

Mineralised 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 Iron Age

The archaeology of the period between 900-1300AD, associated with the development of the Zimbabwe culture, defined by class distinction and sacred leadership.

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.

Table 1 – List of abbreviations used in this report

Abbreviations	Description
AIA	Archaeological Impact Assessment
APHP	Association of Professional Heritage Practitioners
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEFF	Department of Environment, Forestry and Fisheries
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EIAs practitioner	Environmental Impact Assessment Practitioner
ESA	Earlier Stone Age
GN	Government Notice
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LIA	Late Iron Age
LSA	Late Stone Age
MIA	Middle Iron Age
MSA	Middle Stone Age
NEMA	National Environmental Management Act, 1998 (Act No 107 of 1998)
NHRA	National Heritage Resources Act, 1999 (Act No 25 of 1999)
NCW	Not Conservation Worthy
PGS	PGS Heritage (Pty) Ltd
PHRA	Provincial Heritage Resources Authority
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

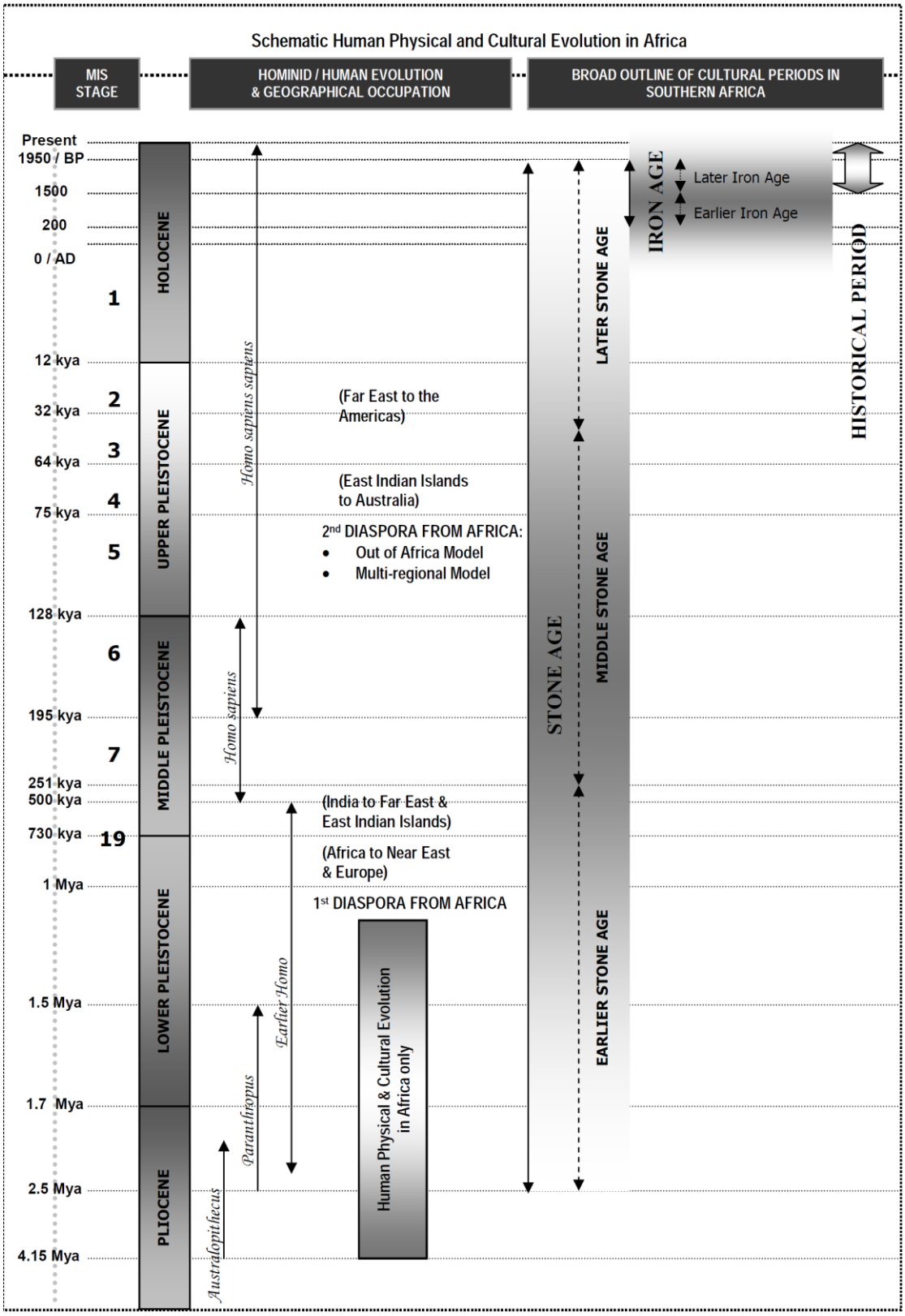


Figure 1 – Human and Cultural Timeline in Africa

1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by Savannah Environmental (Pty) Ltd (Savannah) to undertake a Heritage Impact Assessment (HIA) which will serve to inform the Environmental Impact Assessment Process (EIA) and Environmental Management Programme (EMPr) for the proposed Zero Waste Recovery Plant is located on Highveld Industrial Park No 1230 JS, eMalahleni Local Municipality within the Nkangala District Municipality (DM) in Mpumalanga.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites and finds that may occur in the proposed development area. The HIA aims to inform the EIA in the development of a comprehensive EMPr to assist the project applicant in responsibly managing the identified heritage resources in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA was compiled by PGS.

The staff at PGS have a combined experience of nearly 90 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, the author and Project Coordinator, is registered with the ASAPA as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the research undertaken, it is necessary to realise that the heritage resources located during the desktop research and fieldwork do not necessarily represent all the possible heritage resources present within the area.

Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified
- National Environmental Management Act (NEMA), Act 107 of 1998 – Appendix 6
- National Heritage Resources Act (NHRA), Act 25 of 1999

1.4.1 Notice 648 of the Government Gazette 45421

Although minimum standards for archaeological (2007) and palaeontological (2012) assessments were published by SAHRA, GN.648 requires sensitivity verification for a site selected on the national web based environmental screening tool for which no specific assessment protocol related to any theme has been identified. The requirements for this Government Notice (GN) are listed in **Table 2** and the applicable section in this report noted.

Table 2 - Reporting requirements for GN648

GN 648	**Relevant section in report**	**Where not applicable in this report**
2.2 (a) a desktop analysis, using satellite imagery;	Section 4.3	
2.2 (b) a preliminary on-site inspection to identify if there are any discrepancies with the current use of land and environmental status quo versus the environmental sensitivity as identified on the national web-based environmental screening tool, such as new developments, infrastructure, indigenous/pristine vegetation, etc.	Section 4.3	-
2.3(a) confirms or disputes the current use of the land and environmental sensitivity as identified by the national web-based environmental screening tool;	Section 4.3	-
2.3(b) contains motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity;	Section 4.34.3	-

1.4.2 NEMA – Appendix 6 requirements

The HIA report has been compiled considering the NEMA Appendix 6 requirements for specialist reports as indicated in the table below. The HIA report will be in compliance of Appendix 6 and include a table guide for ease of reference.

Table 3 - Reporting requirements as per NEMA Appendix 6 for specialist reports

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
1.(1) (a) (i) Details of the specialist who prepared the report	Page 2 of Report – Contact details and company	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1.2 – refer to **Appendix B**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 2.1	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 3	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 6	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3	-
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 5	
(g) An identification of any areas to be avoided, including buffers	Section 4.6	
(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;	**Error! Reference s ource not found.**	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 6	
(k) Any mitigation measures for inclusion in the EMPr	Section 7	
(l) Any conditions for inclusion in the environmental authorisation		None required
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 7	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 8	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 8	-
(o) A description of any consultation process that was undertaken during the course of carrying out the study		Not applicable. A public consultation process was handled as part of the EIA and EMP process.
(p) A summary and copies if any comments that were received during any consultation process		Not applicable. To date no comments regarding heritage resources that require input from a specialist

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
		have been raised.
(g) Any other information requested by the competent authority.		Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	NEMA Appendix 6 and GN648	

1.4.3 The National Heritage Resources Act

- National Heritage Resources Act (NHRA) Act 25 of 1999
  - Protection of Heritage Resources – Sections 34 to 36; and
  - Heritage Resources Management – Section 38

The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of NHRA. This study falls under S38(8) and requires comment from the relevant heritage resources authority.

2 SITE LOCATION AND DESCRIPTION

2.1 Locality and Site Description (provided by GAE)

The waste recovery plant is located on Highveld Industrial Park No 1230 JS (the 'site'), and comprises an area of approximately 4,10ha footprint within the property, located in the eMalahleni LM within the Nkangala DM in Mpumalanga, approximately 17km west of eMalahleni town. The site may be reached directly off the R104, from the N4 turnoff near Kwa-Guqa informal settlement (**Figure 2** and **Figure 3**).

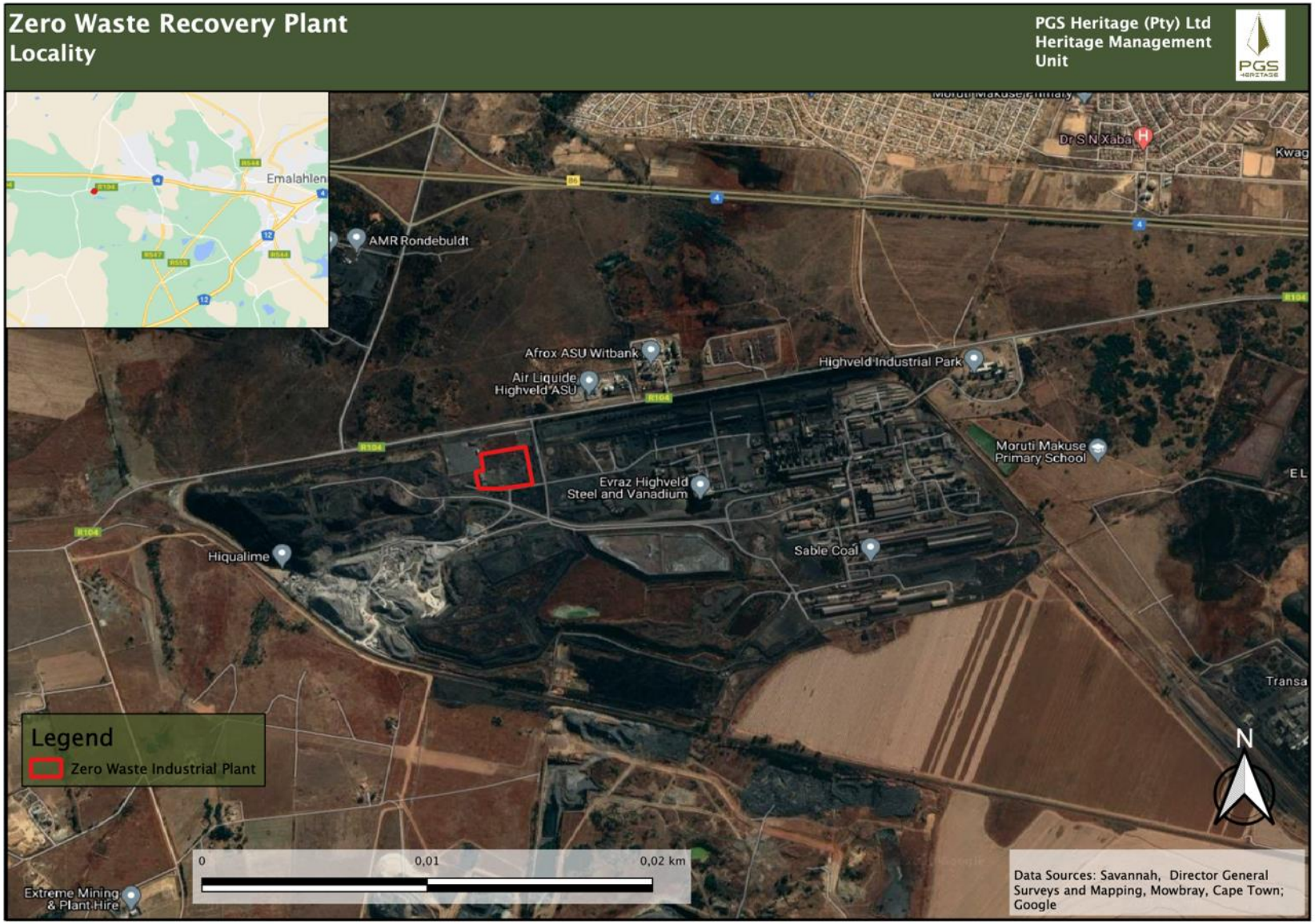


Figure 2 – Regional locality of the study area

Figure 3 – Locality of the study area

2.2 Project description (provided by Savannah)

Anglo African Metals (Pty) Ltd (the South African registered company of Fodere Titanium) has identified a suitable tailings/slag resource at Highveld Steel in Mpumalanga between Balmoral and Emalahleni. A site for a small-scale industrial plant has been defined within the Highveld Steel property. It is understood that the following is relevant to the proposed facility:

- The plant would be developed to process 2000 tonnes of tailings/slag per month, approximately 3 tons per day. This plant would be developed within the Highveld industrial plant owned property. The purpose of this plant would be to confirm the process inputs and outputs and refine the extraction processes as necessary.
- The plant would be primarily fuelled by LPG and Sasol gas brought into site by dedicated transport truck deliveries.
- As the sites are located within the highveld Steel property, it is assumed that the studies to be undertaken for the EIA process would be informed by existing information available for this site. Project-specific specialist studies required to be undertaken relate to air quality, socio-economic impacts and heritage impacts.

The plan will comprise the following infrastructure, all wholly contained within Highveld Industrial Park No 1230 JS (**Figure 4**):

- Acid plant area, where process chemicals are produced, stored and handled as required by the waste recovery process;
- Substation and plant utility unit as interface and controlling unit for the electricity utilised by the plant during operation;
- Slag stockpile
- Crushing plant;
- Mill;
- Product area for storage of the various products produced through the recovery process;
- Reagent area, for the storage and handling of reactants utilised in the waste recovery process;
- A security area
- Parking lot;
- Admin and control room including offices and ablutions for staff.

