



MANUNGU COLLIERY

**PROPOSED EXTENSION OF THE MINING OPERATIONS AT THE EXISTING
MANUNGU COLLIERY, NEAR DELMAS, VICTOR KHANYE LOCAL
MUNICIPALITY, MPUMALANGA PROVINCE**

HERITAGE IMPACT ASSESSMENT

Issue Date: 15 February 2018
Revision No.: 1
Project No.: 274HIA

Declaration of Independence

I, Jessica Angel, 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 an 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 (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

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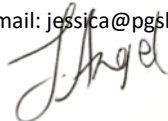
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Manungu Colliery– HIA

Report Title	Proposed, extension of the mining operations at the existing Manungu Colliery, near Delmas, Victor Khanye Local Municipality, Mpumalanga Province.		
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ACKNOWLEDGEMENT OF RECEIPT

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EXECUTIVE SUMMARY

PGS Heritage (Pty) Ltd (PGS) was appointed by Environmental Impact Management Services (Pty) Ltd (EIMS) to undertake an Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) as part of the proposed extension of the mining operations at the existing Manungu Colliery, near Delmas, Victor Khanye Local Municipality, Mpumalanga Province.

During the field assessment, a total of 12 heritage sites were located. These include 7 burial grounds (**MN001, MN002, MN003, MN005, MN007, MN008 and MN012**) and 5 structures **MN004, MN006, MN009, MN010 and MN011**, Refer to **Figure 12** for the locality of the identified heritage resources in relation to the mining areas.

The management and mitigation measures as described in Section 7 of this report have been developed to minimise the project impact on heritage resources. Impacts on historic or recent structures are rated as a MEDIUM NEGATIVE before mitigation and a LOW NEGATIVE after mitigation measures are implemented. Impacts on Burial grounds and Graves are rated as having a HIGH NEGATIVE before mitigation and a LOW NEGATIVE after mitigation measures are implemented. Impacts on Palaeontological resources are rated as a LOW NEGATIVE before and after mitigation measures are implemented.

It is my considered opinion that overall impact on heritage resources after the implementation of the recommended mitigation measures is acceptably low and that the project can be approved from a heritage perspective.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- i. 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;
- ii. 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;
- iii. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Burial Ground

A place containing one or many graves.

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:

- i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- ii. carrying out any works on or over or under a place;
- iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;

- iv. constructing or putting up for display signs or boards;
- v. any change to the natural or existing condition or topography of land; and
- vi. any removal or destruction of trees, or removal of vegetation or topsoil

Earlier Stone Age

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

Holocene

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

Later Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

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

Middle Stone Age

The archaeology of the Stone Age between 20 000-300 000 years ago, associated with early modern humans.

Palaeontology

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

Abbreviations	Description
ASAPA	Association of South African Professional Archaeologists
DMS	Dense Medium Separation
EA	Environmental Authorisation
EAP	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services
EMP	Environmental Management Plan
ESA	Earlier Stone Age
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
IWUL	Integrated Water use Licence
LOM	Life of Mine
MPRDA	Mineral and Petroleum Resources Development Act
NEMA	National Environmental Management Act
NEMWA	National Environmental Management Waste Act
NHRA	National Heritage Resources Act
NWA	National Water Act
PCD	pollution control dam
PGS	PGS Heritage (Pty) Ltd
ROM	Run of Mine
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
S&EIR	Scoping and Environmental Impact Report
WML	Waste Management Licence
WUL	Water Use Licence

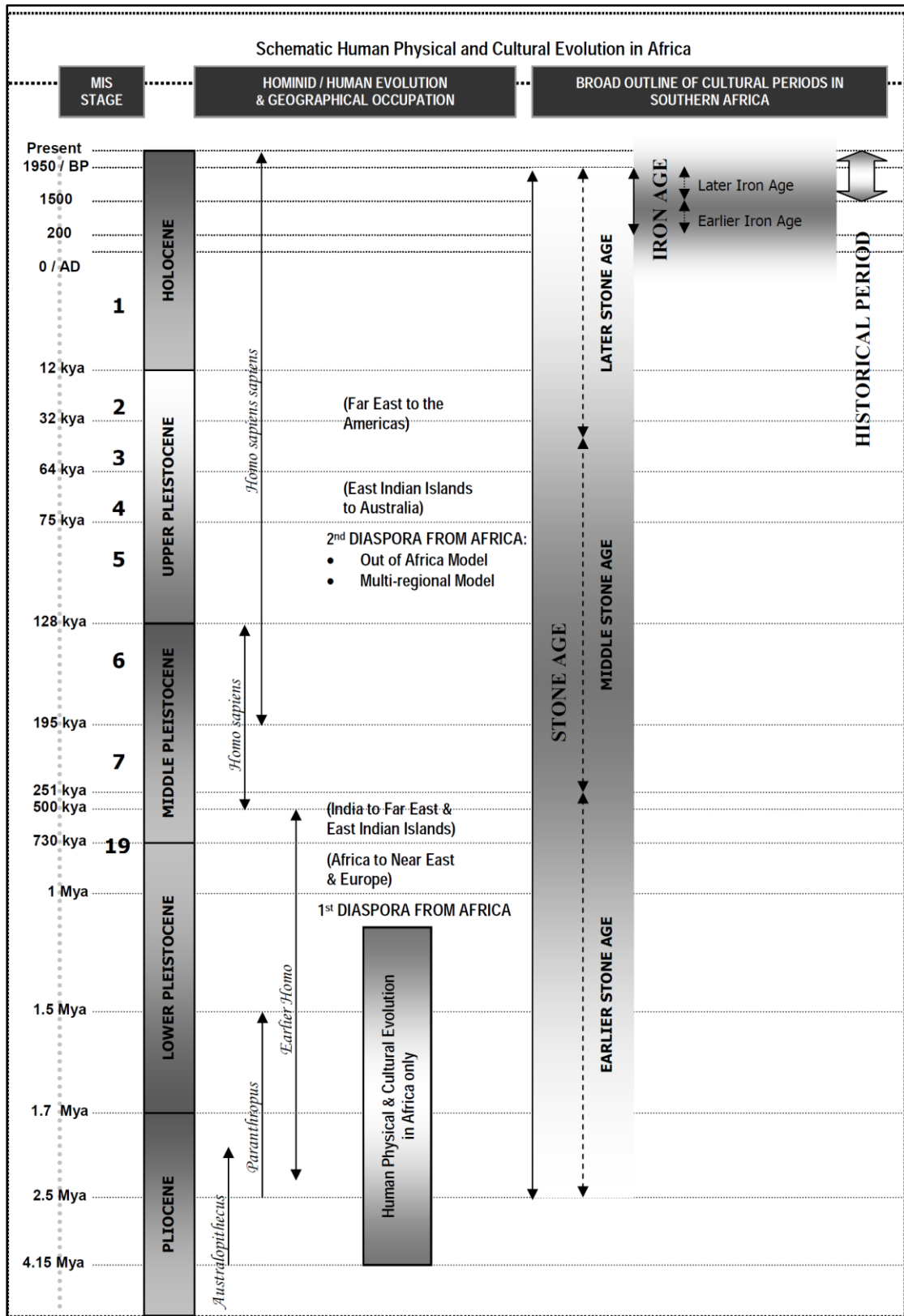


Figure 1 – Human and Cultural Time line in Africa (Morris, 2008)

1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by Environmental Impact Management Services (Pty) Ltd (EIMS) to undertake an Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) as part of the proposed extension of the mining operations at the existing Manungu Colliery, near Delmas, Victor Khanye Local Municipality, Mpumalanga Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage resources 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 developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA was compiled by PGS.

The staff at PGS has a combined experience of nearly 40 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.

Jessica Angel, the heritage specialist and author, holds a Masters degree in Archaeology and is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA).

Ilan Smeyatsky, graduated with his Masters degree (MSc) in Archaeology and is registered as a Professional Archaeologist with the ASAPA.

Wouter Fourie, the 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 fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover in some areas.

As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must be contacted immediately. Such observed or located heritage features and/or objects may not be disturbed or removed in any way until 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. In the event that any graves or burial places are located during the development the procedures and requirements pertaining to graves and burials will apply as set out below.

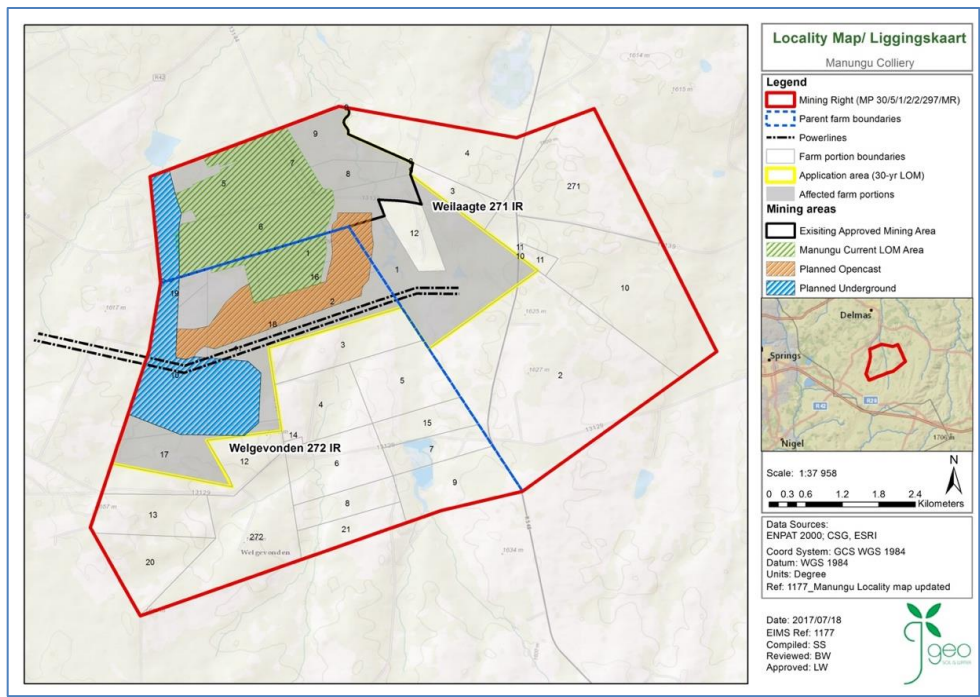


Figure 2 – Surface impact areas (application area) visited during the heritage fieldwork, (EIMS 2018)

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:

- i. National Environmental Management Act (NEMA), Act 107 of 1998
- ii. National Heritage Resources Act (NHRA), Act 25 of 1999
- iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

- i. GNR 982 of 2014 (Government Gazette 38282) promulgated under the (NEMA):
 - a. Basic Assessment Report (BAR) – Regulations 19 and 23
 - b. Environmental Scoping Report (ESR) – Regulation 21
 - c. Environmental Impacts Report (EIR) – Regulation 23
 - d. Environmental Management Programme (EMPr) – Regulations 19 and 23
- ii. NHRA:
 - a. Protection of Heritage Resources – Sections 34 to 36; and
 - b. Heritage Resources Management – Section 38
- iii. MPRDA Regulations of 2014:
 - a. Environmental reports to be compiled for application of mining right – Regulation 48

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, “no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority...” The NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a

major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Section of these Acts relevant to heritage (Fourie, 2008).

The NEMA 23(2)(b) states that an integrated environmental management plan should, “...*identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage*”.

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location

The existing Manungu Colliery is located approximately 9km south of the town of Delmas and covers all Portions of the farms Weilaagte 271IR and Welgevonden 272IR (comprising the approved mining right area) within the Victor Khanye Local Municipality, Mpumalanga, South Africa (refer **Figure 2** above for a locality map).

2.2 Project description

The Tshedza Mining Resources (Pty) Ltd. (hereafter referred to as “Tshedza”) will be applying for the relevant approvals to cover their 30-year life-of-mine (LOM) which will include future opencast and underground mining operations and associated infrastructure (refer to **Figure 2**).

This additional scope will ensure that the EIA process considers the cumulative impacts of the mining operations.

Tshedza wishes to establish a coal processing facility at Manungu Colliery in order to complement the existing beneficiation facility (crushing and screening plant). The proposed new processing facility will include a coal wash plant with associated residue discard dump and water

management infrastructure. The proposed processing facility and discard dump will be located within the mining right boundary.

The wash plant will consist of the following aspects:

- Dry fines screening circuit;
- Dense Medium Separation (DMS) module;
- Feed desliming;
- Circulating medium circuit;
- Dilute medium circuit;
- Grits dewatering circuit;
- Tailings thickener circuit;
- Tailings filter circuit;
- Product handling circuit;
- Plant services circuit;
- Raw and potable water system; and
- Process water circuit.

During the course of these application processes, Tshedza wishes to include licensing of three (3) new boreholes for domestic consumption as well as a French drain system to complement the septic tank system for ablution grey water. Furthermore, various options are to be considered to manage excess water volumes within the pollution control dam. Various amendments to the existing EA/EMP as well as the Integrated Water Use Licence (IWUL) will also be applied for in order to align the specific conditions with the current status of the mine as well as to clarify certain conditions.

The proposed project includes *inter alia* the following application processes with associated activities:

2.2.1 New Integrated Environmental Authorisation (Scoping and Environmental Impact Report (S&EIR)) for:

- Construction of a wash plant and associated infrastructure to complement the existing coal beneficiation plant.
- Disposal of wash plant waste (requiring Waste Management Licence).
- New residue deposits and/or residue stockpiles (requiring Waste Management Licence).

- Various activities including the primary processing of a mineral resource related to the 30 year LOM.

2.2.2 *New Integrated Water Use Licence (IWUL) for:*

- Discard (wash plant waste) disposal;
- Abstraction boreholes;
- A new French drain system;
- Evaporation sprays at the existing pollution control dam (PCD).

2.2.3 *Amendments to existing Environmental Authorisation and Environmental Management Plan for inter alia:*

- Stockpile height amendments;
- Stockpile vegetation requirements;
- Tree screen requirements.

2.2.4 *Amendments to the existing IWUL for:*

- Update of water balance for PCD;
- Water storage volume;
- Ash layer condition below run of mine (ROM);
- Flow meter reading frequency;
- Additional storm water structures within watercourses.

2.2.5 *Section 102 Amendment (to be confirmed with the Competent Authority)*

- Revised Mine Works Programme to include wash plant; and
- Revised consolidated EMPR to include wash plant.

2.3 Listed Activities Application

The proposed project must be authorized in terms of a number pieces of South African environmental legislation, namely:

- The Mineral and Petroleum Resources Development Act (MPRDA, Act No. 28 of 2002);
- The National Environmental Management Act (NEMA, Act No. 107 of 1998);

- The National Environmental Management Waste Act (NEMWA, Act No, 59 of 2008); and
- The National Water Act (NWA, Act No. 36 of 1998).

Where relevant, these pieces of core legislation stipulate the required studies, reports and legal processes to be conducted and the results thereof submitted to the relevant authorities for approval prior to commencement. It is anticipated that the following approvals will be required:

- Environmental Authorisation (EA) in terms of the 2014 NEMA EIA regulations (GNR 982, GNR 983, GNR984 and/or GNR 985);
- Amendment to existing EA/EMP (NEMA GNR 982, Chapter 5, Section 31 (Part 2 Amendment));
- Waste Management Licence (WML) in terms of the NEMWA (GNR 921, Category B11);
- Water Use Licence (WUL) in terms of the NWA (Section 21 water uses); and
- Amendment to existing Water Use Licence in terms of the NWA (Section 50).

The following listed activities, in accordance with the above pieces of legislation, are currently anticipated to be triggered by the proposed new infrastructure, facilities and amendments to existing licences on Manungu Colliery. The applicability of each of these listed activities (or the requirement for any additional listed activities) will be assessed during the initial Authority consultation process as well as during the scoping phase.

- NEMA GNR 983: Activities 12,19, 20, 24, 34;
- NEMA GNR 984: Activities 6, 15
- NEMA GNR 985: Activity: 14
- NEMWA GNR 921: Category B11.
- NWA: Section 21 (a) and (g) water uses;
- NWA: GN 704

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This HIA report was compiled by PGS for the proposed extension of the mining operations at the existing Manungu Colliery. The applicable maps, tables and figures, are included as stipulated in the NHRA, the NEMA. The HIA process consisted of three steps:

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

Step II – Physical Survey: A physical survey was conducted by vehicle and on foot through the proposed project area by two qualified archaeologists (10-11th January 2017), 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.

The significance of heritage sites was based on four main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
 - Low - <10/50m²
 - Medium - 10-50/50m²
 - High - >50/50m²
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate development activity position;

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site.

Impacts on these sites by the development will be evaluated as follows:

3.2 Site Significance

Site significance classification standards prescribed by the SAHRA (2006) and approved by the ASAPA for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 1: Site significance classification standards as prescribed by SAHRA.

Field Rating	Grade	Significance	Recommended Mitigation
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	-	Low Significance	Destruction

3.3 Methodology for Impact Assessment

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall

significance (S). Please note that the impact assessment must apply to the identified Sub-Station alternatives as well as the identified Transmission Line routes.

3.3.1 Determination of Environmental Risk:

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER).

The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E + D + M + R) \times N}{4}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 2**.

Table 2: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site)
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).