Operation of the plan is anticipated for 24 hours per day, 365 per year (i.e. non-stop operation) and will utilise the slag produced by the highveld steel operations. The process offers solutions for simultaneously extracting both vanadium and titanium oxide from slag materials. The technology developed by the Anglo African Metals is also demonstrated to extract aluminium as aluminium oxide (Al_2O_3), magnesium as magnesium oxide (MgO) and calcium as calcium sulphate/gypsum ($CaSO_4$), and involves the following approximate process (please note, due to intellectual property and commercial sensitivity of this process, various technical details are omitted):

- Crushing and milling of titanium dioxide (TiO_2) slag to the appropriate size for further treatment;

- Magnetic separation of entrained metallic iron from the crushed slag, which is used in a separate ferroalloy production processes;
- Alkali roasting of the remaining feedstock using a gas fired kiln. Off-gases from the kiln is a combination of carbon monoxide (CO) and sulphur dioxide (SO_2). By comparison, sulphur dioxide (SO_2) is only 3-5% of the carbon monoxide gas. These off gases are passed through the off-gas scrubber to remove SO_2 and the remaining CO_2 is reused in the kiln to supply part of the required heat.
- The material produced during alkali roasting from the kiln is then leached in water to dissolve vanadium and alumina.
- A further process produces vanadium pentoxide and recovers aluminium oxide from the leached products in the steps above.
- The remaining solid or residue after extracting vanadium is treated via leaching and roasting with sulphuric acid. The SO_2 gases or fumes given out during leaching or roasting are scrubbed off.
- Iron, magnesium and TiO2 are recovered from solution via precipitation steps.
- Precipitated TiO2 is heated in order to remove water of hydration.
- The leach solution is neutralised with lime form calcium sulphate and respective sulphates. The mixture of sulphates is heated in the furnace to produce sulphuric acid which is then used in the leaching step. The solid material after heating in the furnace is mainly calcium silicate which is used for cement production and construction.
- The remaining material after leaching of titanium, magnesium, aluminium oxide etc is mainly silica sand which is also used for construction.

This process therefore recovers vanadium and titanium oxide from slag materials, with water, carbon dioxide, gypsum and synthetic rutile produced at the various stages. These materials are all useful in other processes and are collected and sold to third parties with uses therefore, and thus the process itself results in no further waste production, while simultaneously utilising a common waste type – slag.

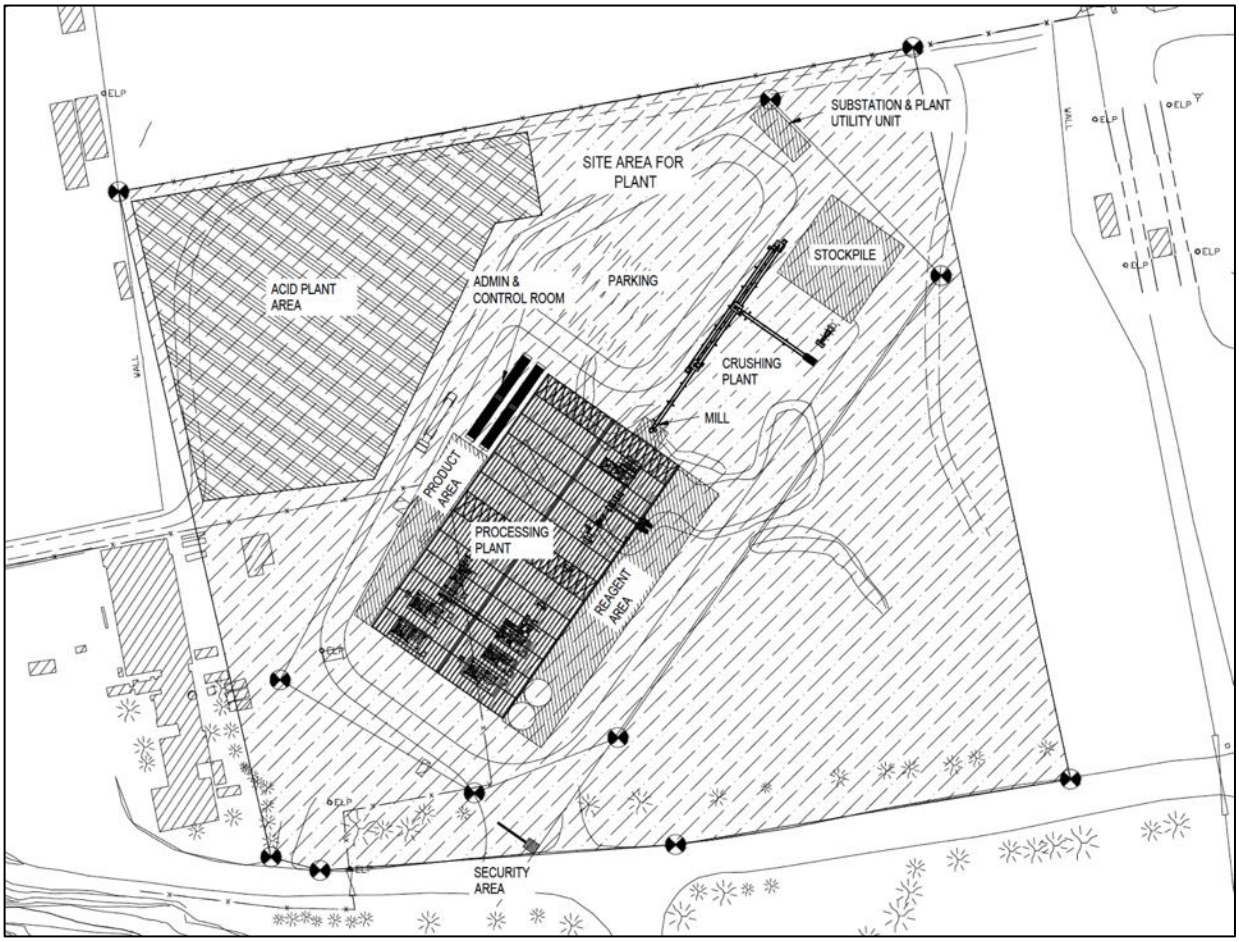


Figure 4 – Proposed layout of the plant

3 METHODOLOGY & PLAN OF STUDY FOR EIA

The methodology to be utilised for the whole HIA study will be as follows

The applicable maps, tables and figures, will be included as stipulated in the NHRA (no 25 of 1999), the NEMA (no 107 of 1998). The HIA process consists of three steps:

- Step I – Literature Review and sensitivity analysis[1]: The background information to the field survey relies greatly on previous studies completed for the project to determine known sensitivities, as well as the heritage background research completed for this report.
- Step II – Physical Survey: A physical survey will be conducted of proposed project area by a qualified heritage specialist. The survey is aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.
- Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

[1] *According to Notice 648 of the Government Gazette 45421*

3.1 Site Significance

Site significance classification standards use is based on the heritage classification of Section 3 in the NHRA and developed for implementation keeping in mind the grading system approved by SAHRA for archaeological impact assessments (2012). The updated classification and rating system as developed by Heritage Western Cape (HWC) (2016) is implemented in this report. Although the SAHRA guidelines for Archaeological and Palaeontological Impact Assessments (2012) provide a grading system the system as published by HWC Is seen as more comprehensive (**Table 4** and
Table 5).

Table 4 - Rating system for archaeological resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current examples: Langebaanweg (West Coast Fossil Park), Cradle of Humankind	May be declared as a National Heritage Site managed by SAHRA. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Highest Significance
II	Heritage resources with special qualities which make them significant, but do not fulfil the criteria for Grade I status. Current examples: Blombos, Paternoster Midden.	May be declared as a Provincial Heritage Site managed by HWC. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Exceptionally High Significance
III	Heritage resources that contribute to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare. Current examples: Varschedrift; Peers Cave; Brobartia Road Midden at Bettys Bay	Resource must be retained. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree.	Resource must be retained where possible where not possible it must be fully investigated and/or mitigated.	Medium Significance
IIIC	Such a resource is of contributing significance.	Resource must be satisfactorily studied before impact. If the recording already done (such as in an HIA or permit application) is not sufficient, further recording or even mitigation may be required.	Low Significance
NCW	A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.	No further actions under the NHRA are required. This must be motivated by the applicant or the consultant and approved by the authority.	No research potential or other cultural significance

Table 5 - Rating system for built environment resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current examples: Robben Island	May be declared as a National Heritage Site managed by SAHRA.	Highest Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
II	Heritage resources with special qualities which make them significant in the context of a province or region, but do not fulfil the criteria for Grade I status. Current examples: St George's Cathedral, Community House	May be declared as a Provincial Heritage Site managed by HWC.	Exceptionally High Significance
II	Such a resource contributes to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare. These are heritage resources which are significant in the context of an area.	This grading is applied to buildings and sites that have sufficient intrinsic significance to be regarded as local heritage resources; and are significant enough to warrant that any alteration, both internal and external, is regulated. Such buildings and sites may be representative, being excellent examples of their kind, or may be rare. In either case, they should receive maximum protection at local level.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree. These are heritage resources which are significant in the context of a townscape, neighbourhood, settlement or community.	Like Grade IIIA buildings and sites, such buildings and sites may be representative, being excellent examples of their kind, or may be rare, but less so than Grade IIIA examples. They would receive less stringent protection than Grade IIIA buildings and sites at local level.	Medium Significance
IIIC	Such a resource is of contributing significance to the environs. These are heritage resources which are significant in the context of a streetscape or direct neighbourhood.	This grading is applied to buildings and/or sites whose significance is contextual, i.e. in large part due to its contribution to the character or significance of the environs. These buildings and sites should, as a consequence, only be regulated if the significance of the environs is sufficient to warrant protective measures, regardless of whether the site falls within a Conservation or Heritage Area. Internal alterations should not necessarily be regulated.	Low Significance
NCW	A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.	No further actions under the NHRA are required. This must be motivated by the applicant and approved by the authority. Section 34 can even be lifted by HWC for structures in this category if they are older than 60 years.	No research potential or other cultural significance

4 CURRENT STATUS QUO

4.1 Site Description

The proposed plant falls within the boundaries of the existing Highveld Steel industrial site and is completely transformed due to the industrial activities within the site. The site is presently characterised by large volumes of slag waste dumped from the surrounding industrial activity since ~1975.

Along the boundary of the area there is some vegetation which includes small trees and bushes, and some areas are covered in long grasses (**Figure 5** and **Figure 6**). Overall, the area is totally disturbed with the bulk of the site covered in iron slag and waste associated with the larger steel works (**Figure 7** and **Figure 8**).

Figure 5 – General view of study area

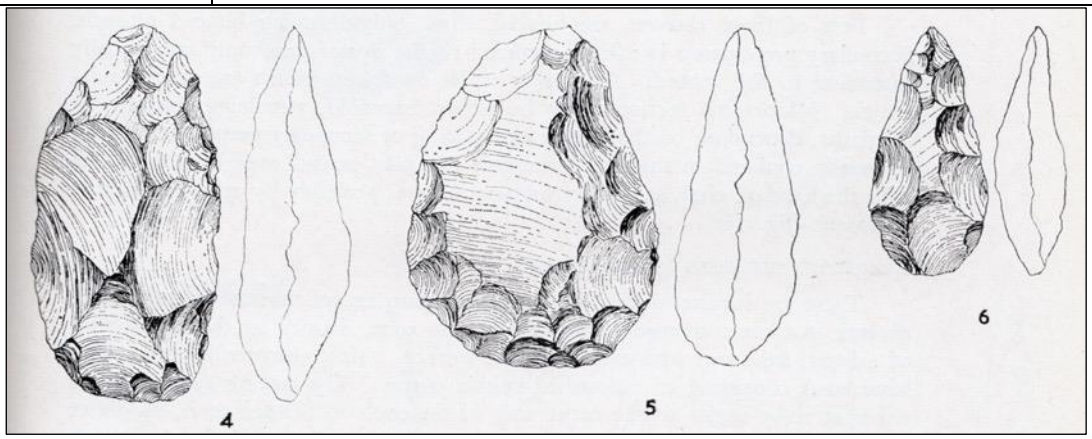
Figure 6 – Disturbed area

Figure 7 – Waste material on site

Figure 8 – Waste material

4.2 Archaeological Background to the Study Area and Surroundings

DATE	DESCRIPTION
The South African Stone Age is the longest archaeologically identified phase identified in human history and lasted for millions of years. Very little is known about the Stone Age archaeology of the study area and its immediate surroundings.	

2.5 million to 250 000 years ago	The Earlier Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these technological phases is known as Oldowan which is associated with crude flakes and hammerstones and dates to approximately 2 million years ago. The second technological phase in the Earlier Stone Age of Southern Africa is known as the Acheulian and comprises more refined and better-made stone artefacts such as the cleaver and bifacial handaxe. The Acheulian phase dates back to approximately 1.5 million years ago. No information with regard to Early Stone Age sites from the surrounding area could be found. However, it seems possible for such sites to exist here.
 *Figure 9 – Example of Early Stone Age Later Acheulian handaxes. These handaxes were identified at Blaaubank near Rooiberg. Cropped section of an illustration published in Mason (1962:199).*	
250 000 to 40 000 years ago	The Middle Stone Age (MSA) dates to between 250 000 to 40 000 years BP. MSA dates of around 250 000 BP originate from sites such as Leopards Kopje in Zambia, while the late Pleistocene (125 000 BP) yields a number of important dated sites associated with modern humans (Deacon & Deacon, 1999). The MSA is characterised by flake and blade industries, the first use of grindstones, wood and bone artefacts, personal ornaments, use of red ochre, circular hearths and hunting and gathering lifestyle. Two low-density surface scatters of Middle Stone Age lithics are located 6.1km south-east of the closest point along the boundaries of the present study area alternatives. These surface scatters (TAV 3 & TAV 5) were identified on the western bank of the Steenkoolspruit during a heritage impact assessment undertaken in 2001 by a team which also included the author of this report (CRM Africa & Matakoma, 2001). During the present study a low density scatter of MSA lithics was identified in the southwestern section of the project area (refer site GRS 32). The flakes were found in a disturbed field between the R555 an a railway track.
40 000 years ago to the historic past	The Later Stone Age (LSA) is the third phase identified in South Africa's Stone Age history. This phase in human history is associated with an abundance of very small stone artefacts or microliths. A large number of Later Stone Age materials are found around the general vicinity of the study area. Unfortunately, these are mostly in the form of surface material which has been eroded out of dongas and riverbeds. As a result, the primary context of these sites and associated material is often in doubt (Van Schalkwyk, 2001). A natural sandstone shelter containing some Later Stone Age lithics is located 6km south-east of the closest point along the boundaries of the present study area alternatives. This sandstone shelter (TAV 6) was identified during a heritage impact assessment undertaken in 2001 by a team which also included the author of this report (CRM Africa & Matakoma, 2001).
The arrival of early farming communities during the first Millenium heralded in the start of the Iron Age for South Africa. The Iron Age is that period in South Africa's archaeological history associated with pre-colonial farming communities who practised cultivation and pastoralist farming activities,	

metalworking, cultural customs such as lobola and whose settlement layouts show the tangible representation of the significance of cattle (known as the Central Cattle Pattern) (Huffman, 2007).	
AD 1700 – AD 1840	The Buispoort facies of the Moloko branch of the Urewe Tradition is the first association of the study area's surroundings with the Iron Age. It is most likely dated to between AD 1700 and AD 1840. The key features on the decorated ceramics of this facies include rim notching, broadly incised chevrons and white bands, all with red ochre (Huffman, 2007). Buispoort can be associated with the Western Sotho-Tswana, including the Hurutshe and Kwena, and the settlement layouts of Buispoort sites are known as Molokane-type walling (Huffman, 2007). According to the map published by Huffman (2007:203), the present study area is located on the far eastern edge of the known distribution of Buispoort facies sites and settlements.
AD 1821 – AD 1823	After leaving present-day KwaZulu-Natal the Khumalo Ndebele (more commonly known as the Matabele) of Mzilikazi migrated through the general vicinity of the study area under discussion before reaching the central reaches of the Vaal River in the vicinity of Heidelberg in 1823 (www.mk.org.za). Two different settlement types have been associated with the Khumalo Ndebele. The first of these is known as Type B walling and was found at Nqabeni in the Babanango area of KwaZulu-Natal. These walls stood in the open without any military or defensive considerations and comprised an inner circle of linked cattle enclosures (Huffman, 2007). The second settlement type associated with the Khumalo Ndebele is known as Doornspruit, and comprises a layout which from the air has the appearance of a 'beaded necklace'. This layout comprises long scalloped walls (which mark the back of the residential area) which closely surround a complex core which in turn comprises a number of stone circles. The structures from the centre of the settlement can be interpreted as kitchen areas and enclosures for keeping small stock. It is important to note that the Doornspruit settlement type is associated with the later settlements of the Khumalo Ndebele in areas such as the Magaliesberg Mountains and Marico and represent a settlement under the influence of the Sotho with whom the Khumalo Ndebele intermarried. The Type B settlement is associated with the early Khumalo Ndebele settlements and conforms more to the typical Zulu form of settlement. As the Khumalo Ndebele passed through the general vicinity of the study areas shortly after leaving Kwazulu-Natal, one can assume that their settlements here would have conformed more to the Type B than the Doornspruit type of settlement. It must be stressed however that no published information could be found which indicates the presence of Type B sites in the general vicinity of the study area.

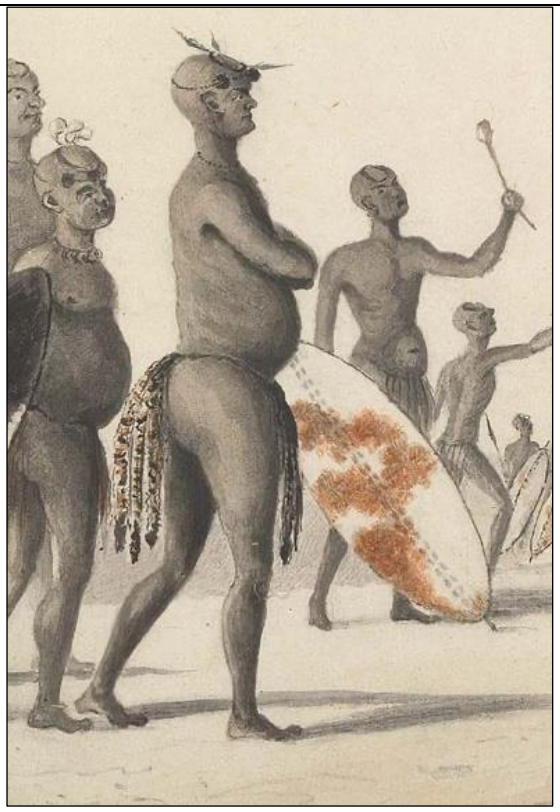
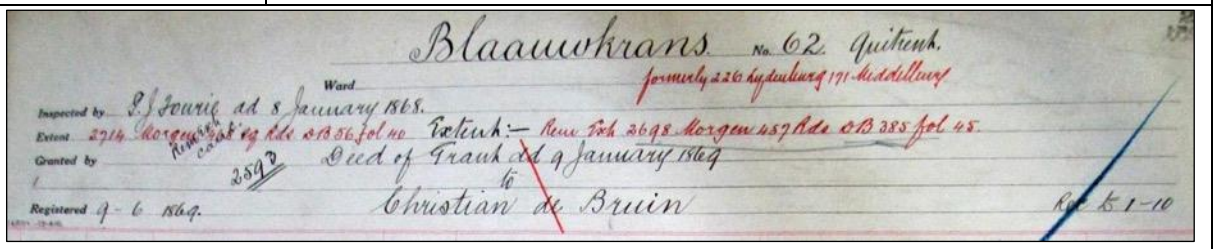
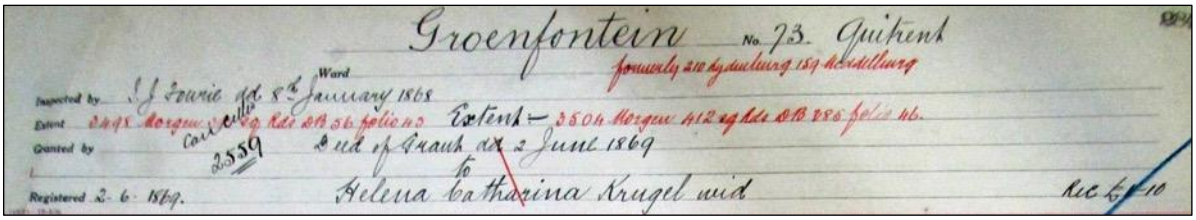


Figure 10 - King Mzilikazi of the Matabele. This depiction was made by Captain Cornwallis Harris in c. 1838 (www.sahistory.org.za).

The early Historical Period within the study area and surroundings were characterised by the arrival of newcomers to this area. The first arrivals would almost certainly have been travellers, traders, missionaries, hunters and fortune seekers. However, with time, this initial trickle was replaced by a flood of white immigrants during the 1830s, when mass migration of roughly 2 540 Afrikaner families (comprising approximately 12 000 individuals) from the frontier zone of the Cape Colony to the interior of Southern Africa took place. The people who took part in this Great Trek were later to be known as Voortrekkers (Visagie, 2011).

1836	The first Voortrekker parties crossed over the Vaal River (Bergh, 1999).
1845	Both the district and town of Lydenburg was established in this year (Bergh, 1999). The study area fell within the Lydenburg district at the time.
The 1850s - 1860s	In general terms, this period saw the early establishment of farms by white farmers in the general vicinity of the study area. The archival research undertaken for this study has shown that most of the farms from within the study area were formally inspected by one P.J. Fourie, as representative of the government of the Zuid-Afrikaansche Republiek, during the late 1960s. It seems likely for P.J. Fourie to have been the local *veldkornet* or commandant. The archival record shows that the farms Blaauwkrans and Groenfontein were both inspected on 8 January 1868, the farm Klippan on 19 February 1868 and the farm Klipfontein on 8 June 1869 (National Archives, RAK, 3082). Interestingly, the farm Klippoort was inspected some time before the other farms, namely on 19 July 1862 by one C.A. van Niekerk (National Archives, RAK, 3081). While these inspection dates provide an indication as to when these farms were officially proclaimed and registered with the government of the day, these dates do not necessarily mean that none of these farms was already settled and farmed before these dates. The permanent settlement of white farmers in the general vicinity of the study area would have resulted in the proclamation of individual farms and the establishment of permanent farmsteads. Features that can typically be

	associated with the early farming history of the area include farm dwellings, sheds, rectangular stone kraals and cemeteries. The other sites often associated with these early farms are graves and cemeteries for farmers and farm workers, and their respective families. These sites are often all that remains of the farmsteads of the mid to late nineteenth century. This may be due to their age as well as the destruction of farmsteads by the British forces during the South African War in accordance with the so-called 'scorched earth' policy.
  *Figure 11 – These two images provide sections of the actual farm ownership records for the farms Blaauwkrans and Groenfontein held in the National Archives (RAK, 3082). These sections of the farm ownership records indicate that Christian de Bruin and the widow Helena Catharina Krugel became the first registered owners of these two farms on 9 January and 2 June 1869 respectively.*	
1872	The study area now fell within the district of Middelburg (Bergh, 1999). During the same year, the general surroundings of the study area were visited by a geologist from Eastern Europe, Woolf Harris. During his visit, Harris identified coal in the Van Dyksdrift area. He is also believed to have started the Maggie's Mine the following year (Falconer, 1990).
1872 – 1894	During this time a number of small coal mining operations were started in the general vicinity of the study area. With no railway line connecting this area with the coal markets further to the west, these early coal mines proved a difficult commercial undertaking. Four coal mines were in existence in the Witbank area by 1889, namely Brugspruit Adit, Maggie's Mine, Steenkoolspruit and Douglas (Falconer, 1990). Although not certain, it would appear that the Brugspruit Adit was the closest of these four mines to the present study area.

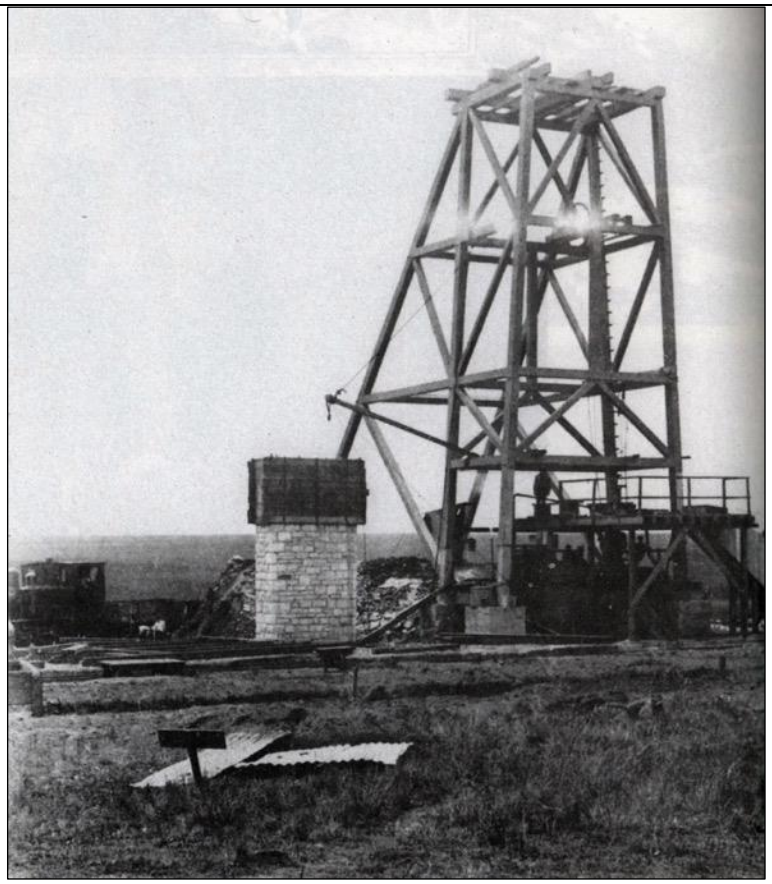


Figure 12 - Historic photograph of the coal mine at Brugspruit (Lang, 1995).