Aspect	Score	Definition
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/scored as per **Table 3.**

Table 3: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

$$ER = C \times P$$

Table 4: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in **Table 5**.

Table 5: Significance Classes

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk),
≥9; <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction of the degree to which the impact can be managed/mitigated.

3.3.2 Impact Prioritisation:

In accordance with the requirements of Regulation 31 (2)(l) of the EIA Regulations (GNR 543), and further to the assessment criteria presented in the Section above it is necessary to assess each potentially significant impact in terms of Cumulative impacts and the degree to which the impact may cause irreplaceable loss of resources.

In addition, it is important that the public opinion and sentiment regarding a prospective development and consequent potential impacts is considered in the decision-making process. In

an effort to ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 6: Criteria for Determining Prioritisation

Public response (PR)	Low (1)	Issue not raised in public response.
	Medium (2)	Issue has received a meaningful and justifiable public response.
	High (3)	Issue has received an intense meaningful and justifiable public response.
Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable loss of resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in **Table 7**. The impact priority is therefore determined as follows:

$$\text{Priority} = \text{PR} + \text{CI} + \text{LR}$$

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to **Table 7**).

Table 7: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
3	Low	1
4	Medium	1.17
5	Medium	1.33
6	Medium	1.5
7	Medium	1.67
8	Medium	1.83
9	High	2

In order to determine the final impact significance, the PF is multiplied by the ER of the post-mitigation scoring. The ultimate aim of the PF is to be able to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential, significant public response, and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 8: Final Environmental Significance Rating

Environmental Significance Rating	
Value	Description
< 10	Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
≥10 <20	Medium (i.e. where the impact could influence the decision to develop in the area),
≥ 20	High (i.e. where the impact must have an influence on the decision process to develop in the area).

4 BACKGROUND STUDY

4.1 Archival findings

The high level archival research focused on available information sources that were used to compile a general background history of the study area and surrounds.

4.2 Archival/historical maps

Historical topographic maps were available for utilisation in the study:

- Topographical map 2628BA – First edition 1968. The aerial photography on which the map was based dates to 1958 and its survey work was undertaken in 1965. It was drawn in 1966 by the Trigonometrical Survey Office.
- Topographical map 2628BA – Second edition 1977. Remapped in 1977 by the Director – General of Surveys.
- Topographical map 2628BA – Third edition 1995.
- Topographical map 2628BC – First edition 1966. The aerial photography on which the map was based dates to 1958 and the survey work was undertaken in 1966. It was drawn in 1967 by the Trigonometrical Survey Office.
- Topographical map 2628BC – Second edition 1984.
- Topographical map 2628BC – Third edition 1991.

4.3 Topographical Maps 2628BA and 2628BC (First Edition)

The map was utilised to identify structures that could possibly be older than 60 years and thus protected under Section 34 and 35 of the NHRA. Several structures are identified in the overall area. These features consist of “huts” and structures (**Figure 3**).

4.4 Topographical Maps 2628BA and 2628BC (Second Edition)

This map depicts evidence of more development in the area with an increased number of structures identified. Although these structures are not heritage sites, they do often have associated burial grounds which will need to be confirmed during the field work phase.

4.5 Topographical Maps 2628BA and 2628BC (Third Edition)

Several structures were identified on this map. Most are not of heritage significance.

4.6 Google Earth imagery

The final observation was of Google Earth historical imagery. The images help to confirm possible features located on the topographic maps and also provide a visual aspect to the natural terrain. As many heritage sites occur in forested areas or river valleys, for example, these areas were classed as sensitive areas to observe during the field study. The above mentioned topographic maps, as well as the Google Earth imagery were used to create a heritage sensitivity map (**Figure 6 and Figure 7**)

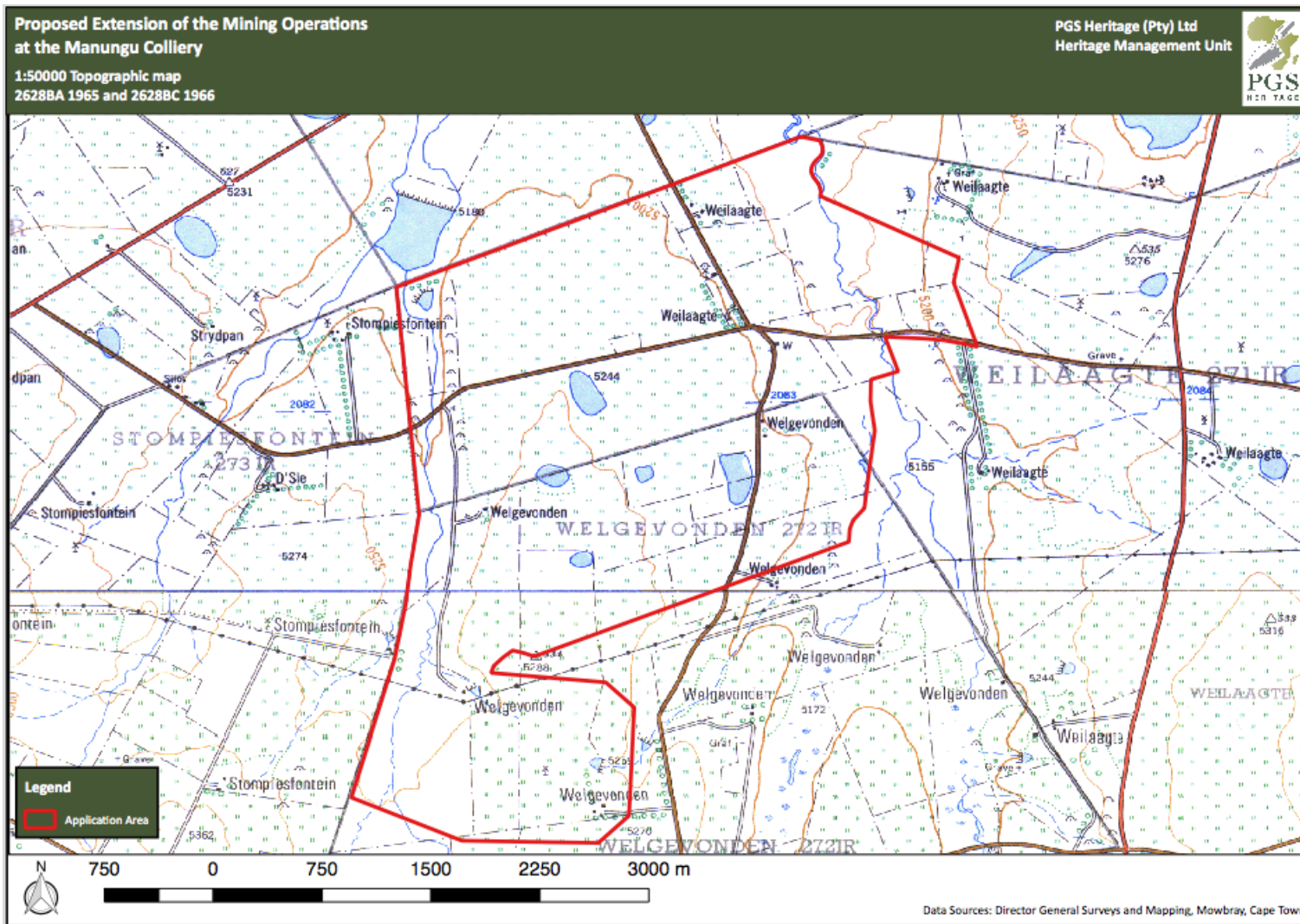


Figure 3 – 1965 and 1966 Topographic Map showing heritage features present within the study area.

Proposed Extension of the Mining Operations
at the Manungu Colliery

1:50000 Topographic map
2628BA 1977 and 2628BC 1984

PGS Heritage (Pty) Ltd
Heritage Management Unit

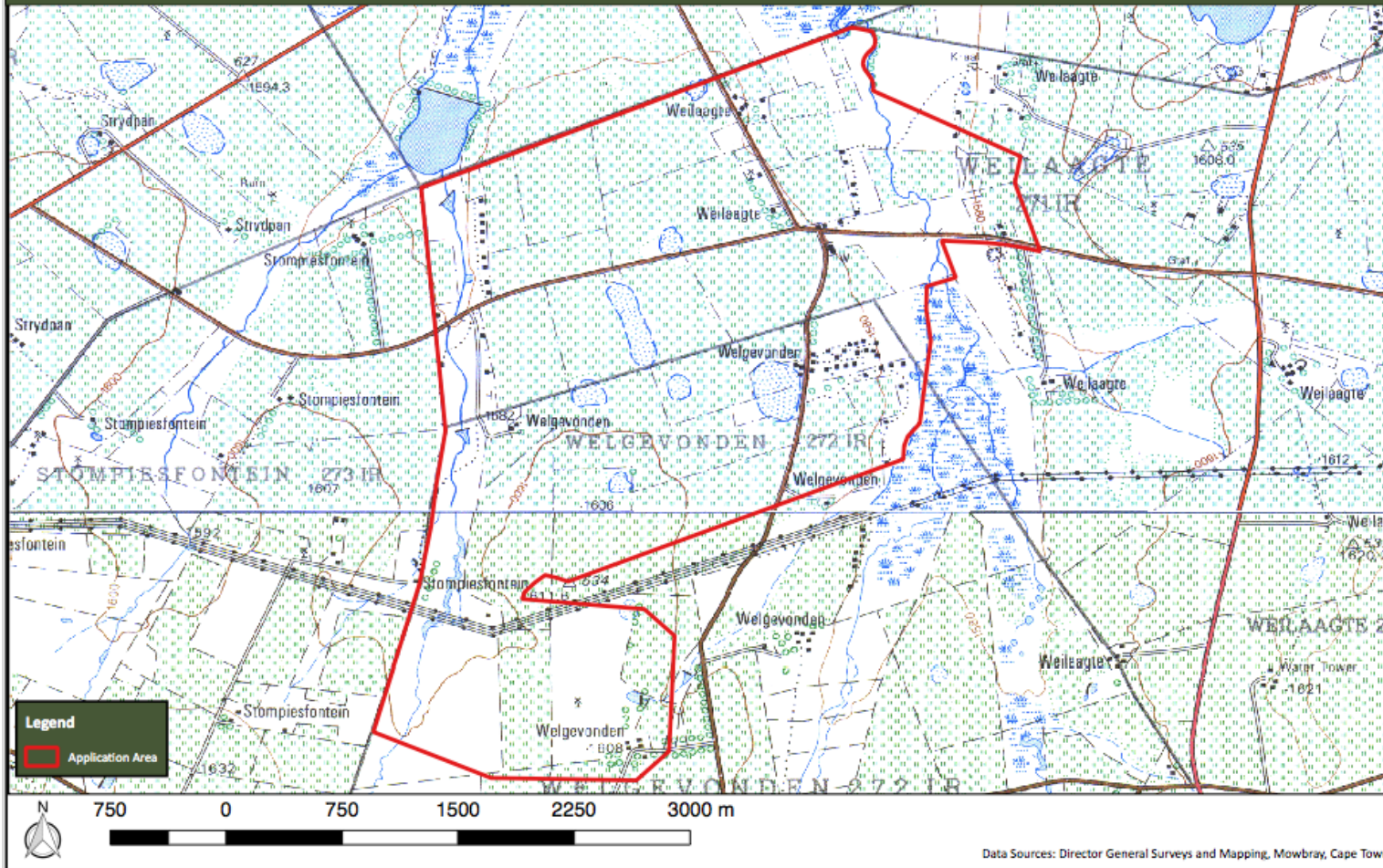


Figure 4 - 1977 Topographic Map showing heritage features present within the study area

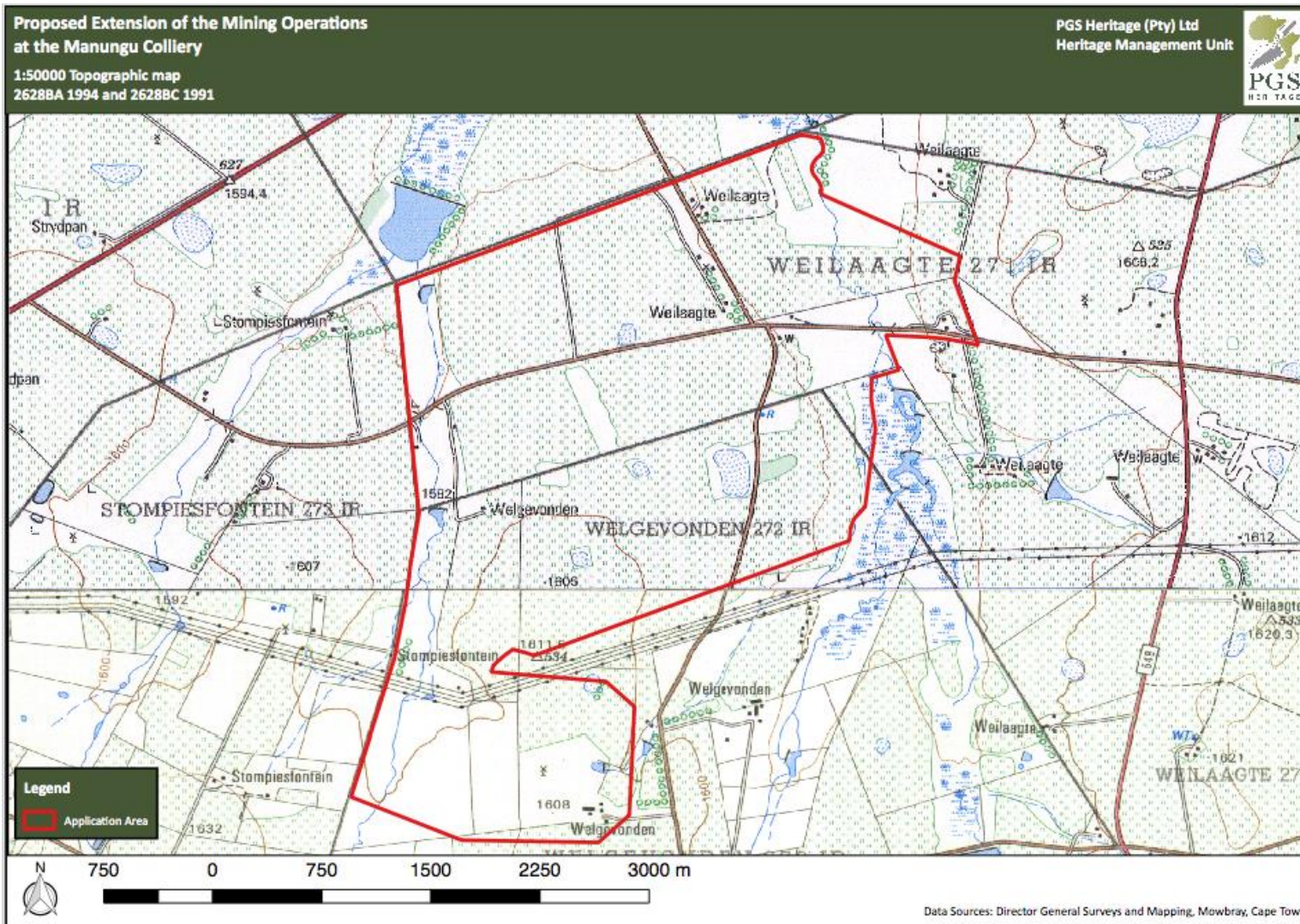


Figure 5 - 1991 Topographic Map showing heritage features present within the study area