20 October 1894 – 2 November 1894	On this day the railway line between Pretoria and Delagoa Bay (present-day Maputo) was completed, with the last work on the line taking place near Balmoral, some 19 km north-west of the study area. However, the symbolic completion of the line's construction took place at Brugspruit Station, where the last rail screw was fastened by President Paul Kruger on 2 November 1894 (De Jong, 1996). Brugspruit (later Clewer) Station was located 3.3km north-west of the present study area. The completion of the NZASM Eastern Line, as it was known, was very significant for the study area and surroundings. This is due to the fact that the vast deposits of coal known to have existed in this area since the mid 19th century, could now be commercially mined (Bulpin, 1989) and easily transported to the Witwatersrand gold mines and the populated centres of Pretoria and Johannesburg where it was most required. As a result, the completion of the Eastern Line created a massive stimulus not only for the mining of coal but also for the establishment of coal mines. As will be seen below, a number of coal mines were established in the years following on the completion of the Eastern Line.
1895	According to Schalekamp (2006), the Landau Colliery was established in 1895 by the Cassel Coal Company on the farm Klipfontein to supply coal to the gold mines along the Witwatersrand. If this date is correct, it would mean that the Landau Colliery was the earliest coal mine to be established in close proximity to the present study area and in all likelihood also one of the first such collieries to be established in proximity to present-day Emalahleni. However, other sources such as the South African Mining Yearbook of 1911 indicate that the Cassel Coal Company was registered in August 1895 as a reconstruct of the Cassel Colliery Company Limited. According to this source, the property of the Cassel Coal Company at the time of its registration was restricted to sections of a farm near Springs. In November 1898 the Cassel

	Coal Company resolved to acquire the property and assets of Landau's Transvaal Colliery comprising 26 860 acres on the farms Klipfontein, Klippan, Kleinkopje, Wolvekrans and Blaauwkrans. This means that the Cassel Coal Company became involved in properties located within and surrounding the present study area in November 1898.
1896	A coal mine shaft was sunk on the farm Witbank in this year by Samuel Stanfield (Erasmus, 2004). In September 1896, Witbank Colliery Limited was established (South African Mining Yearbook, 1941/1942).
9 April 1897	The Anglo-French (Transvaal) Navigation Coal Estates Limited was registered on 9 April 1897. This company was established to purchase the undertaking of the Anglo-French Collieries Syndicate Limited. Possibly at the time of its establishment and certainly before 1911, the company acquired the coal leasehold rights to the farm Blaauwkrans (South African Mining Yearbook, 1911). A section of the present study area is located on the farm Blaauwkrans.
The South African War (also known as the Anglo Boer War) between Great Britain and her allies and the Boer Republics of the Transvaal (known as the *Zuid-Afrikaansche Republiek*) and Free State took place between October 1899 and May 1902. No battles or skirmishes associated with this war are known from within the study area or its direct surroundings, although a number are known from the surrounding landscape. The primary battles from the surrounding landscape include the Battle of Rhenosterkop of 29 November 1900 (43km north-west of the study area), the Battle of Wilmansrust of 12 June 1901 (27.9 km south-east of the study area) and the Battle of Bakenlaagte of 30 October 1901 (located 31.3km to the south) (Van der Westhuizen & Van der Westhuizen, 2000). During the war, the railway line between Pretoria and Delagoa Bay (present-day Maputo) was of immense strategic significance for both sides. As a result, and especially during the guerrilla phase of the war, the Boer forces spent considerable energy in blowing up and derailing trains and also damaging and destroying bridges and culverts. These Boer activities were aimed at suppressing the rapid movement of British troops, ammunition and supplies by rail. In response, the British Army built a series of fortifications and blockhouses along the railway line and also made use of armoured trains.	
13 December 1899 – 21 December 1899	On 13 December 1899 the future Prime Minister of Great Britain, Winston Churchill, escaped from a Prisoner of War Camp in Pretoria. He escaped from the Boer capital in an open coal truck (some sources indicate that Churchill walked) and travelled by rail to Clewer Siding, some 3.2km north-west of the present study area. Near Clewer Siding, Churchill jumped off the train and headed for lights he could see in the distance. These lights turned out to be the Transvaal and Delagoa Bay Colliery, where Churchill knocked on the first house he found. He was fortunate to have knocked on the door of the English mine manager, John Howard, who as a pro-Briton decided to assist Winston Churchill. With the assistance of a small number of pro-British mine employees, Howard hid Churchill for a couple of days in one of the colliery's mineshafts and subsequently for a few more days behind packing cases at the mine office. Early on the morning of 19 December 1899 Winston Churchill was taken to the colliery siding by John Howard and hidden in one of the train wagons carrying a cargo of wool. He safely reached Lourenco Marques (present-day Maputo) on 21 December 1899. After the war, Winston Churchill sent engraved gold watches to everyone at the Transvaal and Delagoa Bay Colliery who assisted in his escape (Sandys, 1999) (Van der Westhuizen & Van der Westhuizen, 2000). The Transvaal and Delagoa Bay Colliery where Winston Churchill was hidden appears to have been located near the boundary between the farms Schoongezicht and Driefontein, some 8 km north of the present study area.

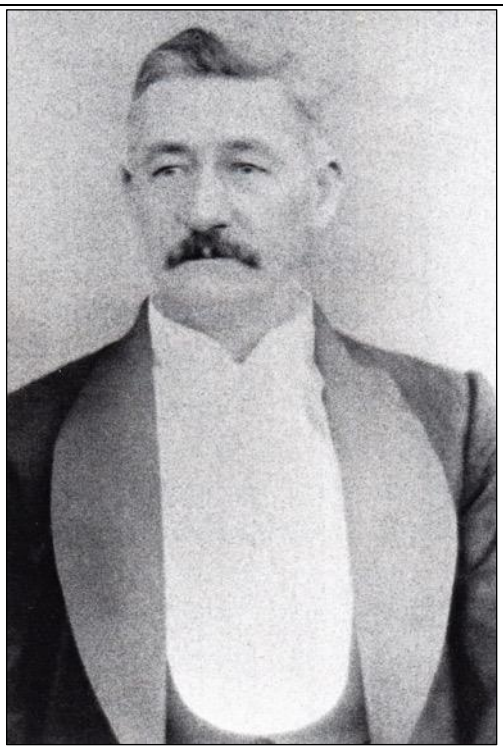


Figure 13 – John Howard, the mine manager of the Transvaal and Delagoa Bay Colliery, who was a key figure in Winston Churchill's escape from the Transvaal Republic (Sandys, 1999).

Figure 14 – Sir Winston Leonard Spencer Churchill as Prime Minister of the United Kingdom during the Second World War (www.wikipedia.org).

7 October 1900	On this day a railway culvert near Brugspruit was destroyed by Boer forces (Aitken, 2000). The blowing up and derailment of trains, as well as the acts of sabotage against the Eastern Line by Boer forces, formed part of their tactics during the guerrilla war to try and suppress the rapid movement of British troops, ammunition and supplies by rail.
Late 1900	One of the closest known skirmishes to the present study area appears to be mentioned in the published war memoir of General Ben Viljoen (1902), which states that a skirmish between his commando and the British forces took place near Witbank Station. This skirmish appears to have taken place during the latter part of 1900. As mentioned elsewhere, the Witbank railway station is located approximately 5.3 km north of the present study area.
17 January 1901	A British train was derailed near Brugspruit Station on the morning of 17 January 1901. This was the work of the infamous Irish-born train-wrecker of the Boer forces, namely Captain Jack Hindon (Aitken, 2000). As mentioned elsewhere, Brugspruit Station was located 3.3km north-west of the present study area.
11 April 1901	On 11 April 1901, a British train was blown up by Boer forces near Witbank (Meijer, 2000).
The general surroundings of the study area underwent significant changes and development during the twentieth century, including extensive development in the form of coal mining, railway and transportation development as well as the establishment of nearby towns such as Witbank (present-day Emalahleni), Ogies and Kriel.	
1903	The town of Witbank was formally proclaimed (Erasmus, 2004).

Figure 15 – Historic photograph of Witbank taken in 1936 (Delius, 2007:340).

1905	While no details are available, it would appear that the Cassel Coal Company's Landau Colliery started producing coal in 1905. The coal output for this year was 181,071 tons (The Mining Yearbook, 1911). The mine continued to operate during the subsequent years.
1906	The town of Witbank received its first Health Board (Bulpin, 1989).
December 1906	The new railway line from near Johannesburg all the way to Witbank (present-day Emalahleni) was officially opened on 26 December 1906 (www.wikipedia.org). The opening of this line meant that a direct route between the coal mines from the surroundings of Witbank and the markets in the Witwatersrand now became available. The importance of this new railway line for the coal mines from within the study area and its surroundings can *inter alia* be seen in the fact that during its early development, the Anglo-French (Transvaal) Navigation Colliery built a railway siding which connected it with this new railway link between Witbank and Johannesburg (The Mining Yearbook, 1911). The nearest railway station along this new railway line to the present study area was Blackhill Station, located 1.5km south-west of the present study area. The railway line originally built in 1906 also passes through a small section of the present study area, however, many changes and development would have taken place to this line over the course of the last 113 years. It is interesting to note that in many books and documents referring to the Navigation and Landau Collieries, Blackhill Station is indicated to be the nearest railway station.
December 1906	In December 1906 the Anglo-French (Transvaal) Navigation Colliery produced its first coal output. This followed on the striking of four coal seams during shaft sinking activities (South African Mining Yearbook, 1911). This mine also continued to operate during the subsequent years.
1914	The town of Witbank became a municipality in this year (Bulpin, 1989).
13 April 1921	On 13 April 1921 the South African Coal Estates (Witbank) Limited was established to acquire the assets of the Cassel Coal and Anglo-French companies (South African Mining Yearbook, 1941/2). These companies were amalgamated into this newly established company, and as a result of both the

	Landau and Navigation Collieries now formed part of the South African Coal Estates (Witbank) Limited.
1923 - 1926	Based on the information that is presently available, it would appear that the village of Clewer was established during this period by the South African Coal Estates (Witbank) Limited. The company owned Clewer for some time after its establishment. In a number of inscriptions in these mining yearbooks, Clewer is referred to as '*the garden township'.* See for example the South African Mining Yearbook that was published in 1941/2.
1928	The town of Ogies was established (Erasmus, 2004). Ogies is located 20 km south-west of the present study area.

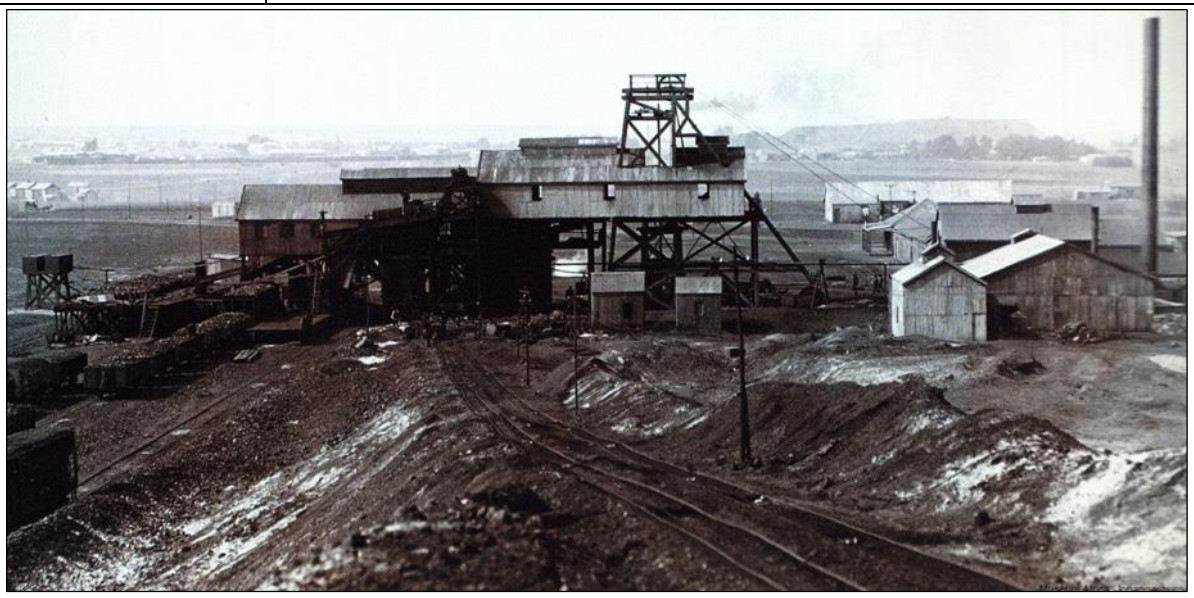


Figure 16 – Historic photograph was taken during the late 1940s of an unknown colliery near Witbank (Delius, 2007:159).

4.3 Heritage Screening

4.3.1 Previous Heritage Impact Assessment Reports from the Study Area and Surroundings

An assessment of the South African Heritage Resources Information System (SAHRIS) of SAHRA was undertaken to establish whether any previous archaeological and heritage impact assessments had revealed archaeological and heritage sites within the present study area components. Previous reports were also made available by the client.

This assessment has revealed that a number of previous studies had been undertaken in the surroundings of the study area. However, although a few sites were identified in proximity to the present study area, no sites from these studies were identified within the present study area.

All previous studies that were located on the SAHRIS system and/or received from the client, will be briefly discussed in chronological order below. In each case, the results of each study is shown in bold.

- KUSEL, U. 2006. Cultural Heritage Resources Impact Assessment of Portion 1 of the farm Klippoort 334 JS (A Portion of 71) of the farm Klipfontein 322 JS, Witbank, Mpumalanga. **No sites were identified during the study.**
- BIRKHOLTZ, P.D. 2008. Heritage Impact Assessment for the Proposed Development of the Remaining Extent of Portion 71 of the farm Klipfontein 322 JS, eMalahleni Municipality, Mpumalanga Province. **Two sites were identified during the study, namely a historic homestead and a cemetery. These sites are located 1.84km and 1.74km respectively north-east from the corresponding closest points along the study area boundary.**
- PISTORIUS, J.C.C. 2010. Phase 1 Heritage Impact Assessment (HIA) Study for the Proposed Landau Expansion Project near eMalahleni (Witbank) in the Mpumalanga Province of South Africa. **The study identified three cemeteries, three historic houses and one railway bridge. The closest of any of these seven identified sites to the present study area, is a cemetery located 1.66 km north of the closest point along the study area boundary.**
- CELLIERS, J.P. 2010. Phase 1 Archaeological Impact Assessment for Aurecon Environmental Consultants concerning the proposed Khanyisa Power Station on portions of the farms Klippan 332 JS, Groenfontein 331 JS and Klipfontein 322 JS near Witbank, Mpumalanga Province. **The study identified a total of six sites, comprising one cemetery, one building, one demolished dwelling, two ruins and one site where traces of a previous settlement were identified. None of these sites is located within the present study area. The most significant of these sites is the cemetery, which is located 610m from the closest point along the study area boundary.**
- PISTORIUS, J.C.C. 2014. Phase 1 Heritage Impact Assessment (HIA) Study for Anglo Operations Limited Greenside Colliery's New Discard Facility near eMalahleni on the Eastern Highveld in the Mpumalanga Province. **Two cemeteries were identified during the study. These cemeteries are located 442m and 330m respectively from the corresponding closest points along the study area boundary.**
- KUSEL, U. 2016. Phase 1 Cultural Heritage Resources Impact Assessment for a Temporary Road for a Large Dragline to be Moved from Kromdraai Coal Mine to Clewer in the eMalahleni District Mpumalanga Province. **Two cemeteries were identified during the study. The closest of these two cemeteries to the present study area is a cemetery comprising seven graves located 5.1 km north-west of the closest point along the study area boundary.**
- MLILO, T. & F. BANDAMA 2017. Phase 1 Heritage Impact Assessment for the Proposed Reclaiming of Clinker (Ash from Old Power Stations) in Witbank, eMalahleni Local Municipality in Mpumalanga Province. **No sites were identified during the study.**
- BIRKHOLTZ, P.D. 2019. Pre-Feasibility Heritage Study for the SACE Lifex Project, near eMalahleni, Mpumalanga Province. An unpublished report for SRK Consulting (Pty) Ltd. **The fieldwork resulted in the identification of 39 heritage sites. Seven sites identified within the Landau 1 & Landau 2 areas of the Khwezela Colliery. These sites comprise one cemetery, one historic Farm Worker Dwelling where the risk exists for unmarked stillborn graves to be buried and five historic structures and buildings. Nine sites were identified within the Clydesdale area of the Greenside Colliery. These nine sites comprise three cemeteries,**

five historic Farm Worker Dwellings where the risk exist for unmarked stillborn graves to be buried and one historic structure and building. Twenty-three (23) sites were identified within the North West Pit area. These 23 sites comprise two cemeteries, six historic Farm Worker Dwellings where the risk exist for unmarked stillborn graves to be buried and 15 historic structures and buildings.

4.4 Findings of the historical desktop study

4.4.1 Palaeontological Heritage

Butler (2021) indicates that the proposed Anglo African Metals Zero Waste Recovery Plant is underlain by the Undifferentiated Ecca Group (Pe) (Vryheid Formation). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website) (**Figure 17**).

However, the proposed development is only 4,10ha in extent and photographs obtained by PGS indicates that the proposed development site has previously been disturbed.

Figure 17 – Palaeontological Heritage Sensitivity map. As can be viewed, most of the area is of very highly sensitive (red shading). Yellow outline demarcates the approximate study area.

4.4.2 Heritage Screening

A Heritage Screening Report was compiled by the Department of Environmental Affairs National Web-based Environmental Screening Tool as required by Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended **(Figure 19**). According to the Heritage screening report, the

directly affected area has a Medium heritage sensitivity. The fieldwork has however shown that the site has no heritage resources and therefore has no heritage significance.

4.4.3 Heritage Sensitivity

The sensitivity maps were produced by overlying:

- Satellite Imagery;
- Current Topographical Maps; and
- First edition Topographical Maps dating to 1960 (**Figure 18**).

The map analysis shows that no heritage sensitive features were identified in the study area.

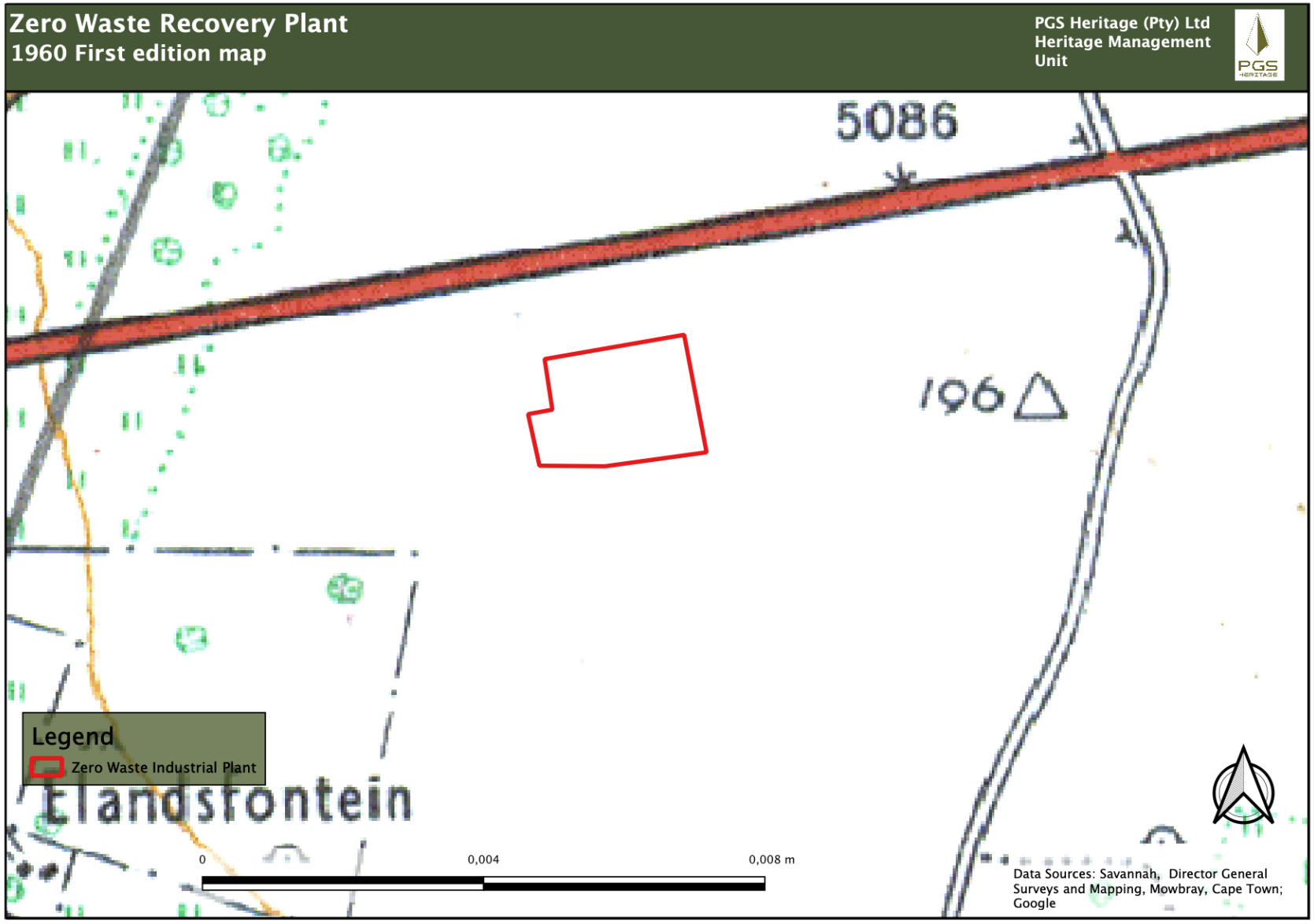


Figure 18 – First Edition of 2529CC Topographic Map 1:50000 dating to 1960

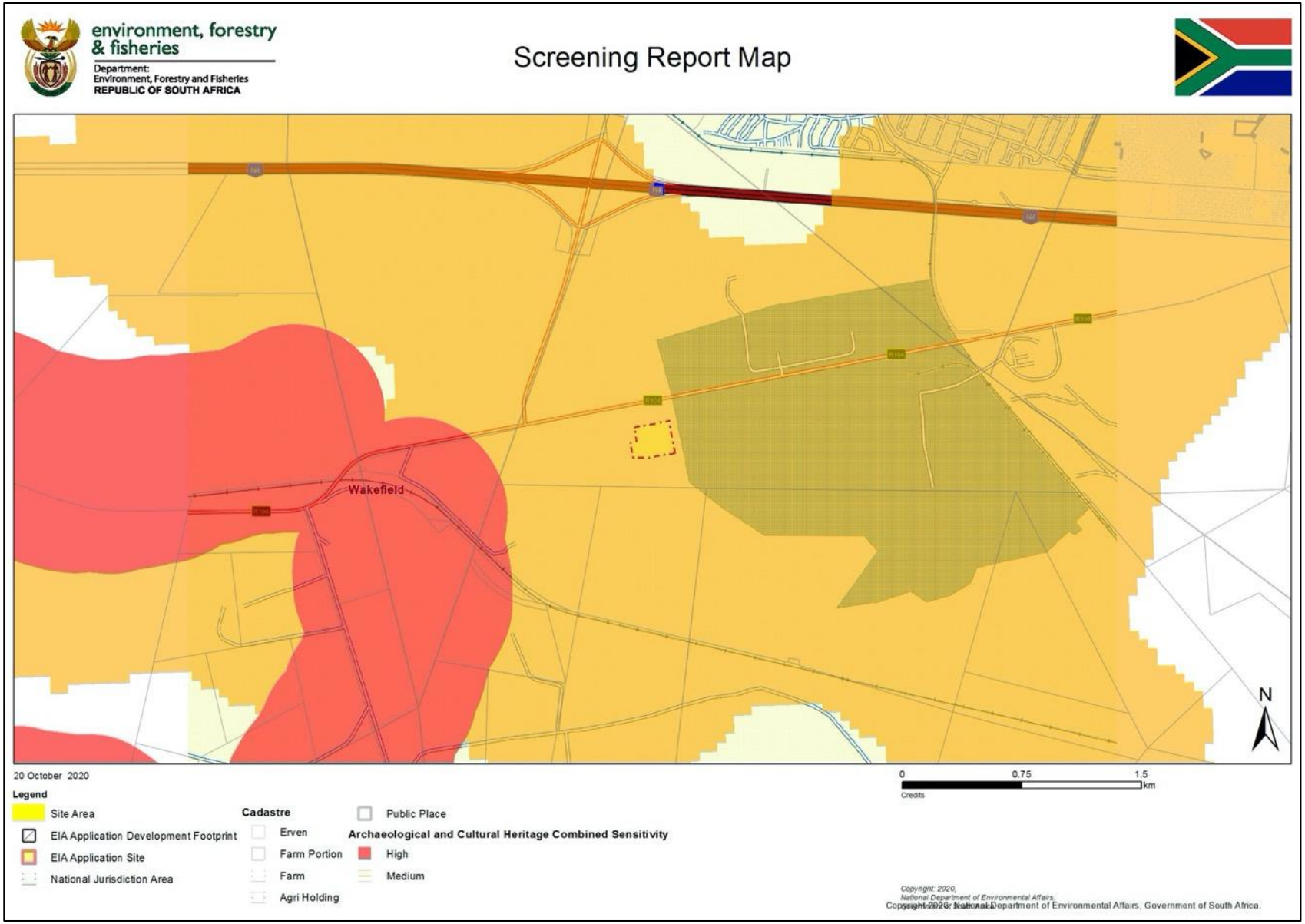


Figure 19 - Heritage Screening map. Source: Department of Environment, Forestry and Fisheries (DEFF)

5 FIELDWORK AND FINDINGS

A controlled surface survey was conducted on foot and by a vehicle by an archaeologist from PGS. The fieldwork was conducted on 5 March 2021. During the fieldwork, hand-held GPS devices were used to record tracklogs.

No heritage resources were identified in the study area.

6 IMPACT ASSESSMENT

The impact assessment methodology to be utilised is supplied by Savannah Environmental.

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

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

Direct, indirect and cumulative impacts associated with the projects must be assessed in terms of the following criteria:

- **Nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
    - the lifetime of the impact will be of very short duration (0–1 year) – assigned a score of 1;
    - the lifetime of the impact will be of short duration (2-5 years) - assigned a score of 2;
    - medium-term (5–15 years) – assigned a score of 3;
    - long term (> 15 years) - assigned a score of 4; or
    - permanent - assigned a score of 5;

- The **magnitude**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in the complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. The probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (a distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:

S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

6.1 Heritage Impacts

Due to the level of disturbance of the area, **no impact on heritage resources is envisaged.**

The high sensitivity rating for palaeontological heritage resources requires a separate impact assessment rating (**Table 6**).

Table 6 - Impact Assessment Table for Palaeontological Resources (After Butler, 2021)

Nature: The excavations and clearing of vegetation during the construction phase consist of digging into the superficial sediment cover as well as underlying deeper bedrock. These excavations will change the existing topography and may possibly damage, destroy or even permanently close-in fossils at or below the surface of the ground. These fossils will then be lost for research. Impacts on Palaeontological Heritage are only likely to happen within **the construction phase**. No impacts are expected to occur during the operation phase or decommissioning phase.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term/permanent (5)	Long term/permanent (5)
Magnitude	High (8)	Moderate (1)
Probability	Probable (3)	Improbable (1)
Significance	**MEDIUM (42)**	**LOW (7)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Residual Risk: *Loss of Fossil Heritage*		

A Medium impact significance on palaeontological resources has thus been allocated to the development based on the disturbed character of the area. For these reasons it is considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

6.1.1 Cumulative Impacts

The only potential impacts are predicted is on palaeontological resources with no additional impacts that could add to the overall impact load on heritage resources

Table 7 – Projected cumulative impacts on heritage

Nature:
The only potential impacts are predicted is on palaeontological resources with no additional impacts that could add to the overall impact load on heritage resources

	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term/permanent (5)	Long term/permanent (5)
Magnitude	High (8)	Moderate (1)
Probability	Probable (3)	Improbable (1)
Significance	**MEDIUM (42)**	**LOW (7)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation procedure: See Chance find protocol

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 Environmental Officer (EO) (if appointed) or site manager. The EO 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 EO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the EO (or 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.

Residual Impacts:
Loss of fossil heritage

7 MANAGEMENT RECOMMENDATIONS AND GUIDELINES

7.1 Construction phase

The project will encompass a range of activities during the construction phase, including ground clearance, and small-scale infrastructure development associated with the project.

It is possible that cultural material will be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, however, foundation holes do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered for. Temporary infrastructure developments, such as construction camps and laydown areas, are often changed or added to the project as required. In general, these are low impact developments as they are superficial, resulting in a little alteration of the land surface, but still, need to be catered for.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following chance find procedure should be implemented.