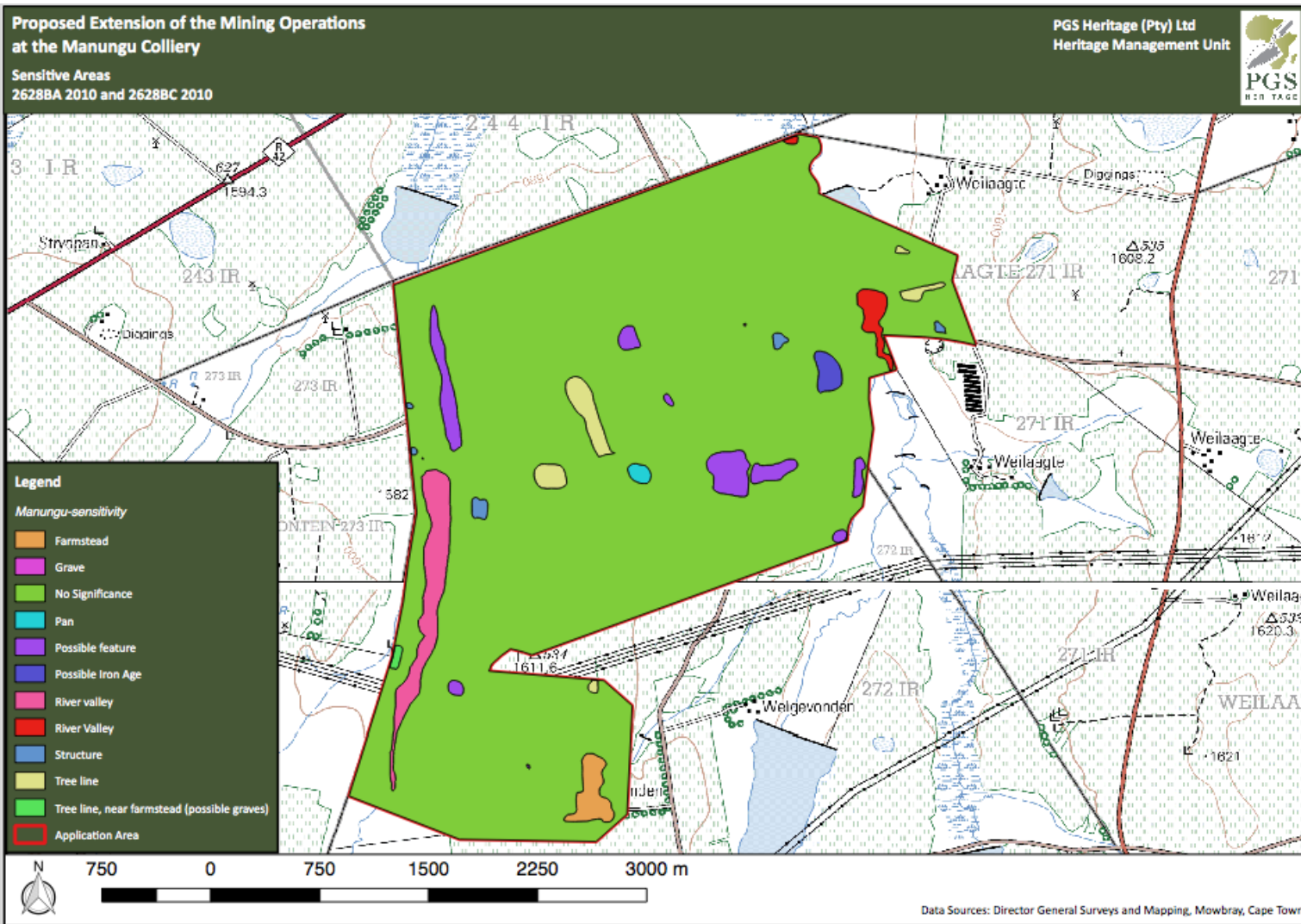


Figure 6 – Heritage sensitive areas

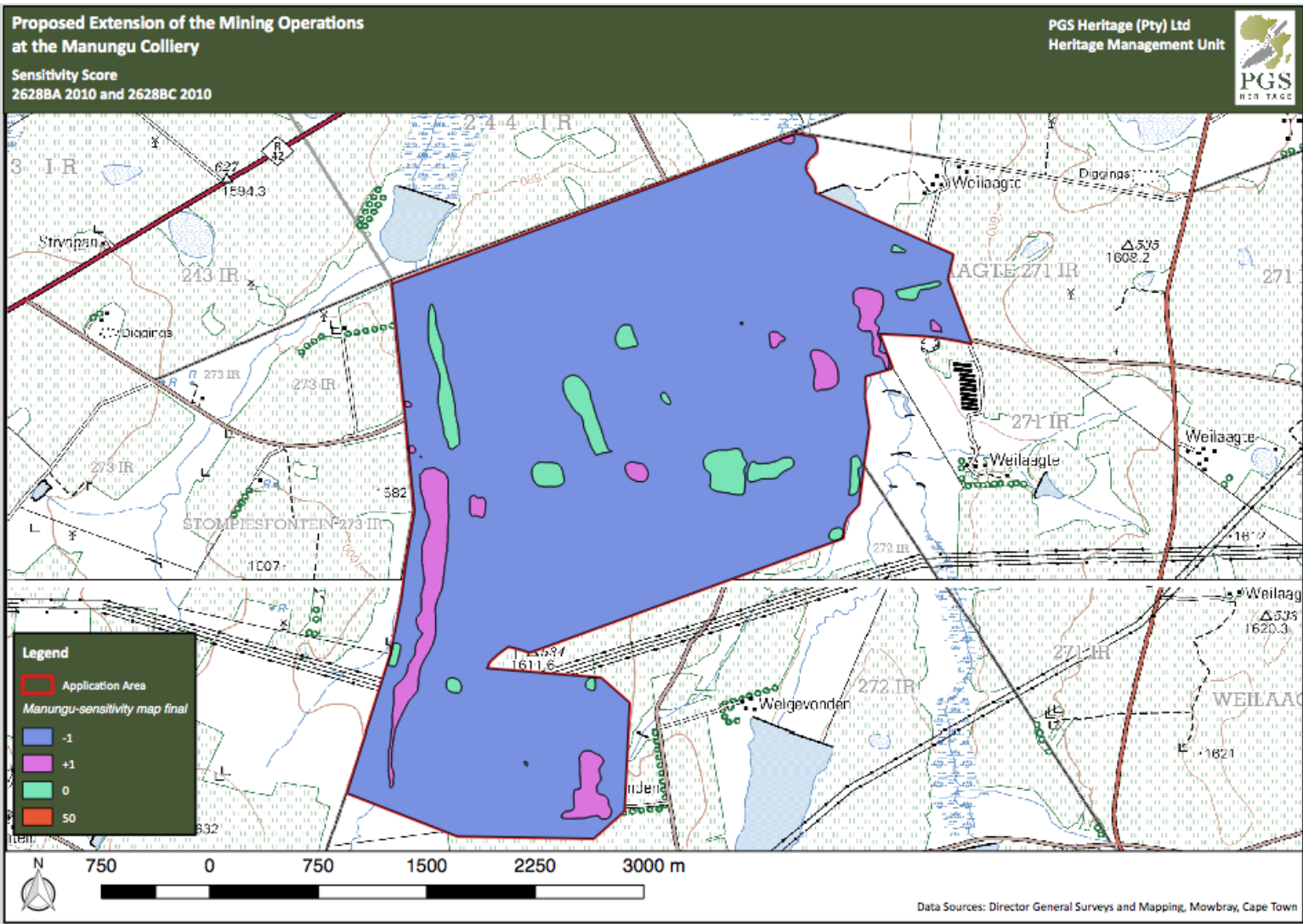


Figure 7 - Heritage sensitivity ratings

4.7 Previous Heritage Studies in area

A search on the South African Heritage Resources Information System (SAHRIS) has identified Heritage Impact Assessments conducted in and around the study area:

Pistorius J. 2015. Cultural-Historical Impact Assessment for the proposed Amadwala Integrated Waste Management Facility, Ekurhuleni, Gauteng.

Dr. Julius Pistorius was commissioned to carry out a cultural-historical impact assessment for the proposed waste management facility on portions 14 and 27 of the Farm Holfontein 71-IR, on Inqwelo Street, off the K175 Road, Ekurhuleni, Gauteng. Only one heritage site was located in the report's study area, namely a residence with historical significance.

In addition, a search of the South African Heritage Resources Information System database (SAHRIS – (<http://www.sahra.org.za/sahris>), identified several previous HIA's undertaken within the wider area. A selection of previous studies for the area is listed in descending chronological order below:

Pelser AJ. 2015. Baseline Study & Heritage Assessment Report for the proposed Gold One International Holfontein Project, near Springs, Gauteng.

A Pelser Archaeological Consulting was appointed by Prime Resources (Pty) Ltd to conduct a Baseline Study Phase 1 HIA for the Gold One International Holfontein Project, situated near the old Holfontein Shaft and existing Modder East operations. The study area is located on the East Rand, near Springs, in Gauteng. During the assessment a number sites and features were identified, all related to earlier gold mining at Holfontein. The sites and features recorded during the assessment include the remains of various structures such as headgear foundation and bases, the old Holfontein Shaft as well as some mine buildings. Old houses and a burial ground were recorded next to the haul road from Holfontein to the Modder East operations. The old Mine Compound was also identified during the study.

Pelser, A.J. 2014. Updated Report on a Phase 1 HIA for a proposed Coal Mine on Portions 26, 46 & 47 of the Farm Droogenfontein 242IR, Delmas District, Mpumalanga. For Shangoni Management Service (Pty) Ltd.

A Pelser Archaeological Consulting was appointed by Shangoni Management Services (Pty) Ltd, on behalf of Ngululu Resources (Pty) Ltd, to conduct a Phase 1 HIA for the proposed development of an opencast Coal Mine on portions 26, 46 & 47 of the farm Droogenfontein 242-IR, near Sundra (in the Delmas district), Mpumalanga Province. Two sites were identified on Portion 26, namely a burial ground and the remains of a farm labour settlement, possibly related to the grave site. No heritage sites, features or objects were identified on the two other portions of land.

Pistorius, J.C.C. 2012. A Phase I Heritage Impact Assessment (HIA) Study for a proposed 600MW Power Plant and associated infrastructure for Kipower (Pty) Ltd near Delmas on the Eastern Highveld in the Mpumalanga Province of South Africa.

Dr Pistorius was contracted by Jones and Wagner Consulting to conduct a heritage impact assessment for the proposed 600MW Power Plant and associated infrastructure for Kipower (Pty) Ltd near Delmas. The results of the survey found a series of informal graveyards and historical structures, located about 10km SE of the current study area.

Van Vollenhoven, A. 2011. A Report on a Cultural Heritage Baseline Study and Impact Assessment for the Proposed New Kleinfontein Goldmine (Modder East Operations), close to Springs, Gauteng Province. For Prime Resources (Pty) Ltd.

Archaetnos cc was requested by Prime Resources (Pty) Ltd to conduct a cultural heritage baseline study and impact assessment for the proposed Modder East Operations at the New Kleinfontein Goldmine. This is to the east of the town of Boksburg and to the north of the town of Springs in the Gauteng Province. During the survey, three sites of cultural heritage significance were identified close to the proposed development area namely an extensive burial ground as well as two small clusters of dilapidated industrial buildings. No other cultural resources were identified.

Coetzee, F.P. 2008. Cultural Heritage Survey of Portion 1 of Portion 228 (a Portion of 213) and Portion 63 of the Farm Geduld 123 IR, Gauteng Province. For AGES Environmental.

The project study area was situated between the suburbs of Dersley and Eastvale, east of Benoni and Brakpan. Two built structures of recent date and an extensive burial ground containing approximately 100 graves were recorded. Extensive mining activities were observed outside of the project area which are associated with Geduld Proprietary Mines.

Van der Walt, J. 2008. Archaeological Impact Assessment on the Remainder of Portion 7 of the Farm Modderfontein East 72 IQ, Benoni, Gauteng Province. Prepared by the Wits Heritage Contracts Unit for Eco Assessment Environmental Consultants.

The impact assessment was undertaken for a proposed mixed use residential township development on the Remainder of Portion 7 of the farm Modderfontein East 72 IR, Benoni, Gauteng Province. The only site identified in the study area was an area of approximately 3ha in extent which included the foundations of several demolished buildings. Several other features associated with the site were also identified, including a ventilation shaft and an ash dump. These features were identified from an archival map as being part of the old mine compound for the Modder East mine.

Van Schalkwyk, J.A. 1997. A Survey of Cultural Resources in the Proposed Erwat Sewer Outfall Route, north of Springs, Gauteng Province. For Afrosearch Index. Prepared by the National Cultural History Museum.

A survey to establish the nature, extent and significance of cultural resources was undertaken in the area of the proposed Erwat Sewer outfall route and two proposed sewer sites, Springs District, Gauteng Province. The area surveyed was located on the farms Klipfontein 70 IR, Welgedacht 74IR, Modderfontein 76IR and Geduld 123IR of the Springs, Benoni and Brakpan districts, Gauteng Province. A number of sites were identified during the survey including two cemeteries and a number of structures. One of the two cemeteries was still in use, and located at the north-eastern extremity of the proposed sewer outfall route on the farm Klipfontein. The second, containing approximately 1000 graves, is located just west of an old Modderfontein slimes dam. These graves are apparently of Chinese mine labourers and date to the turn of the century. A number of structures, all possibly related to mining or farming activities, were located. Except for one site, all were in ruins. The Klipfontein No 5 Shaft, though abandoned, shows architecture that is specific to mining activities of the last 50 years. A number of houses, possibly dating to the 1930s were identified on the farm Welgedag, next to the railroad. These houses belonged to Transnet.

4.8 Archaeological Background

Table 9 - Summary of archival data found on the general area

DATE	DESCRIPTION
2.5 million to 250 000 years ago	<p>The Earlier Stone Age (ESA) is the first phase identified in South Africa’s archaeological history and comprises two technological phases. The earliest of these is known as Oldowan and is associated with crude flakes and hammer stones. It dates to approximately 2 million years ago. The second technological phase is the Acheulian and comprises more refined and better made stone artefacts such as the cleaver and bifacial hand axe. The Acheulian dates to approximately 1.5 million years ago.</p> <p>No Early Stone Age sites are known in the vicinity of the study area. However, this is probably due more to a lack of research on the surroundings of the study area rather than a lack of sites.</p>
250 000 to 40 000 years ago	<p>The Middle Stone Age (MSA) is the second oldest phase identified in South Africa’s archaeological history. This phase is associated with flakes, points and blades manufactured by means of the so-called ‘prepared core’ technique.</p> <p>A Middle Stone Age site is known from Primrose Ridge in Germiston (Harcus, 1945) (situated roughly 34 km west of the present study area), as well as two sites near Brakpan (Gaigher, 2013) (located roughly 16.6 km south-west of the present study area). However, no Middle Stone Age sites are known in the direct vicinity of the study area. However, this is probably due to a lack of research on the surroundings of the study area rather than a lack of sites.</p>
40 000 years ago, to the historic past	<p>The Later Stone Age (LSA) is the third archaeological phase identified and is associated with an abundance of very small artefacts known as microliths.</p> <p>No Later Stone Age sites are known in the vicinity of the study area. However, this is in all likelihood rather due to a lack of research focus on the surroundings of the study area than a lack of sites.</p>
AD 1450 – AD 1650	<p>The Uitkomst facies of the Blackburn Branch of the Urewe Ceramic Tradition represents the first Iron Age period to be identified for the surroundings of the study area. This facies can likely be dated to between AD 1650 and AD 1820.</p>

	<p>The decoration on the ceramics associated with this facies is characterised by stamped arcades, appliqué of parallel incisions, stamping, as well as cord impressions, and is described as a mixture of the characteristics of both Ntsuanatsatsi (Nguni) and Olifantspoort (Sotho).</p> <p>The Uitkomst facies (with the Makgwareng facies) is seen as the successor to the Ntsuanatsatsi facies. The Ntsuanatsatsi facies is closely related to the oral histories of the Early Fokeng and represents the earliest known movement of Nguni people out of Kwazulu-Natal into the inland areas of South Africa. In terms of this theory, the Bafokeng settled at Ntsuanatsatsi Hill in the present-day Free State Province. Subsequently, the BaKwena lineage broke away from the Bahurutshe cluster and crossed southward over the Vaal River to come in contact with the Bafokeng. As a result of this contact, a Bafokeng-Bakwena cluster was formed, which moved northward and became further ‘Sotho-ised’ by coming into increasing contact with other Sotho-Tswana groups. This eventually resulted in the appearance of Uitkomst facies type pottery which contained elements of both Nguni- and Sotho-Tswana speakers (Huffman, 2007).</p> <p>No sites associated with the Uitkomst facies are known from the surroundings of the study area.</p>
<p>AD 1700 – AD 1840</p>	<p>The Buispoort facies of the Moloko branch of the Urewe Ceramic Tradition is the next phase to be identified within the study area’s surroundings. It is most likely dated to between AD 1700 and AD 1840. The key features on the decorated ceramics include rim notching, broadly incised chevrons and white bands, all with red ochre (Huffman, 2007). It is believed that the Madikwe facies developed into the Buispoort facies. The Buispoort facies is associated with sites such as Boschhoek, Buffelshoek, Kaditshwene, Molokwane and Olifantspoort (Huffman, 2007).</p> <p>No sites associated with the Buispoort facies are known from the surroundings of the study area.</p>
<p>AD 1821 – AD 1823</p>	

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 represents 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.

No sites associated with this period of the archaeological history of the surroundings of the study area are presently known.

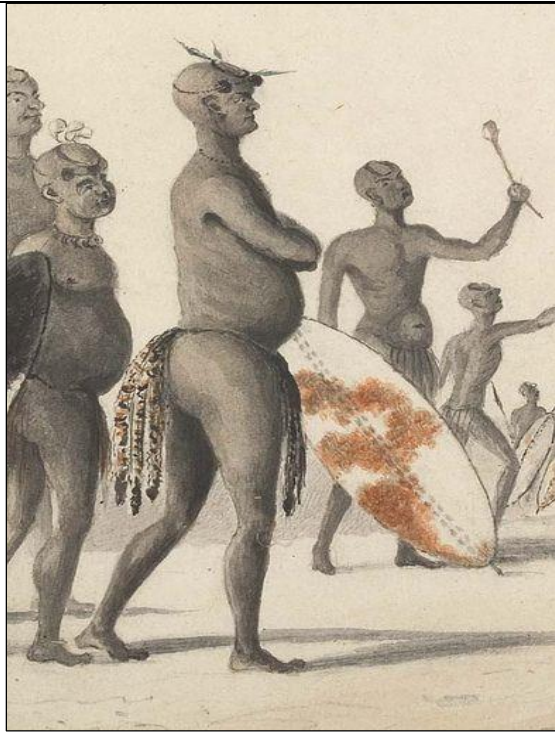


Figure 8 - King Mzilikazi of the Matabele. This illustration is by Captain Cornwallis Harris in c. 1838 (www.sahistory.org.za).