7.2 Chance find procedure

- A heritage practitioner/archaeologist should be appointed to develop a heritage induction program and conduct training for the ECO as well as team leaders in the identification of heritage resources and artefacts.
- An appropriately qualified heritage practitioner/archaeologist must be identified to be called upon in the event that any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities halted.
- The qualified heritage practitioner/archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and the impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the materials and data are recovered.

- Construction can commence as soon as the site has been cleared and signed off by the heritage practitioner/archaeologist.

7.2.1 Possible finds during construction

The study area occurs within a greater historical and archaeological site as identified during the desktop and fieldwork phase. Soil clearance for infrastructure as well as the proposed reclamation activities could uncover the following:

- stone foundations;
- ash middens associated with the historical structures that can contain bone, glass and clay ceramics, ash, metal objects such as spoons, forks, and knives.
- unmarked graves

7.3 Timeframes

It must be kept in mind that mitigation and monitoring of heritage resources discovered during construction activity will require permitting for collection or excavation of heritage resources and lead times must be worked into the construction time frames. **Table 8** gives guidelines for lead times on permitting.

Table 8 - Lead times for permitting and mobilisation

Action	Responsibility	Timeframe
Preparation for field monitoring and finalisation of contracts	The contractor and service provider	1 month
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	3 months
Documentation, excavation and archaeological report on the relevant site	Service provider – Archaeologist	3 months
Handling of chance finds – Graves/Human Remains	Service provider – Archaeologist and SAHRA	2 weeks
Relocation of burial grounds or graves in the way of construction	Service provider – Archaeologist, SAHRA, local government and provincial government	6 months

8 CONCLUSIONS

This HIA has shown that the proposed Zero Waste Recovery Plant will have a projected minimal impact on heritage resources within the project area due to the extensive disturbance of the footprint by industrial activity.

The SAHRIS palaeontological sensitivity map rates the study as underlain by geological strata with a Very High palaeontological significance. However, the palaeontological desktop assessment has

considered the potential impact and due to the disturbed nature of the site has concluded that no further fieldwork will be required but that a change finds protocol must be implemented as provided in the palaeontological desktop assessment (Butler, 2021).

It is the author's considered opinion that the overall impact on heritage resources will be Low. Provided that the recommended mitigation measures are implemented, the impact would be acceptably Low or could be totally mitigated to the degree that the project could be approved from a heritage perspective.

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9.4 Historical Topographic Maps

All the historic topographical maps used in this report were obtained from the Directorate: National Geo-spatial Information of the Department of Rural Development and Land Reform in Cape Town.

9.5 Internet

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www.wikipedia.org

9.6 Google Earth

At least some of the aerial depictions of the study área were obtained using Google Earth

WOUTER FOURIE

Professional Heritage Specialist and Professional Archaeologist and Director PGS Heritage

Summary of Experience

Specialised expertise in Archaeological Mitigation and excavations, Cultural Resource Management and Heritage Impact Assessment Management, Archaeology, Anthropology, Applicable survey methods, Fieldwork and project management, Geographic Information Systems, including *inter alia* -

Involvement in various grave relocation projects (some of which relocated up to 1000 graves) and grave "rescue" excavations in the various provinces of South Africa

Involvement with various Heritage Impact Assessments, within South Africa, including -

- Archaeological Walkdowns for various projects
- Phase 2 Heritage Impact Assessments and EMPs for various projects
- Heritage Impact Assessments for various projects
    - Iron Age Mitigation Work for various projects, including archaeological excavations and monitoring
    - Involvement with various Heritage Impact Assessments, outside South Africa, including -
- Archaeological Studies in Democratic Republic of Congo
- Heritage Impact Assessments in Mozambique, Botswana and DRC
- Grave Relocation project in DRC

Key Qualifications

BA [Hons] (Cum laude) - Archaeology and Geography - 1997

BA - Archaeology, Geography and Anthropology - 1996

Professional Archaeologist - Association of Southern African Professional Archaeologists (ASAPA) - Professional Member

Accredited Professional Heritage Specialist – Association of Professional Heritage Practitioners (APHP)

CRM Accreditation (ASAPA) -

- Principal Investigator - Grave Relocations
- Field Director – Iron Age
- Field Supervisor – Colonial Period and Stone Age
- Accredited with Amafa KZN

Key Work Experience

2003- current - Director – Professional Grave Solutions (Pty) Ltd

2007 – 2008 - Project Manager – Matakoma-ARM, Heritage Contracts Unit, University of the Witwatersrand

2005-2007 - Director – Matakoma Heritage Consultants (Pty) Ltd

2000-2004 - CEO– Matakoma Consultants

1998-2000 - Environmental Coordinator – Randfontein Estates Limited. Randfontein, Gauteng

1997-1998 - Environmental Officer – Department of Minerals and Energy. Johannesburg, Gauteng

Worked on various heritage projects in the SADC region including, Botswana, Mozambique, Malawi, Mauritius, Zimbabwe and the Democratic Republic of the Congo

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED ANGLO AFRICAN METALS ZERO WASTE RECOVERY PLANT IN THE HIGHVELD INDUSTRIAL PARK NO 1230 JS, EMALAHLENI LOCAL MUNICIPALITY WITHIN THE NKANGALA DISTRICT MUNICIPALITY IN MPUMALANGA

Issue Date:	**24 March 2021**
Revision No.:	v0.1
Client:	Savannah Environment
PGS Project No:	363HIA-

PGS HERITAGE

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Directors: HS Steyn, PD Birkholtz, W Fourie

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.

PALAEONTOLOGICAL CONSULTANT: Banzai Environmental (Pty) Ltd

CONTACT PERSON: Elize Butler

Tel: +27 844478759

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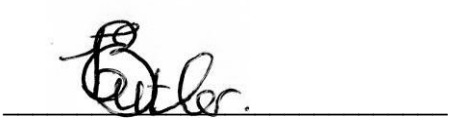
SIGNATURE: 

ACKNOWLEDGEMENT OF RECEIPT

Report Title	Palaeontological Desktop Assessment for the proposed Anglo African Metals Zero Waste Recovery Plant in the Highveld Industrial Park No 1230 JS, Emalahleni Local Municipality, Mpumalanga		
Control	**Name**	**Signature**	**Designation**
Author	**Elize Butler**		**Palaeontologist**
Reviewed	**Wouter Fourie**		**Principal Heritage Specialist**

CLIENT:

CONTACT PERSON:

SIGNATURE: _____

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

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Relevant section in report**	**Comment where not applicable.**
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to **Appendix A**	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment		Desktop Assessment
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and Methodology	-
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated	Section 1 and 10	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
structures and infrastructure, inclusive of a site plan identifying site alternative;		
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation	Section 11	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	None	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 10	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should	Section 1 and 10	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
be included in the EMPr, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Desktop Assessment (PDA) to assess the proposed Anglo African Metals Zero Waste Recovery Plant in the Highveld Industrial Park No 1230 JS in the Emalahleni Local Municipality in Mpumalanga. In agreement with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), a Palaeontological Assessment is necessary to establish if fossils are present in the planned development. This PDA is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The proposed Anglo African Metals Zero Waste Recovery Plant is underlain by the Undifferentiated Ecca Group (Pe) (Vryheid Formation). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website). However, the proposed development is only 4,10ha in extent and photographs obtained by PGS Consultants indicates that the proposed development has previously been disturbed. A Medium significance has thus been allocated to the development. For these reasons it is considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

However, if fossil remains are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Officer (EO) in charge of these developments. These discoveries ought to be protected and the EO must report to SAHRA (Contact details: SAHRA, 1 st and 2nd floor, Building 5 Government complex, 7 Government Boulevard Riverside Park, Private Bag X11316, Nelspruit, Fax number: 013 7668256) so that mitigation can be carry out by a paleontologist.

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

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Appendix A: CV

TERMINOLOGY AND ABBREVIATIONS

Cultural significance

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

Development

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

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

Fossil

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

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 2: Abbreviations

Abbreviations	**Description**
ASAP	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEFF	Department of Environmental Department of Environment, Forestry and Fisheries
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NECSA	Nuclear Energy Corporation of South Africa
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PDA	Palaeontological Desktop Assessment
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

1 INTRODUCTION

The proposed Anglo African Metals Zero Waste Recovery Plant in the Highveld Industrial Park No 1230 JS in the Emalahleni Local Municipality in Mpumalanga is approximately 4,10ha in extent (Figure 1-2).

1.1 Project Description

Anglo African Metals Zero Waste Recovery Plant has developed a disruptive technology for the economic extraction of valuable minerals from mining ore and waste materials. The process offers solutions for simultaneously extracting both vanadium and titanium oxides from slag materials. The technology also demonstrated to extract aluminium as aluminium oxide (Al_2O_3), magnesium as magnesium oxide (MgO) and calcium as calcium sulphate/gypsum ($CaSO_4$) [1].

Anglo African Metals (Pty) Ltd has identified a suitable tailings/slag resource at Highveld Steel in Mpumalanga between Balmoral and Emalahleni. A site for a small-scale industrial plant has been defined within the Highveld Steel property. It is understood that the following is relevant to the proposed facility[1]:

- The plant would be developed to process 2000 tonnes of tailings/slag per month, approximately 3 tons per day. This plant would be developed within the Highveld industrial plant owned property. The purpose of this plant would be to confirm the process inputs and outputs and refine the extraction processes as necessary.
- The plant would be primarily fuelled by LPG and Sasol gas brought into site by dedicated transport truck deliveries.
- As the sites are located within the highveld Steel property, it is assumed that the studies to be undertaken for the EIA process would be informed by existing information available for this site. Project-specific specialist studies required to be undertaken relate to air quality, socio-economic. The plan will comprise the following infrastructure, all wholly contained within Portion 4 of Farm No. 309[1]:

- Acid plant area, where process chemicals are produced, stored and handled as required by the waste recovery process.
- Substation and plant utility unit as interface and controlling unit for the electricity utilised by the plant during operation.
- Slag stockpile
- Crushing plant.
- Mill.
- Product area for storage of the various products produced through the recovery process.
- Reagent area, for the storage and handling of reactants utilised in the waste recovery process.
- A security area
- Parking lot.
- Admin and control room including offices and ablutions for staff.

Operation of the plan is anticipated for 24 hours per day, 365 per year (i.e., non-stop operation) and will utilise the slag produced by the highveld steel operations. The process offers solutions for simultaneously extracting both vanadium and titanium oxide from slag materials. The technology developed also demonstrated to extract aluminium as aluminium oxide (Al_2O_3), magnesium as magnesium oxide (MgO) and calcium as calcium sulphate/gypsum ($CaSO_4$), and involves the following approximate process (please note, due to intellectual property and commercial sensitivity of this process, various technical details are omitted) [1]:

- Crushing and milling of titanium dioxide (TiO_2) slag to the appropriate size for further treatment;
- Magnetic separation of entrained metallic iron from the crushed slag, which is used in a separate ferroalloy production processes.
- Alkali roasting of the remaining feedstock using a gas fired kiln. Off-gases from the kiln is a combination of carbon monoxide (CO) and sulphur dioxide (SO_2). By comparison, sulphur dioxide (SO_2) is only 3-5% of the carbon monoxide gas. These off gases are passed through the off-gas scrubber to remove SO_2 and the remaining CO_2 is reused in the kiln to supply part of the required heat.
- The material produced during alkali roasting from the kiln is then leached in water to dissolve vanadium and alumina.
- A further process produces vanadium pentoxide and recovers aluminium oxide from the leached products in the steps above.
- The remaining solid or residue after extracting vanadium is treated via leaching and roasting with sulphuric acid. The SO_2 gases or fumes given out during leaching or roasting are scrubbed off.
- Iron, magnesium and TiO2 are recovered from solution via precipitation steps.
- Precipitated TiO2 is heated in order to remove water of hydration.

- The leach solution is neutralised with lime form calcium sulphate and respective sulphates. The mixture of sulphates is heated in the furnace to produce sulphuric acid which is then used in the leaching step. The solid material after heating in the furnace is mainly calcium silicate which is used for cement production and construction.
- The remaining material after leaching of titanium, magnesium, aluminium oxide etc is mainly silica sand which is also used for construction.

This process therefore recovers vanadium and titanium oxide from slag materials, with water, carbon dioxide, gypsum and synthetic rutile produced at the various stages. These materials are all useful in other processes and are collected and sold to third parties with uses therefore, and thus the process itself results in no further waste production, while simultaneously utilising a common waste type – slag[1].

[1]Information provided by Anglo African Metals (Pty) Ltd

Figure 1: Google Earth (2020) Image of the proposed Anglo African Metals Zero Waste Recovery Plant in Mpumalanga is indicated in orange.

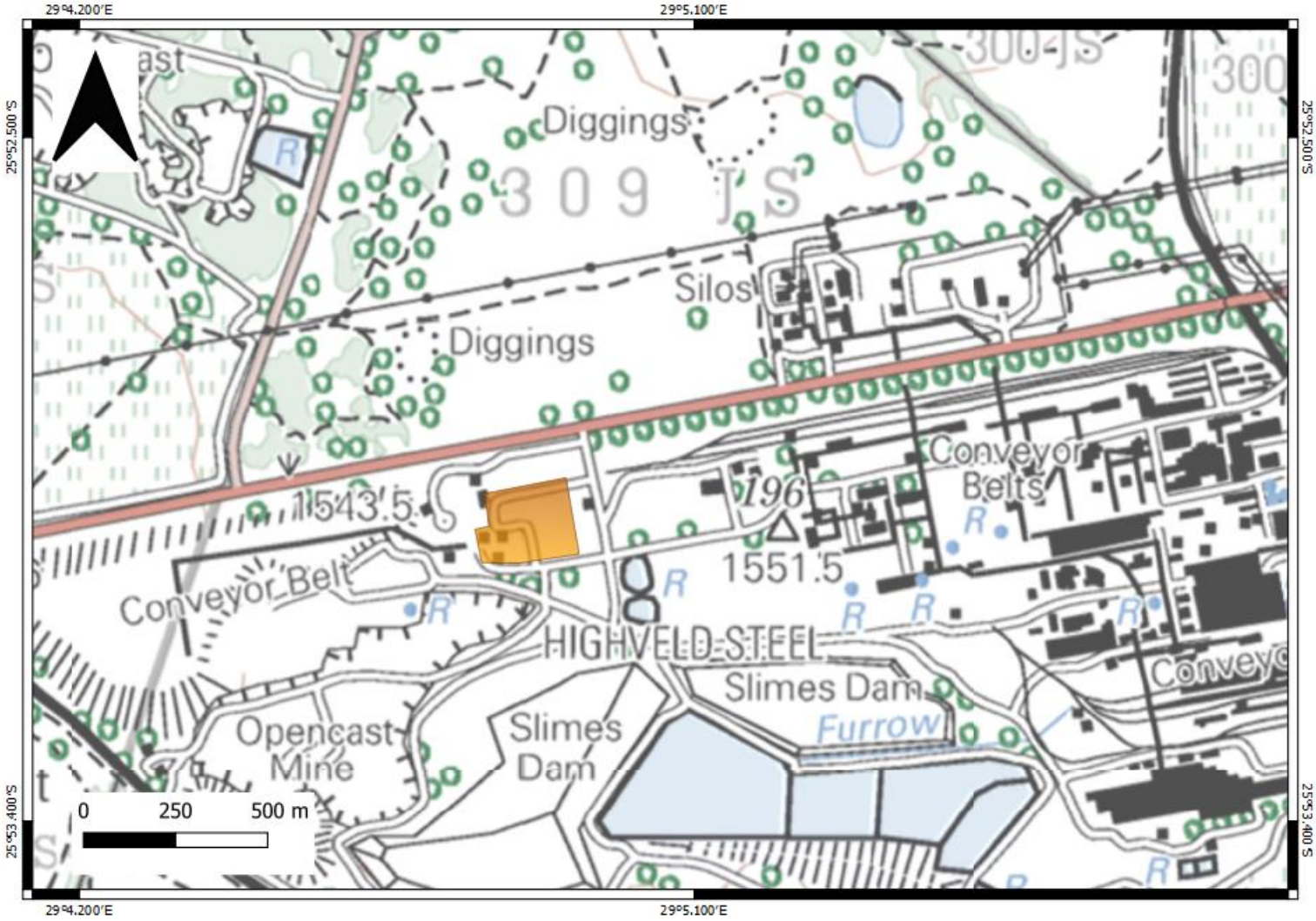

Figure 2: Location of the proposed Anglo African Metals Zero Waste Recovery Plant *is indicated in orange.*

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

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

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

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

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

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 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 m² in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

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

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

The terms of reference of a PIA are as follows:

General Requirements:

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

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

- Fair assessment of alternatives (infrastructure alternatives have been provided):
- Recommend mitigation measures to minimise the impact of the proposed development; and

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

5 GEOLOGICAL AND PALAEONTOLOGICAL HISTORY

The proposed Anglo African Metals Zero Waste Recovery Plant is depicted on the 1: 250 000 2528 Pretoria Geological Map (1978) (Council for Geosciences, Pretoria) (Figure 3). The proposed development is underlain by the Undifferentiated Ecca Group (Pe) (Vryheid Formation). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website).

West of the proposed development is a large area underlain by the Dwyka Group (Pd) as well as basalt (di) and formations of the Pretoria Group (Transvaal Supergroup). Sedimentary rocks of the Dwyka and Pretoria Groups in and near the study area are intruded, and locally metamorphosed, by sills of diabase (di, green in Figure 3). The **diabase** has no palaeontological significance. However, the existence of the diabase rocks would have had a thermal metamorphic effect on nearby Formations and would decrease the chance of fossil preservation in these formations.

Table 3: Rock formations present in the development area.

Symbol	**Group/Formation**	**Lithology**
Pe	Undifferentiated Ecca Group (Vryheid Fm)	Sandstone, shale, coal
Pd	Dwyka Group	Tillite, sandstone, mudstone, shale
Vsi	Silverton Fm; Pretoria Group; Transvaal Supergroup	Marine mudrocks with minor carbonates, volcanic rocks
Vdq	Daspoort Fm; Pretoria Group; Transvaal Supergroup	Quartzite
Vst	Stubenkop Fm; Pretoria Group; Transvaal Supergroup	Shale in places, firruginous
di	Diabase	Basalt

Figure 3: Extract of the 1:250 000 2528 Pretoria Geological Map (1978) (Council of Geoscience) indicating the surface geology of the proposed development. The development is underlain by the Vryheid Formation (Ecca Group, Karoo Supergroup).

Dwyka Group

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup and spans the Late Carboniferous to Early Permian. The Dwyka Group overlies the glaciated Precambrian bedrocks in the north and overlies the Natal Group and Msikaba Formation unconformably while it overlies unconformably and paraconformably the Cape Supergroup in the south and east. Glacial pavements underlaying the Dwyka Group have well-developed striations (specifically in the north) (Johnson et al, 2006). According to Visser et al (1987) the Dwyka Group was deposited in a marine basin.

South Africa was covered by an ice sheet during the Dwyka period. These deposits were deposited in a cold, glacial environment. This Group consists mainly of gravelly sediments with subordinate vorved shales and mudstones with scraped and facetted pebbles. The retreating glaciers deposited dark-grey tillite (Visser et al, 1987) and thus the Dwyka is known for its rich assemblage of dropstones of various sizes. The Permo-Carboniferous Dwyka Group is known for its trackways (trace fossils), which are also known as iIchnofacies, that were formed by fish and arthropods, while fossilized faeces (coprolites) have also been recovered. Body fossils comprise of gastropods, invertebrates and marine fish. Fossil plants include a rich diversity of conifers, cordaitaleans, glossopterids, ginkgoaleans, horsetails, lycopods, pollens and fern spores (Almond and Pether, 2008).

Vryheid Formation

The coalfields of South African occur in the Main Karoo Basin or its associated sub-basins. The Main Karoo Basin forms part of a series of Gondwanan basins that was established along the southern boundary of Gondwana (Cole, 1992; De Wit and Ransome 1992; Veevers et al. 1994; Catuneanu et al. 1998). These basins include Beacon Basin in Antarctica, Bowen Basin in Australia as well as the Paraná Basin in South America. The Basins were formed between the Late Carboniferous and Middle Jurassic and their joint stratigraphies portray the best non-marine sedimentation record globally.

Most of the coal mined in South Africa originates in the Permian Vryheid Formation (**Error! Reference source not found.**). The depth of the Vryheid Formation in the main Karoo Basin varies from 70 m to 500 m near Vryheid and Newcastle in Kwazulu-Natal, where the basin was at its deepest. The main seams in the area are numbered 1-5, with one at the bottom and 5 at the top, while seams 2 and 4 are usually thicker than the rest (Snyman, 1998). Generally, Seam 5 is approximately 15 to 45 m below the surface. The overburden must be removed before the opencast mining can commence.

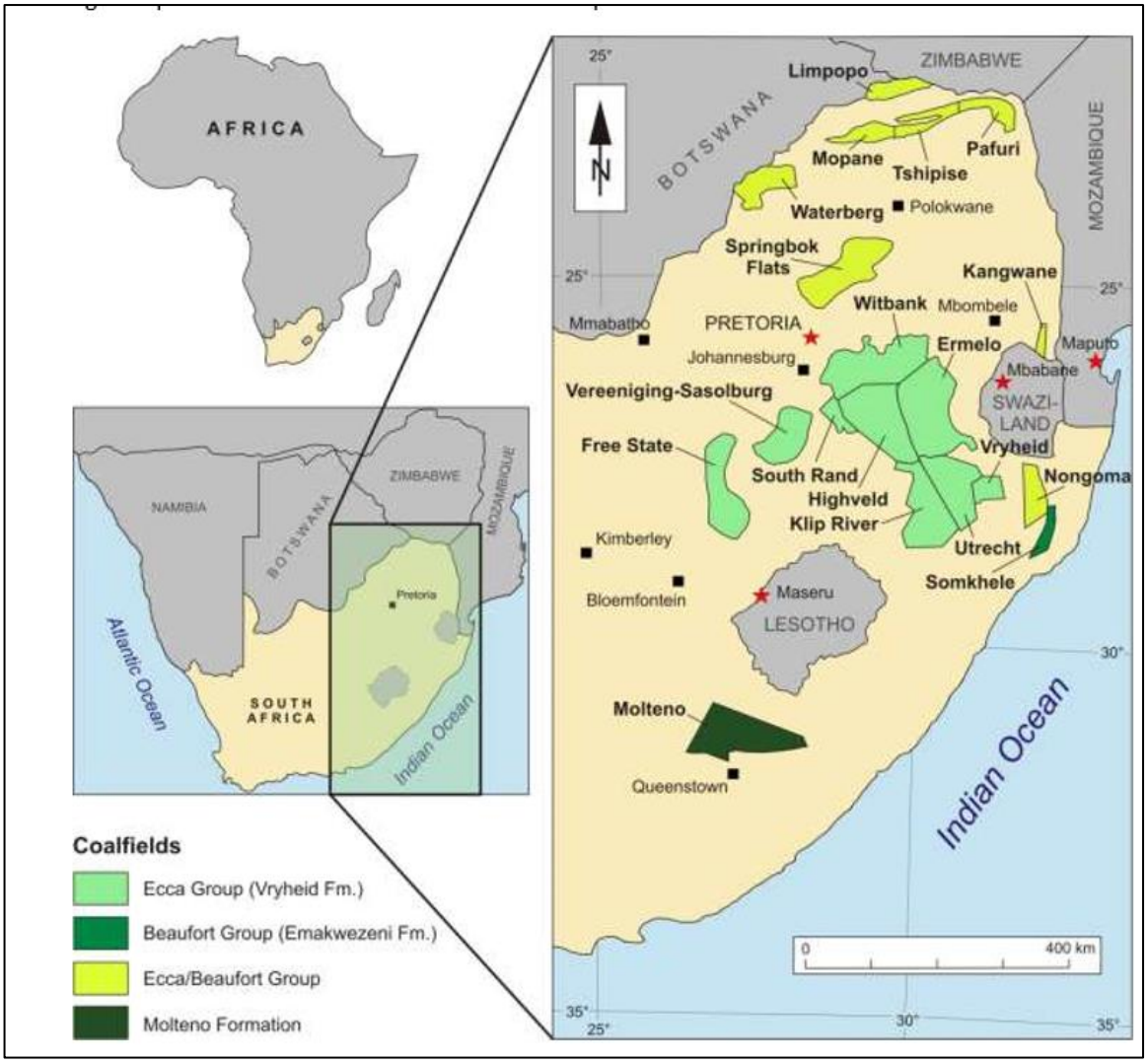

Figure 4: Coalfields of Southern Africa, taken from Hancox and Götz (2014).

The **Vryheid Formation** comprises mudrock, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places). The Formation contains up to five (mineable) coal seams. The different lithofacies are mainly arranged in upward-coarsening deltaic cycles (up to 80m thick in the southeast). Fining-upward fluvial cycles, of which up to six are present in the east, are typically sheet-like in geometry, although some form valley-fill deposits. They comprise coarse-grained to pebbly, immature sandstones - with an abrupt upward transition into fine-grained sediments and coal seams.

The Vryheid Formation comprise of a rich assemblage of Glossopteris flora. After continental deglaciation took place Gymnospermous glossopterids (Figure 4) dominated the peat and non-peat accumulating Permian wetlands (Falcon, 1986, Greb et al., 2006).

Table 4: Ecca Group and Formations. (Modified from Johnson et al, 2006).

Period	Supergroup	Group	Formation West of 24º E	Formation East of 24º E	Formation Free State / KwaZulu Natal
Permian	Karoo Supergroup	Ecca Group	Waterford Formation	Waterford Formation	Volksrust Formation
			Tierberg / Fort Brown Formation	Fort Brown Formation	
			Laingsburg / Rippon Formation	Rippon Formation	Vryheid Formation
			Collingham Formation	Collingham Formation	Pietermaritzburg Formation
			Whitehill Formation	Whitehill Formation	
			Prince Albert Formation	Prince Albert Formation	Mbizane Formation

Recent paleobotanical studies in the Vryburg Formation include that of Bordy and Prevec (2008) and Prefec et al. (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. Azaniodendron fertile, Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum sp., Scutum sp., Ottokaria sp., Estcourtia sp., Arberia sp., Lidgetonnia sp., Noeggerathiopsis sp., Podocarpidites sp as well as more than 20 Glossopteris species.

In the past palynological studies have focused on the coal bearing successions of the Vryheid Formation and include articles by Aitken (1994, 1998), and Millsteed (1994, 1999), while recent studies focussed on the Witbank Coalfield were conducted by Götz and Ruckwied (2014).

Bamford (2011) is of the opinion that only a small amount of data has been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur, they are usually abundant. According to Bamford, it is not feasible to preserve all the sites, but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Fish scales and non-marine bivalves has been reported. Trace fossils are found abundantly but the diversity is low. The mesosaurid reptile, Mesosaurus (Figure 5) has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare and irregular occurrence of fossils in this biozone, a single fossil may be of scientific value, as many fossil taxa are known from a single fossil.

Rocks of the Transvaal Supergroup in the Transvaal Basin were encroached by the Bushveld Complex about 2060 million years ago (Walraven and Martini, 1995). The Archaean basement as well as the Witwatersrand and Ventersdorp Supergroups underlies the Transvaal Supergroup. In the far western and Kanye Basins rocks belonging to the Kanye Formation and Gaborone Granite Suite is also overlain by the Transvaal Supergroup.