<p>1832</p>	<p>At this time, a Zulu impi of King Dingane moved through the general vicinity of the study area on their way to attack the Matabele of Mzilikazi, who were settled along the Magaliesberg Mountains (Bergh, 1999).</p>
<p>1836</p>	<p>The first Voortrekker parties started crossing over the Vaal River at this time. The earliest Voortrekker party to cross over the Vaal River was the one under the leadership of Louis Trichardt and Johannes Jacobus Janse van Rensburg. Although the exact route followed by the Trichardt-Janse van Rensburg party was not recorded, one suggestion is that they passed through the strip of land in-between the Bronkhorst Spruit in the west and the Wilge River to the east (Bergh, 1999). These two rivers are located to the east of Delmas.</p>
<p>1841 – 1850</p>	<p>These years saw the early establishment of farms by the Voortrekkers in the general vicinity of the study area (Bergh, 1999).</p>
<p>1845</p>	<p>Both the district and town of Lydenburg were established in this year (Bergh, 1999). The district of Lydenburg at the time encompassed a massive land mass, and it would appear that the study area fell just within this newly proclaimed district at the time.</p>

1857	The district of Pretoria was established in 1857, with the town of that name established in 1855 (Bergh, 1999). The study area now fell within this newly proclaimed district.
1866	The town and district of Heidelberg were established in this year (Bergh, 1999). The study area fell within the Heidelberg district at this time.
1883 - 1887	In 1883, the farm, "The Springs" was surveyed by James Brooks. Coal was discovered on the farm in 1887 and the region soon became the most productive coal mining region in the country. Unfortunately, the low quality and inflammable nature of the coal resulted in most of the coal mines closing down after better quality coal was discovered in Witbank (Erasmus, 2004).
1899 – 1902	<p>The South African War took place during this time. No events or activities during the war can be associated with the present study area. However, a number of such events and activities are known from the general vicinity. These will be briefly mentioned in the paragraphs below.</p> <p>Skirmishes or battles from the surrounding landscape include an action between a British force under the command Lieutenant-General J.D.P. French and a Boer commando of some 1 000 men on 23 July 1900. The main component of the battle occurred a short distance to the east and south-east of the present-day town of Delmas, at a distance of roughly 20 km east of the present study area (Changuion, 2001).</p> <p>Another incident occurred during the early morning of 26 December 1900, when a section of the Heidelberg Commando of some 350 men attacked the town of Benoni, as well as some of the gold mines surrounding the town, including the Kleinfontein Mine. The attack was a success, and according to some eye witnesses resulted in 22 British casualties (eight killed and 14 wounded), as well as the capture of three prisoners by the Boer commando (Blake, 2012).</p> <p>It is also interesting to note that the Boer Commando used the farm Rietkol as a meeting place from where the attack on Benoni proceeded (Blake, 2012).</p>



Figure 9 - Henning Petrus Nicolaas Viljoen (left) of the Heidelberg Commando, who's diary provides an eyewitness account of the attack on Benoni and its mines on 26 December 1900 (Blake, 2012). The image on the right depicts Lieutenant-General J.D.P. French, the commanding officer of the British force at the battle which occurred in close proximity to Delmas on 23 July 1900 (Changuion, 2001:77).

<p>1902</p>	<p>After the end of hostilities in 1902, the new Witwatersrand District was created from farms which were previously located in the districts of Krugersdorp, Heidelberg and Pretoria. The study area now fell within the district of Witwatersrand (Bergh 1999).</p>
<p>1907</p>	<p>The town of Delmas was laid out on the farm Witklip and comprised 192 residential stands, 48 smallholdings (of 4 hectares each) with a commonage of 134 hectares. It was established by the owner of Witklip, who was a Frenchman named Frank Dumat (Erasmus, 2004). The name Delmas was derived from the French phrase 'de le mas', which means 'of the small farm' (www.sa-venues.com).</p>

4.9 Palaeontological Background

4.9.1 Geological background

The proposed Manungu Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup);

Jurassic aged Dolerite and Quaternary superficial deposits (**Figure 10**). The geology of the development is illustrated on the 1:250 000 map (Banzai Environmental, 2018)

DWYKA GROUP

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup. During the Dwyka, South Africa lay below a massive ice sheet and thus the Dwyka deposits were deposited in a cold, glacially-dominated environment. The Dwyka Group consists mainly of gravelly sediments with subordinate varved shales and mudstones containing scraped and faceted pebbles. The retreating glaciers deposited dark-grey tillite. This Group is known for its rich assemblage of dropstones of various sizes (Banzai Environmental, 2018).

VRYHEID FORMATION

The Vryheid Formation is characterized by light grey, fine to coarse sandstone and siltstone sediments. The dark coloured siltstones can be accredited to the existence of carbon enrichment and coal beds. Infrequent coal seams, deltaic mudrocks and sandstones as well as coastal and fluvial deposits are present in this formation. These sediments were probably deposited on a sandy shoreline that stretched out beyond massive swamplands. In these swamps, plants accumulated and formed the coal deposits that are mined today (Johnson et al, 2006).

KAROO DOLERITE SUITE

The Karoo Dolerite Suite were formed in the Early Jurassic Period (approximately 183 million years ago). The Karoo Dolerite Suite is a widespread system of igneous bodies (dykes, sills) that encroached into the sediments of the Main Karoo Basin. These igneous rocks are unfossiliferous (Banzai Environmental, 2018).

QUATERNARY SUPERFICIAL DEPOSITS

The Tertiary to Quaternary Cenozoic superficial deposits consist of aeolian sand, alluvium (clay, silt and sand deposited by flowing floodwater in a river valley/ delta producing fertile soil), colluvium (material collecting at the foot of a steep slope), spring tufa/tuff (a porous rock composed of calcium carbonate and formed by precipitation from water, for example, around mineral springs) and lake deposits, peats, pedocretes or duricrusts (calcrete, ferricrete), soils and gravels.

4.9.2 Palaeontological Heritage

DWYKA GROUP

The Permo-Carboniferous Dwyka Group is known for its track ways (Ichnofacies) that were mostly formed by fish and arthropods (invertebrates) as well as for fossilized faeces (coprolites). When body fossils do occur they are of marine fish, gastropods and invertebrates as well as fossil plants (a rich diversity of glossopterids, cordaitaleans, conifers, ginkgoaleans, spores and pollens have been described while lycopods, ferns and horsetails are also found). Most of the Dwyka sediments are of low overall palaeontological sensitivity (Banzai Environmental, 2018).

VRYHEID FORMATION

The Vryheid Formation (Ecca Group) is world renowned for the occurrence of coal beds formed by the accumulation of plant material over long periods of time. 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).

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 while 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.

The Vryheid Formation is also characterised by its trace fossil assemblages of the non-marine *Mermia* Ichnofacies, insect fossils track ways, fish and small crustaceans. The *Mesosaurus* reptile may also be present (Banzai Environmental, 2018).

QUATERNARY SUPERFICIAL DEPOSITS

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Cenozoic superficial deposits although they sometimes comprise significant fossil biotas. Fossil assemblages may comprise mammalian teeth, bones and horn cores, reptile skeletons and

fragments of ostrich eggs. Microfossils, non-marine mollusc shells and freshwater stromatolites are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

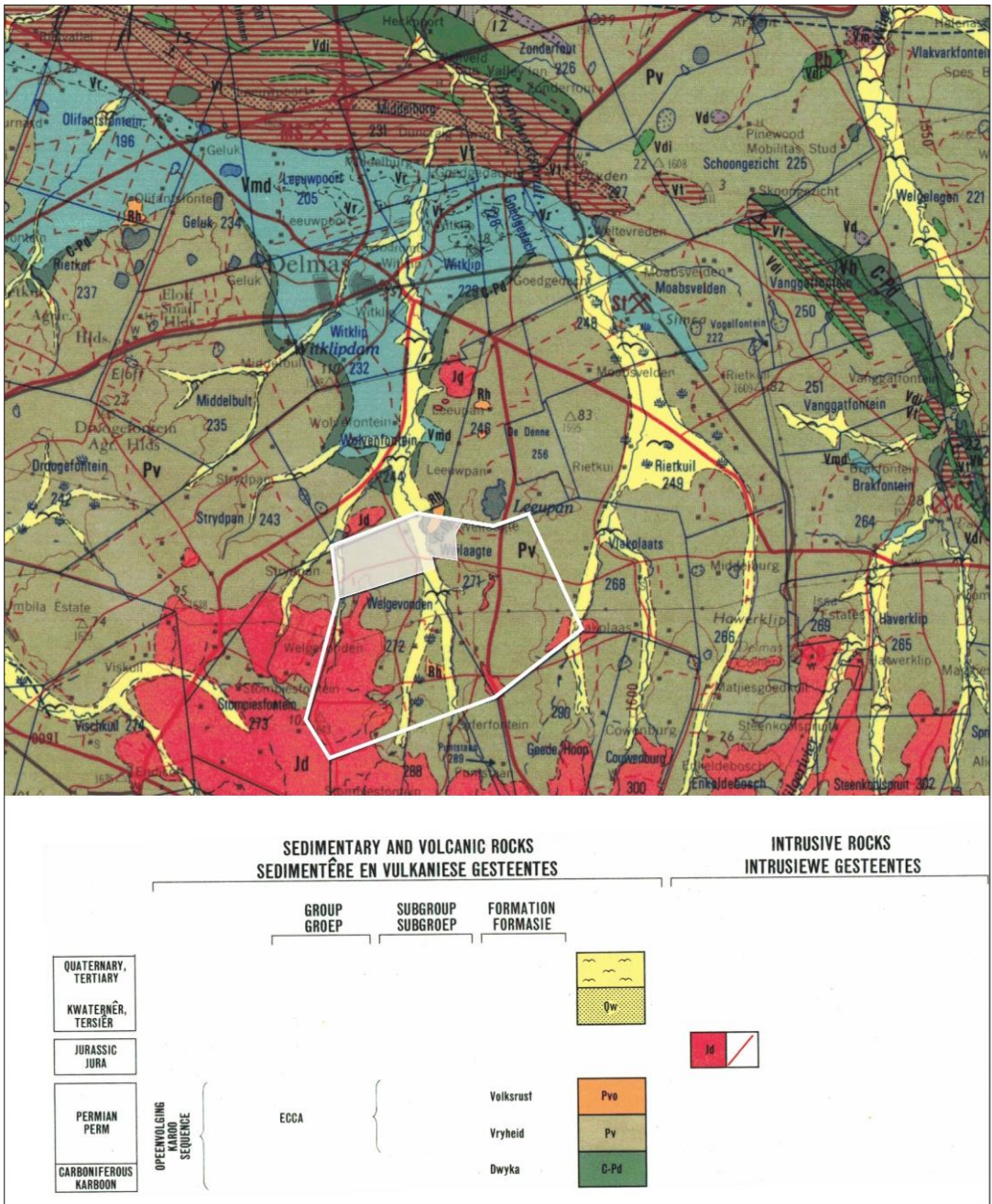


Figure 10 - Extract of the 2628 Geological map of the East Rand showing the surface geology of the proposed Manangu Colliery (shaded in white) near Delmas. The development site is completely underlain by by sedimentary rocks of the Permo-Carboniferous Dwyka Group (shaded in green); Permian aged Vryheid Formation (sandy coloured), (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (red) (Karoo Supergroup) and Quaternary superficial deposit (yellow). (Banzai Environmental, 2018)

5 FIELD WORK FINDINGS

Due to the nature of cultural remains, with the majority of artefacts occurring below the surface, a controlled-exclusive surface survey was conducted over a period of two days by vehicle and on foot by two archaeologists from PGS. The fieldwork was conducted from the 10th – 11th January 2018. The fieldwork was logged with a GPS receiver and all finds were marked (**Figure 11** and **Figure 12**).

During the field assessment, a total of 12 heritage sites were located. These include 7 burial grounds (**MN001, MN002, MN003, MN005, MN007, MN008 and MN012**) and 5 structures **MN004, MN006, MN009, MN010 and MN011**, Refer to **Figure 12** for the locality of the identified heritage resources in relation to the mining areas.

Figure 13 indicates the correlation between field finds and the First Edition topographical maps that shows relative ages of some of the structures.



Figure 11 – Track log of field assessment.



Figure 12- Located heritage features

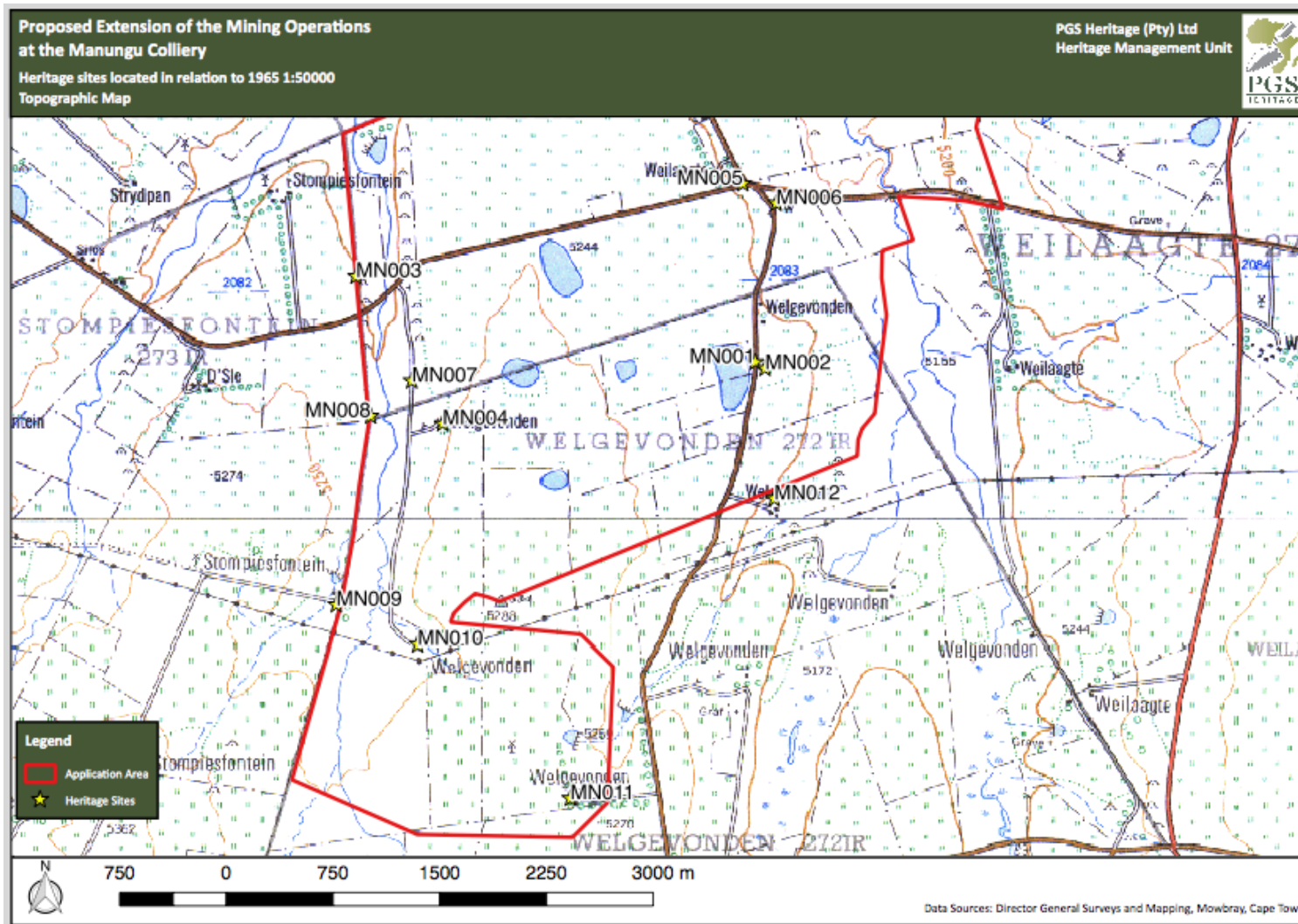


Figure 13 – Heritage sites located, in relation to 1965 Topographic map.

5.1 Site descriptions

Refer to section 7.5 for the recommended management measures as proposed for inclusion in the EMPr.

5.1.1 Site MN001:

GPS: -26.241968°, 28.699357°

Description: A burial ground was identified at this location.

Some of the graves have formal granite dressings with an inscribed granite headstone, others are unmarked or stone packed. There are approximately 50 graves which are orientated in an east to west direction that occur within this burial ground. There are no fences in place, and the site occurs next to an access road. Some names and dates include,

- David Wele Mbonani 26/10/1902 – 29/08/1983
- Mpotswana George Ndlangisa (no date)

Mining area: This site occurs within the planned opencast area.

Site size: 30m x 40m.

Site significance: GP.A

It is important to understand that the identified burial ground and the graves could have significant heritage value to the relevant families (if identified) and should therefore be preserved. The site is deemed to be of High/Medium Significance and is rated as Generally Protected A (GP.A).

The process of exhumation and re-interment of human remains in the Mpumalanga Province is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA), and the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act (Act 8 of 2005) (MPCCEBA). *The remainder of the provinces elected not to issue provincial law or regulation, but to implement Regulation 363 promulgated under the National Health Act (Act 61 of 2003) as the guidelines for the handling of human remains.*

The management and authorisation for the relocation of burial grounds and graves are managed under Subsection 3(a) of section 36 of the NHRA. This specifically controls relocations of *the grave*

of a victim of conflict (s3(a)(a) or graves or burial grounds older than 60 years (s3(a)(b)). While Regulation promulgated under the NHRA defines the consultation process to be complied with regarding burial grounds and graves.

All exhumation in the province is further managed by the provisions of the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act, 2005 (Act 8 of 2005) was gazetted on 27 December 2006. Of specific relevance is Section 14, which determines the process and requirements for the issuing of an approval for exhumation.

Mitigation measures and permits are therefore required before the graves may be affected or moved/destroyed.



Figure 14 – Burial ground at MN001



Figure 15 – MN001, not maintained or fenced

5.1.2 Site MN002

GPS: -26.242213° 28.699936°

Description: A Burial ground was identified at this location.

Occurring about 20 meters east from **MN001** at an east to west orientation. Some of the graves have formal granite dressings with an inscribed granite headstone, with several being unmarked or stone packed. There are approximately 30 to 40 graves which are orientated in an east to west direction that occur within this burial ground. This burial ground is not well maintained and has no fencing in place. Some names and dates include,

- Maria Mabena (No birth date - 13-09-1987)
- Magile Oria Sibanyoni (15-09-1968 – 03-09-1977)
- Melie Mahlangu (1968)

Mining area: Within the planned opencast area

Site size: 25m x 25m.

Site significance: GP.A

It is important to understand that the identified burial ground and the graves could have significant heritage value to the relevant families (if identified) and should therefore be preserved. The site is deemed to be of High/Medium Significance and is rated as Generally Protected A (GP.A).

The process of exhumation and re-interment of human remains in the Mpumalanga Province is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA), and the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act (Act 8 of 2005) (MPCCEBA). *The remainder of the provinces elected not to issue provincial law or regulation, but to implement Regulation 363 promulgated under the National Health Act (Act 61 of 2003) as the guidelines for the handling of human remains.*

The management and authorisation for the relocation of burial grounds and graves are managed under Subsection 3(a) of section 36 of the NHRA. This specifically controls relocations of *the grave of a victim of conflict (s3(a)(a) or graves or burial grounds older than 60 years (s3(a)(b)*. While Regulation promulgated under the NHRA defines the consultation process to be complied with regarding burial grounds and graves.

All exhumation in the province is further managed by the provisions of the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act, 2005 (Act 8 of 2005) was gazetted on 27 December 2006. Of specific relevance is Section 14, which determines the process and requirements for the issuing of an approval for exhumation.

Mitigation measures and permits are therefore required before the graves may be affected or moved/destroyed.



Figure 16 – Burial ground at MN002



Figure 17 – MN002 graves with formal dressing

5.1.3 Site MN003

GPS: -26.237266° 28.675183°

Description: A Burial ground was identified at this location

About 30 graves were located alongside a farm access road. The graves are orientated in an east to west position. Some of the graves have formal dressings, many of which have collapsed. The site is not fenced off and not maintained. Some names and dates include,

- Sibongile Masanabo (22-05-1971 - 18-01-1972)
- Moses Mabena (1969)

Mining area: Within the planned underground mining area

Site size: 25m x 20m.

Site significance: GP.A

It is important to understand that the identified burial ground and the graves could have significant heritage value to the relevant families (if identified) and should therefore be preserved. The site is deemed to be of High/Medium Significance and is rated as Generally Protected A (GP.A).

The process of exhumation and re-interment of human remains in the Mpumalanga Province is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA), and the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act (Act 8 of 2005) (MPCCEBA). *The remainder of the provinces elected not to issue provincial law or regulation, but to implement Regulation 363 promulgated under the National Health Act (Act 61 of 2003) as the guidelines for the handling of human remains.*

The management and authorisation for the relocation of burial grounds and graves are managed under Subsection 3(a) of section 36 of the NHRA. This specifically controls relocations of *the grave of a victim of conflict (s3(a)(a) or graves or burial grounds older than 60 years (s3(a)(b).* While Regulation promulgated under the NHRA defines the consultation process to be complied with regarding burial grounds and graves.

All exhumation in the province is further managed by the provisions of the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act, 2005 (Act 8 of 2005) was gazetted on 27 December 2006. Of specific relevance is Section 14, which determines the process and requirements for the issuing of an approval for exhumation.



Figure 18 – MN003 burial ground



Figure 19 – Overgrown conditions at MN003

5.1.4 Site MN004:

GPS: -26.245259° 28.680407°

Description: Several structures occur at this location. An old farm stead (6 rooms) with several out buildings, a grain silo and a farm house are in a poor state of preservation. The building materials consist of mostly red brick and cement for the main structure, with yellow brick used where additions to the structure occur. Red brick and cement were used for the later structures. The structure does occur on the first edition topographic map which suggests it may be older than 60 years and therefore a protected under s34 of the NHRA. Further investigation will need to take place to determine a more accurate age of the structures.

Mining area: Affected farm portion just north of the current LOM area

Site size: 100m x 100m.

Site significance: GP.B

The structures are protected under s34 of the NHRA and will require a permit before destruction of the site can occur.



Figure 20 – MN004 dilapidated farm house



Figure 21 – Old stone walling at MN004

5.1.5 Site MN005:

GPS: -26.232208° 28.698668°

Description: Burial ground

Two graves occur at this location. They both have small headstones with no inscriptions. The burial ground is formally fenced off.

Mining area: Current LOM area

Site size: 5 x 5m.

Site significance: GP.A.

It is important to understand that the identified burial ground and the graves could have significant heritage value to the relevant families (if identified) and should therefore be preserved. The site is deemed to be of High/Medium Significance and is rated as Generally Protected A (GP.A).



Figure 22 – Fenced off burial ground at MN005



Figure 23 – Two concrete dressings at MN005

5.1.6 Site MN006:

GPS: -26.233262° 28.700685°

Description: Structures in a very poor state of decay were located here. Possible old farmstead with a water tank stand remaining. The structures have already been demolished and have little significance.

Mining area: Current LOM area

Site size: 50m x 50m.

Site significance: None



Figure 24 – Rubble remains at MN006

5.1.7 Site MN007:

GPS: -26.242909° 28.678618°

Description: A Burial ground was identified at this location

Two graves orientated in an east to west fashion occur here. The graves are poorly fenced and not maintained. The graves are marked with concrete headstones. There is an unmarked white sign made of corrugated metal marking the site. No dates occur on the headstones.

Mining area: Planned underground area

Site size: 2x2m

Site significance: GP.A

It is important to understand that the identified burial ground and the graves could have significant heritage value to the relevant families (if identified) and should therefore be preserved. The site is deemed to be of High/Medium Significance and is rated as Generally Protected A (GP.A).

The process of exhumation and re-interment of human remains in the Mpumalanga Province is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA), and the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act (Act 8 of 2005) (MPCCEBA). *The remainder of the provinces elected not to issue provincial law or regulation, but to implement Regulation 363 promulgated under the National Health Act (Act 61 of 2003) as the guidelines for the handling of human remains.*

The management and authorisation for the relocation of burial grounds and graves are managed under Subsection 3(a) of section 36 of the NHRA. This specifically controls relocations of *the grave of a victim of conflict (s3(a)(a) or graves or burial grounds older than 60 years (s3(a)(b).* While Regulation promulgated under the NHRA defines the consultation process to be complied with regarding burial grounds and graves.

All exhumation in the province is further managed by the provisions of the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act, 2005 (Act 8 of 2005) was gazetted on 27 December 2006. Of specific relevance is Section 14, which determines the process and requirements for the issuing of an approval for exhumation.



Figure 25 – MN007 with poor fencing and white marker



Figure 26 – MN007 concrete headstone

5.1.8 Site MN008:

GPS: °-26.245152° 28.676021°

Description: A burial ground is located here.

There are several graves at this location, however it was difficult to discern the total number. At least 20 headstones were counted, but there are also stone packed graves and possible unmarked graves occurring in the burial ground. The site was incredibly overgrown. The definite graves cover a distance of about 50 meters suggesting graves could occur within the spaces between the headstone positions. There is some remains of fencing, but it is almost non-existent.

Mining area: Planned underground area

Site size: 50m x 15m.

Site significance: GP.A

It is important to understand that the identified burial ground and the graves could have significant heritage value to the relevant families (if identified) and should therefore be preserved. The site is deemed to be of High/Medium Significance and is rated as Generally Protected A (GP.A).

The process of exhumation and re-interment of human remains in the Mpumalanga Province is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA), and the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act (Act 8 of 2005) (MPCCEBA). *The remainder of the provinces elected not to issue provincial law or regulation, but to implement Regulation 363 promulgated under the National Health Act (Act 61 of 2003) as the guidelines for the handling of human remains.*

The management and authorisation for the relocation of burial grounds and graves are managed under Subsection 3(a) of section 36 of the NHRA. This specifically controls relocations of *the grave of a victim of conflict (s3(a)(a) or graves or burial grounds older than 60 years (s3(a)(b))*. While Regulation promulgated under the NHRA defines the consultation process to be complied with regarding burial grounds and graves.

All exhumation in the province is further managed by the provisions of the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act, 2005 (Act 8 of 2005) was gazetted on 27 December 2006. Of specific relevance is Section 14, which determines the process and requirements for the issuing of an approval for exhumation.



Figure 27 – General view of graves at MN008



Figure 28 – MN008 formal dressings

5.1.9 Site MN009:

GPS: -26.255190° 28.674147°

Description: Several structures occur at this location. The structures appear on the first edition topographic map as the farm Stompiesfontein. Many of the buildings are clearly more recent, however the original structure could be considered a heritage as the walling is stone built. The more recent structures can be identified as they are built with red brick. Alterations on the main stone structure (sand stone) can be seen with the addition of red brick.

Mining area: Planned underground area

Site size: 150m x 50m.

Site significance: Provisionally graded GP.B

Some of the structure on site are older than 60 years and protected under s34 of the NHRA. Any alterations or destruction of the site can only be done with a permit issued under s34 of the NHRA.



Figure 29 –Sand stone structure at MN009



Figure 30 – MN009 general view



Figure 31 – Remains of a rondavel MN009



Figure 32 – MN009 within the stone building

5.1.10 Site MN010:

GPS: -26.257222° 28.678894°

Description: Stone foundations occur at this location. Little remains of the original structure. The structures are shown on the first edition topographic maps. It must be noted that infant or stillborn burials could occur around such structures. Such burials are a part of African customs (and must be considered during vegetation and soil clearing around these sites).

Mining area: Planned underground area

Site size: 20m x 20m.

Site significance: Provisionally graded GP.B

The site is provisionally graded as locally significant GP.B, due to the possible presence of infant burials.



Figure 33 – Mound showing the foundations MN010



Figure 34 –MN010 foundations

5.1.11 Site MN011:

GPS: -26.266189° 28.688138°

Description: A farmstead is located here. The farm structures are presently in use. The buildings can also be seen on the first edition topographic maps and therefore possibly have heritage significance.

Mining area: Planned underground area

Site size: 400m x 300m.

Site significance: Provisionally graded GP.B

It is recommended that the building is evaluated by an architectural historian to determine the architectural significance of the older buildings on site.



Figure 35 – Farm house at MN011



Figure 36 – Animal enclosures at MN011

5.1.12 Site MN012:

GPS: -26.249394° 28.700546°

Description: A burial ground occurs at this location.

The burial ground consists of three graves, two with granite dressings and one unmarked. No fences demarcate the site and it is overgrown and poorly maintained. The names and dates include;

- Johannes Stephanus Gerhardus Venter (23-05-1874 – 27-01-1941)
- Hester Susara Fourie (06-06-1883 – 18-08-1947)

Mining area: Planned opencast area

Site size: 2m x 2m.

Site significance: GP.A

It is important to understand that the identified burial ground and the graves could have significant heritage value to the relevant families (if identified) and should therefore be preserved. The site is deemed to be of High/Medium Significance and is rated as Generally Protected A (GP.A).

The process of exhumation and re-interment of human remains in the Mpumalanga Province is governed by the National Heritage Resources Act (Act 25 of 1999) (NHRA), and the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act (Act 8 of 2005) (MPCCEBA). *The remainder of the provinces elected not to issue provincial law or regulation, but to implement Regulation 363 promulgated under the National Health Act (Act 61 of 2003) as the guidelines for the handling of human remains.*

The management and authorisation for the relocation of burial grounds and graves are managed under Subsection 3(a) of section 36 of the NHRA. This specifically controls relocations of *the grave of a victim of conflict (s3(a)(a) or graves or burial grounds older than 60 years (s3(a)(b).* While Regulation promulgated under the NHRA defines the consultation process to be complied with regarding burial grounds and graves.

All exhumation in the province is further managed by the provisions of the Mpumalanga Cemeteries, Crematoria and Exhumation of Bodies Act, 2005 (Act 8 of 2005) was gazetted on 27 December 2006. Of specific relevance is Section 14, which determines the process and requirements for the issuing of an approval for exhumation.



Figure 37 – Graves at MN012



Figure 38 – MN012 formal dressing

6 IMPACT ASSESSMENT

The aim of the impact evaluation is to determine the extent of the impact of the proposed project on the identified heritage resources and predict possible impacts on unidentified heritage resources.

During the field work a total of twelve heritage related sites were identified. These can be subdivided into burial grounds, and recent or historic structures. It must be considered that the heritage significance of the identified site plays a role in the evaluation of the impact and must influence the magnitude rating of the impact tables. Thus, a heritage resource with a high heritage significance rating will have a higher impact magnitude rating than a resource with a low or no heritage significance rating. Consequently, mitigation measures will be more extensive for a heritage resource with a high heritage significance than for those with a low heritage significance.

All the impacts are envisaged to happen during construction activities. Where there is an impact during Operations/Mining this is mentioned pertinently in the following section.

6.1 Status Quo and “No Go” option

6.2 Status Quo

No fatal flaws were identified from a cultural, historical, archaeological and paleontological perspective

6.3 “No go” Option

No such option is contemplated.

6.4 Project Impact

6.5 Heritage resources and sensitivity

Table 10 indicates the locality of each identified heritage resource in relation to the proposed mining areas.

Table 10: Heritage resources in relation to development areas

Resource Number	Type	Heritage Grading	Impact Zone
MN001	Burial ground	GP.A	Planned opencast
MN002	Burial ground	GP.A	Planned opencast
MN003	Burial ground	GP.A	Planned underground
MN004	Structure	Provisionally GP.B	Affected farm portion
MN005	Burial ground	GP.A	Current LOM
MN006	Structure	none	Current LOM
MN007	Burial ground	GP.A	Planned underground
MN008	Burial ground	GP.A	Planned underground
MN009	Structure	Provisionally GP.B	Planned underground
MN010	Structure	Provisionally GP.B	Planned underground
MN011	Structure	Provisionally GP.B	Planned underground
MN012	Burial ground	GP.A	Planned opencast

The identified heritage resources are allocated a sensitivity buffer based on the general accepted management buffers accepted by SAHRA in the past few years. No regulations in the NHRA provide guidelines on buffer zones. In the case of heritage sensitivity, a buffer of 20 – 50 meters is proposed based on the type of heritage resource. In the case of Burial grounds and graves (BGG) a buffer of 50 meters is generally proposed and 20 meters for a heritage structure such as ruins and other built structures (**Figure 39**).

The Mine Health and Safety Act No. 29 of 1996, Regulation 17(7), however further determines that no mining can take place closer than 100 meters from man-made structures which would include burial grounds and graves (BBG). **Figure 39** provides an indication of the 100-meter buffers required around BGGs in the event that the BGG is not relocated.