The Precambrian Transvaal Supergroup is approximately 2550-2050 Ma years old (Catuneanu *et al*. 1999) (Late Archaean to Early Proterozoic) and is about 15 km thick. This Supergroup consists of sedimentary, volcanic and unmetamorphosed clastic rocks. The sandstone dominated Magaliesberg Formation overlies the mudrocks of the Silverton Formation, and in turn the Silverton Formation overlies the sandstone dominated Daspoort Formation. The Silverton Formation is a lithologically varied, mudrock-dominated sequence that was deposited on an offshore shelf along the borders of the Kaapvaal Craton (Eriksson et al. 1995; 1998; 2006, 2012). Volcanic ash-rich layers are common as well as minor layers of carbonate and chert. Sandstones become more regular in the upper part of the sequence and was deposited under shallower conditions. In the eastern part of the Pretoria Basin, the Machadodorp Member lies in the middle of the Silverton Formation and is represented by a conspicuous layer of volcanic rocks (including agglomerates basaltic lavas as well as tuffs). The presence the volcanic pillow lavas and water-lain tuffs suggests that they were formed beneath the sea. The deep-water Silverton mudrocks were deposited in high sea levels and was followed by shallowing fluvial and deltaic sandstones in the low sea levels of the overlying Magaliesberg Formation. The Hekpoort formation consists of Basaltic andesite and pyroclastic rocks and is volcanic in origin.

The Pretoria Group of the Transvaal Basin comprise of a collection of stromatolites (microbial laminates), ranging from supratidal mats to intertidal columns and large subtidal domes (Eriksson *et al.* 2006). Stromatolites are layered mounds, columns and sheet-like sedimentary rocks (Figure 5). 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-based 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 described by various authors (Eriksson and Altermann, 1998). Detailed descriptions of South African Archaean stromatolites are available in the literature (Altermann, 1995, 2001; Buick, 2001; and Schopf, 2006). In the eastern part of the Transvaal Basin the Silverton Formation is approximately 1 to 3 km thick and consists of recessive weathering producing a topography of rolling hills and valleys (Visser 1989). Carbonate rocks are present at the top of the Silverton Formation. Research indicated that microbes under low oxygen conditions causes organic carbon within the shales (Eriksson *et al*. 1989). Organic-walled microfossils may be present in the carbon-rich Silverton Formation while the chert horizons may contain other microbial assemblages. However, the Silverton Formation is not known to contain macrofossils. The Daspoort and Magaliesberg Formations contain microbial mats.

Figure 5: Glossopteris leaf. https://www.Mesosaurus

Figure 6: Mesosaurus sp. https://www.Mesosaurus

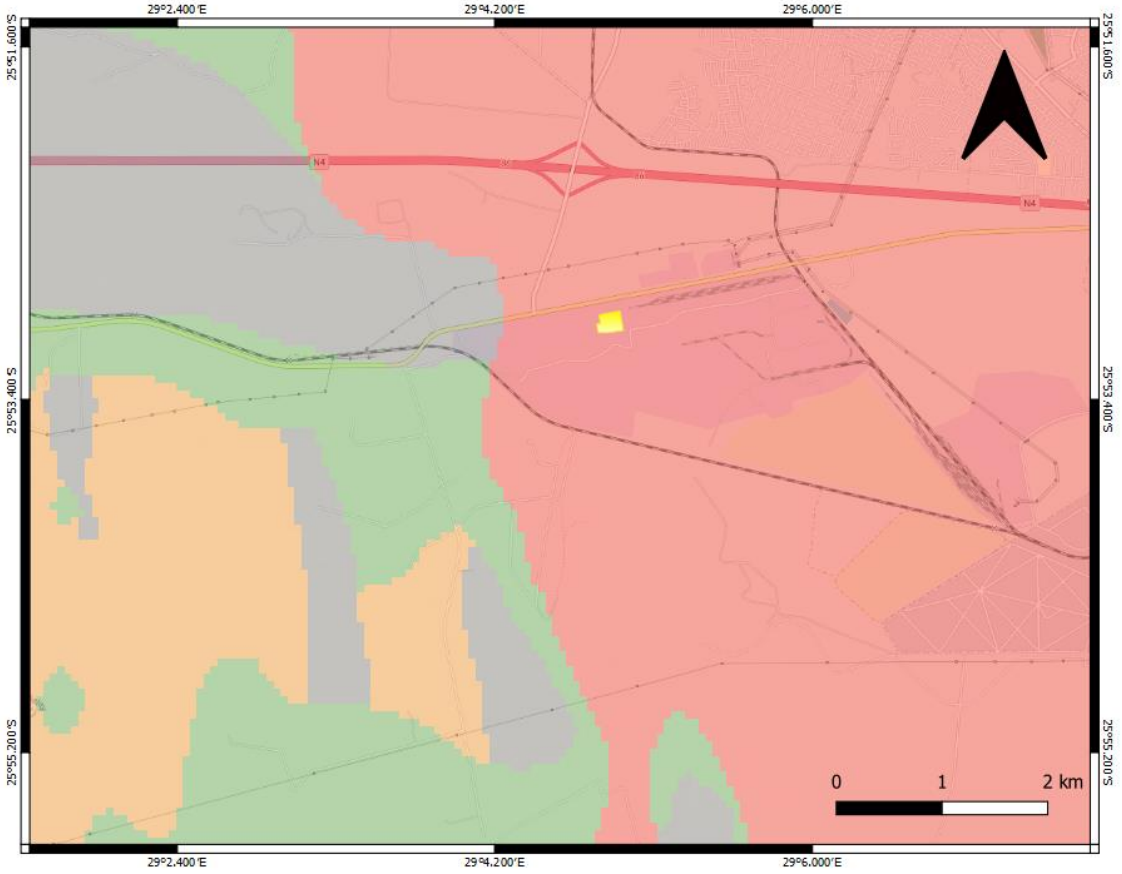

Figure 7: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in yellow.

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 Palaeo Sensitivity map (Figure 77) there is a Very High chance of finding fossils in the proposed development. Only a desktop was undertaken for this study as the development area falls in an existing development where the area has already been severely disturbed (see photos in Section 8)

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed development is situated on Highveld Industrial Park No 1230 JS and is approximately 4,10ha in extent (eMalahleni Local Municipality within the Nkangala District Municipality in Mpumalanga), The development is approximately 17km west of eMalahleni town. The site may be accessed directly off the R104, from the N4 turnoff near Kwa-Guqa informal settlement. The following farm portions are located adjacent the site:

Portion/Farm No.	SG 21 digit key ID
33/309	T0JS00000000030900033
49/309	T0JS00000000030900049
34/309	T0JS00000000030900034
26/309	T0JS00000000030900026
123/300	T0JS00000000030000123
5/303	T0JS00000000030300005
25/309	T0JS00000000030900025
29/308	T0JS00000000030800029
308	T0JS00000000030800000
32/309	T0JS00000000030900032

4/309	T0JS00000000030900004
16/309	T0JS00000000030900016
RE/38/309	
4/303	
92/300	
309	
8/303	
7/303	
303	
92/300	

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes all trace fossils and fossils. All available information is consulted to compile a desktop study and includes: Palaeontological impact assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps. As already mentioned in Section 5 only a desktop was undertaken for this study as the development area falls in an existing development where the area has already been severely disturbed (see photos in Section 8)

7.1 Assumptions and Limitations

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

Comparable Assemblage Zones in other areas is used to provide information on the existence of fossils in an area 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.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- 1: 250 000 2528 Pretoria Geological Map (Council of Geoscience)

- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.

The following photographs were obtained from PGS and shows that the proposed development has previously been disturbed.

Figure 8: Waste Material and road

Figure 9: Waste Material

9 IMPACT ASSESSMENT METHODOLOGY

9.1 Significance Assessment

Direct, indirect and cumulative impacts of the impacts identified above will be assessed according to the following standard methodology:

- The **nature** which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent** wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The **duration** wherein it will be indicated whether:
    - The lifetime of the impact will be of very short duration (0 - 1 years) – assigned a score of 1;
    - The lifetime of the impact will be of short duration (2 - 5 years) – assigned a score of 2;
    - Medium-term (5 - 15 years) – assigned a score of 3;
    - Long-term (> 15 years) – assigned a score of 4; or

    - Permanent – assigned a score of 5.
- The **magnitude** quantified on a scale from 0 - 10 where 0 is small and will have no effect on the environment, 2 is minor and will result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease) and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1 - 5 where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but of low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **significance** which shall be determined through a synthesesof the characteristics described above and can be assessed as low, medium or high; and
- The **status**, which is described as positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources.
- The degree to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:

S = (E + D + M) x P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area);
- 30 – 60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated); and
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

9.2 IMPACT ASSESSMENTS

An assessment of the impact significance of the proposed Anglo African Metals Zero Waste Recovery Plant is presented here:

9.2.1 Nature of the impact

The excavations and site clearance of the proposed development will involve extensive excavations into the superficial sediment cover as well as into the underlying bedrock. These excavations will change the existing topography and may destroy or permanently seal-in fossils at or below the ground surface that will no longer be available for research. According to the Geology of the project site on the SAHRIS PalaeoMap there is a high possibility of finding fossils during construction.

9.2.2 Sensitive areas

The proposed development is underlain by the Undifferentiated Ecca Group (Pe) (Vryheid Formation). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Vryheid Formation is Very High. The Vryheid Formation comprise of a rich assemblage of Glossopteris flora.

9.2.3 Geographical extent of impact

The impact on fossil heritage will be restricted to the construction phase when new excavations into 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**. (1)

9.2.4 Duration of impact

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.** (5)

9.2.5 Potential significance of the impact

Should the project progress without due care to the possibility of fossils being present at the proposed development site the resultant damage, destruction or inadvertent relocation of any affected fossils will be **permanent and irreversible**. Thus, any fossils occurring within the development area are potentially scientifically and culturally significant and any negative impact on them would be of zero significance.

9.2.6 Severity / benefit scale

The development will be **beneficial** on a local level, but regional and national level as well.

9.2.7 Intensity

Probable significant impacts on palaeontological heritage during the construction phase are high (8).

9.2.8 Probability of the impact occurring.

The probability of significant impacts on palaeontological heritage during the construction phase are low (3 - probable).

9.2.9 Damage mitigation, reversal, and potential irreversible loss

Mitigation

If fossil material occurs within the proposed development any negative impact upon it may be mitigated by description and collecting of well-preserved fossils. These actions should take place after vegetation clearance but *before* the ground is levelled for construction. Excavation of fossil heritage will require a permit from SAHRA, and the material must be housed in a permitted institution.

9.2.10 Degree to which the impact can be mitigated.

Recommended mitigation related to the damage and destruction of fossil heritage within the proposed footprint would include the collection and describing of fossils. These actions would take place after initial vegetation clearance but *before* the ground is levelled for construction.

9.2.11 Degree of irreversible loss

Impacts on fossil heritage are irreversible. From a scientific point of view all well-documented records and palaeontological studies of any fossils exposed during construction would represent a positive impact. A negative impact on the palaeontological heritage can be reduced by the application of adequate damage mitigation procedures. If mitigation is properly undertaken the impact may be regarded as beneficial.

9.2.12 Degree to which the impact may cause irreplaceable loss of Resources.

Stratigraphic and geographical distribution of fossils in the development footprint Subgroup is expected to be of low palaeontological sensitivity.

Table 5: Impact table of the construction phase of the Anglo African Metals Zero Waste Recovery Plant

Nature: The excavations and clearing of vegetation during the construction phase consist of digging into the superficial sediment cover as well as underlying deeper bedrock. These excavations will change the existing topography and may possibly damage, destroy or even permanently close-in fossils at or below the surface of the ground. These fossils will then be lost for research. Impacts on Palaeontological Heritage are only likely to happen within **the construction phase**. No impacts are expected to occur during the operation phase or decommissioning phase.		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long term/permanent (5)	Long term/permanent (5)
Magnitude	High (8)	Moderate (1)
Probability	Probable (3)	Improbable (1)
Significance	**LOW (42)**	**LOW (7)**
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Residual Risk: *Loss of Fossil Heritage*		

9.3 SUMMARY OF IMPACT TABLES

The proposed development is underlain by the Undifferentiated Ecca Group (Pe) (Vryheid Formation). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website).

Only the site will be affected by the proposed development. The expected duration of the impact is assessed as potentially permanent to long term. The impact could occur. The significance of the impact occurring will be Medium. As fossil heritage will be destroyed the impact is irreversible. The impact on fossil heritage will be medium.

10 FINDINGS AND RECOMMENDATIONS

The proposed Anglo African Metals Zero Waste Recovery Plant is underlain by the Undifferentiated Ecca Group (Pe) (Vryheid Formation). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website). However, the proposed development is only 4,10ha in extent and photographs obtained by PGS Consultants indicates that the proposed development has previously been disturbed. A Medium significance has thus been allocated to the development. For these reasons it is considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

However, if fossil remains or trace fossils are discovered during any phase of construction, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the Environmental Officer (EO) in charge of these developments. These discoveries ought to be protected and the EO must report to SAHRA (Contact details: SAHRA, 1 st and 2nd floor, Building 5 Government complex, 7 Government Boulevard Riverside Park, Private Bag X11316, Nelspruit, Fax number: 013 7668256) so that mitigation can be carry out by a paleontologist.

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

11 CHANCE FINDS PROTOCOL

A following procedure will only be followed if fossils are uncovered during excavation.

11.1 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.

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

11.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ESO or site manager. The ESO or site manager must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ESO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ESO (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 on the affected area.

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APPENDIX A – ELIZE BUTLER CV

ELIZE BUTLER

PROFESSION:	Palaeontologist
YEARS' EXPERIENCE:	26 years in Palaeontology

EDUCATION:	B.Sc Botany and Zoology, 1988 University of the Orange Free State
	B.Sc (Hons) Zoology, 1991 University of the Orange Free State
	Management Course, 1991 University of the Orange Free State
	M. Sc. *Cum laude* (Zoology), 2009 University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

MEMBERSHIP

Palaeontological Society of South Africa (PSSA)	2006-currently

EMPLOYMENT HISTORY

Part time Laboratory assistant	Department of Zoology & Entomology University of the Free State Zoology 1989-1992
Part time laboratory assistant	Department of Virology University of the Free State Zoology 1992
Research Assistant	National Museum, Bloemfontein 1993 – 1997
Principal Research Assistant and Collection Manager	National Museum, Bloemfontein 1998–currently

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