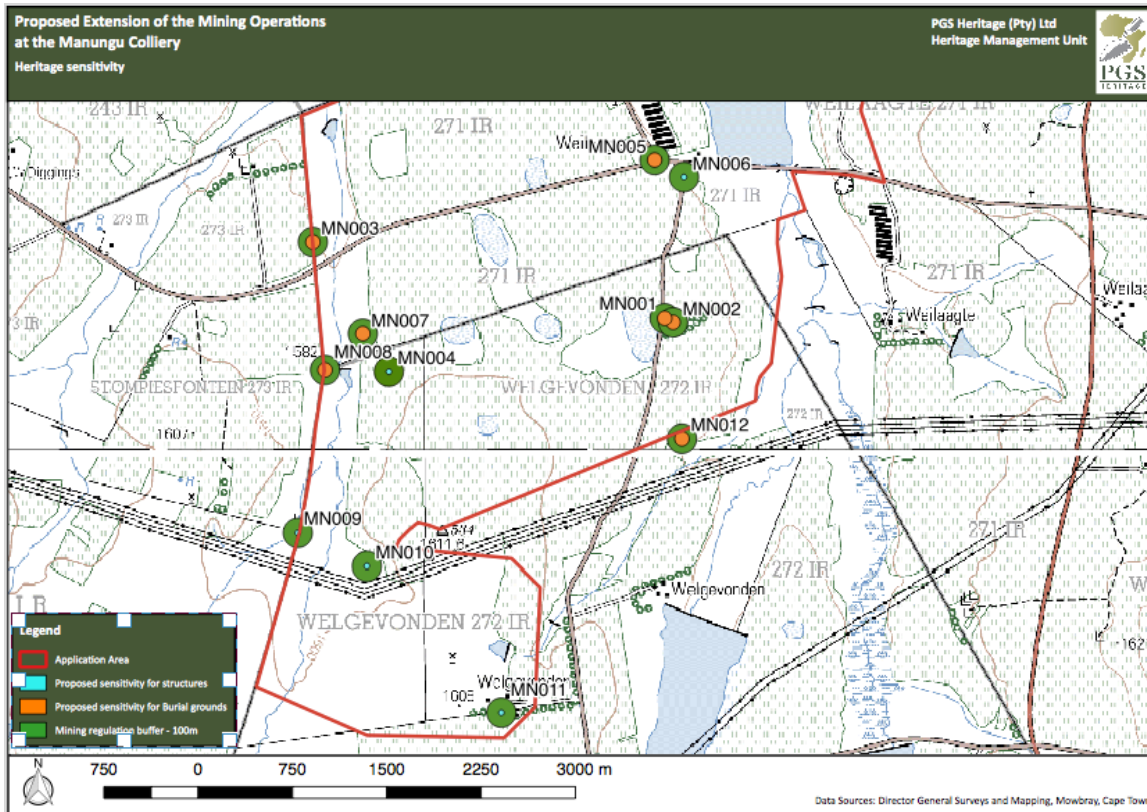


Figure 39 - Proposed management buffers based on heritage sensitivities of the resources identified

6.6 Impact on recent historic structures

A total of five recent historic structures were identified of which one (**MN006**) has no heritage significance. The remaining four historic heritage resources (**MN004**, **MN009**, **MN010** and **MN011**) are all rated as having a medium to high heritage significance. In the case of **MN010**, this is based on the probability of infant or stillborn burials occurring around the structures. Such burials are a part of African customs (and must be considered during vegetation and soil clearing around these sites).

The historic structures (**MN004**, **MN009**, **MN010** and **MN011**) will not be directly impacted by mining. The impact significance rated as MEDIUM negative before mitigation and with the implementation of the mitigation measures the impact significance is reduced to LOW negative.

Table 11 – Impact assessment table - Destruction of heritage structures

Impact Name	Destruction of Heritage structures				
Alternative	0				
Phase	Construction				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	1	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	3	2
Environmental Risk (Pre-mitigation)					-11,25
Mitigation Measures					
<i>MN009, MN010, and MN011 should not be directly affected as they occur on UG mining areas. MN004 is located on an affected farm portion. The sites should be avoided with at least a 20 m buffer if activities should occur near them. If the sites will be affected directly, the sites will need to be documented before a destruction permit can be applied for at the provincial heritage authority (Mpumalanga). In the event that any other heritage resources are uncovered SAHRA should be contacted and a qualified archaeologist appointed to evaluate the finds and make appropriate recommendation on mitigation</i>					
Environmental Risk (Post-mitigation)					-6,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
<i>Low: Issue not raised in public responses</i>					
Cumulative Impacts					3
<i>Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.</i>					
Degree of potential irreplaceable loss of resources					3
<i>The impact may result in the irreplaceable loss of resources of high value (services and/or functions).</i>					
Prioritisation Factor					1,67
Final Significance					-10,00

6.7 Impact on burial grounds

Seven (7) burial grounds in total have been identified during the field work. Due to the social and cultural significance of burial grounds and graves a high heritage significance is given to these sites. Of the seven cemeteries six are informal, with no fences demarcating the sites. Only **MN005** has been officially demarcated.

The impact of the proposed project on the burial grounds is rated as having a HIGH negative significance before mitigation and with the implementation of mitigation measures as having a LOW negative significance.

Table 12 - Assessment of impact of mining on burial grounds

Impact Name	Destruction of burial grounds				
Alternative	0				
Phase	Construction				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature of Impact	-1	-1	Magnitude of Impact	5	2
Extent of Impact	2	1	Reversibility of Impact	5	5
Duration of Impact	4	4	Probability	5	2
Environmental Risk (Pre-mitigation)					-20.00
Mitigation Measures					
<i>Demarcate sites with a 50-meter buffer and avoid them. If the sites cannot be avoided a grave relocation process will need to take place. Stakeholder engagement will need to be implemented to determine the possibility of infant burials at MNO10</i>					
Environmental Risk (Post-mitigation)					-6.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
<i>Low: Issue not raised in public responses</i>					
Cumulative Impacts					2
<i>Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.</i>					
Degree of potential irreplaceable loss of resources					3
<i>The impact may result in the irreplaceable loss of resources of high value (services and/or functions).</i>					
Prioritisation Factor					1.50
Final Significance					-9.00

In the event of any heritage resources being uncovered SAHRA should be contacted and a qualified archaeologist appointed to evaluate the finds and make appropriate recommendation on mitigation

The combined weighted project impact to the heritage resources (prior to mitigation) is medium. After mitigation the impacts will be low to medium.

7.3 Impact on Paleontological Resources

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. However, although fossil occurrences are generally uncommon, a single fossil may scientifically be very important as many fossil taxa are known from a single fossil only.

The impact of the proposed project on the palaeontology is rated as having a LOW negative significance before mitigation and with the implementation of mitigation measures as having a LOW negative significance.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

Table 13 - Assessment of impact of mining on palaeontological resources

A. Destruction of Fossil Heritage -					
Impact Name	Destruction of Fossil Heritage				
Alternative	0				
Phase	Construction				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	5	5	Probability	3	1
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
<p>It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.</p> <p>In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations or removal of vegetation, the ECO in charge for the developments ought to be informed immediately. These finds must be protected (if possible <i>in situ</i>) and the ECO must alert SAHRA (South African Heritage Research Agency) to make sure that mitigation (<i>e.g.</i> recording, sampling or collection) can be undertaken by a professional paleontologist.</p>					

Preceding any excavation of fossils, a collection permit from SAHRA must be obtained. The fossil material must be housed in an approved collection (museum or university collection) and the fieldwork and reports need to comply with the minimum standards for palaeontological impact studies developed by SAHRA.	
Environmental Risk (Post-mitigation)	-2,50
Degree of confidence in impact prediction:	Medium
Impact Prioritisation	
Public Response	1
<i>Low: Issue not raised in public responses</i>	
Cumulative Impacts	2
<i>Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.</i>	
Degree of potential irreplaceable loss of resources	1
<i>The impact is unlikely to result in irreplaceable loss of resources.</i>	
Prioritisation Factor	1,17
Final Significance	-2,92

7 MANAGEMENT RECOMMENDATIONS AND GUIDELINES

7.1 Construction phase

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area 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, such as construction camps and laydown areas, is often changed or added to the project as required. In general, these are low impact developments as they are superficial, resulting in 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 is implemented.

7.2 Chance find procedure

- A heritage practitioner 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 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 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 impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the archaeologist.

7.3 Possible finds during construction

The study area contains numerous old homesteads as identified during the fieldwork. Excavations of foundations and soil clearance can uncover the following:

- Stone foundations;
- Ash middens associated with the farmsteads and homesteads that can contain bone, glass and clay ceramics, ash, metal objects such as spoons, forks, and knives.
- Possible infant burials

7.4 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 14** gives guidelines for lead times on permitting.

Table 14: Lead times for permitting and mobilisation

ACTION	RESPONSIBILITY	TIMEFRAME
Preparation for field monitoring and finalisation of contracts	The contractor and service provide	1 months

ACTION	RESPONSIBILITY	TIMEFRAME
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	1 month
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 ground or graves in the way of construction	Service provider – Archaeologist, SAHRA, local government and provincial government	6 months

7.5 Heritage Management Plan for EMP implementation

NO.	MITIGATION MEASURES	PHASE	TIMEFRAME	RESPONSIBLE PARTY FOR IMPLEMENTATION	MONITORING PARTY (FREQUENCY)	TARGET	PERFORMANCE INDICATORS (MONITORING TOOL)	COST
<i>Possible finds</i>								
A	Implement chance find procedures in case where possible heritage finds area made	Construction	During construction	Applicant ECO Heritage Specialist	ECO (weekly)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	Possibly R50 000
Known sites								
Structur es	<ul style="list-style-type: none"> <i>MN004, MN009, MN010, and MN011</i> should be demarcated with a 20m buffer if activities are to occur in close proximity If the sites are to be directly affected, the sites will need to be documented before a destruction permit can be applied for at the provincial heritage authority (Mpumalanga). In the event that any other heritage resources are uncovered SAHRA should be contacted and a qualified archaeologist appointed to evaluate the finds and make 	Construction	During construction	Applicant ECO	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	Between R100-200 000

NO.	MITIGATION MEASURES	PHASE	TIMEFRAME	RESPONSIBLE PARTY FOR IMPLEMENTATION	MONITORING PARTY (FREQUENCY)	TARGET	PERFORMANCE INDICATORS (MONITORING TOOL)	COST
	appropriate recommendation on mitigation.							
Burial Grounds	<ul style="list-style-type: none"> Demarcate sites with a 50-meter buffer and avoid them. Stakeholder engagement will need to be implemented to determine the possibility of infant burials at MN010 If this is not possible a detailed grave relocation process must be implemented as required under the NHRA and National Health Act regulations. 	Construction	During construction	Applicant ECO	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	Approximately R2 - 3 million
Palaeontology	<ul style="list-style-type: none"> The following recommendations ought to form part of the EMP of the Manungu Colliery mining project. The EAP and ECO for the Manungu Colliery should be informed that the sediments of the Vryheid Formation, Ecca Group contain important fossil remains of plant fossil assemblages and trace fossil. 	Construction through to Operational	Construction Operational	Applicant ECO Palaeontologist	Applicant ECO	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report	Less than R100 000

8 CONCLUSION

PGS was appointed by EIMS to undertake an HIA that forms part of the EIA as part of the proposed extension of the mining operations at the existing Manungu colliery, near Delmas, Victor Local Municipality, Mpumalanga Province.

During the field assessment, a total of 12 heritage sites were located. These include 7 burial grounds (**MN001, MN002, MN003, MN005, MN007, MN008 and MN012**) and 5 structures **MN004, MN006, MN009, MN010 and MN011**, Refer to Figure 12 for the locality of the identified heritage resources in relation to the mining areas.

The management and mitigation measures as described in Section 7 of this report have been developed to minimise the project impact on heritage resources. Impacts on historic or recent structures are rated as a MEDIUM NEGATIVE before mitigation and a LOW NEGATIVE after mitigation measures are implemented. Impacts on Burial grounds and Graves are rated as having a HIGH NEGATIVE before mitigation and a LOW NEGATIVE after mitigation measures are implemented. Impacts on Palaeontological resources are rated as a LOW NEGATIVE before and after mitigation measures are implemented.

It is my considered opinion that overall impact on heritage resources after the implementation of the recommended mitigation measures is acceptably low and that the project can be approved from a heritage perspective.

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ANNEXURE A – PALAEOLOGICAL IMPACT ASSESSMENT

**PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE AUTHORISATION AND AMENDMENT
PROCESSES FOR MANANGU MINE NEAR DELMAS, VICTOR KHANYE LOCAL MUNICIPALITY,
MPUMALANGA**

Prepared for:

PGS Heritage (Pty) Ltd

DATE: 17 January 2018

Prepared by

BANZAI ENVIRONMENTAL (PTY) LTD

EXECUTIVE SUMMARY

Geo Soil and Water cc (GSW) was appointed by Tshedza Mining Resources (Pty) Ltd., a subsidiary of Mbuyelo Coal (Pty) Ltd as the Environmental Assessment Practitioner (EAP) to assist with the undertaking of the required authorisation and amendment procedures for Manungu Colliery. The planned new mining development falls within the list of properties approved under the NEMA for a range of listed activities. According to the National Heritage Resources Act (Act No 25 of 1999, section 38), a palaeontological impact assessment is essential to detect the existence of fossil material within the planned development footprint and to evaluate the impact of the construction and operation of the proposed development on the palaeontological heritage.

The proposed development footprint of the Manungu Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (Karoo Supergroup) and Quaternary superficial deposits.

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup. This Group is characterized by the presence of trace fossils (track ways, coprolites), body fossils of marine fish, gastropods and invertebrates as well as fossil plants. The rocks of the **Dwyka** are of **low palaeontological sensitivity**. The Vryheid Formation of the Ecca Group is well-known for the presences of coal beds which have been formed due to the accumulation of plant material over long periods of time. Trace fossils, fish, small crustaceans, insects, as well as plant fossils are common in this Formation. The sedimentary rocks of the **Vryheid Formation** have a **very high palaeontological sensitivity**. The **Dolerite** of the Jurassic has a **very low palaeontological sensitivity** as these rocks are unfossiliferous. The fossil assemblages of the Quaternary deposits (low palaeontological sensitivity) are usually rare, low in diversity, and occur over a wide geographic area.

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. Regardless of the uncommon occurrence of fossils in this biozone a solitary fossil may be of scientific value as many fossil taxa are known from a single fossil. The recording of fossils will enhance our knowledge of the Palaeontological Heritage of the development area.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations or removal of vegetation, the ECO in charge of the developments ought to be informed immediately. These finds must be protected (if possible *in situ*) and the ECO must alert SAHRA (South African Heritage Research Agency) to make sure that mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist.

Preceding any excavation of fossils a collection permit from SAHRA must be obtained. The fossil material must be housed in an accredited collection (museum or university collection) and the fieldwork and reports need to comply with the minimum standards for palaeontological impact studies developed by SAHRA.

Recommendations:

1. The following recommendations ought to form part of the EMP of the Manungu Colliery mining project.
2. The EAP and ECO for the Manungu Colliery should be informed that the sediments of the Vryheid Formation, Ecca Group contain important fossil remains of plant fossil assemblages and trace fossils.
3. A qualified palaeontologist must be employed to assess and record fossils recovered at the development footprint.
4. These fossils may be placed on a stockpile where a professional palaeontologist may inspect them at regular intervals (determined by the mine and palaeontologist).

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1 INTRODUCTION

Tshedza Mining Resources (Pty) Ltd. (Tshedza) proposes the expansion of the existing beneficiation facility (crushing and screening plant) to include a coal processing facility at Manungu Colliery. The Colliery will consist of opencast and underground mining operations and associated infrastructure. Tshedza will present an application for the appropriate approvals to cover their 30 year life-of-mine (LOM). The planned new processing facility will comprise of a coal wash plant with associated residue discard dump and water management infrastructure. The processing facility and discard dump will be situated within the mining right border. It is expected that several listed activities contained in the National Environmental Management Act (Act 107 of 1998) (NEMA), National Environmental Management Waste Act (Act 59 of 2008) (NEMWA) and National Water Act (Act 36 of 1998) (NWA) will be triggered by the planned facilities and/or amendments.

The wash plant will consist of the following: (information provided by Geo Soil and Water cc)

- Dry fines screening circuit;
- Dense Medium Separation (DMS) module;
- Feed desliming
- Circulating medium circuit
- Dilute medium circuit
- Grits dewatering circuit
- Tailings thickener circuit
- Tailings filter circuit
- Product handling circuit
- Plant services circuit
- Raw and potable water system; and
- Process water circuit.

Tshedza plan to incorporate the licensing of three new boreholes for domestic intake and a French drain system to increase the septic tank system for grey water as part of the application processes. Various possibilities are planned to manage spare water volumes within the pollution control dam. Several amendments to the present EA/EMP and IWUL will be applied for to support the specific conditions with the current status of the mine as well as to explain certain conditions.

The following application processes with associated activities are planned:

- New Integrated Environmental Authorisation (Scoping and Environmental Impact Report (S&EIR)) for:
 - Erection of a wash plant and related infrastructure to supplement the existing coal beneficiation plant; and
 - Dumping of wash plant waste (requiring Waste Management Licence).
 - New residue deposits and/or residue stockpiles (requiring Waste Management Licence); and
 - Several activities comprising the primary processing of a mineral resource associated to the 30 year LOM.
- New Integrated Water Use Licence (IWUL) for:
 - Discard (wash plant waste) disposal;
 - Abstraction boreholes;
 - A new French drain system; and
 - Evaporation sprays at the present pollution control dam (PCD).
- Amendments to current Environmental Authorisation and Environmental Management Plan for among others:
 - Stockpile height amendments;
 - Stockpile vegetation requirements; and
 - Tree screen requirements.
- Amendments to the existing IWUL for:
 - Update of water balance for PCD;
 - Water storage volume;
 - Ash layer condition below run of mine (ROM);
 - Flow meter reading frequency; and
 - Additional storm water structures within watercourses.
- Section 102 Amendment (to be confirmed with the Competent Authority)
 - Revised Mine Works Programme to include wash plant; and
 - Revised consolidated EMPR to include wash plant.

LISTED ACTIVITIES APPLICATION:

The planned project must be authorized in terms of South African environmental legislation:

- The Mineral and Petroleum Resources Development Act (MPRDA, Act No. 28 of 2002);
- The National Environmental Management Act (NEMA, Act No. 107 of 1998);
- The National Environmental Management Waste Act (NEMWA, Act No, 59 of 2008); and
- The National Water Act (NWA, Act No. 36 of 1998).

The following listed activities are anticipated to be triggered by the proposed new infrastructure, facilities and amendments to existing licences on Manungu Colliery.

- NEMA GNR 983: Activities 12,19, 20, 24, 34;
- NEMA GNR 984: Activities 6, 15

- NEMA GNR 985: Activity: 14
- NEMWA GNR 921: Category B11.
- NWA: Section 21 (a) and (g) water uses;
- NWA: GN 704

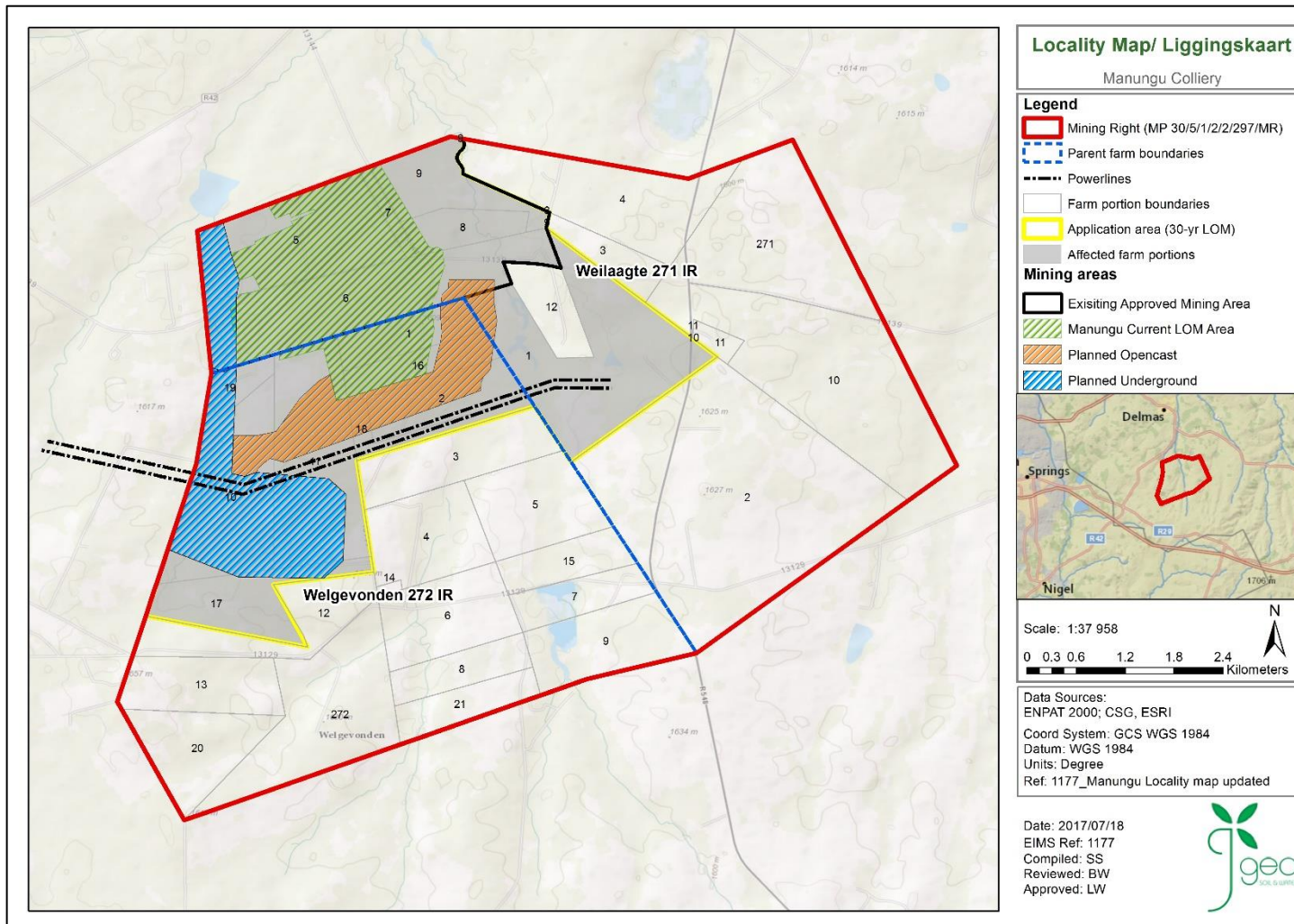


Figure 1: Locality map of the Manungu Colliery. (Map provided by GeoSoil and Water).

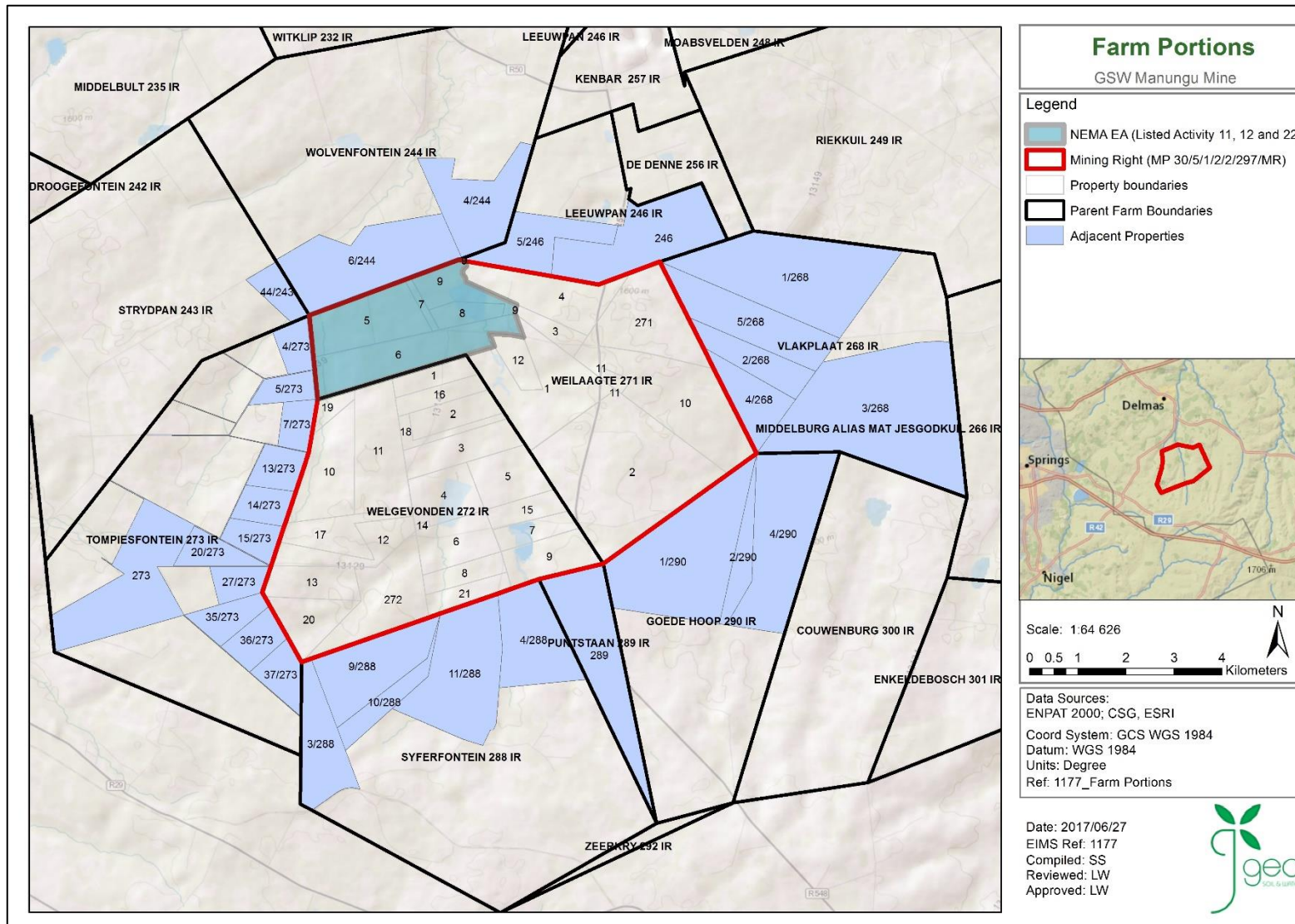


Figure 2: Relevant farm portions of the Manungu Colliery. (Map provided by GeoSoil and Water).

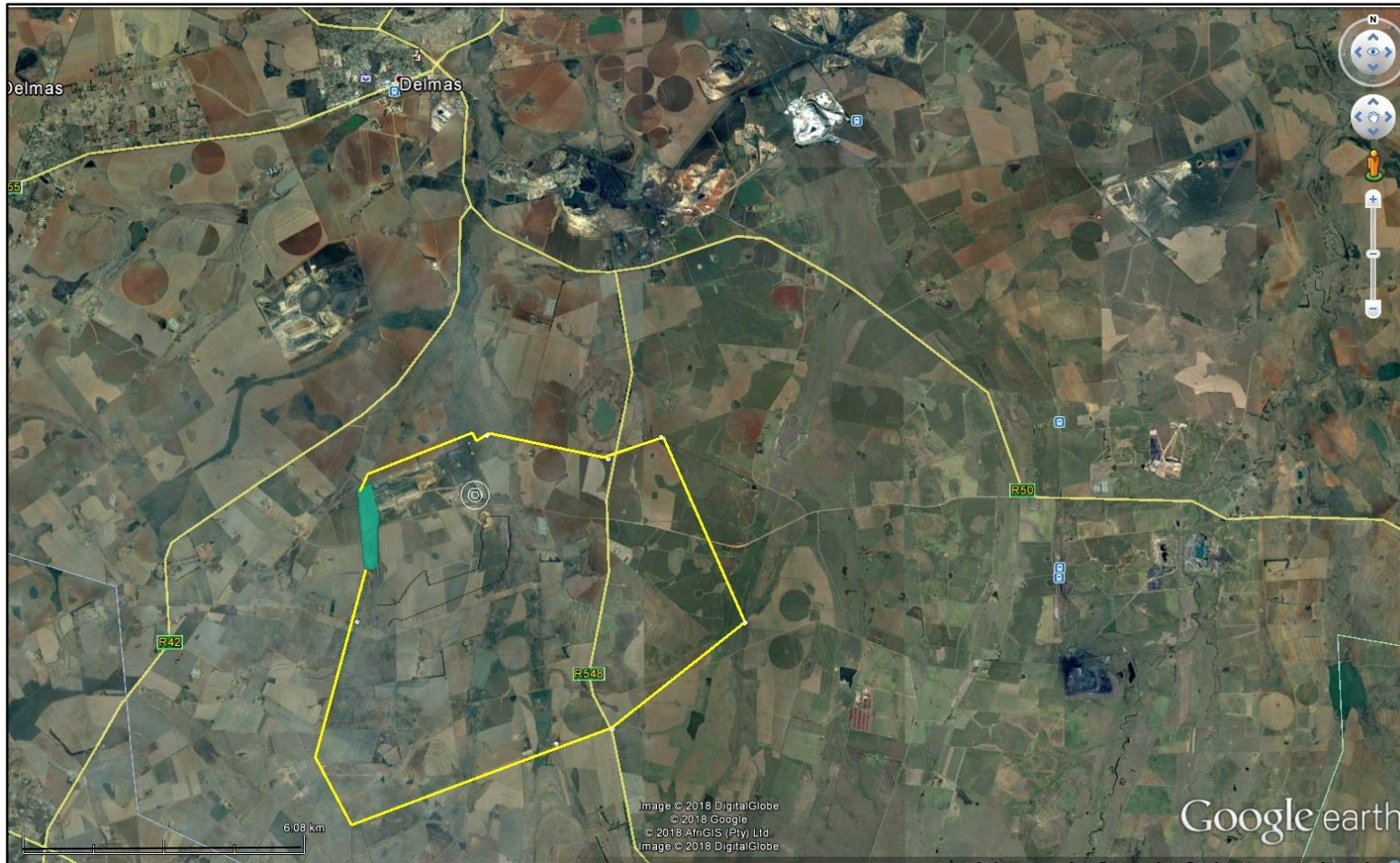


Figure 3: Google Earth Image (2018) of the proposed mining development on the Manungu Colliery. Scale bar represented by 6.08 km

2 LEGISLATION

NATIONAL HERITAGE RESOURCES ACT (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). Heritage resources as defined in Section 3 of the Act include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”. Palaeontological heritage is unique and non-renewable and is protected by the above-mentioned Act. Palaeontological resources may not be unearthed, moved, broken or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority.

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

ACCORDING TO SECTION 35 OF THE NATIONAL HERITAGE RESOURCES ACT 1999, DEALING WITH ARCHAEOLOGY, PALAEOLOGY AND METEORITES:

35. (1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority—

(a) Destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) Destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(a) Serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

(b) Carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and (d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

(6) The responsible heritage resources authority may, after consultation with the owner of the land on which an archaeological or palaeontological site or a meteorite is situated, serve a notice on the owner or any other controlling authority, to prevent activities within a specified distance from such site or meteorite.

(7) (a) Within a period of two years from the commencement of this Act, any person in possession of any archaeological or palaeontological material or object or any meteorite which was acquired other than in terms of a permit issued in terms of this Act, equivalent provincial legislation or the National Monuments Act, 1969 (Act No. 28 of 1969), must lodge with the responsible heritage resources authority lists of such objects and other information prescribed by that authority. Any such object which is not listed within the prescribed period shall be deemed to have been recovered after the date on which this Act came into effect. (b) Paragraph (a) does not apply to any public museum or university. (c) The responsible authority may at its discretion, by notice in the *Gazette* or the *Provincial Gazette*, as the case may be, exempt any institution from the requirements of paragraph (a) subject to such conditions as may be specified in the notice, and may by similar notice withdraw or amend such exemption.

(8) An object or collection listed under subsection (7) — (a) Remains in the ownership of the possessor for the duration of his or her lifetime, and SAHRA must be notified who the successor is; and (b) must be regularly monitored in accordance with regulations by the responsible heritage authority.

HERITAGE RESOURCES MANAGEMENT

38. (1) Subject on the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorized as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site—(i) exceeding 5 000 m² in extent; or (ii) involving three or more existing erven or subdivisions thereof; or (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority (d) the re-zoning of a site exceeding 10 000 m² in extent; (e) or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

3 SCOPE

The **objective of a Palaeontological Impact Assessment is to determine the impact of the development on potential palaeontological material** at the site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the aims of the palaeontological impact assessment are: 1) to identify the palaeontological importance of the exposed and subsurface rock formations in the development footprint 2) to evaluate the palaeontological importance of the formations 3) to determine the impact of the development on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

When a palaeontological desktop study is compiled, the potentially fossiliferous rocks (i.e. groups, formations, etc.) present within the study area are established from 1:250 000 geological maps. The topography of the development area is identified using 1:50 000 topography maps as well as Google Earth Images of the development area. Fossil heritage within each rock section is obtained from previous palaeontological impact studies in the same region, the PalaeoMap from SAHRIS; and databases of various institutions (identifying fossils found in locations specifically in areas close to the development area). The palaeontological importance of each rock unit of the development area is then calculated. The possible impact of the proposed development footprint on local fossil heritage is established on the following criteria: 1) the palaeontological importance of the rocks and 2) the type and scale of the development footprint and 3) quantity of bedrock excavated.

In the event that rocks of moderate to high palaeontological sensitivity are present within the study area, a field-based assessment by a professional palaeontologist is required. Based on both the desktop data and field examination of the rock exposures, the impact significance of the planned development is measured with recommendations for any further studies or mitigation. In general, destructive impacts on palaeontological heritage only occur during construction. The excavations will transform the current topography and may destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

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

4 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed Manungu Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite and Quaternary superficial deposits (Fig.4-5). The geology of the development is illustrated on the 1:250 000 map

4.1 Geology

DWYKA GROUP

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup. During the Dwyka, South Africa lay below a massive ice sheet and thus the Dwyka deposits were deposited in a cold, glacially-dominated environment. The Dwyka Group consists mainly of gravelly sediments with subordinate varved shales and mudstones containing scraped and faceted pebbles. The retreating glaciers deposited dark-grey tillite. This Group is known for its rich assemblage of dropstones of various sizes.

VRYHEID FORMATION

The Vryheid Formation is characterized by light grey, fine to coarse sandstone and siltstone sediments. The dark coloured siltstones can be accredited to the existence of carbon enrichment and coal beds. Infrequent coal seams, deltaic mudrocks and sandstones as well as coastal and fluvial deposits are present in this formation. These sediments were probably deposited on a sandy shoreline that

stretched out beyond massive swamplands. In these swamps, plants accumulated and formed the coal deposits that are mined today (Johnson et al, 2006).

KAROO DOLERITE SUITE

The Karoo Dolerite Suite were formed in the Early Jurassic Period (approximately 183 million years ago). The Karoo Dolerite Suite is a widespread system of igneous bodies (dykes, sills) that encroached into the sediments of the Main Karoo Basin. These igneous rocks are unfossiliferous.

QUATERNARY SUPERFICIAL DEPOSITS

The Tertiary to Quaternary Cenozoic superficial deposits consist of aeolian sand, alluvium (clay, silt and sand deposited by flowing floodwater in a river valley/ delta producing fertile soil), colluvium (material collecting at the foot of a steep slope), spring tufa/tuff (a porous rock composed of calcium carbonate and formed by precipitation from water, for example, around mineral springs.) and lake deposits, peats, pedocretes or duricrusts (calcrete, ferricrete), soils and gravels.

4.2 Palaeontological Heritage

DWYKA GROUP

The Permo-Carboniferous Dwyka Group is known for its track ways (Ichnofacies) that were mostly formed by fish and arthropods (invertebrates) as well as fossilized faeces (coprolites). When body fossils do occur it is of marine fish, gastropods and invertebrates as well as fossil plants (a rich diversity of glossopterids, cordaitaleans, conifers, ginkgoaleans, spores and pollens have been described while lycopods, ferns and horsetails are also found). Most of the Dwyka sediments are of low overall palaeontological sensitivity.

VRYHEID FORMATION

The Vryheid Formation (Ecca Group) is world renowned for the occurrence of coal beds formed by the accumulation of plant material over long periods of time. 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.*, *Lidgettonia sp.*, *Noeggerathiopsis sp.*, *Podocarpidites sp* as well as more than 20 *Glossopteris* species).

Bamford (2011) is of the opinion that only a small amount of data have been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines while 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.

The Vryheid Formation is also characterised by its trace fossil assemblages of the non-marine *Mermia* Ichnofacies, insect fossils track ways, fish and small crustaceans. The *Mesosaurus* reptile may also be present

QUATERNARY SUPERFICIAL DEPOSITS

Quaternary fossil assemblages are generally rare and low in diversity and occur over a wide-ranging geographic area. These fossil assemblages may in some cases occur in extensive alluvial and colluvial deposits cut by dongas. In the past palaeontologists did not focus on Cenozoic superficial deposits although they sometimes comprise significant fossil biotas. Fossil assemblages may comprise mammalian teeth, bones and horn cores, reptile skeletons and fragments of ostrich eggs. Microfossils, non-marine mollusc shells and freshwater stromatolites are also known from Quaternary deposits. Plant material such as foliage, wood, pollens and peats are recovered as well as trace fossils like vertebrate tracks, burrows, termitaria (termite heaps/ mounds) and rhizoliths (root casts).

STRATIGRAPHY							
AGE		WEST OF 24°E	EAST OF 24° E	FREE STATE/ KWAZULU- NATAL	SACS RECOGNISED ASSEMBLAGE ZONES	PROPOSED BIOSTRATIGRAPHIC SUBDIVISIONS	
JURASSIC	"STORMBERG"		Drakensberg F.	Drakensberg F.			
			Clarens F.	Clarens F.		<i>Massospondylus</i>	
TRIASSIC	"STORMBERG"		Elliot F.	Elliot F.		" <i>Euskelosaurus</i> "	
			MOLTENO F.	MOLTENO F.			
PERMIAN	BEAUFORT GROUP		BURGERSDORP F.	DRIEKOPPEN F.	<i>Cynognathus</i>		
			KATBERG F.	VERKYKERSKOP F.	<i>Lystrosaurus</i>	A	
			Palingkloof M.	Harrismith M.	<i>Daptocephalus</i>		
			Elandsberg M.	Schoondraai M.			
			Barberskrans M.	Rooinekke M.			
			Daggaboersnek M.	Frankfort M.			
			Steenkamps- vakte M.	BALFOUR F.	VOLKSRUST F.	<i>Cistecephalus</i>	
			Oukloof M.	Oudeberg M.		<i>Tropidostoma</i>	
			Hoedemaker M.	MIDDELTON F.		<i>Pristerognathus</i>	
			Poortjie M.			<i>Tapinocephalus</i>	UPPER UNIT
			ABRAHAMSKRAAL F.	KROONAP F.		<i>Eodicynodon</i>	LOWER UNIT
			WATERFORD F.	WATERFORD F.			
			TIERBERG/ FORT BROWN F.	FORT BROWN F.			
			LAINGSBURG/ RIPON F.	RIPON F.		VRYHEID F.	
COLLINGHAM F.	COLLINGHAM F.	PIETER- MARITZBURG F.					
WHITEHILL F.	WHITEHILL F.						
PRINCE ALBERT F.	PRINCE ALBERT F.		" <i>Mesosaurus</i> "				
CARBON- IFEROUS	DWYKA GROUP			MBIZANE F.			
			ELANDSVLEI F.	ELANDSVLEI F.		ELANDSVLEI F.	

SANDSTONE-RICH UNIT HIATAL SURFACE END BEAUFORT GROUP HIATUS

Figure 4: Lithostratigraphic (rock-based) and biostratigraphic (fossil-based) subdivisions of the Ecca and Beaufort Group of the Karoo Supergroup with rock units and fossil assemblage zones relevant to the present study marked in green (Modified from Rubidge 1995). The subdivisions of the Ecca Group include the Vryheid Formation which is Early Permian in age. Abbreviations: F. = Formation, M. = Member.

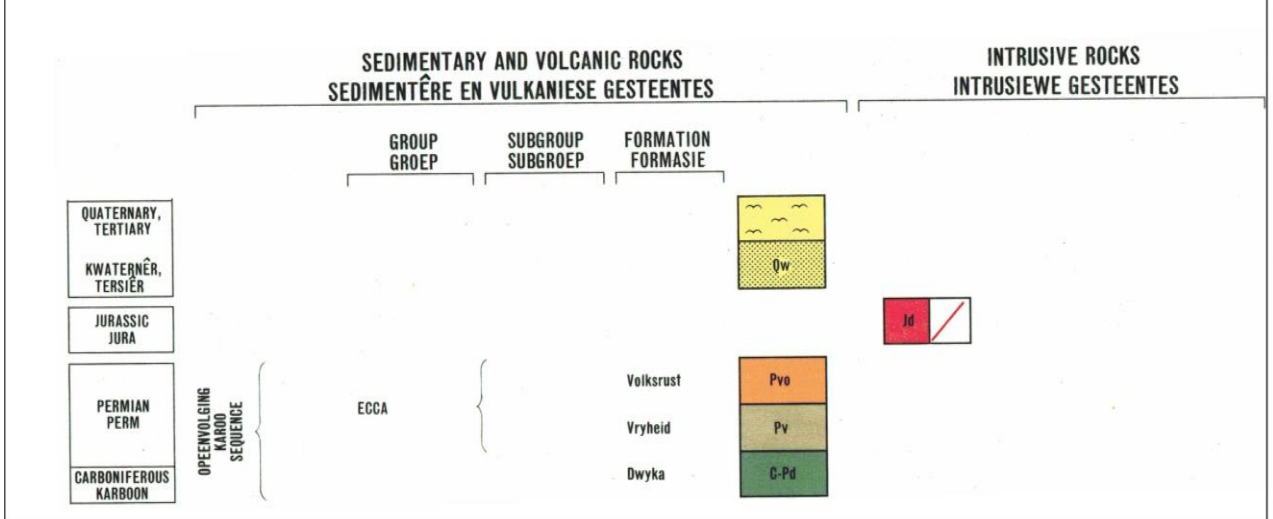
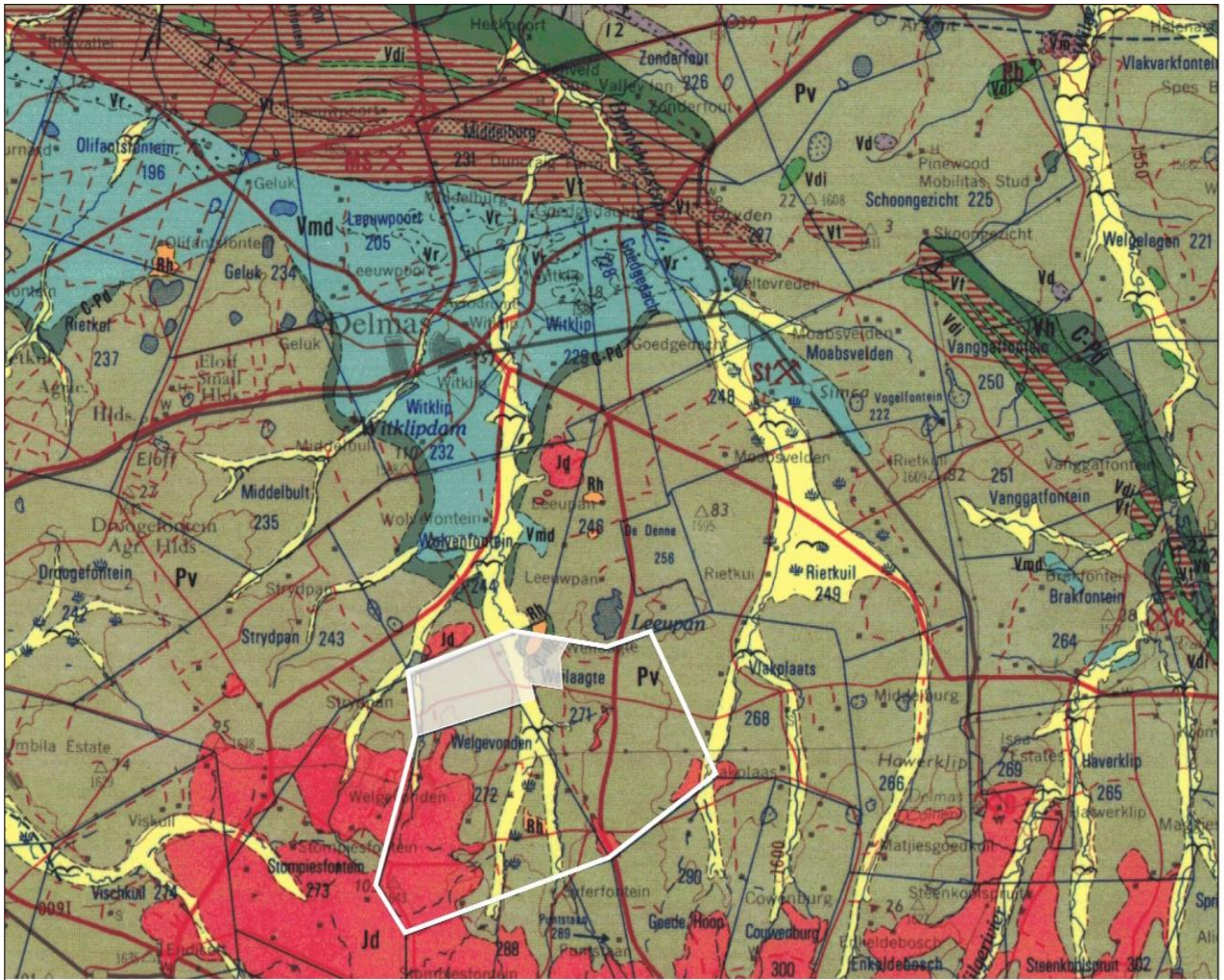


Figure 5: Extract of the 2628 Geological map of the East Rand. The surface geology of the proposed Manungu Colliery (shaded in white) near Delmas. The development site is completely underlain by by sedimentary rocks of the Permo-Carboniferous Dwyka Group (shaded in green); Permian aged Vryheid Formation (sandy coloured), (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite (red) (Karoo Supergroup) and Quaternary superficial deposit (yellow).

5 GEOGRAPHICAL LOCATION OF THE SITE

The existing Manungu Colliery is located 9 km south of Delmas. The Colliery covers all portions of the farms Weilaagte 271IR and Welgevonden 272IR (comprising the approved mining right area) within the Victor Khanye Local Municipality, Mpumalanga, South Africa (Fig. 1-3).

6 METHODS

A Palaeontological Scoping study was thus conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed area of development. The author's experience, aerial photos (using Google, 2018), topographical and geological maps and other reports from the same area were used to assess the proposed area of the development. The proposed development area has been heavily changed from natural habitats by decades of agricultural development. As the ground surface has been disturbed the possibility of recovering fossil heritage on the surface is small.

26° 14" 27'S; 28° 40" 13'E



26° 13"52E; 28°38" 60'S



26° 16"53'S; 28°39" 56'E



2616"33'S; 28°40" 25'E



26° 16"33'S; 28°40" 25'E



26° 13'32"S; 28°43' 45'E



6.1 Assumptions and Limitations

The accurateness of Palaeontological Desktop Impact Assessments is reduced by old fossil databases that do not always include relevant locality or geological formations. The geology in various remote areas of South Africa may be less accurate because it is based entirely on aerial photographs. The accuracy of the sheet explanations for geological maps is inadequate as the focus was never intended to be on palaeontological material.

The entire South Africa has not been studied palaeontologically. Similar Assemblage Zones but in different areas, might provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations generally assume that unexposed fossil heritage is present within the development area. Thus, the accuracy of the Palaeontological Impact Assessment is improved by a field-survey.

7 IMPACT ASSESSMENT

Impacts from mining are rated as medium significance (Table 13).

Table 15 - Assessment of impact of mining on palaeontological resources

A. Destruction of Fossil Heritage -					
Impact Name	Destruction of Fossil Heritage				
Alternative	0				
Phase	Construction				
Environmental Risk					
Attribute	Pre-mitigation	Post-mitigation	Attribute	Pre-mitigation	Post-mitigation
Nature of Impact	-1	-1	Magnitude of Impact	2	1
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	5	5	Probability	3	1
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
<p>It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.</p> <p>In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations or removal of vegetation, the ECO in charge for the developments ought to be informed immediately. These finds must be protected (if possible <i>in situ</i>) and the ECO must alert SAHRA (South African Heritage Research Agency) to make sure that mitigation (<i>e.g.</i> recording, sampling or collection) can be undertaken by a professional paleontologist.</p> <p>Preceding any excavation of fossils a collection permit from SAHRA must be obtained. The fossil material must be housed in an approved collection (museum or university collection) and the fieldwork and reports need to comply with the minimum standards for palaeontological impact studies developed by SAHRA.</p>					
Environmental Risk (Post-mitigation)					-2,50
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					1
<i>Low: Issue not raised in public responses</i>					
Cumulative Impacts					2
<i>Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.</i>					
Degree of potential irreplaceable loss of resources					1
<i>The impact is unlikely to result in irreplaceable loss of resources.</i>					

Prioritisation Factor	1,17
Final Significance	-2,92

8 FINDINGS AND RECOMMENDATIONS

The proposed consolidation footprint of the Manungu Colliery is entirely underlain by sedimentary rocks of the Permo-Carboniferous Dwyka Group; Permian aged Vryheid Formation, (Ecca Group, Karoo Supergroup); Jurassic aged Dolerite and Quaternary superficial deposits.

The Permo-Carboniferous Dwyka Group forms the oldest deposit in the Karoo Supergroup. This Group is characterized by the presence of trace fossils (track ways, coprolites), body fossils of marine fish, gastropods and invertebrates as well as fossil plants. The rocks of the Dwyka are of low palaeontological sensitivity. The Vryheid Formation of the Ecca Group is world renowned for the presence of coal beds which have been formed due to the accumulation of plant material over long periods of time. Trace fossils as well as fish, small crustaceans, insects, and plant fossils are common in this Formation. The sedimentary rocks of the Vryheid Formation have a very high palaeontological sensitivity. The Dolerite of the Jurassic has a very low palaeontological sensitivity as these rocks are unfossiliferous. The fossil assemblages of the Quaternary deposits (low palaeontological sensitivity) are usually rare, low in diversity, and occur over a wide geographic area. The fossil heritage of Quaternary deposits may sometimes contain important fossil biotas.

During a thorough field survey of the proposed development footprint no fossils were found. Mining thus far, has also not recovered any fossils. For this reason, a moderate palaeontological sensitivity is allocated to the development footprint. However, although fossils occurrences are generally uncommon, a single fossil may scientifically be very important as many fossil taxa are known from a single fossil.

It is therefore considered that the construction and operation of the development footprint and associated infrastructure is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

In the event that fossil remains are discovered during any phase of construction, either on the surface or exposed by new excavations and removal of vegetation, the ECO in charge of these developments should be informed immediately. These discoveries must be protected (preferably *in situ*) and the ECO must alert SAHRA (South African Heritage Research Agency) to ensure that mitigation (*e.g.* recording, sampling or collection) can be undertaken by a professional paleontologist.

Preceding any excavations of fossils a collection permit from SAHRA must be obtained. Fossil material ought to be curated in an accredited collection (*e.g.* museum or university collection) and all fieldwork and reports must comply with the minimum standards for palaeontological impact studies developed by SAHRA.

Recommendations:

1. The following recommendations ought to form part of the EMP of the Manungu Colliery mining project.
2. The EAP and ECO for the Manungu Colliery should be informed that the sediments of the Vryheid Formation, Ecca Group contains important fossil remains of plant fossil assemblages and trace fossil.
3. A qualified palaeontologist must be employed to assess and record fossils recovered at the development footprint. These fossils may be placed on a stockpile where a professional palaeontologist may inspect them at regular intervals (determined by the mine and palaeontologist).

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10 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty three years. She has been conducting Palaeontological Impact Assessments since 2014.

11 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 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 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 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 a palaeontological specialist 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;*

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SIGNATURE:

