HYDROGEOLOGICAL STUDY REPORT

2023

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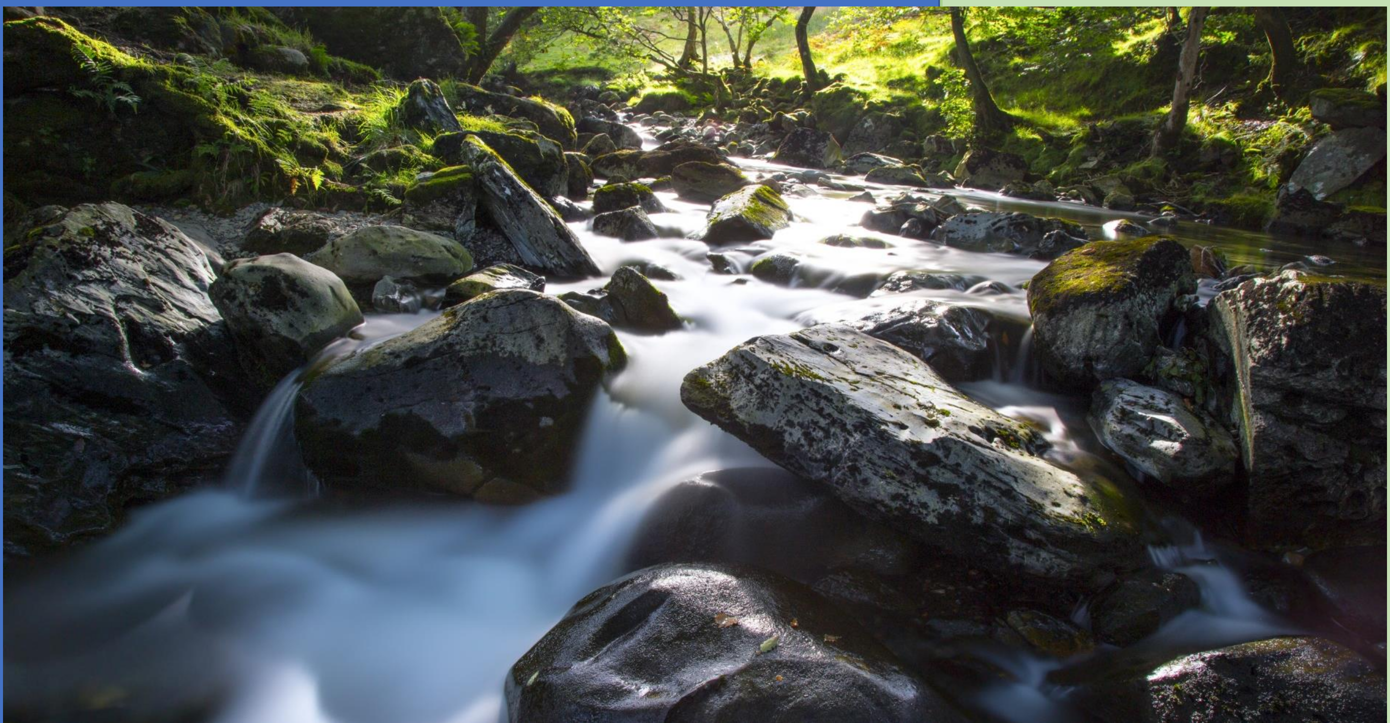

Hydrogeological Report on behalf of Siphosizwe Construction CC for the proposed Mining Permit Application on portion of Portion 139 of the farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province

PREPAID BY:

Singo Consulting (Pty) Ltd

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Project Information

Report type	**Hydrogeological Study for a Mining Permit**	
Project title	Hydrogeological Report on behalf of Siphosizwe Construction CC for the proposed Mining Permit Application on portion of Portion 139 of the farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province	
Mineral (s)	Coal	
Client	Siphosizwe Construction CC	
Site location	Portion of Portion 139 of the farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province	
Version	01	
Date	April 2023	
		Electronic signatures
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1. INTRODUCTION

1.1 Background information

Siphosizwe Constraction CC has appointed Singo Consulting (Pty) Ltd as an independent consulting company to conduct a hydrogeological study. The hydrogeological study is being conducted in support of a mining permit application for coal mineral within portion of portion 139 of the farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province

The proposed activity has a potential to contaminate the groundwater through possible accident of leakage and infiltration to the sub-surface. The proposed study area is in the residential zone and any possible groundwater pollution will have impact on down-gradient located external user's boreholes.

Chapter 3 of the National Water Act (Act 36 of 1998) requires that a person who owns, control, occupies, uses the land is responsible for preventing pollution of water resources and is also responsible to remedy (correct) the effects of the pollution. It is with this Act that the hydrogeological report was deemed necessary for the site to gather all relevant information related to groundwater and its related potential impacts.

Facilities on site within the mining permit area include but not limited to:

- Pollution control Dam
- Mobile Sanitation
- Mobile crushing and screening unit
- ROM stockpile area
- Overburden stockpile area
- Product Stockpile area
- Topsoil and Subsoil stockpile area

The aim of this study is:

- To assess the quality condition of surface and groundwater within and around the mining permit area, and to draft a water monitoring programme for the project site and provide recommendations.
- Prediction of the environmental impact of the proposed mining activity on the geohydrological regime of the area.
- Forecasting the effects of the activity on the receiving environment

1.2 Proposed Activities

The activities to take place are categorized based on phases of the life of the mine.

Construction phase:

- Clearing of vegetation
- Hardening surfaces to create roads
- Installation of mobile machinery such as crusher.

Operational Phase:

- Movement of machinery
- Stripping of overburden
- Coal processing which include but not limited to crushing

1.3 Scope of work

- Description of the baseline groundwater regime:
  - Conduct hydrocensus of existing boreholes, including groundwater use type and volume.
  - Identification of monitoring boreholes during which hydrogeological data such as depth to water strike and groundwater quality will be monitored.
  - Laboratory testing of samples for physical, chemical, and biological parameters.

- Environmental impact assessment using 3D numerical flow and contaminant transport modelling to calculate:
  - Groundwater inflow volumes into the mining area over the life of mine.
  - The cone of dewatering that forms due to mine dewatering and its development over time. This includes the impact on surrounding groundwater users.
  - Contaminant transport away from point and diffuse sources within the mining area and the impacts on surrounding aquifers and users.

- Reporting:
  - Using the above components, a final hydrogeological report is compiled.

- Information Sourcing and Literature review.
  To determine the baseline climatic and hydrological parameters of the site and surroundings, research on multiple information sources was conducted:
  - QGIS was used to identify streams, wetlands.
  - Scientific journals and scientific books

- Department of water affairs for the document on aquifer classification of south Africa.
- Aerial imagery of the world map (Google earth).

- **Legislation and policy context:**

  The following legislation was considered during the compiling of this assessment.

  - **The National Water Act (Act 36 of 1998**):

    The NWA governs water resource management in South Africa. As guardians of water, the Department of Human Settlements, Water and Sanitation (DHSWS) must guarantee that resources are used, preserved, safeguarded, developed, managed, and controlled in a sustainable manner for the benefits of all people of south Africa and the environment. Key provisions applying to the current study include:

    - **Catchment Areas** - Any disturbance to a watercourse, such as the construction and operation of surface mining infrastructure, may require authorisation from DWS.

  - **Regulations on the use of Water for Mining and Related Activities:**

    Government Notice 704 or GN704 was established to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. The four main regulations of GN704 applicable to this project are:

    - **Condition 4** – indicates that no person in control of a mine or activity may locate or place any residue deposit, dam, reservoir, together with any structure of another facility within the 1:100-year flood line or within a horizontal distance of 100-metres from any watercourse
    - **Regulation 5** - indicates that no residue or substance which causes or is likely to cause pollution of a water resource may be used in the construction of any dams, impoundments or embankments or any other infrastructure which may cause pollution of a water resource.
    - **Regulation 6** - describes the capacity requirements of clean and dirty water systems. Clean and dirty water systems must be kept separate and must be designed, constructed, maintained, and operated to ensure conveyance of the flows of a 1:50-year recurrence event. Clean and dirty water systems should not spill into each other more frequently than once in 50 years. Any dirty water dams should have a minimum freeboard of 0.8m above full supply level
    - **Regulation 7** - describes the measures which must be taken to protect water resources. All dirty water or substances which may cause pollution should be prevented from entering a water resource (by spillage, seepage, erosion etc.) and ensure that water used in any process is recycled as far as practicable.

2. TERMS OF REFERENCE

The baseline hydrogeological assessment for the project area is mainly constructed by a combination of desktop study and site-specific field study. Most of the information used for this study was compiled with an aid of nearby study sites information and experience from similar geohydrological settings. All collected data will be compiled to construct a conceptual geohydrological model.

The objective of the study:

- To collect hydrogeological and geochemical baseline information to address the subsequent environmental impact assessment for the coal mining permit.
- To draft management and mitigation measures for identified impacts outlined for the construction, operational, decommissioning, and post-mining phase of the project and associated monitoring programme.

The following aspects covered in this hydrogeological study:

Table 1: Hydrogeological aspects in the study.

Aspect	Description
Desktop Study	❖ Project Initiation and Data Collection ❖ Review available site specific hydrogeological and hydrological information to conceptualize the different aquifer systems and their interaction with surface water features in the area.
Site visits	❖ Site visit is the most significant part of the investigation, a site visit was conducted to collect water samples and conducting hydrocensus at the surrounding firms (within 2kms) of the project area.
Groundwater levels	❖ A water level meter was used to measure the water level at all the boreholes within the study site
Aquifer classification	❖ Aquifers will be classified into either minor or major aquifer types and dominant water source will be identified
Hydrogeological Modelling	❖ Interpret geochemical analyses of water samples conducted by Regen waters Lab. ❖ Numerical Groundwater Flow and Transport Model o Model inputs o Model Calibration o Scenario Modelling o Hydrogeological Impact Assessment

Reporting	❖ Writing a comprehensive geohydrological report outlining all the findings and existing environment of the proposed project area. This groundwater specialist report compiles all methodologies, findings, quantitative analysis (geochemical assessment and modelling outcomes), impact assessments, recommendations (proposed monitoring programme and recommended mitigation measures for predicted impacts) and conclusions. Appendices to the specialist report will include laboratory results.

3. METHODOLOGY

3.1 Hydrocensus

Hydrocensus' literally means, 'water census'. A hydrocensus is a task that involves gathering information on water features, water supply sources and sources of potential water pollution in a particular site or area (Alana, Kerry, and Irene, 2004).

A hydrocensus aims to:

- Identify details of water-related features (e.g., storm water channels, erosion gullies, weirs, diversion embankments), and disused or abandoned boreholes and wells.
- Identify features where water could collect in rainy periods (quarries, borrow pits, seasonal puddles, etc.).
- Identify potential sources of contamination (latrines, waste disposal sites, animal kraals, defecation sites, animal watering points, soak-away pits and drains, etc.).
- Identify visible features and symptoms (e.g. borehole casing rusted away at the surface, presence of algal blooms in stagnant water) that indicate the potential for water contamination.
- Identify water sources and, where possible, indicate the flow rate and the quality.

3.2 Sampling and chemical analysis

The data was collected using a variety of equipment, including a water level meter, a handheld GPS, a measuring tape, and a bailer. On site, these tools were employed on a variety of boreholes. For each borehole that was being monitored, the hand GPS was utilized to determine the longitudinal, latitude, and elevation. The measuring tape was used to take all collar height measurements of the boreholes after recording the GPS coordinates. The water levels were measured using a level meter and a measuring tape.

3.2.1 Surface water sampling

- **Sampling using sampling Vessels**

Before sampling, the sampler must thoroughly clean the sampling vessel on site by rinsing it with water three to four times. Care must be taken to avoid contaminating the water used for sampling during rinsing. Gently submerge the collecting vessel, fill it with the water sample, and securely close it. If the obtained water sample can be frozen, leave some room for expansion equal to around 10% of the sampling vessel (Singh, 2015).

3.2.2 Groundwater sampling

- **Bailer**

A bailer is a hollow tube used to collect samples of groundwater from wells for monitoring. Bailers are tied to a dip meter and lowered into the water column by a piece of rope, or a piece of wire connected to the dip meter. When lowered, the bailer uses a simple ball check valve to seal a sample of the groundwater table at the bottom to raise it up. The bailers are made of polyethylene, PVC, FEP or stainless steel and can be disposable or reusable (Singh, 2015).

Bailers are easy and relatively inexpensive devices to use. In addition, bailers can be lowered to any depth although the depth of the well is sharply limited by pumps. Aeration of the water when the sample is collected, which could release volatile organic compounds that need to be tested, is the main downside to using bailers. This can also conflict with the proper seating of the ball check valve if there is a high volume of sediment or turbidity (Singh, 2015).

Figure 1: Bailer used to sample borehole water.

- **Water Level Meter (Dip Meter)**

Water level meters are best used to measure water levels in piezometers, monitoring wells, and bore holes**.** Designed to be very accurate to great distances, they can also be used to determine total well depth before or after installation. Most of these meters have probes that detect the water via fluid conductivity. A typical example of a water level meter is shown in Figure 2

Figure 2: Solinst Dip Meter used to sample borehole water.

3.3 Groundwater modelling

The chosen software is MODFLOW. During model setup, the conceptual model is translated into a numerical model. This stage entails selecting the model domain, defining the model boundary conditions, discretizing the data spatially and over time, defining the initial conditions, selecting the aquifer type, and preparing the model input data. The above conditions together with the input data are used to simulate the groundwater flow in the model domain for pre steady state conditions.

Conceptual model

A conceptual model is a simplification of the complex real system down to familiar aspects that can easily be solved. This conceptual model is just a step prior to a solution model which can either be analytical or numerical.

Numerical model

Numerical groundwater modelling consists of flow and transport modelling types. Groundwater flow modelling can be represented by finite difference method or finite element. In this project a finite difference method is used.

3.4 Groundwater availability assessment

The availability of groundwater as a water source depends largely upon surface and subsurface geology as well as climate. The porosity and permeability of a geologic formation control its ability to hold and transmit water. Porosity is measured as a ratio of voids to the total volume of rock material and is usually described as a percentage.

Shallow, weathered and/or fractured rock and relatively low yielding aquifer systems are underlain over 80 percent of South Africa. By contrast, appreciable quantities of groundwater can be abstracted at relatively high rates from dolomitic and quarzitic aquifer systems located in the northern and southern parts of the country respectively, as well as from a number of primary aquifers situated along the coastline.

Groundwater systems

Aquifer types

The aquifer systems in South Africa can be divided into two major types: **primary** and **secondary** aquifers.

Primary aquifers: The primary aquifers are: 1. Coastal Coal and unconsolidated material along the South African coast, such as areas along the west coast at Port Nolloth, Doringbaai, Lambertsbaai, Langebaan, Atlantis, Cape Flats, Gansbaai, Bredesdorp, Stilbaai, Alexandria, Boesmansriviermond, Kidds beach, Richards bay; 2. Coal along stream beds such as those along the Crocodile and Caledon rivers, at De Aar, De Doorns, Rawsonville, Pietersburg (Polokwane), Messina, and Makatini Flats (Kok, 1991).

Characteristics of Primary Aquifers include but not limited to:

- Usually, shallow unconfined systems and groundwater surface in the aquifer is at atmospheric pressure (100 kPa).
- Mostly consist of unconsolidated material, usually less than 30 m thick.
- Contain 1 to 20 percent water by aquifer volume
- Recharge rate is generally high. Some 15 to 30 percent of rainfall would infiltrate into aquifers.
- Geohydrological characteristics of aquifer do not vary greatly over short distances.
- The transportation of contaminants in the primary aquifers is slow because of high effective porosity.

Secondary aquifers: The degree of fracturing of rocks in South Africa is dependent upon the tectonic history of rocks as well as the rock composition. For example, competent rocks, such as dolerite and quartzite and sandstones, fracture more readily than incompetent or ductile rocks, such as dolomite and shale. The magnitude of fracturing does not necessarily determine how much water an aquifer can transmit. It is estimated that at depths greater than 60 m, about less than one percent of the fractures transmit significant amounts of water. However within quartzite rocks, significant yields are possible at greater depths.
Typical characteristics of secondary or fracture flow aquifers are:

- Fractured flow aquifers are either confined or unconfined aquifers. The confined aquifers are overlain by sediments or rock of confining nature, which limits direct recharge from rainfall.
- They belong to shallow systems, usually less than 60 m thick and in exceptional circumstances can be about 200 m thick.
- Characteristics of aquifers as well as borehole yields vary greatly over short distances.
- Mpumalanga is characterized by primary and secondary aquifers. Groundwater accumulates in the fractures of the sandstone and contact zones between different lithologies.

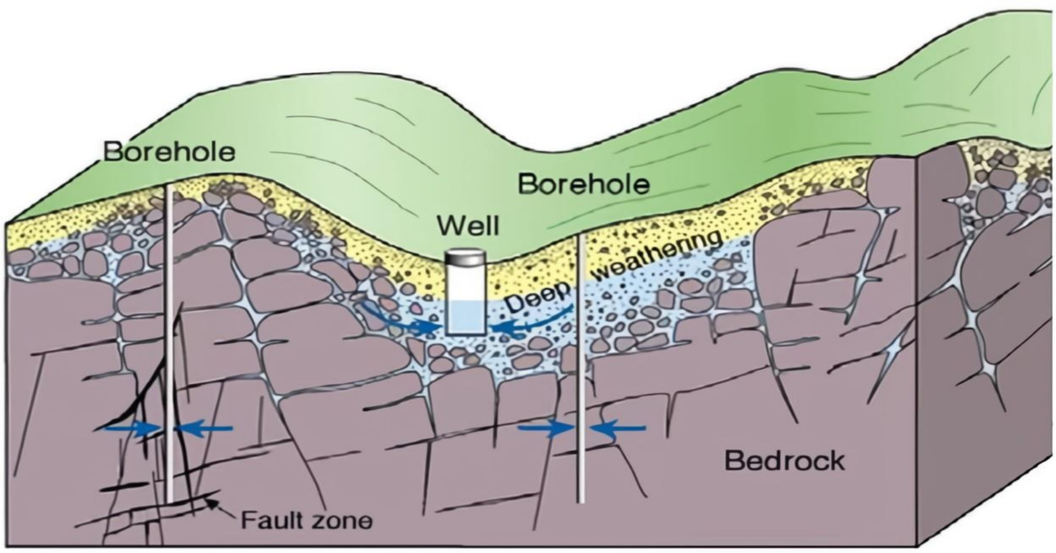

Figure 3: Fractured aquifer regime in the study area (Source: (Akhtar, et al., 2020)).

3.5 Groundwater recharge calculations

Chloride Mass Balance (CMB)

The method compares total chloride deposition (through precipitation) at the surface with chloride concentrations in groundwater as measured in samples from wells/boreholes. Chloride in the precipitation originates from sea salt. Chloride inputs from atmospheric deposition are conserved in the soil zone and concentrated due to loss of moisture by evapotranspiration.

Chloride ion is often used as a tracer for the investigation of water and solute movement in the unsaturated zone and aquifers. Tracers should be conservative behaviour, i.e. the tracer movement is not slowed or decreased in concentration by interaction with the solid phase and that it is not produced in the soil nor introduced by external sources.

Assumptions:

- All chloride in ground water is derived from precipitation, no other sources
- Chloride is concentrated by evaporation prior to recharge.
- Chloride is conservative in the system
- Runoff after precipitation is negligible (most the precipitation that reaches the ground recharges infiltrates into the unsaturated zone contributing to recharge)

Basic equation for chloride mass balance method (Wood and Sanford, 1995)

$$\mathbf{q} = \mathbf{P} \times \frac{\mathbf{Clwap}}{\mathbf{Clgw}}$$

Where: **q** is the flux recharge (units of precipitation); **P** is the average annual precipitation; **Clwap** - is the weight-average chloride concentration in precipitation (a conservative value of 1 mg/l is often assumed) and **Clgw** – chloride concentration in the groundwater. **Recharge** is often expressed as % of rainfall.

4. PHYSIOGRAPHICAL AND GEOLOGICAL SETTING

4.1. Project Location

The proposed coal mining permit application is situated within portion of portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province.The permit area is located approximately 0.69 km South-East of Klarinet town and approximately4.90 km North-West of Modelpark town. The project site covers an area approximately 5 hectares.

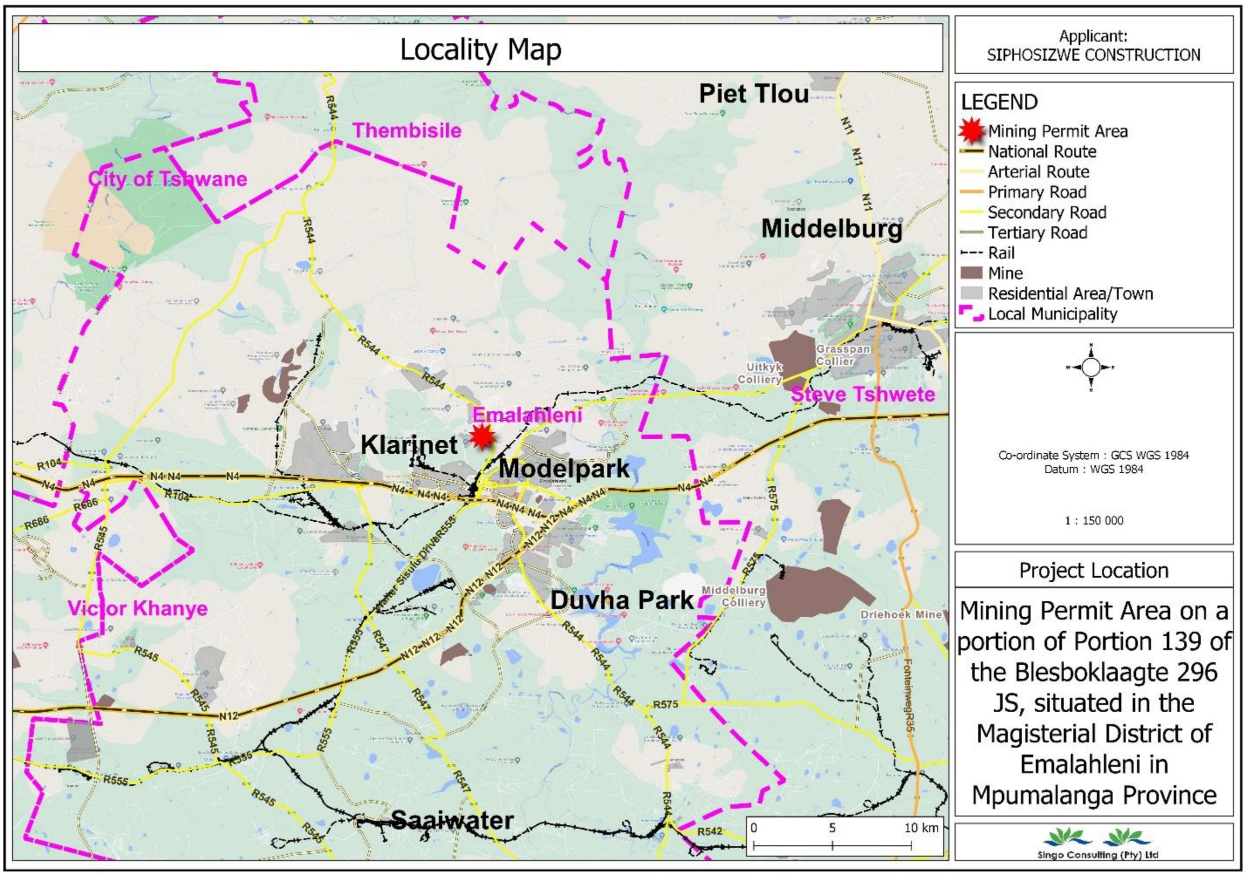

Figure 4: Locality map of the study area. (Singo Consulting, 2023)

4.2. Climate

Climate is the state of the atmosphere over a long period of time, such as over years, decades, centuries or greater and weather is defined as atmospheric conditions of an area over a short period of time (Naomi, 2004). Climate for the purpose of the study is chosen based on the fact that it does not change over a long period of time whereas weather conditions fluctuate more rapidly, and its data cannot be relied upon.

The climate in Witbank is warm and partly cloudy while the winters are short, cold, dry, and clear. Over the course of the year, the temperature typically varies from 2.2°C *to* 26°C and is rarely below -1°C or above 29°C.

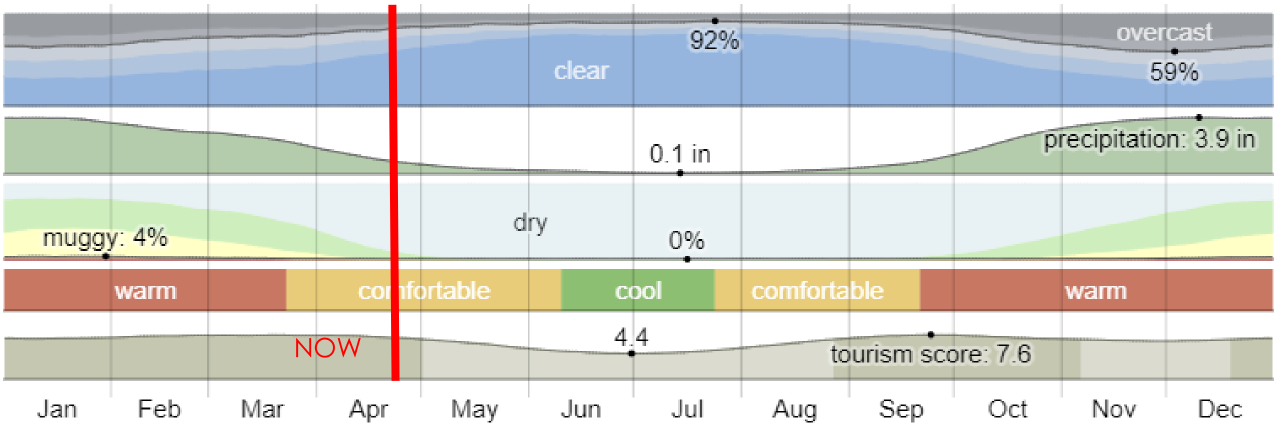

Figure 5:Climate in Witbank. (https://weatherspark.com/, n.d.)

The warm season lasts for 6.2 months, from September 19 to March 25, with an average daily high temperature above 24°C. The hottest month of the year in Witbank is January, with an average high of 25°C and low of 15°c. The cool season lasts for 1.9 months, from June 1 to July 31, with an average daily high temperature below 19°C. The coldest month of the year in Witbank is July, with an average low of 3°C and high of 18°C. (https://weatherspark.com/, n.d.).The information retrieved from the weather spark websites co-relates with the information received from the in-house GIS specialist which is it more site specific and it shows on Figure 7 that the proposed mining permit area consist of an mean minimum annual temperature that is 0.1-2°C.

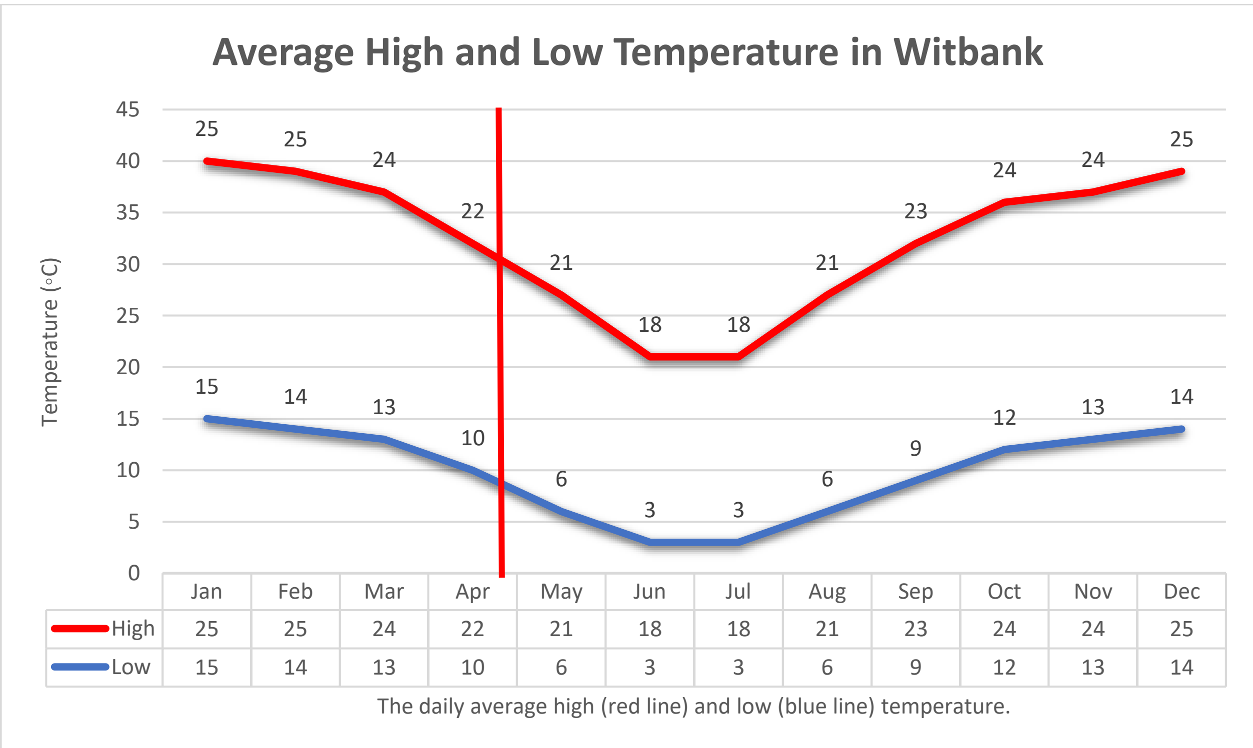

Figure 6: Average temperature of Witbank. (https://weatherspark.com/, n.d.)

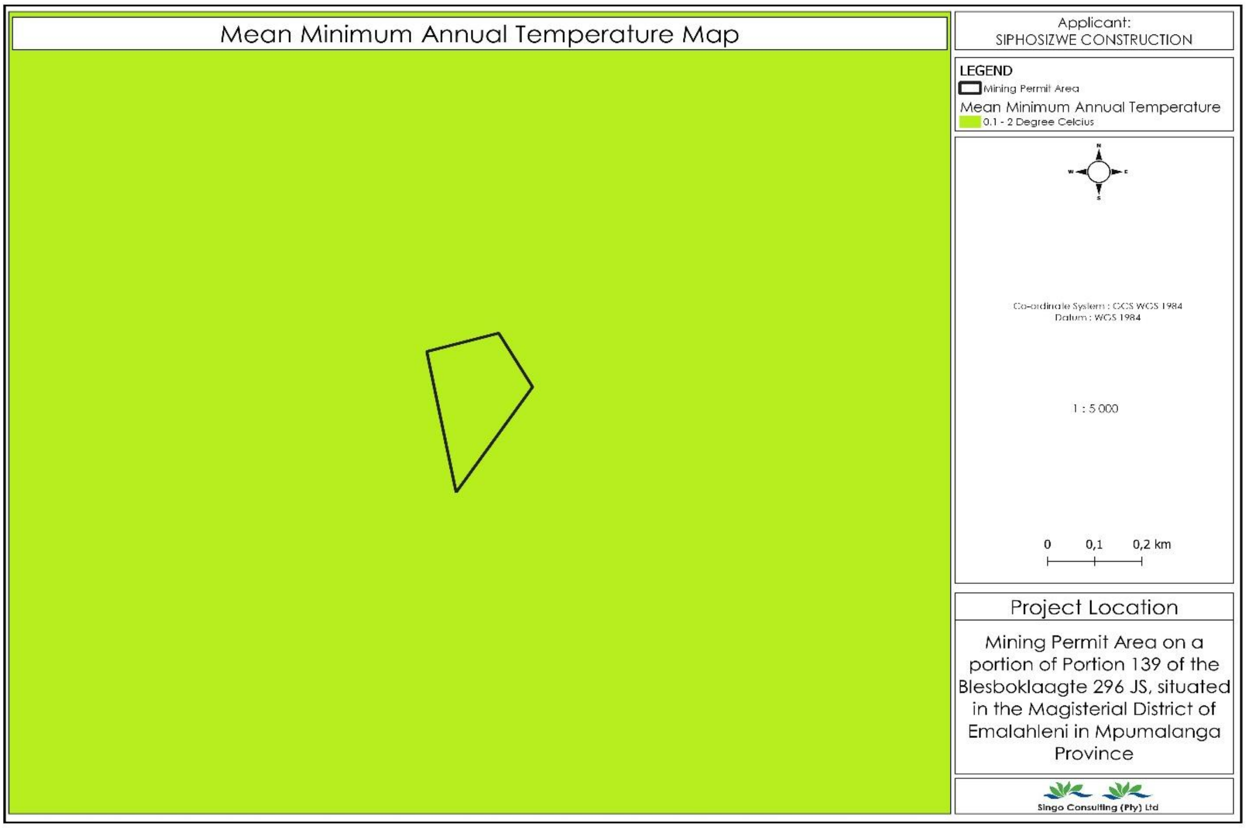

Figure 7: Mean Annual Temperature map. (Singo Consulting, 2023)

With a peak probability of 54% on December 18. Rain is the most common form of precipitation in Witbank. A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Witbank varies very significantly throughout the year.

The wetter season with the most wet days in Witbank is December with a greater than 27% chance of a given day being a wet day. The month, with an average of approximately 0.04 inches of precipitation and the drier season is in July, with an average of 0.5 days with at least 0.04 inches of precipitation. The mean annual rainfall according to the in-house GIS specialist is between 601-800 mm (24-31 inches).

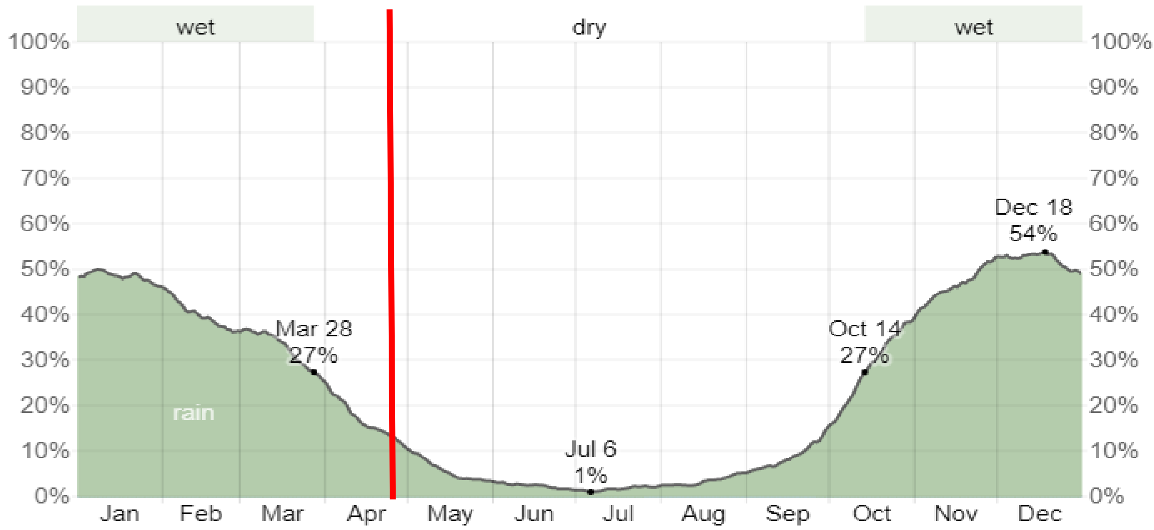

Figure 8:Daily chance of precipitation in Witbank. (https://weatherspark.com/, n.d.)

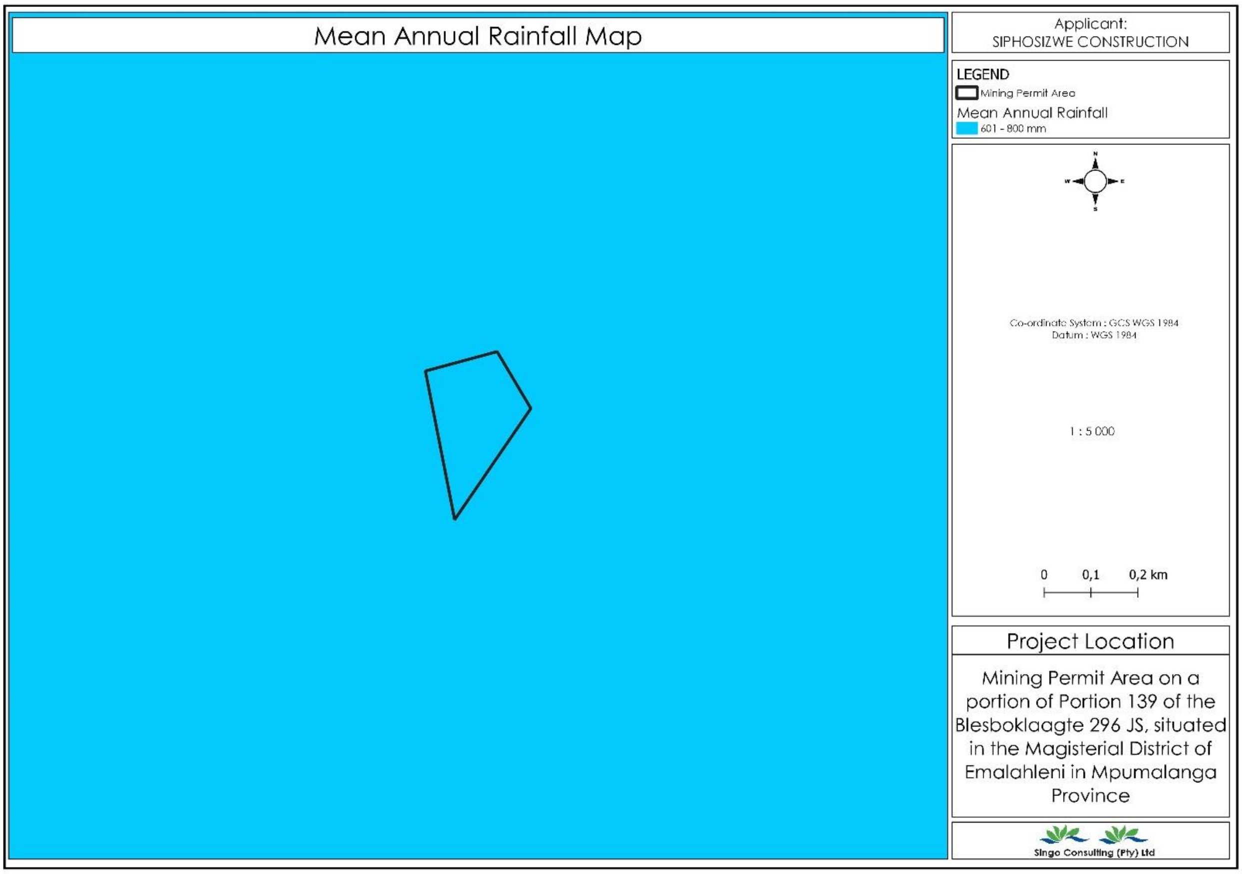

Figure 9: mean Annual rainfall map. (Singo Consulting, 2023)

4.3. Topography and Drainage

Topography

The topology of the area is illustrated below by Figure 10 below. A detailed description or representation on a map of the physical features of an area. SA's landscape has been shaped over a long time by movement below the surface of the Earth and by the movement of water across the surface of the Earth. Different layers of rocks have been laid down over millions of years and then shaped by erosion. Different strata and rock formations are eroded and the topography results from these processes.

In this environmental project, topography can be used to deduce the movement of surface water during rainy seasons. In the context of the study, topography will play a crucial role in the surface transport of contaminants and site-specific recommendations thereof. The topography of an area influences groundwater vulnerability, as topography also influences run-off and infiltration.

The topography of the study will be analysed based on its slope types and landforms observed onsite as well as seen on Figure 10. The highest point in the study area is at an elevation of 1535 mamsl in the southern direction and the lowest point is at an elevation of 1529 in the northern direction of the study area.

Types of slope.

- **Gradual Slope:** A slope with contour lines widely spread. This even spacing is maintained in both up and down slope. The slope covers the entire study area, and it continues outside the project area in all the directions.

Influence of Slope on Groundwater Contamination

Slope of an area plays a major role in the transport of liquid or solid contaminants. In the context of the study area, two slope types were identified and observed during the site assessment. Gentle slope/Gradual Slope influences groundwater contamination as it consists of high groundwater level since less time is allowed for stormwater to infiltrate which means the will be an increase in residence time of contaminants such as Total Petroleum Hydrocarbon (TPH) (Gradual slope) and allowing faster movement of contaminants downhill (towards lower elevation).

Landforms identified in the study area.

- **Summit:** Point on a surface that is higher in elevation than all points immediately adjacent to it. The summit in the study area is located at an elevation of 1535 mamsl in the southern direction at the boundary of the study area, and at an elevation of 1529 mamsl in the northern direction.
- **Valleys:** Valleys are depressed areas of land–scoured and washed out by the conspiring forces of water or gravity. Valleys are identified by contours that form a "V" pattern. The V pattern points upstream. A valley is identified on the North-East of the study area from an elevation of 1505 mamsl to 1535 mamsl. The identified valley influence groundwater contamination through channelling of contaminants, which will carry them to the nearby streams and or wetlands identified.
- **Saddle:** Flat area between hills/ Summit, ground rises to 2 sides and descends on 2 sides. A saddle is identified in the southeastern direction in-between the summits of approximate elevation of 1575 mamsl.

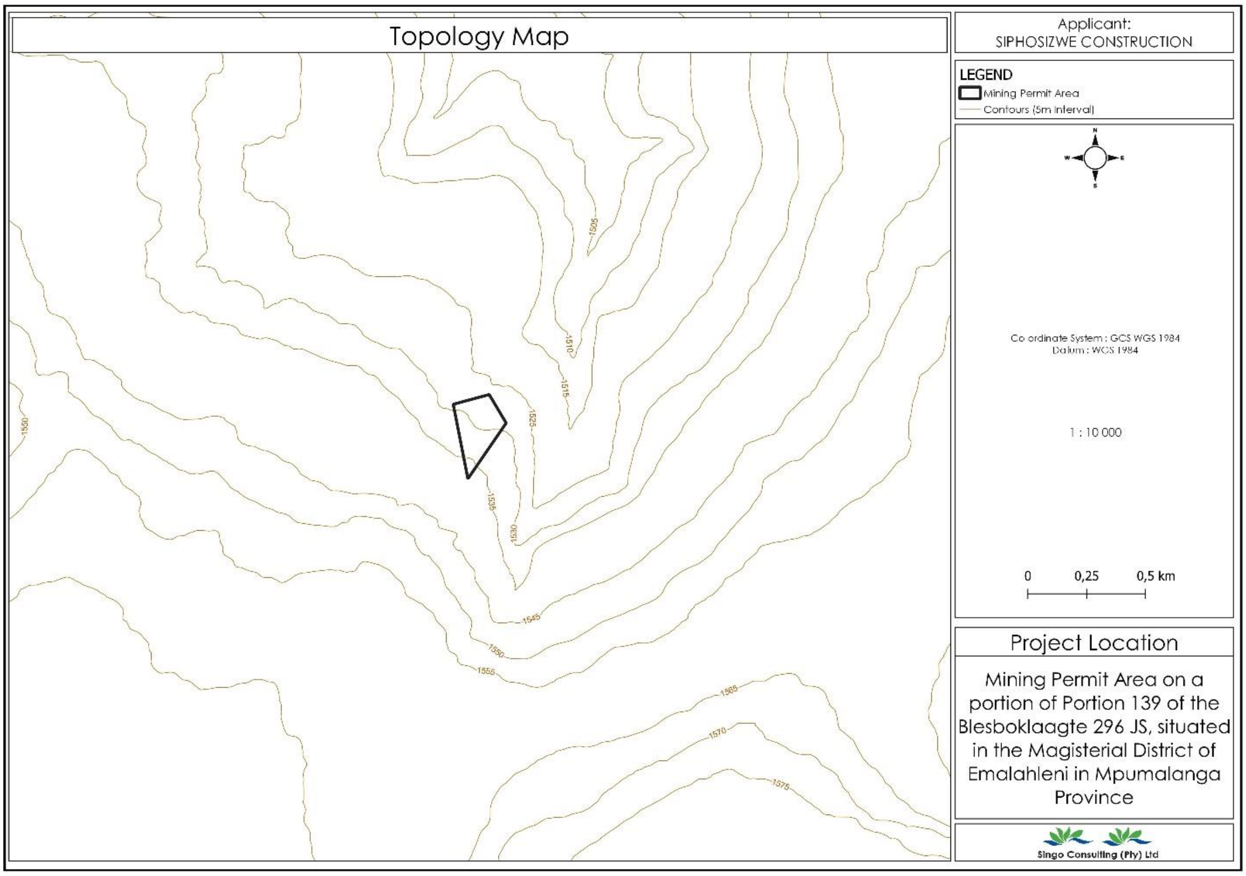

Figure 10: Topology map of the study area. (Singo Consulting, 2023)

Drainage

The hydrology surrounding the proposed area is of vital importance. In this context hydrology is all the surface waters appearing within and nearby the proposed project area, where a potential to be impacted upon by the project existence. The hydrology map as seen on Figure 12, illustrates that the following water bodies exists nearby the project area:

- **Channeled Valley Bottom wetlands:** Channelled valley bottom wetlands are linear fluvial, net depositional valley bottom surfaces which have a straight channel with flow on a permanent, seasonal, or ephemeral/episodic basis (Rountree, Todd, Kleynhans, et al, 2007: iv). A channelled valley bottom wetland was identified, the closest wetland identified northern direction of the study area at an approximate elevation of 1505 mamsl.
- **Non-perennial :** non-Perennial rivers are rivers that flow seasonally, such as summer. The rivers flow from an area of higher elevation to an area of lower elevation. A non-perennial streams was identified at the south-eastern part of the project area, these non-perennial rivers are associated with valleys and they are found in all directions of the perennial river. They act as tributaries of the perennial river.
- **Perennial:** perennial rivers are rivers that flow all year round. The perennial river flowing from the northern direction towards the southern direction at an elevation of 1320 mamsl, this perennial river connects with the non-perennial river which is flowing from the eastern direction towards southeastern direction, and they connect at an approximate 1535 mamsl elevation.

- **Dam:** At the southern direction of the study area the is a dam. It is identified at an approximate elevation of 1565 mamsl.

Drainage pattern in the study area

The drainage pattern observed within the study area is dendritic pattern.

- **Dendritic Pattern:** The dendritic pattern develops when the river channel follows the slope of the terrain often found in mountainous areas**.** It is the most common form of drainage pattern and looks like the branching pattern of a tree when joined by tributaries. The pattern is made by non-perennial rivers found within the proposed project area, it is most common along the boundary in the south-eastern direction, as seen on Figure 11.

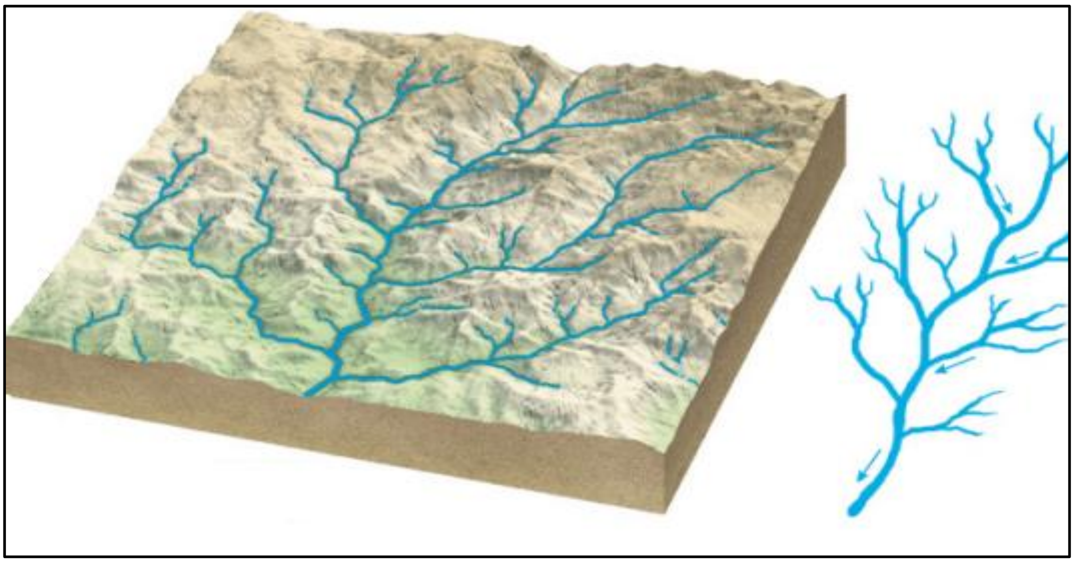

Figure 11: Drainage pattern.

The hydrology of the study area shows the presence of water bodies, once identified the project before it commences, the designing of the area will be influenced by the nearby waterbodies. These identified water bodies also recharge groundwater in that area.

There will be procedures and guidelines put in place for this project to avoid the risk of water contamination through nearby wetlands, and waterbodies, such as placing more mitigation measures to ensure that the waterbodies are not contaminated. However, given the fact that all the waterbodies and wetlands observed on the map are more than 500 m away from the proposed project, the will be no impacts occurring on the site. Operations should be carried out at the mining permit boundary only to prevent any contamination of the water bodies. As shown in Figure 13, the proposed mining permit project does not have any water bodies within and close to the boundary present within the project area.

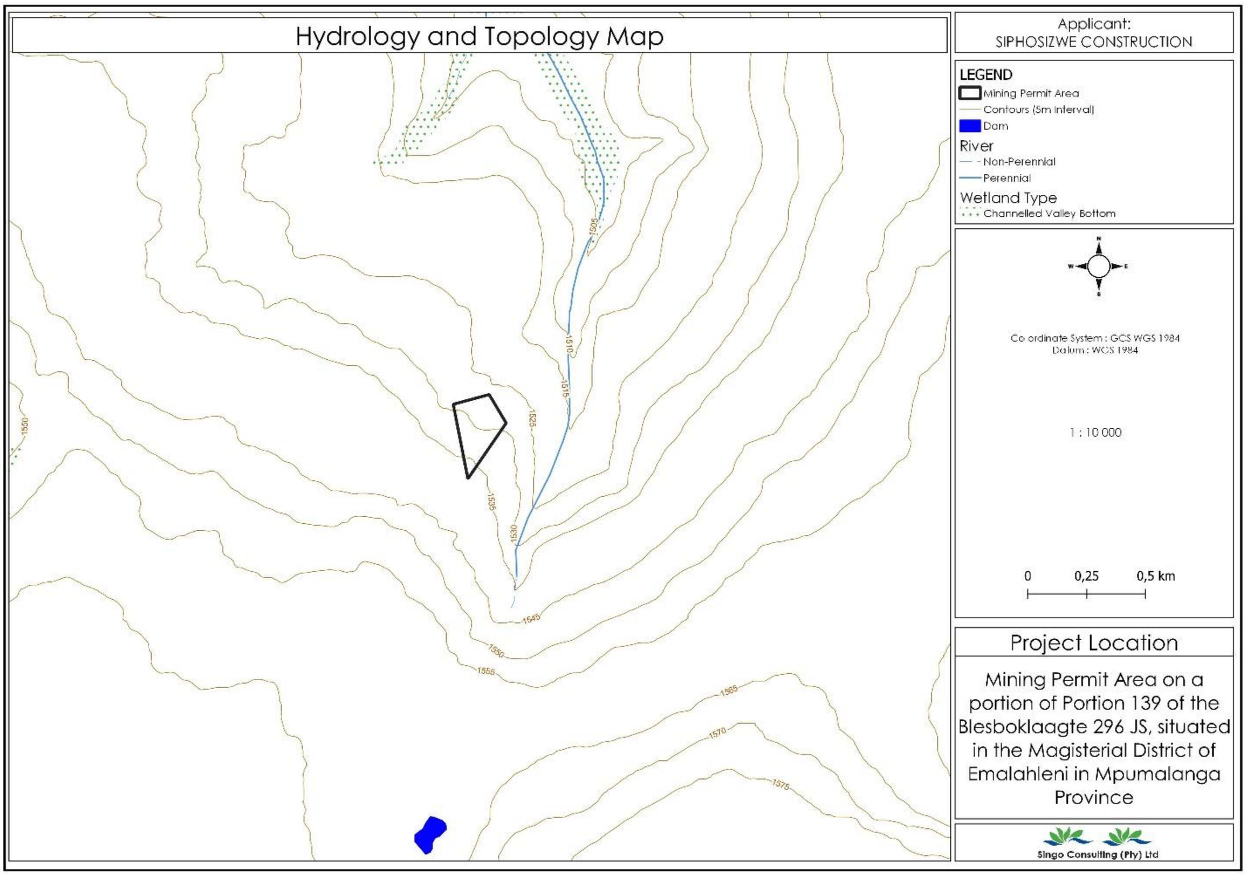

Figure 12: Drainage map of the study are. (Singo Consulting, 2023)

Figure 13:The proposed Mining permit area. (Singo Consulting, 2023)

4.4. Catchment Information

The Olifants WMA is one of the most economically important WMA's in South Africa. Economic activity in the WMA is highly diverse and is characterised by mining, metallurgic activities, commercial agriculture, dry land and subsistence agriculture and eco-tourism. The economy of the WMA is largely driven by the mining sector, with large coal deposits found in the Emalahleni and Middelburg areas and large platinum group metal (PGM) deposits found in the Steelpoort and Phalaborwa areas (IUA, Delineation Report, 2011).

The study area falls on Quaternary Catchment B11K Water Management Area.

Table 2: WRC of 2012, Water management area, MAP and QC

Water management	Quaternary catchment	Catchment Area (km^2)	MAP (mm)	Evaporation Zone
Olifants	B11K	931	705	4A

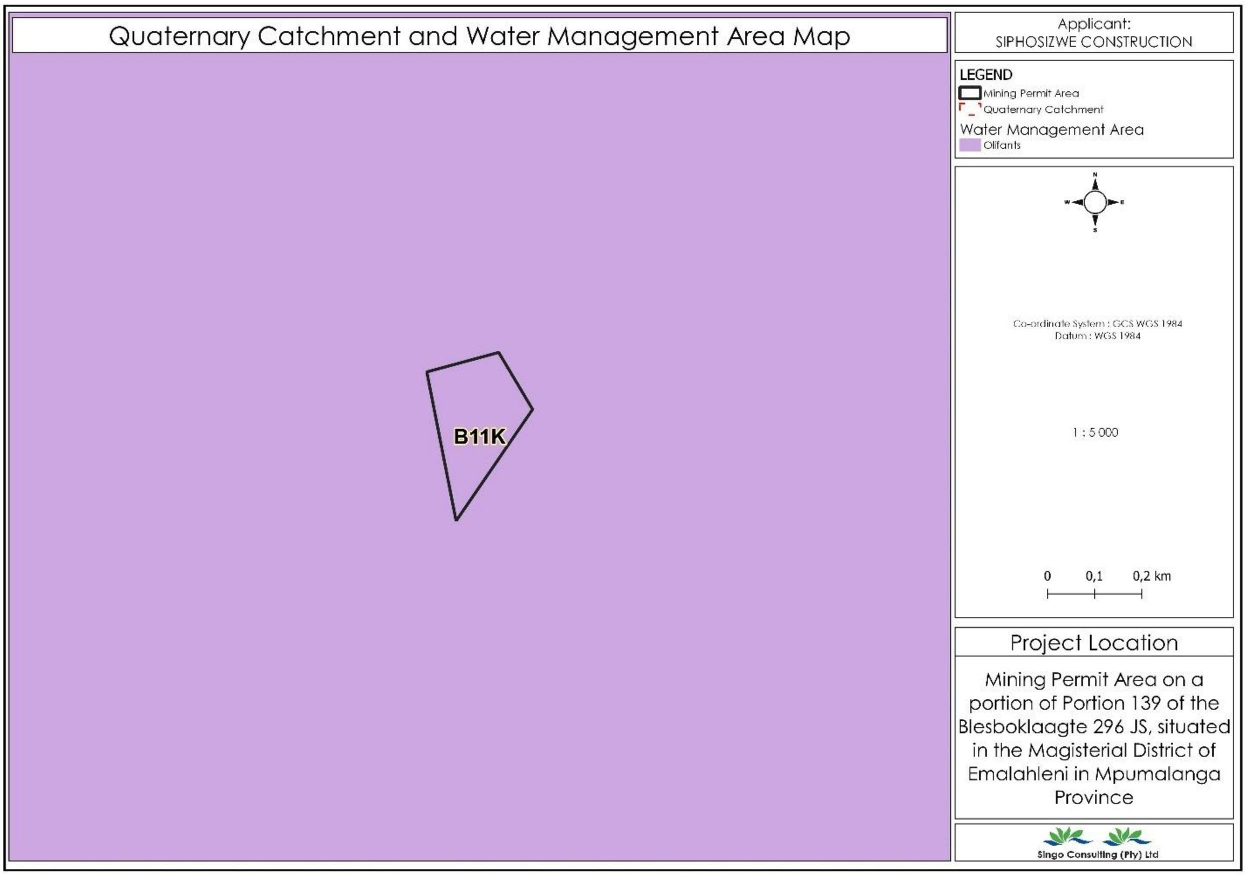

Figure 14: Quaternary catchment in the study area. (Singo Consulting, 2023)

4.5. Geology

The study of groundwater incorporates both the fluid (water) and the medium through which it is flowing (rock, soil, or any other geological material). As such, it is necessary to understand the geology of the permit area in order to gain a better understanding of the aquifer type and flow of ground water.

Regional Geology

The Karoo Supergroup is a thick sequence of sedimentary rocks deposited between 300 and 180 million years ago. The main Karoo Supergroup basin covers over 50% of South Africa's surface and consists of five age-based groups, which show a change of depositional environment in time. These groups are the Dwyka (glacial), Ecca (shallow marine and coastal plain), Beaufort (non-marine fluvial), Stormberg (aeolian) and the volcanic Lebombo or Drakensberg groups (SACS, 1980; Veevers et al., 1994; Johnson et al., 1996; Johnson et al., 2006).

The rocks of the supergroup underlie approximately half of South Africa. The principal outcrops form the Main Karoo Basin. The main Karoo basin forms part of a major series of Gondwanan basins that developed through subduction, compression, collision, and terrane accretion along the southern margin of Gondwana (Cole, 1992; De Wit and Ransome 1992; Veevers et al. 1994; Catuneanu et al. 1998;). These include the Paraná Basin in South America, the Beacon Basin in Antarctica, and the Bowen Basin in Australia. These depocenters filled between the Late Carboniferous and Middle Jurassic and their combined stratigraphies represent the best record of non-marine sedimentation of this period anywhere in the world.

The basal Stratigraphy of the Karoo Supergroup comprises the Dwyka Group which is a Late Carboniferous to Early Permian (~320Ma) sequence of glacial and periglacial sediments including diamictites, till moraine, conglomerate, sandstone, mudstone and varved shale.

The Dwyka group is overlain by the Ecca Group which is an Early to Late Permian (~260 Ma) sequence composed of sandstone, siltstone, mudstone, and large deposits of coal seams deposited in a terrestrial basin on a gently subsiding shelf platform. In the surrounding Witbank Coalfield areas, the Ecca Group is overlain by the Beaufort Group, which is Early Triassic (~260 to 210 Ma), comprising multi-coloured mudstone and sandstone with only minor coal accumulation, and was deposited in a fluvial environment.

The Molteno Formation rests unconformably on the Beaufort Group and comprises Late Triassic (~210 Ma) coarse, immature sandstone with minor argillaceous layers derived from braided streams. This in turn is overlain by the Elliot Formation consisting of red mudstone and sandstone and the Clarens Formation comprising Aeolian sandstone. At the top of the Karoo Supergroup stratigraphy is the Drakensburg Group, which comprises Early to Middle Jurassic (~180 Ma) flood basalts.

According to the 2628 East Rand 1:250 000 geology series map the site is situated on Permian (245 000 – 290 000 million years) sandstone, shale and coal beds of the Vryheid Formation of the Ecca Group, and Karoo Supergroup. Jurassic (145 000 – 208 000 million years) dolerite sills intruded into the older sediments through vertical feeder dykes. Quaternary surficial deposits of alluvium and ferricrete can be found throughout the surrounding area.

The Ecca Group, which is part of the Karoo Supergroup, comprises of sediments deposited in shallow marine and fluvial-deltaic environments with coal accumulated as peat in swamps and marshes associated with these environments. The sandstone and coal layers are normally reasonable aquifers, while the shale trends to act as aquitards. Several layered aquifers perched on the relative impermeable shale are common in such sequences. The Dwyka Formation comprises consolidated products of glaciations (with high amounts of clay) and is normally considered have impermeable qualities.

The general horizontally disposed sediments of the Karoo Supergroup are typically undulating with a gentle regional dip to the south. The extent of the coal is largely controlled by the pre-Karoo topography ((Hancox and Götz, 2014)). Abundant dolerite intrusions are present in the Ecca sediments. These intrusions comprise sills, which vary from being concordant to transgressive in structure, and feeder dykes. Although these structures serve as aquitards and tend to compartmentalize the groundwater regime, the contact zones with the pre-existing geological formations also serve as groundwater conduits. There are common occurrences of minor slips or faults, particularly in close proximity to the dolerite intrusions. Within the coalfield, these minor slips, displacing the coal seam by a matter of 1 to 2 meters, are likely to be common in places.

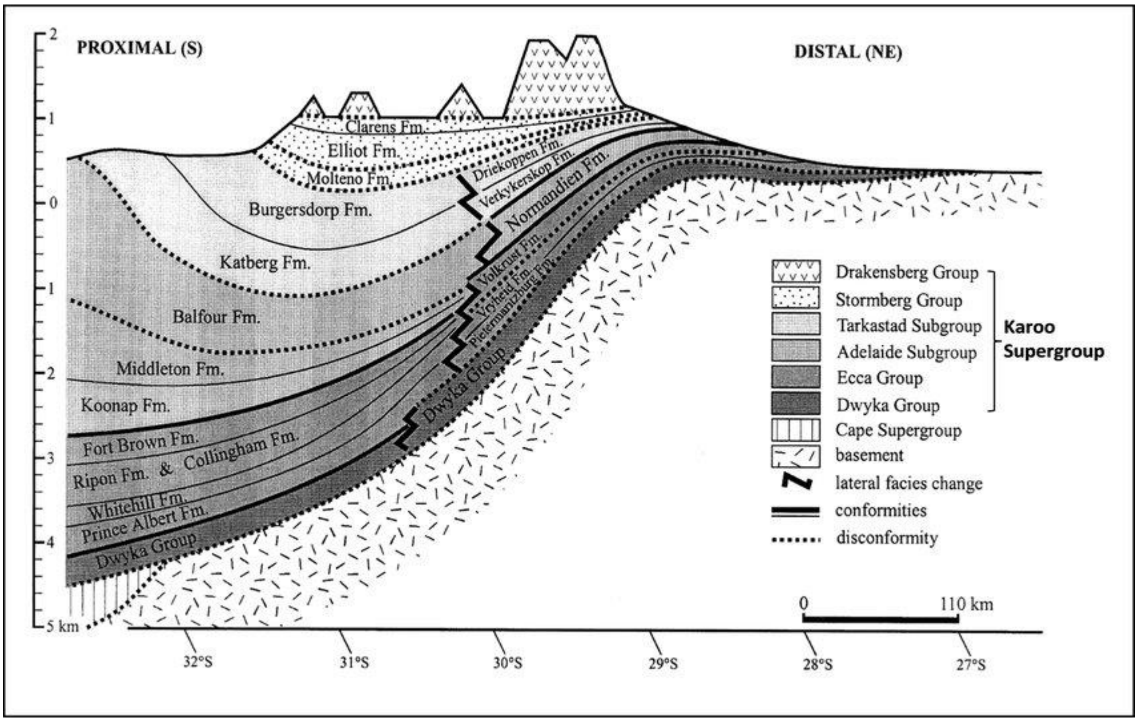

Figure 15: Stratigraphy of the karoo supergroup

The Karoo Supergroup is the most prevalent stratigraphic unit in Africa south of the Kalahari Desert. The supergroup is made up of a series of units that were deposited between the Late Carboniferous and Early Jurassic, or roughly 120 million years ago. The majority of these units are not marine in origin. Nearly two-thirds of the current land area in southern Africa is made up of rocks from the Karoo Supergroup, which also includes all of Lesotho, practically all of the Free State, and sizable portions of the Eastern Cape, Northern Cape, Mpumalanga, and KwaZulu-Natal Provinces of South Africa.

Outcrops of the Karoo supergroup can also be found on other continents that were once a part of Gondwana, including Namibia, Eswatini, Zambia, Zimbabwe, and Malawi. The development and dissolution of Pangea resulted in the formation of the basins where it was deposited.

The Great Karoo in South Africa, where the most significant outcrops of the sequence are found, is the type region of the Karoo Supergroup. From the Late Carboniferous to the Early Jurassic, its strata, which are primarily made up of shales and sandstones, record an essentially continuous sequence of marine glacial to terrestrial deposition. These accumulated in the "main Karoo" Basin, a retroarc foreland basin. Southern Gondwana, near the southern border of what would eventually become Southern Africa, experienced subduction and orogenesis, resulting in the formation of this basin. Its sediments can be as thick as 12 km cumulatively, and the Drakensberg Group of basaltic lavas that lie on top of it are at least 1.4 km thick.

Table 3: Stratigraphy of the Karoo Supergroup in the Karoo Basin

Stratigraphy of the Karoo Supergroup in the Karoo Basin				
Period	**Group**	**Formation west of 24°E**	**Formation east of 24°E**	**Assemblage Zone**
Jurassic	Drakensberg	Hiatus	Drakensberg	
	Stormberg		Clarens	
			Elliot	
Triassic			Molteno	
	Beaufort		Burgersdorp	*Cynognathus*
			Katberg	*Lystrosaurus*

<table>
<tr><td rowspan="12">Permian</td><td rowspan="6"></td><td></td><td rowspan="2">Balfour</td><td>Dicynodon</td></tr>
<tr><td rowspan="3">Teekloof</td><td>Cistecephalus</td></tr>
<tr><td rowspan="2">Middleton</td><td>Tropidostoma</td></tr>
<tr><td>Pristerognathus</td></tr>
<tr><td rowspan="2">Abrahams-Kraal</td><td rowspan="2">Abrahams-Kraal</td><td>Tapinocephalus</td></tr>
<tr><td>Eodicynodon</td></tr>
<tr><td rowspan="6">Ecca</td><td>Waterford</td><td>Waterford</td><td rowspan="7"></td></tr>
<tr><td>Tierberg / Fort Brown</td><td>Fort Brown</td></tr>
<tr><td>Laingsburg / Ripon</td><td>Ripon</td></tr>
<tr><td>Collingham</td><td>Collingham</td></tr>
<tr><td>Whitehill</td><td>Whitehill</td></tr>
<tr><td>Prince Albert</td><td>Prince Albert</td></tr>
<tr><td>Carboniferous</td><td>Dwyka</td><td>Elandsvlei</td><td>Elandsvlei</td></tr>
<tr><td colspan="5">References: Rubidge (2005), Selden and Nudds (2011).</td></tr>
</table>

Local Geology

Vryheid formation

The Vryheid Formation consists mainly of sandstone and shale with some subordinate coal seams associated with it (SACS, 1980). The sediments of the Vryheid Formation probably represent alluvial plain, upper, and lower delta plain deposits with associated shallow lagoon and coastal swamps (Jeremy and Bell, 1990). The change from stable margin to subsiding foreland basin confined the Vryheid Formation and the shales of the succession to "pinch-out" to the north. This "pinching-out" results in a gradation of a fluvial valley-fill sequence into sediments of deltaic origin (Van Vuuren, 1981). According to Cadle et al. (1990) the sandstones become interfingered with the deeper water shales, a so-called "shale-out", approximately 500 km from the present northern basin margin. They state that this is due to rapid basin ward facies migration down the southernly dipping paleo slope.

The Formation attains a maximum thickness of 500 m in the deeper part of the basin (SACS, 1980), but in the area of the Eastern Transvaal Coalfield only attains a maximum thickness of 170 m (Greenshields, 1986) and thins to about 80 m in thickness in the proximal basin settings (Cadle et al., 1990). The Vryheid Formation contains 5 major coal seams, with locally developed partings and splits in the coal seams increasing the number to 8, within an 85 m thick stratigraphic horizon (Greenshields, 1986) although this horizon can attain thicknesses up to 160 m in the deeper parts of the basin (Cadle et al., 1990). According to Cidle et al. (1990) all five major seams are still present in the thinnest and most proximal parts of the formation.

Greenshields (1986) states that all four cyclothems exhibit a regressive phase where sedimentation occurred in fluvio-deltaic environments, followed by a transgressive phase where sedimentation was typical of both marine and non-marine transgressive shorelines. A seam is therefore associated with clastic successions comprising carbonaceous shale or siltstone, fine to coarse grained sandstone and minor conglomerate (Cadle et al., 1990).

Although the five major coal seams, and their associated overlying and underlying sedimentary packages, can be correlated between coalfields (Cadle et al., 1990), they have different names in different coalfields (Greenshields, 1986). Greenshields (1986) states that the mining potential of the seams varies throughout the area but that the C seam has the biggest potential, although the B and E, and occasionally the D, seams attain mineable thicknesses over limited areas. The general distribution of the upper seams is often restricted by present-day topography, while the development of the lower seams is controlled by the pre-Karoo topography. Structurally the seams are flat lying with a gentle south-westerly dip (Greenshields, 1986). The Dundas, Gus and Alfred seams are present in the Majuba Colliery mining area, but only the Gus seam is exploited by the colliery (Lear and Hill, 1989).

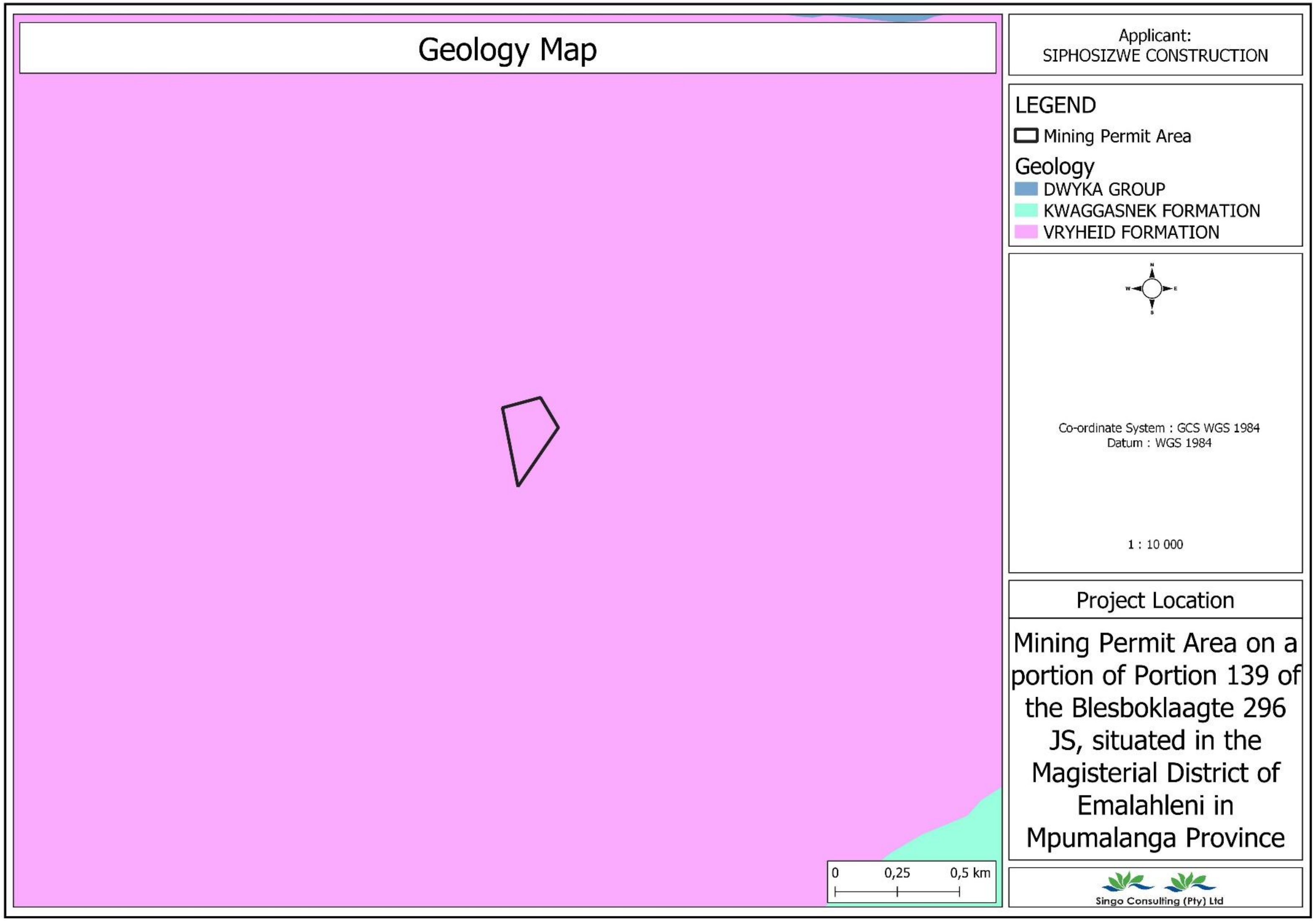

Figure 16: Geological formation map. (Singo Consulting, 2023)

5. AQUIFER CHARACTERIZATION

5.1. Groundwater vulnerability

Vulnerability of groundwater is a relative, non-measurable, dimensionless property (IAH, 1994). It is based on the concept that “some land areas are more vulnerable to groundwater contamination than others” (Vrba and Zaporozec 1994). The upper aquifer is associated with the weathered horizon. In boreholes, water may often be found at this horizon. The aquifer is recharged by rainfall. Rainfall that infiltrates into the weathered rock reaches impermeable layers of solid rock underneath the weathered zone. Water resources such as groundwater and surface water are in many cases threatened in terms of quality or quantity, this ranging from over abstraction to contamination. Water that recharges the aquifer must pass through many mediums, some of which pose a threat to that very same aquifer. Groundwater vulnerability depends on the following factors.

5.1.1. Depth to water table.

The data for the depth to groundwater map shown in the Figure 17 below was obtained from Department of Water Affairs and was derived from water level data for the National Groundwater Database (NGDB). The lower the depth to groundwater, the shorter the flow path for contaminants and this increases the potential for contamination of groundwater. In the study area, the depth to watertable is between 5 and 15 m as the project area falls on the yellow shaded area which is Mpumalanga Province.

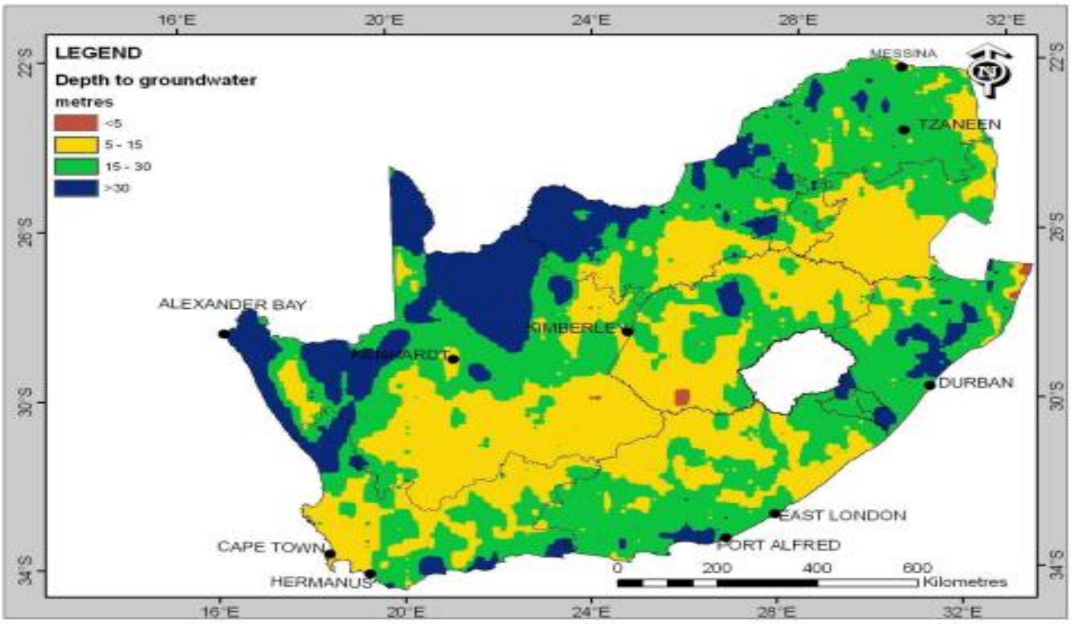

Figure 17: depth of groundwater across south African boreholes (CGS, 2011)

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5.1.2. Net recharge

Recharge is the principal vehicle for leaching and transporting solid or liquid contaminants to the water table (Aller et al., 1987).

5.1.3. Aquifer media

The type of aquifer affects groundwater vulnerability, the more fractured and the higher permeability of the rock, the higher the vulnerability. The 1:1 000 000 scale geological map of South Africa from the Council for Geoscience (Keyser, 1997) was grouped into different aquifer types (see Figure 18). The ratings and weights assigned to each aquifer. The study area falls under the intergranular and farctured aquifers, according to the council of geoscience map, its susceptibility is between 0.18 to 5.1 when compared with other aquifer types in south africa.

Table 4: showing the rating scale of aquifer vulnerability using Drastic Model (CGS, 2011).

Aquifer Media	Rate
Dolomite	5.1
Intergranular	2.24
Fractured	0.9
Fractured and weathered	0.18

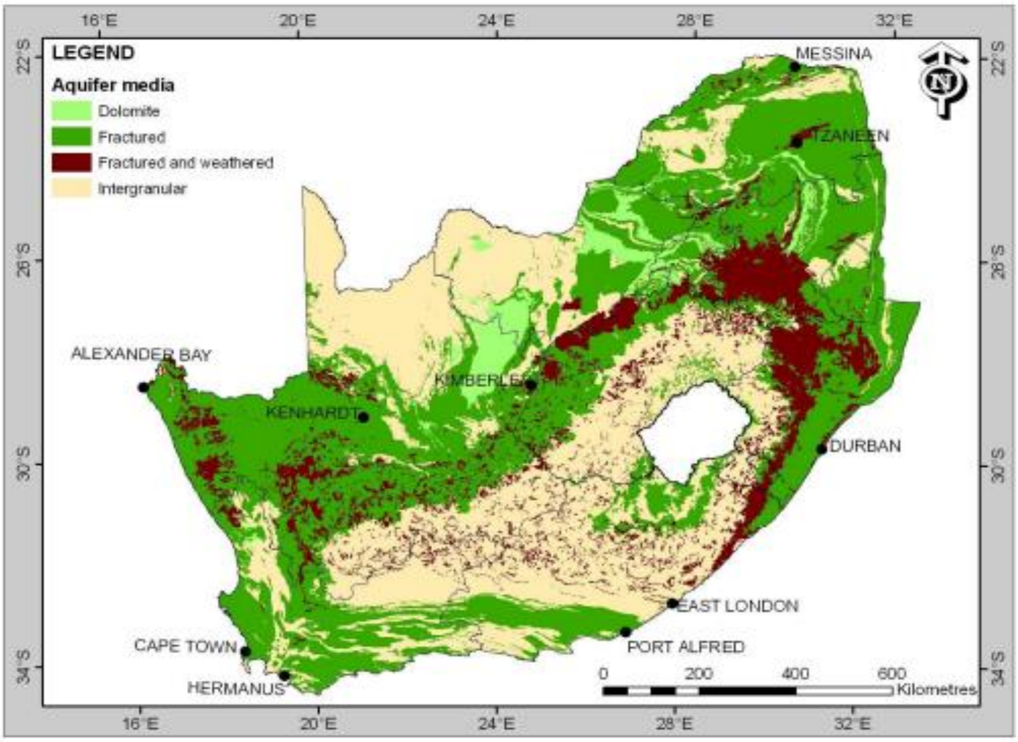

Figure 18: Showing the location of different aquifer types in south Africa (CGS, 2011)

5.1.4. Soil media

The soil media affects the vulnerability of groundwater to contamination. For example, soils with a high organic matter or high clay content lessen the potential for contamination when compared to soils with a low clay and organic matter content. Consequently, sandy soils are assigned a higher rating and weight than clay soils. The study area falls under Association of Classes 1 to 4: Undifferentiated structureless soils, which according to the rating on DRASTIC model is less susceptible to groundwater contamination.

5.1.5. Topography (slope)

In areas of shallow slope there is a greater chance of the pollution infiltrating the aquifer as opposed to areas of steep slope (where the pollutant is more likely to run off). The study area as seen on a topology map Figure 10 above, the slope is gentle, this increases the residence time of water or contaminants in an area, which promotes infiltration, increasing the likelihood of contamination. Knowledge in topography, the study area is surrounded by steep slopes, which influences run-off towards the mining permit area.

5.1.6. Impact of the vadose zone

The type of the vadose zone media affects the vulnerability of groundwater. This parameter involved the consideration of the properties of the aquifer including the soil porosity, the permeability, and the depth to water levels.

5.1.7. Land use

The land use has an effect of groundwater vulnerability. Irrigation water or agricultural chemical lead to the occurrence of non-point source pollution hence cultivated areas are assigned higher ratings than other land use classes. According to Merchant (1994) cited in Secunda *et al.,* 1998, extensive agriculture land use over prolonged periods of time at the same area can result in the altering of the soil colloidal nature and the degree of percolation through the soil matrix.

Areas with a high degree of human activity, i.e., built up urban areas have a high risk of soil and groundwater contamination (Meinardi et al., 1994). Mine and quarries, dongas and sheet erosion also significantly contribute to groundwater pollution. The area under study is to be used for mining, coal mining. Such activity makes the groundwater in the area more vulnerable to contamination with respect to the processes involved during mining activities.

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5.2. Groundwater Vulnerability Map

The figure below is showing different areas in South Africa with their respective groundwater vulnerability. The study area is situated in Mpumalanga, Emalahleni Magisterial district, and according to the figure below, it lies between Low (20-25) and Moderate (25-30). Mpumalanga is largely influenced by mining activities; it is because of that reason as to why certain area pose very high risk of contamination of groundwater contamination.

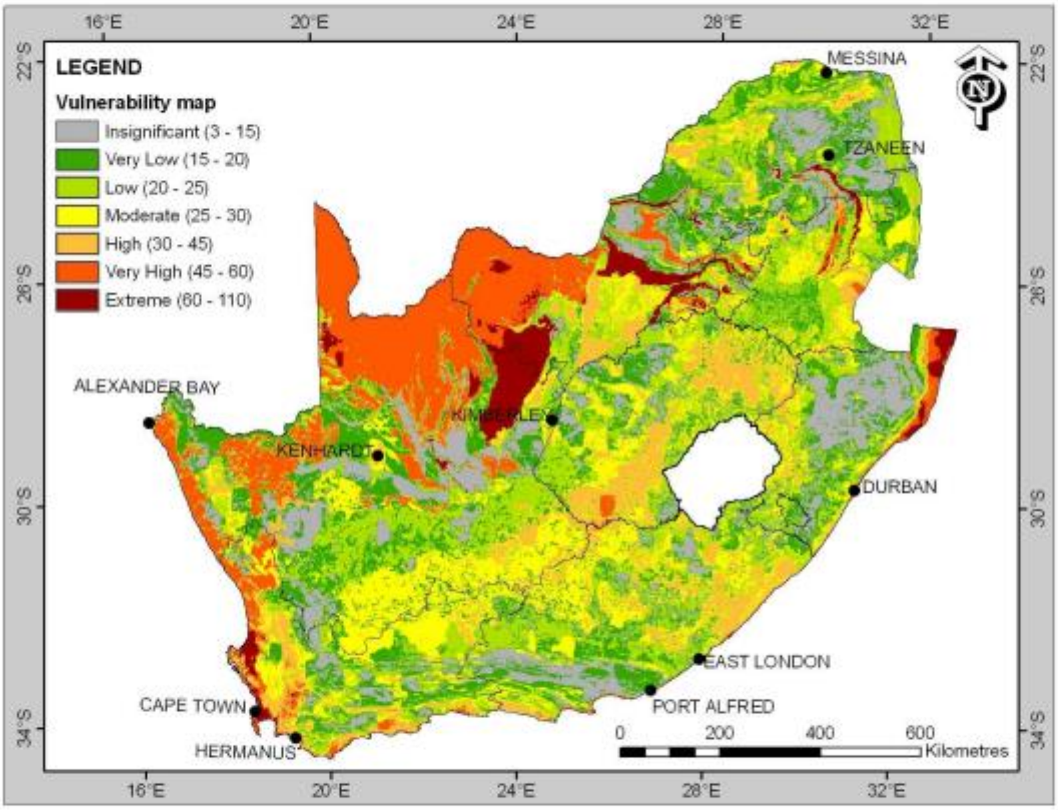

Figure 19: showing areas more vulnerable to groundwater contamination across South Africa, (CGS, 2011).

5.3. Aquifer classification

The figure below illustrates aquifer classification of different areas in South Africa. It can be deduced that the project area at magisterial district of eMalahleni comprises of poor aquifers and the dominant water source is surface water. Table 5 interprets the meaning of the aquifer classification and when an area is said to have minor aquifer it means that the aquifer is low yielding or unacceptable quality aquifer.

Table 5: Aquifer classification (Source:(Vegter & Seymour, , 2012))

Table 6: Aquifer characterization

Sole source aquifer	An aquifer used to supply 50% or more of urban domestic water for a given area, for which there are no reasonably available alternative sources should this aquifer be impacted upon or depleted.
Major aquifer region	High-yielding aquifer of acceptable quality water.
Minor aquifer region	Moderately yielding aquifer of acceptable quality or high yielding aquifer of poor-quality water.
Poor aquifer region	Insignificantly yielding aquifer of good quality or moderately yielding aquifer of poor quality, or aquifer that will never be utilised for water supply and that will not contaminate other aquifers.

5.4. Hydrogeology

Typically, five distinct aquifer types:

- Basement (fractured Achaean-Proterozoic igneous/ metamorphic)
- Hard rock (e.g., Table Mountain TMG, Waterberg, and Natal Groups sandstone; fractured)
- Karst/ dolomite (dissolution)
- Karoo (fractured and influenced by dykes)
- Porous (intergranular Quaternary alluvial, coastal, Aeolian and other surficial unconsolidated deposits)

The study area falls under the Karoo (fractured and influenced by dykes) and Bushveld Igneous Complex (BIC). For effective borehole yields, the boreholes must target the fracture zones in this area. Regional Groundwater Occurrence and Aquifers. Based on the geology within the study area, the structural geology, and the geomorphology, the following conditions can arise to enhance aquifer development within the study area:

- The fractured transition zone between weathered and fresh bedrock
- Fractures along contact zones between the host rocks due to heating and cooling of rocks involved with the intrusions
- Contact zones between sedimentary rocks of different types
- Interbed or bedding plane fracturing
- Openings on discontinuities formed by fracturing
- Faulting due to tectonic forces
- Stratigraphic unconformities
- Zones of deeper weathering
- Fractures related to tensional and decompressional stresses due to off-loading of overlying material
- Groundwater occurs within the joints, bedding planes and along dolerite contacts.

Groundwater potential is generally low in these rocks, with 87% of borehole yields < 3 l/s. The lithology sandstone makes up the fractured Ellisras aquifer. The pores of the geological units are generally strongly cemented, and fractured flow over secondary structures such as faults, bedding plane fractures, and so on is the primary flow mechanism. Due to the establishment of cooling joints, the intrusion of dolerite dykes and sills into the fractured aquifer has resulted in the formation of preferential flow routes along the contacts of these lithologies. The dykes may operate as permeable or semi-permeable barriers to prevent water from flowing across them.

6. GROUNDWATER MODELLING

6.1. Software model choice

MODFLOW software is the chosen software to model groundwater flow and contaminant transport in this situation. The finite difference numerical model was created using the US Department of Defence Groundwater Modelling System (GMS9.2) as Graphical User Interface (GUI) for the well-established MODFLOW and MT3DMS numerical codes.

MODFLOW is a 3D, cell-centred, finite difference, saturated flow model developed by the United States Geological Survey. MODFLOW can perform both steady state and transient analyses and has a wide variety of boundary conditions and input options. It was developed by McDonald and Harbaugh of the US Geological Survey in 1984 and underwent eight overall updates since. The latest update (MODFLOW-NWT) incorporates several improvements extending its capabilities considerably, the most important being the introduction of the Newton formulation of MODFLOW. This dramatically improved the handling of dry cells that has been a problematic issue in MODFLOW in the past.

MT3DMS is a 3-D model for the simulation of advection, dispersion, and chemical reactions of dissolved constituents in groundwater systems. MT3DMS uses a modular structure like the structure utilized by MODFLOW and is used in conjunction with MODFLOW in a two-step flow and transport simulation. Heads are computed by MODFLOW during the flow simulation and utilized by MT3DMS as the flow field for the transport portion of the simulation.

Elevation data is crucial for developing a credible numerical model, as the groundwater table in its natural state tends to follow topography. The best currently available elevation data is derived from the SRTM (Shuttle Radar Tomography Mission) DEM (Digital Elevation Model) data. The SRTM consisted of a specially modified radar system that flew on board the Space Shuttle Endeavour during an 11-day mission in February of 2000, during which elevation data was obtained on a near-global scale to generate the most complete high-resolution digital topographic database of Earth. Data is available on a grid of 30 meters in the USA and 90 meters in all other areas.

6.2. Model set-up and boundaries

During model setup, the conceptual model is translated into a numerical model. This stage entails selecting the model domain, defining the model boundary conditions, discretizing the data spatially and over time, defining the initial conditions, selecting the aquifer type, and

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preparing the model input data. The above conditions together with the input data are used to simulate the groundwater flow in the model domain for pre steady state conditions.

6.3. Overview of the Problem

An aquifer system with one stratigraphic unit is bounded by no-flow boundaries on the West and East sides, which are in full hydraulic contact with the aquifer. The hydraulic heads on the west and east boundaries are 10m and 5m above reference level, respectively.

The aquifer system is unconfined and anisotropic. The horizontal hydraulic conductivities of the first stratigraphic units are 0.0001 m/s. Vertical hydraulic conductivity is assumed to be 10 percent of the horizontal hydraulic conductivity. The effective porosity is 25 percent. The elevation of the ground surface is 30m. A constant recharge rate is applied to the aquifer.

A numerical model must be developed for this site to calculate groundwater flow field; we will use MT3D to simulate the contaminant transport. To demonstrate the use of the transport models, we assume that the pollutant is dissolved into groundwater at a rate of 1×10^{-4} µg/s/m2. The initial concentration, molecular diffusion coefficient, and decay rate are assumed to be zero. We will calculate the concentration distribution after a simulation time of 10,50,100 and 500 years.

6.4. Groundwater sources and sinks

The conceptual model was transformed into a numerical model following the characterization of the aquifers, contaminant sources and groundwater receptors, so that the groundwater flow conditions, and mass transport can be solved numerically. A conceptual model is a simplified, but representative description of the groundwater system that illustrates the interaction of the sources, pathways, and receptors at the site.

The SPR conceptual model was first used in the field of environmental engineering in the late 1970"s to describe the flow of environmental pollutants from a source, through different pathways to potential receptors (Holdgate, 1979). Since then the model has been used in several environmental risk assessments (e.g., Environment Agency, 2004, Scottish Government, 2010, Sneddon et al., 2009).

Source - The origin of a hazard (for example, Construction phase, operational phase, Decommissioning phase, and post closure phase).

Pathway - Route that a hazard takes to reach Receptors. A pathway must exist for a Hazard to be realized.

Receptor - Receptor refers to the entity that may be harmed (a person, property, habitat etc.). For example, in the event of construction *(the source)* TPH may propagate through the soil *(the pathway)* and reach groundwater *(the receptor)* that may suffer degrade its quality.

The figure below outlines the sources, pathways, and receptors of the proposed development throughout its phases, ranging from construction to operational phase.

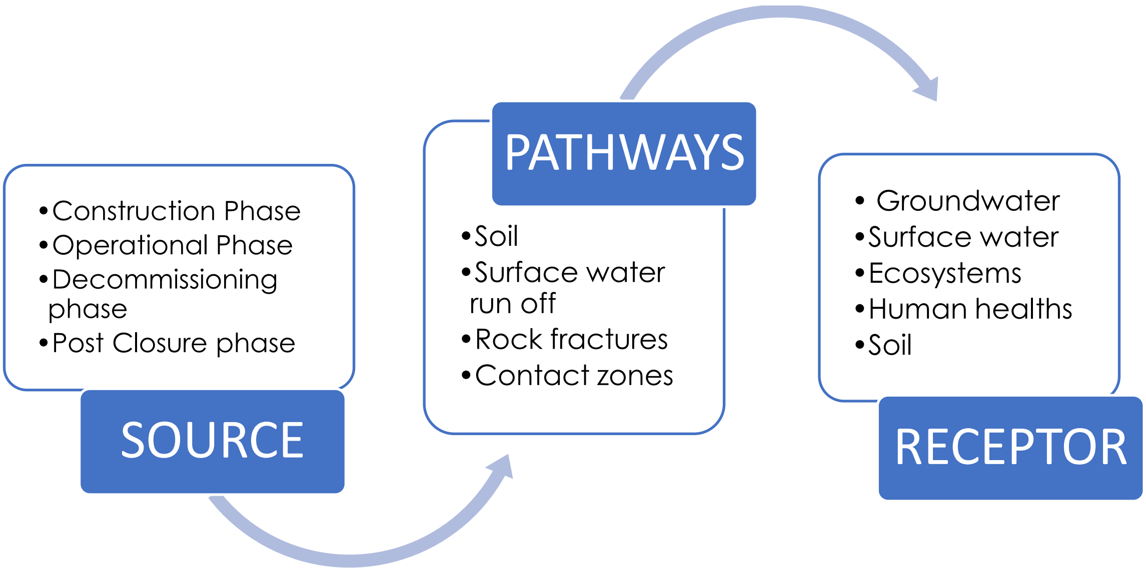

Figure 20: SPR Model for the proposed mining activity.

Risk to groundwater is high if the source of pollution is in contact with the aquifer with no mitigation plans in place.

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7. IMPACT ASSESSMENT

The impacts to groundwater quantity and quality for the development of the mining permit can be discussed according to the different phases. These phases include construction, operational and decommissioning phases.

7.1. Construction phase

7.1.1. Impacts on groundwater quantity

- The establishment of hard paved areas during infrastructure construction and haul road construction reduces the recharge of aquifers due to increased runoff.
- The establishment of the opencast areas is expected to have a negative effect on the surrounding aquifers within the immediate area which can cause lowering of water levels on neighbouring boreholes.
- Dewatering of groundwater in certain areas during the construction phase also leads to reduction in groundwater quantity in the area.
- Substantial amount of groundwater will be used during construction phase of tailings dam, and other infrastructures such as buildings.
- Streams may need to be diverted, to create way or to prevent pollution. Surface water recharges groundwater, their absence in an area also decreases the quantity of groundwater.

7.1.2. Impacts on groundwater quality

- During Construction phase, trucks and other vehicles on site will have to be fuelled, leaks during such process has the potential for causing contamination of surface water and groundwater.
- The operation of offices, ablutions and maintenance workshops has the potential for the contamination of groundwater due to incorrect disposal of domestic and hazardous wastes, incorrect handling of workshop effluent spills and leaks.
- The use of nitrate-based explosives during blasting for the establishment of the opencast areas has the potential to cause surface water pollution due to the addition of nitrates to water.
- Blasting has the potential to contaminate water as well in the sense that the vibrations caused could fracture the neighbouring aquifers, and cause migration of wastewater to mix with freshwater.

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- During the construction phase, a lot of metals is used which often results, metal scraps when exposed to water and oxygen could lead to iron oxide, which could infiltrate into soils and ultimately contaminate groundwater and surface water. And disposal of other wastes is high, which could end up in river streams, and contaminate groundwater

7.1.3. Groundwater management

- Frequent monitoring of spills, which include petrol, diesel, and oils, to quickly clean up.
- Proper management of stormwater drainage infrastructure should be ensured.
- Vehicle repairs on site should be minimized, and when done, it should be on a hard standing surface.
- Regular monitoring of groundwater, for quantity and quality with the use of boreholes as per the WUL and approved monitoring programme.
- Spill kits will be made available in areas of likely spillage.
- All hydrocarbon storage containers will be stored within a bunded areas which are watertight and able to contain 110% of the stored volume.
- All around the site, there should be availability of metal industrial bins, which should be frequently emptied, to avoid overflow of waste.

7.2. Operational phase

7.2.1. Impacts on Groundwater quantity

Once the mine begins operations, below impacts on groundwater quantity can be envisioned.

- The constant movement of trucks, this hardens the surface, which in turn decreases the amount of infiltration and increase run-off in that area.
- There will be regular inflow into the pit through the rock fractures and other geologic features, this water will be pumped out of the pit and discharged somewhere it wasn't.
- The exploitation of the resource still requires the use of blasting, this could still impact the groundwater quantity by creating fissures and migration of groundwater from one area to the other.
- The processing method of coal uses a lot of water as well, such as cooling at the plant and dust suppression at the site uses an extensive amount of groundwater, this is seen by decrease in hydraulic head at the surrounding boreholes.
- Coal washing also will be a huge factor with groundwater reduction in quantity.
- Dust suppression requires a significant amount of water.

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7.2.2. Impacts on groundwater quality

- The spillage of ammonium nitrate-based explosives during charging of holes, misfires and incomplete combustion of explosives may lead to an increase in nitrate levels in groundwater.
- The operation of the fuel and lubricants storage facility has the potential for causing contamination of groundwater due to either an infrastructure failure (emergency) or spillages during normal operation.
- Included in normal operation is the potential for the incorrect disposal of spill absorbing material.
- AMD formation from spoil piles, exposed shale and backfilled spoils and discard in rehabilitated areas will affect groundwater quality through the acidification of groundwater and the leaching of salts and heavy metals from rock.
- Depending on the buffering capacity of the host rock, AMD will either result in the formation of low pH, high dissolved salt, and heavy metal content water (insufficient buffering capacity) or the formation of neutral pH, high salt (including sodium) water, if high buffering capacity exists.
- During the operation stage, mining of coal is associated with sulphur, the reaction of sulphur with water and oxygen lead to acid rock drainage, also called yellow boy.

7.2.3. Impacts on surface water

- Impact on water quality and erosion because of the pipeline breaking and spillage to the nearby wetland and perennial river.
- Pump failure will result in dirty water accumulation in the pit, leading to uncontrolled dirty water management and associated pollution.
- Impact on water quality and availability as a result in ineffective dirty water separation, and dirty water entering the wetland.
- High rate of ground water ingress causing flooding of the pit.
- The rainfall water within the designated dirty water area of the pit area that forms part of the MAR to the local water courses will be removed from the catchment. This will result in a lower intensity potential on the local surface water resource.
- Increase in volume of contaminated water that needs to be managed within the footprint.
- Erosion of stream banks because of crossings and diversions leading to siltation of the streams.

- Impacts on surface water resources quality because of incorrect waste management practices and pollution.
- During the operation of the mine, waste within the mining permit area is likely to increase, contributing to land pollution, which will end up in the streams contaminating the water.

7.2.4. Groundwater management

- All spillages will need to be cleaned up as soon as practically possible.
- Proper management of stormwater drainage infrastructure should be ensured.
- Maintain construction vehicles and encourage contractors to report, react and manage all spills and leaks so that action can be taken to immediately minimise contamination to the groundwater.
- Groundwater monitoring of boreholes should continue as per the WUL and approved monitoring programme.
- Spill kits will be made available in areas of likely spillage.
- All hydrocarbon storage containers will be stored within bunded areas which are watertight and able to contain 11% of the stored volume.
- All equipment utilising hydrocarbons will be stored on a hard standing surface.
- Grouting and capping of boreholes located within the footprint of construction camps be required prior to construction activities.
- Treat the water emanating for the opencasts to increase the decant water quality.
- Dust suppression should be done using already used water, but not polluted water that could lead to groundwater contamination.

7.3. Decommissioning phase

The mining permit area is 5 ha and the potential contaminants are relatively low but can have a long-term adverse effect on the environment. The quality of groundwater will be impacted upon the ceasing of the mining operations, the following impacts are envisioned with respect to coal mining:

- Erosion of the exposed material, such material could end up in the nearing river, this could degrade the water quality of groundwater through infiltration and surface water.
- The mining area might produce a seepage zone or decant as the recharge to opencast workings have increased by the disturbance of the strata.
- Infrastructures no longer maintained, this could lead to rusting of the metals, which could hinder the quality of water resources.

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- Acid Rock Drainage, coal mining is associated with the exposing of sulphur, the reaction of water, sulphur and oxygen leads to ARD which contaminates the water resources.

Mitigation Measures.

- As soon as mining ceases, the mined-out areas should be rehabilitated to avoid the risk of ARD.
- Legislations pertaining to mining, Water, and environment should be abided by.
- Frequent monitoring should be applied.

7.4. Post-mining phase

7.4.1.Groundwater quality

Once the operation of mining stop, the area now in most cases and as instructed by the relevant legislations, will be rehabilitated to an acceptable state. The following impacts are envisioned:

- AMD, upon mining, the area will no longer be maintained, rainfall will fill the open areas if there are any, and exposed or harmful minerals will be dissolved, which will contaminate surface and groundwater and the resulting wastewater is called Acid Mine Drainage.
- ARD, this is usually associated with coal mining since coal contains sulphur. Exposed sulphur reacts with water and oxygen. In most mines, overburden is not returned to where it was, this could expose sulphur to oxygen and water.
- Metal structures no longer in good condition, the metals are likely to rust, which will contaminate the soil and the water resources (Groundwater and surface water).
- The ablution facilities will no longer be maintained, rainfall is likely to wash the waste to the nearby streams or rusting of the sewage pipes.

7.4.2. Cumulative impacts

The cumulative impacts due to the proposed mining could be of a quantitative and qualitative nature. The aquifers within the region are classified as minor aquifer systems and their main function is a domestic water supply source as well as supplying base flow to the surface water environment. This will result in a positive impact locally and could see the importance of groundwater increasing as a potential source within the catchment.

However, the water quality within the workings could be good or deteriorate depending on the geochemical characteristics of the material. This could in turn result in surface water users being put under pressure should the decant water quality lead to the deterioration of surface water resources in the catchment. The cumulative impact on the catchment will have to be considered for mining, agriculture and the remainder of the current surface and groundwater uses in the Emalahleni municipal area.

The regional hydrological setting of the project site is indicated in Figure 21. The project area is in the Olifants Management Area (OWMA). The quaternary catchment is B11k. The WR2012 study, presents hydrological parameters for each quaternary catchment including area, mean annual precipitation (MAP) and mean annual runoff (MAR). An area of the catchment is approximately 931 km^2 with MAP of 705 millimetre (mm).

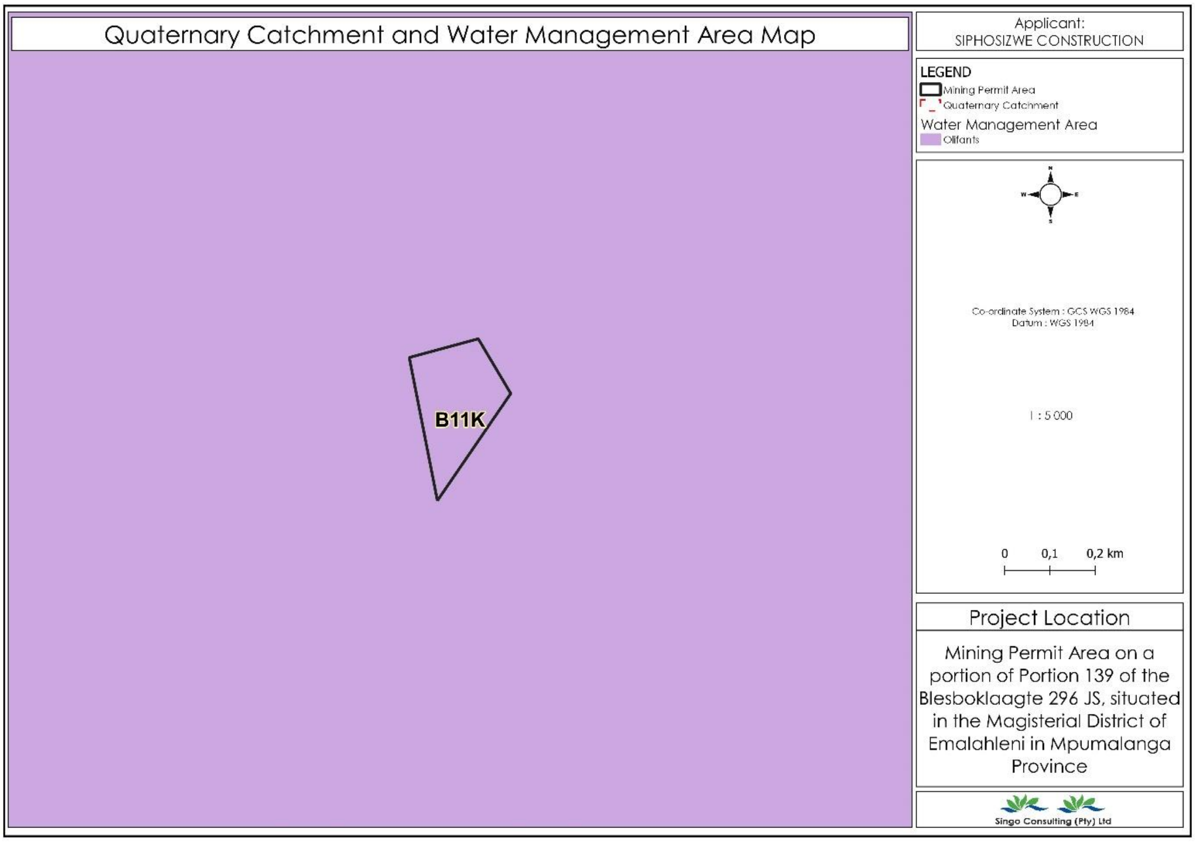

Figure 21: Quaternary Catchments and Water Management Area Map. (Singo Consulting, 2023)

7.5. Impact assessment and mitigation measures table

Severity of impact	RATING	Spatial scope of impact	RATING	Duration of Impact	RATING	Frequency of Activity	RATING	Frequency of Impact	RATING
Insignificant/ non-harmful	1	Activity specific	1	1 day to 1 month	1	Annually or less/ low 6	1	Almost never/ almost impossible	1
Small / potential harmful	2	Mine specific (within the mine boundary)	2	1 month to 1 year	2	Monthly/temporary	2	Very seldom/ highly unlikely	2
Significant/ Slightly harmful	3	Local area (within 5km of the mine boundary)	3	1 year to 10 years	3	Monthly/ Infrequent	3	Infrequent/ unlikely/ seldom	3
harmful	4	Regional	4	Operational life	4	Weekly/life operation/regularly/likely	4	Often/ regularly/ likely/ possible	4
extremely harmful	5	National	5	Post-closure/ Permanent	5	Daily/ permanent/high	5	Daily/ highly likely/ definitely	5

<u>The Environmental Significance is derived from the below mentioned variables:</u>

Severity (Magnitude) Of Impact **(M)**

Spatial Scope **(S)**

Duration of Impact **(D)**

Frequency of Activity **(Fa)**

Frequency of Impact **(Fi)**

Environmental Significance = (Severity of Impact +Spatial Scope + Duration of Scope) X (Frequency of Activity +Frequency Of impact)

SP= (M+S+D) x (FA+ FI)

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7.6. Significance Rating Matrix

(Severity(M) + Spatial scope(S) + Duration(D))

(Frequency Of Activity(Fa) + Frequency Of Impact(Fi))

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

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Table 7: Impact assessment and mitigation measures table

OPERATIONAL PHASE IMPACTS	Potential environmental impact	Environmental significance before mitigation							Recommended measures/remarks for mitigation	Environmental significance after mitigation						
		M	S	D	Fa	Fi	total	SP		M	S	D	Fa	Fi	total	SP
	Increased groundwater contamination potential due to overburdened stockpiles.	1	2	3	2	2	24		**1.**The overburden stockpiles ' compact footprint region to minimize groundwater infiltration. **2.**Stormwater run-off from the overburden stockpiles will be transferred to the dam for dirty water / pollution control. **3.**A surveillance program for groundwater resources will be introduced to identify contamination of groundwater.	1	2	2	1	2	22	
	Fuel & hydrocarbon spills from cars can lead to contamination of groundwater	1	4	2	2	3	35		Clean up immediately after accidental spills & Divert run-off from highways that may contain hydrocarbons into pollution control dams to regulate the pollution.	2	1	3	2	1	18	

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	Borehole / aquifer reduction outcomes from pit dewatering	2	1	3	4	4	48		An area of impact will be caused by pit dewatering. In the case of the proposed mining area, the zone of influence will not extend beyond the estimated 300 m, thus the yields of any supply boreholes or springs around the mining area are not anticipated to affect. Temporary water supply by the mine is a possible mitigation against such an effect.	2	1	3	1	1	12
	Open cast mining will result in pit inflows below the water table.	2	3	5	3	4	70		It is not possible to mitigate pit inflows (needed for a safe working environment). Provision must be produced for the treatment of pit inflows within the mine water balance. It will also need to be treated before discharge.	2	3	5	3	4	70
	Water in dirty water dams can affect the quality of the groundwater	2	2	3	5	3	55		Dams to regulate pollution must be lined and intended to meet the requirements of NEMA and NWA (Act 36 of 1998). Manage any leaks and spills to avoid contamination of groundwater. Monitor groundwater to detect contamination of groundwater.	2	1	2	2	1	15
	Reduction of the baseflow due to mining	2	3	5	4	4	80		Mine dewatering will have a negative impact on the baseflow contribution of the saalboomspruit river tributary. It will not be possible for the rehabilitated open void to provide a comparable baseflo	2	3	5	4	4	80

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									w contribution as before mining (hundred-fold less).							
POST CLOSURE IMPACTS	Contribution of salt load towards the closest river	3	4	4	5	3	88		***1.*** In the backfilled open pit section, groundwater concentrations will be restored after closure, flowing away from the mine to the river's lesser lying tributary. A prospective pollution plume within the stream may result in enhanced salt load. 2. Under the topsoil cover, an impermeable layer can be introduced that will need to be compacted to avoid water from entering. Monitoring of prospective rivers by surface water will be crucial. Quarterly groundwater sampling must be performed to create a plume motion trends database to assist in the eventual closure of the mine.	3	2	3	5	5	80	
	Rebound water concentrations can cause decant within backfill material.	2	4	4	4	5	90		Under the topsoil cover, an impermeable layer can be implemented which will need to be compacted to avoid water from entering, resulting in rebounding and decanting water concentrations. To monitor the water level and water	3	3	4	5	4	90	

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									quality, boreholes should be mounted nearer to the decant points.						
	Aquifer contamination due to backfill	3	5	4	5	5	110		Migration of the pollution plume to the north-east of the backfill region may influence the use of gradient groundwater. The final topography of the backfilled opencast should be designed to divert runoff from the opencast region.	4	2	3	4	5	81

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8. GROUNDWATER MONITORING PLAN

Groundwater management strategies for most mining activities are limited, and emphasis is mostly on pollution prevention rather than on treatment. Early detection of contamination is the key to react and effectively manage any possible sources of pollution. This will assist in identifying potential future impacts from mining operations on the groundwater environment.

8.1. Groundwater monitoring system

8.1.1.System response monitoring network

Groundwater contamination

Groundwater levels and quality may be recorded on monthly basis. Water levels can be measured using an electrical contact tape or pressure transducer to detect any changes or trends in groundwater flow direction. Contamination from the coal stockpile and other surface infrastructure (pollution control dams, water balancing dams, etc) can contaminate the underlying aquifers.

To prevent contaminants from seeping into the underlying aquifers, surface infrastructures such as pollution control dams must be fully sized and lined according to the engineering designs and normal practices. The proposed monitoring boreholes should be constructed to monitor groundwater levels and quality changes close to the pollution control dams, opencast pit, discard dump, and plant area, and around the mining area where the contamination plume is flowing to.

8.2. Sampling Methods and Preservation

Required apparatus:

- Plastic bottles (1L)
- Glass bottles
- Dip meter
- Steel bailer
- Cooler box
- EC and Ph meter
- Marking pens

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Methods and preservation

One litre plastic bottle with unlined plastic caps is required for most sampling exercises; however, in cases where organic constituents are to be tested for, glass bottles are required. Sample bottles must be marked clearly with the borehole name, date of sampling, water level depth and the sampler's name. Water levels (mbgl) should be measured prior to taking the sample, using a dip meter. Purging must be done on each borehole that needs to be sampled, this is to ensure sampling of the aquifer and not stagnant water in the casing. Purging is done using a submersible pump or a clean disposable polyethylene bailer in the event of a small diameter borehole. During purging and continuous water quality monitoring, at least three borehole volumes of water should be removed until the electrical conductivity value stabilizes. Metal samples must be filtered in the field to remove clay suspensions. The pH and EC meter used for field measurements should be calibrated daily using standard solutions obtained from the instrument supplier. Samples should be kept cool in a cooler box in the field and kept cool prior to being submitted to the laboratory to maintain proper preservation thereof.

Sampling Locations

The main objectives in positioning the monitoring boreholes are to:

- Monitoring of groundwater migrating away from the pit area and
- Monitoring the lowering of the water table and the radius of influence

8.3. Data Management

Good hydrogeological decisions require sound information developed from raw data. The production of good, relevant, and timely information is the key to achieving qualified long-term and short-term plans. It is necessary to utilize all relevant groundwater data to minimize groundwater contamination. Monitoring results will be captured in an electronic database as soon as results become available, which allows for:

Data presentation in tabular format,

- Time-series graphs with comparison abilities,
- Graphical presentation of statistics,
- Presentation of data, statistics and performance on diagrams and maps,
- Comparison and compliance to legal and best practice water quality standards.

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8.4. Monitoring frequency

Drastic changes in groundwater composition are not normally detected within days, as groundwater is a slow-moving medium; therefore, groundwater monitoring should be conducted monthly. Samples should be collected by an independent groundwater consultant, using the stipulated best practice guidelines, and should be analysed by a SANAS accredited laboratory. Groundwater levels must be recorded within an accuracy of 0.1m on a quarterly basis, using an electrical contact tape, float mechanism or pressure transducer to detect any changes or trends in the groundwater levels.

9.5 Monitoring parameters

Table 8: Groundwater monitoring

Class	Parameter	Frequency	Motivation
Physical	Static groundwater levels	Monthly	Time dependent data is required for transient calibration of numerical flow models. Changes in static water levels may give early warnings of dewatering in the area.
	Rainfall	Daily	Recharge to the saturated zone is an important parameter for assessing groundwater vulnerability. Time dependent data is required for transient calibration of numerical flow models.
	Groundwater abstraction rates (if present)	Monthly	Response of groundwater levels to abstraction rates can be used to calculate aquifer storativity, which is important for groundwater management.

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Chemical	Major chemical parameters: Ca, Mg, Na, K, NO3, SO4, Cl, Fe, Alkalinity, pH, EC TPH (Total Petroleum Hydrocarbons)	Monthly	Background information is crucial to assess impacts during and after operations. Changes in chemical composition may indicate areas of groundwater contamination and can be used as an early warning system to implement management/remedial actions. Legal requirement. Groundwater chemistry forms an integral part of the development of conceptual models.
	Minor chemical constituents Full scan of trace metals	Monthly	Changes in chemical composition may indicate areas of groundwater contamination and can be used as an early warning system to implement management/remedial actions. Legal requirement
	Other Stable isotopes	Ad-hoc basis	The monitoring program should allow for research and refinement of the conceptual geohydrological model. This may, from time to time, require special analyses like stable isotopes (O^{18}/O^{16}, H)

8.5. Reporting

Based on the recorded water quality data, the data management functions will be carried out and reported to the mine management monthly. The contents of the report should include the monthly water monitoring results and trends at surface points, as well as comments on the effectiveness of the mitigation measures and monitoring program. Reporting to the authorities should be as specified in the permitting/licensing conditions, and any accidental release of pollutants or possible polluting substances should be reported to the relevant authorities as specified in the mining permit conditions.

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9. CONCLUSION AND RECOMMENDATIONS

10.1 Conclusion and Summary

Mining is extremely important to the South African economy. However, it is mining activities that have the greatest impact on the environment, ranging from land pollution to air pollution to water resource contamination, to name a few, and measures must be put in place to protect the environment during all these mining activities that are meant to protect citizens' livelihoods and the country's economy. The paper details all the expected environmental implications of mining operations, as well as how these impacts will be managed to preserve the quality of water supplies.

There are wetlands such as channelled valley bottom around the research area in the northern directions, however they are more than 500m away from the project area and the measures that will be put in place include, monitoring the steam and making sure that the proposed project does not affect the water bosies. These bodies of water are important for the environment as well as the neighbouring communities, which rely on surface water. Throughout the project's lifespan, a monitoring program will be created to detect any changes in the quality or quantity of nearby water resources. The MODFLOW simulation models will be used to model how a contaminated plume will affect the river, considering the data and the affected area. There are poor aquifers in the mining permit region, and the major water source is groundwater.

10.2. Recommendations.

- In the northeast direction, there are water bodies, the construction should take into consideration of surface drainage systems to ensure surface water is not polluted.
- The study area falls on a fractured aquifer system, the mine planning should take into consideration the fracture zones in the Vryheid formation, drilling activities should not contact the fractures as that is where most groundwater in the area is found and to prevent possible groundwater pollution from residual explosive material used.
- The numerical model should be recalibrated as soon as more hydrogeological data such as monitoring holes are made available. This would enhance model predictions and certainty.
- It is recommended that there should be regular testing or monitoring of surrounding soil, water resources to detect any change in chemistry so that remedial measures are implemented in time.
- There should be soil, water resources and land pollution mitigation measures on site.

- Wastewater source should be identified, and mitigation measures put in place to prevent groundwater contamination.
- The stockpile, there should be regular monitoring of any heavy metal which could be exposed, could result in leaching during rainfall.
- Proper and competent structure of the tailings dam should be built, to contain liquid, or solid waste and to prevent such waste from entering the outside environment.
- According to section 21(S21) of the National Water Act 36 of 1998, if a proposed project triggers any of the listed S21 activities, a water use license must be applied for. For this project, there will be activities which includes abstraction of water from groundwater, mining activities within 100 m from the water courses dust suppression, dewatering and ROM stockpiles. It is therefore recommended that a water use license be applied for.
- Should the perennial river in the north direction of the mining permit be diverted for path of any development, it should be directed in a way that it is still sustainable as that river will be used for monitoring purposes.
- It is recommended that throughout the mining project, compliance of NEMA Act 107 of 1998, NWA Act 36 of 1998, NEM: Waste Management Act 58 of 1998.

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2023

HYDROLOGICAL STUDY

DMRE REF: MP 30/5/1/1/3/13338 MP

- Mining Permit Application for Coal on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province

PREPARED BY:

Singo Consulting (Pty) Ltd

PREPAIRED FOR:

SIPHOSIZWE CONSTRUCTION CC

Report Credentials.

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Project details

Report type	**Hydrological Study for a Mining Permit**	
Project title	Hydrological Report on behalf of Siphosizwe Construction CC for the proposed Mining Permit Application on portion of Portion 139 of the farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province	
Mineral (s)	Coal	
Client	Siphosizwe Construction CC	
Site location	Portion of Portion 139 of the farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province	
Version	01	
Date	April 2023	
		Electronic signatures
Compiled by	Dineo Makhubela (Environmental Specialist) Singo Consulting (Pty) Ltd (Candidate Natural Scientist, SACNASP Reg No: 158858)	
Reviewed by	Mutshidzi Munyai (Hydrogeologist) Singo Consulting (Pty) Ltd (Water Resources Science (Professional Natural Scientist), Environment Science (South African Council for Natural Scientific Professions) (SACNASP Registration Number 122464)	
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1 INTRODUCTION

According to the recent World Health Organization (WHO) report, the countries which still have limited access to water for drinking purposes are mainly those in the Sub-Saharan region (Verlicchi and Grillini, 2020). It is with this knowledge that the protection of surface water sources is ensured. According to WHO (2004), Surface water is any body of water that is above ground which includes but not limited to streams, lakes, dams and wetlands.

1.1 Project Background Information

Singo Consulting (Pty) Ltd was appointed by Siphosizwe Construction CC to carry out a specialist surface water study and compilation of a specialist surface water report, providing the surface water information required for the mine to fully comply with environmental authorization stipulated conditions.

Chapter 3 of the National Water Act (Act 36 of 1998) requires that a person who owns, control, occupies, uses the land is responsible for preventing pollution of water resources and is also responsible to remedy (correct) the effects of the pollution. It is with this Act that the hydrological report was deemed necessary for the site to gather all relevant information related to surface water and its related potential impacts.

The proposed mining activity is situated on portion of portion 139 of the farm Blesboklaagte 296 JS, under the District of Emalahleni, Mpumalanga Province. Facilities on site within the mining permit area include but not limited to:

- Dirty water trench
- Access roads
- Mobile sanitation area
- Mobile office area
- Boxcut
- Strip (1 & 2)
- Mobile crushing and screening plant
- ROM stockpile
- Product stockpile
- Overburden stockpile
- Pollution control dam
- Topsoil Stockpile

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The surface water study includes a baseline hydrological assessment and conceptual stormwater management plan for the proposed infrastructure to ensure compliance with best practice and relevant legislation.

The goal of this study:

- ❖ To assess the quality condition of surface water within and around the mining permit area, and to draft a water monitoring programme for the project site and provide recommendations.
- ❖ Prediction of the environmental impact of the proposed mining activity on the hydrological regime of the area.
- ❖ Forecasting the effects of the activity on the receiving environment

1.2 Proposed Activities

This project will entail an open cast method of excavation and all the activities will be guided by the project's EMPr such that the project does not impact the environment negatively.

- The topsoil will be stockpiled elsewhere on site preferably next to the farm boundary and will be used during rehabilitation period
- Once a box cut has been made, the overburden and mineral resources where necessary will be loosened by blasting.
- The loosened material will then be loaded onto trucks by excavators
- A haul road will be situated at the side of the open cast, forming a ramp up which trucks can drive, carrying ore and waste rock.
- Waste rock will be piled up at the surface, near the edge of the open cast (waste dump)
- The waste dump will be tiered and stepped, to minimize degradation

1.3 Scope of Work

The Hydrology Evaluation Scope of Work (SoW) is summarized as follows:

Phase 1:

- Information sourcing / literature review (Desktop Study)
- Collection and revision of relevant information

Phase 2:

- Site visit
    - ➢ Site assessment (better understanding of site) and sampling

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- Update catchment hydrology with newly available data
  - Catchment characteristics and delineation
  - Meteorological analysis (including MAP)
  - Average runoff analyses
  - Peak flow analyses for 1:50
  - Analyses of water quality samples
- Reporting:
  - Using the above components, a final hydrogeological report is compiled

1.4 Project Location

The proposed coal mining permit application is situated within portion of portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province. The permit area is located approximately 0.69 km South-East of Klarinet town and approximately 4.90 km North-West of Modelpark town. The project site covers an area approximately 5 hectares.

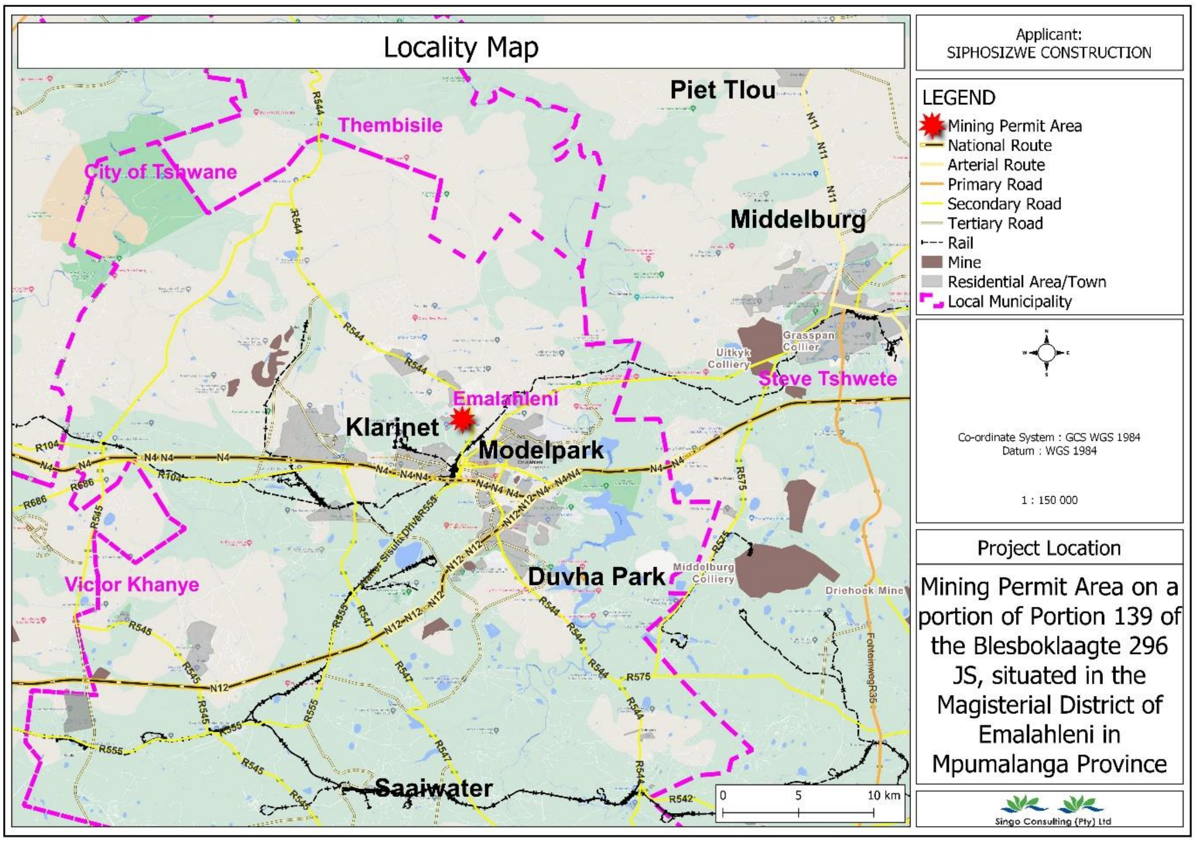

Figure 1: Locality map of the project area. *(Singo Consulting, 2023)*

2 LEGAL FRAMEWORK

Government Notice 704 (Government Gazette 20118 of June 1999) (hereafter referred to as GN 704), was established to provide regulations on the use of water for mining and related activities aimed at the protection of water resources.

- **Condition 4** which defines the area in which, mine workings or associated structures may be located, with reference to a watercourse and associated flooding. Any residue deposit, dam, reservoir together with any associated structure or any other facility should be situated outside the 1:100-year flood-line. Any underground or opencast mining, prospecting or any other operation or activity should be situated or undertaken outside of the 1:50 year flood-line. Where the flood-line is less than 100 metres away from the watercourse, then a minimum watercourse buffer distance of 100 metres is required for infrastructure and activities.
- **Condition 5** which indicates that no residue or substance which causes or is likely to cause pollution of a water resource may be used in the construction of any dams, impoundments or embankments or any other infrastructure which may cause pollution of a water resource.
- **Regulation 6** - describes the capacity requirements of clean and dirty water systems. Clean and dirty water systems must be kept separate and must be designed, constructed, maintained, and operated to ensure conveyance of the flows of a 1:50- year recurrence event. Clean and dirty water systems should not spill into each other more frequently than once in 50 years. Any dirty water dams should have a minimum freeboard of 0.8m above full supply level
- **Condition 7** which describes the measures which must be taken to protect water resources. All dirty water or substances which may cause pollution should be prevented from entering a water resource (by spillage, seepage, erosion etc) and ensure that water used in any process is recycled as far as practicable.
- **Condition 10** which describes the requirements for operations involving extraction of material from the channel of a watercourse. Measures should be taken to prevent impacts on the stability of the watercourse, prevent scour and erosion resulting from operations, prevent damage to in-stream habitat through erosion, sedimentation, alteration of vegetation and flow characteristics, construct treatment facilities to treat water before returning it to the watercourse, and implement control measures to prevent pollution by oil, grease, fuel, and chemicals

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➢ **The National Water Act (Act 36 of 1998)**:

The NWA governs water resource management in South Africa. As guardians of water, the Department of Human Settlements, Water and Sanitation (DHSWS) must guarantee that resources are used, preserved, safeguarded, developed, managed, and controlled in a sustainable manner for the benefits of all people of south Africa and the environment. Key provisions applying to the current study include:

- **Catchment Areas** - Any disturbance to a watercourse, such as the construction and operation of surface mining infrastructure, may require authorisation from DWS.

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3 HYDROLOGICAL SETTING AND BASELINE HYDROLOGY

3.1 Climate

Witbank has a temperate highland tropical climate with dry winters, with an elevation of 1519.81 meters above sea level (Classification: Cwb). The yearly temperature in the district is 22.52oC, which is 1.3 percent higher than the national average. Witbank receives 72.32 millimetres of precipitation on average per year, with 121.11 wet days (33.18 percent of the time), the mean annual rainfall and mean annual temperature is shown respectively in Figure 2 and Figure 3 below.

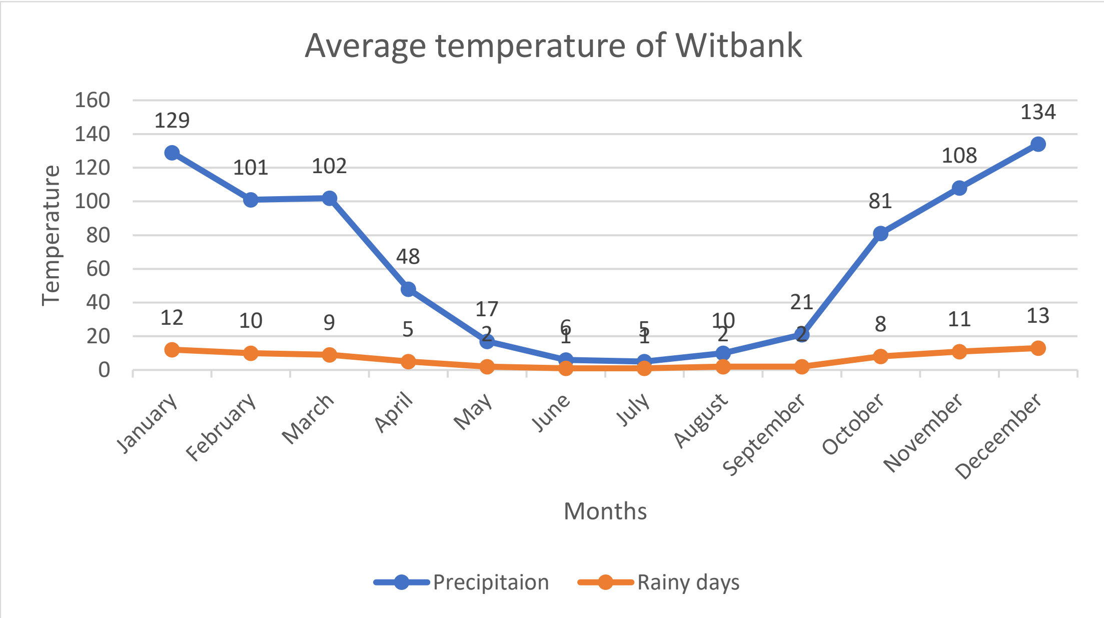

Figure 2: Average temperatures of Witbank

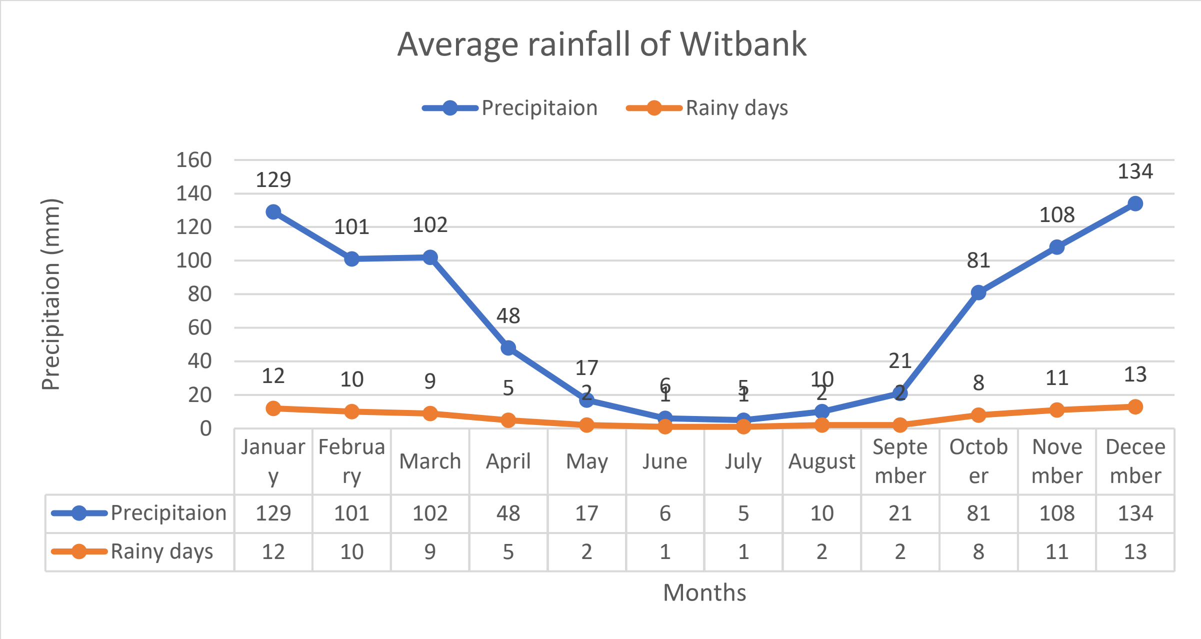

Figure 3: Average rainfall and rainy days in Witbank

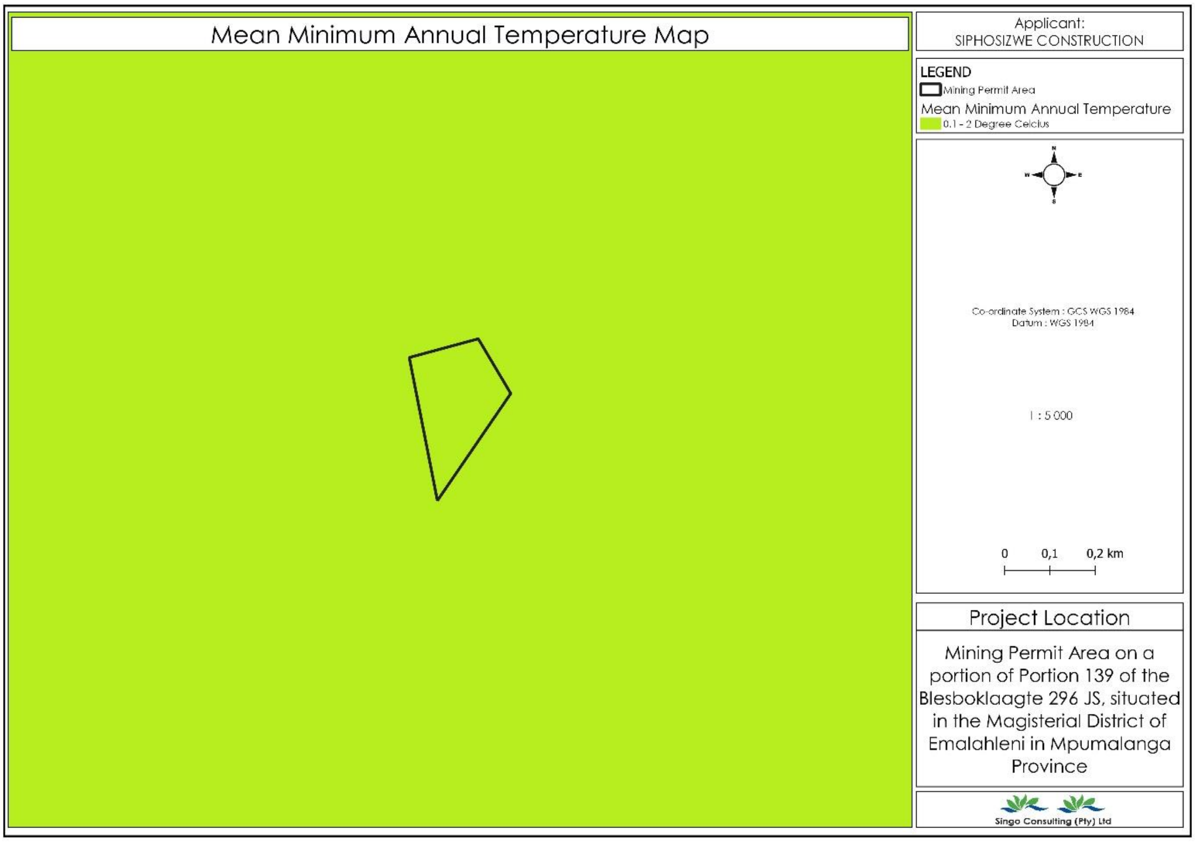

Figure 4: Mean minimum temperature map. *(Singo Consulting, 2023)*

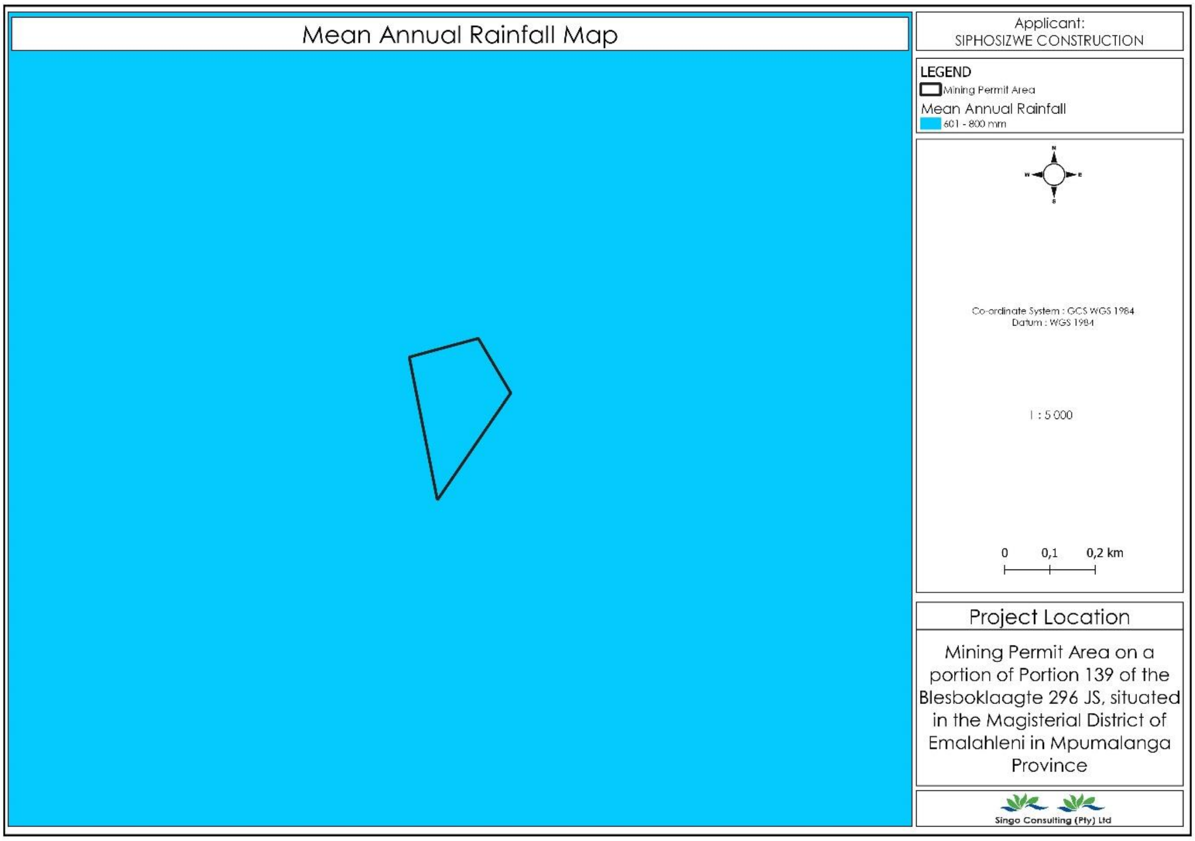

Figure 5: Mean Annual Rainfall map. *(Singo Consulting, 2023)*

3.2 Drainage and Topography

3.2.1 Drainage

The hydrology surrounding the proposed area is of vital importance. In this context hydrology is all the surface waters appearing within and nearby the proposed project area, where a potential to be impacted upon by the project existence. The hydrology map, illustrates that the following water bodies exists nearby the project area:

- Perennial River
- Non- Perennial River
- Channelled valley bottom wetland
- Dam

The above-mentioned water bodies are situated around the site, non-perennial river is situated approximately 5 km south-east of the mining permit area and approximately 5 km north-west there is a perennial river and the channelled valley bottom wetland.

Perennial rivers are defined as rivers that flow throughout all seasons and non-perennial rivers are those that flow only during certain seasons such as rainy seasons, which is summer season in eMalahleni. The identification of these water bodies allows for better mitigation measures which will have to be put in place before and during the mining operation. This is because the water bodies not only serve as habitat for the local ecosystems, but also as a source of water for the local communities for domestic use.

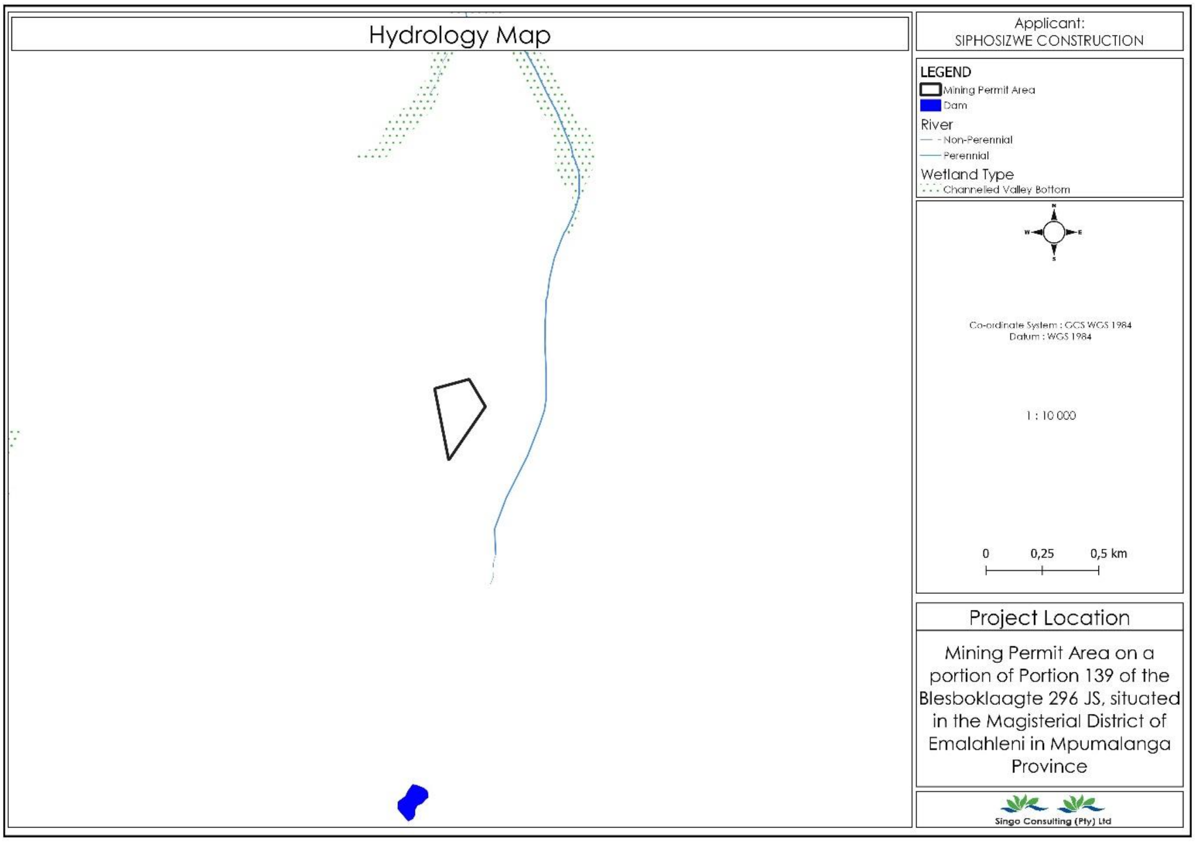

Figure 6: Hydrology map of the study area. *(Singo Consulting, 2023)*

3.2.2 Topography

The topology of the area is illustrated below by Figure 7 below. A Topographic map is a map which indicates, to scale, the natural features of the Earth's surface, as well as human features, with features at the correct relationship to each other (Oxford Dictionary; 2020). The topography map other than showing landform features, rivers, and associated water resources, it also shows the height above sea level with the use of contour lines. Contour lines are an Imaginary line on the ground surface joining the points of equal elevation.

In this environmental project, topography is used to determine how surface water flows during rainy seasons or how it would flow during the existence of the project. The topography also influences groundwater vulnerability, as topography also influences run-off and infiltration rate by means of residence time.

The slope of the study area is gentle, this is seen by the contours being widely spread, the study area lies between 1525 and 1535 mamsl. It can be concluded that in the area water flow is likely to be slow, this will increase the residence time of the water and or contaminants in the area, this gives the management time to deal or manage the contaminants in the area, but it poses a risk of groundwater contamination since it will encourage infiltration and increase the likelihood of groundwater vulnerability. This knowledge helps the site development team to be able to know how to manage water in the area, since the measures to manage water on a gentle and steep slope are different.

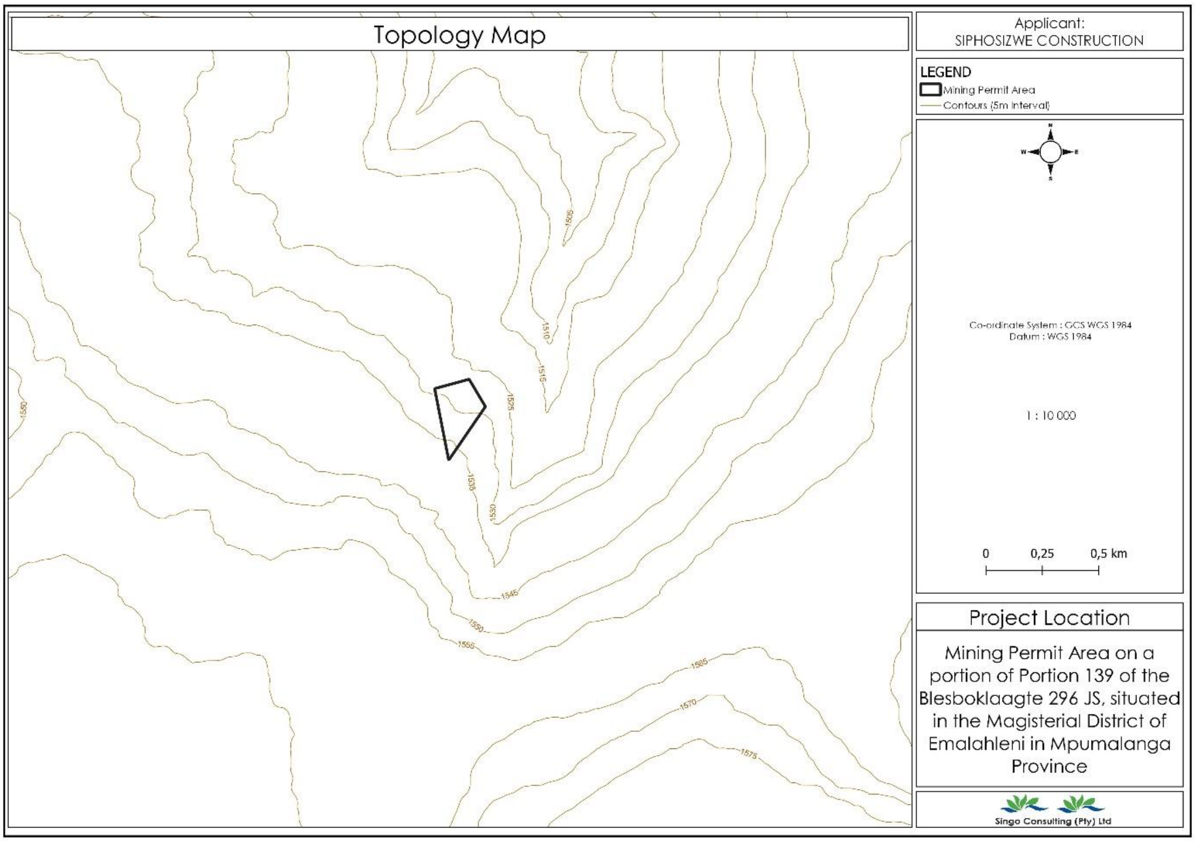

Figure 7: Topology map of the study area. *(Singo Consulting, 2023)*

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3.3 Catchment Description

South Africa's water resources are divided into quaternary catchments, which are the country's primary water management units (DWAF 2011). In a hierarchical classification system, a quaternary catchment is a fourth order catchment below the primary catchments. The primary drainages are further classified as Water Management Areas (WMA) and Catchment Management Agencies (CMA) (CMA). In accordance with Section 5 subsection 5(1) of the National Water Act, 1998, the Department of Water and Sanitation (DWS) has established nine WMAs and nine CMAs as outlined in the National Water Resource Strategy 2 (2013). (Act No. 36 of 1998). The purpose of establishing these WMAs and CMAs is to improve water governance in various regions of the country, ensuring a fair and equal distribution of the Nation's water resources while ensuring resource quality is maintained.

The proposed mining permit application is in the Olifants Water Management Area (WMA) within the main quaternary catchment B11K. The WR2012 study, presents hydrological parameters for each quaternary catchment including area, mean annual precipitation (MAP) and mean annual runoff (MAR). The regional hydrological setting of the project site is indicated in Figure 8.

Table 1: Water Management Area, QC, Catchment area and MAP

Quaternary Catchment	S-Pan Evaporation		Rainfall	
	Evaporation Zone	MAE (mm)	Rainfall Zone	MAP (mm)
B11K	4A	1700	B1C (ZB1CB)	684

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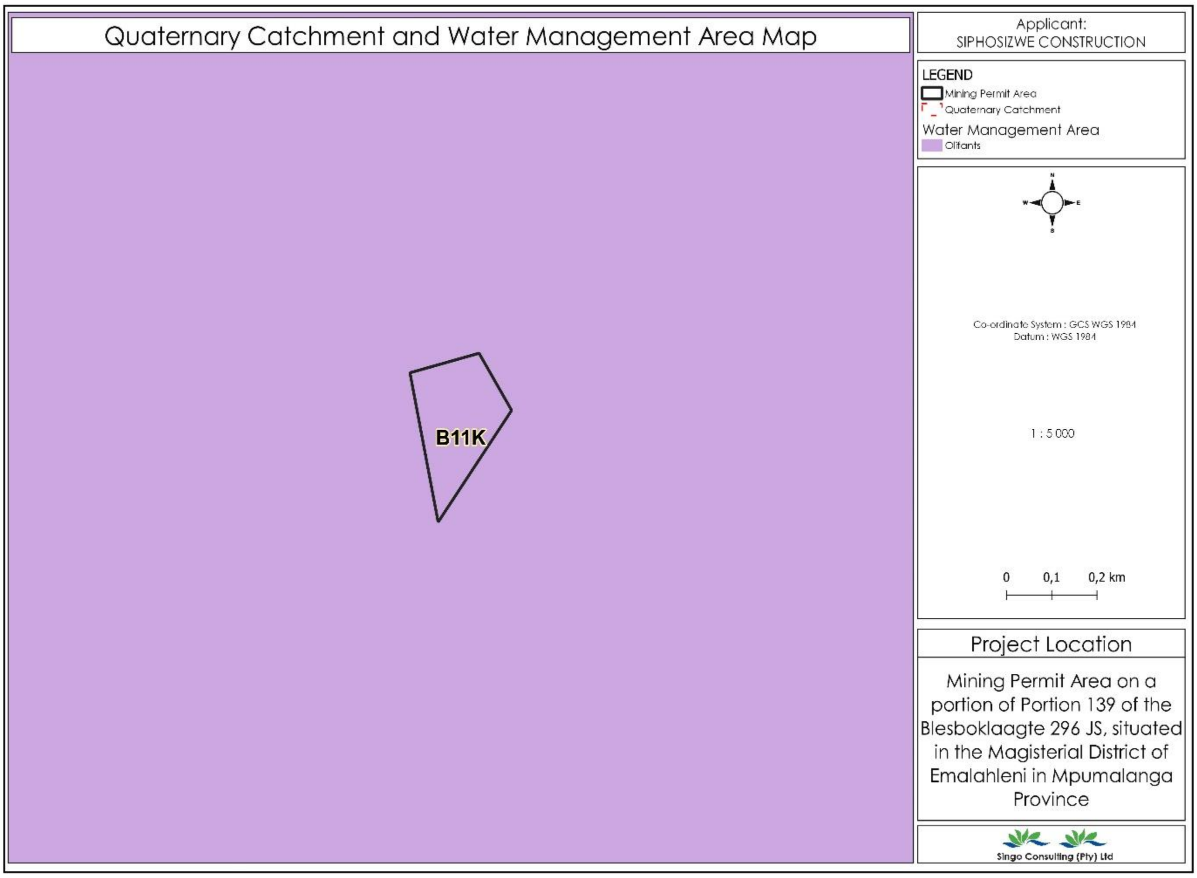

Figure 8: Water management area of the site. *(Singo Consulting, 2023)*

3.4 Wetlands Delineation

According to National water Act 36 of 1998, a wetland is defined as Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Wetland delineation is the process of identifying outer edge of the temporary zone of the wetland. Whilst the identification of a wetland is useful, normally the requirement (specifically for EIA and WULA applications) is for the wetland to be delineated – for its boundaries to be precisely determined so that it can be mapped out and indicated as a sensitive area. This edge marks the boundary between the wetland (water resource) and the adjacent terrestrial areas. This process is aided by using the various indicators which are used to identify a wetland, the indicators are as follows:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur
- The type of soil form (i.e., the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types
  - The presence of wetland vegetation species, and
  - The presence of redoxymorphic soil features, which are morphological signatures that appear in soils with prolonged periods of saturation (due to the anaerobic conditions which result).

The drainage channels on site are recharged by surface water run-off from elevated residential and mountain areas during rainy periods. On a regional scale, rainfall within the Quaternary Catchment boundaries will recharge groundwater in the project area. Although geological structures such as weathered and fractured zones will create preferred pathways for groundwater flow, the general flow direction, particularly in the weathered unsaturated zone, is expected to follow surface gradients. Figure 9 below is a hydrological map illustrating channelled valley bottom wetlands, a dam, perennial and non-perennial rivers.

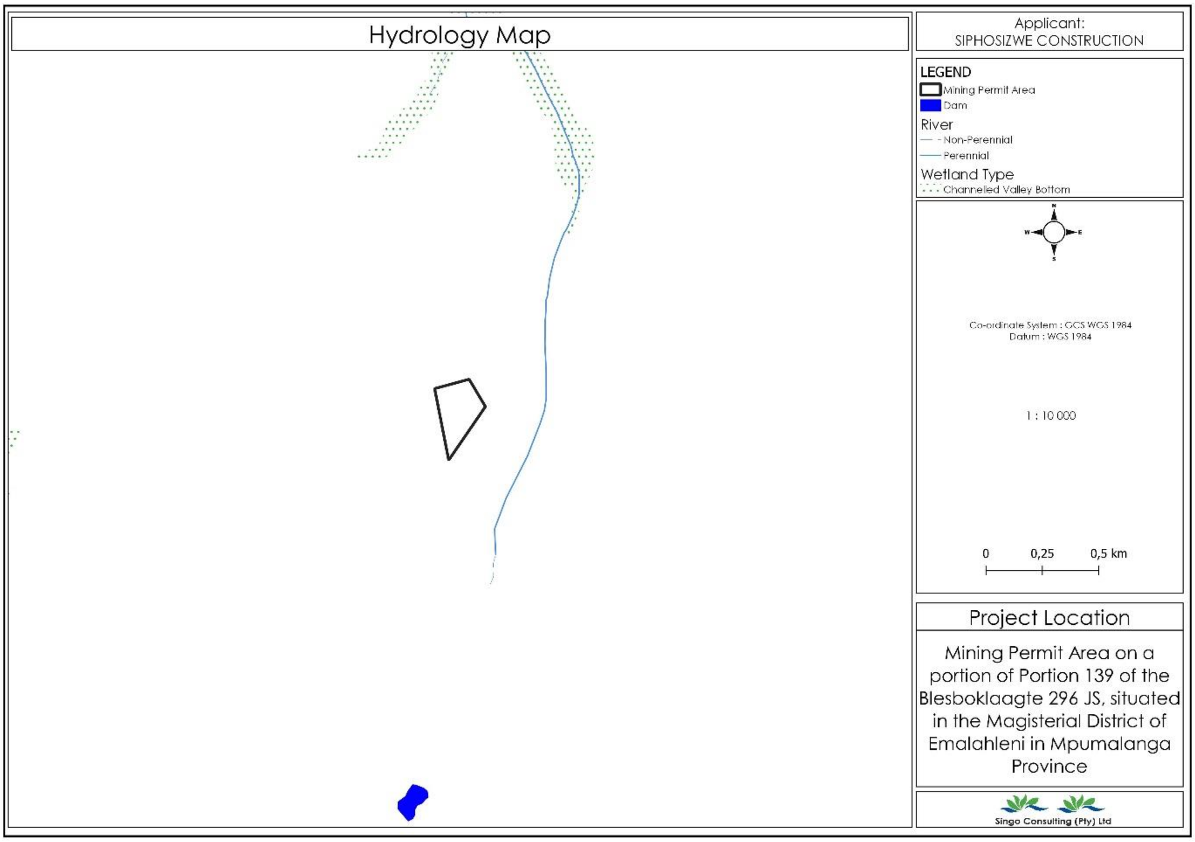

Figure 9: Hydrology map showing different wetlands in the area. (Singo Consulting, 2023)

3.5 Buffer Zones

The natural environment is still being destroyed at an alarming rate, all over the globe (Ebregt and Greve, 2000)

According to the National Environmental Management: Protected area Act of 2003 no 57, Buffers are areas peripheral to a specific protected area, where restrictions on resource use and special development measures are undertaken to enhance the conservation value of the protected area.

A buffer zone is a strip of plants adjacent to land-disturbing sites or bordering streams, lakes, and wetlands which provides streambank stability, reduces soil erosion, reduces storm runoff velocities and filters sediment in stormwater. (Sliva, Lucie, and D. Dudley Williams. "Buffer zone versus whole catchment approaches to studying land use impact on river water quality." (Water research 35.14 (2001): 3462-3472).

Within the vicinity of the proposed site, there are no water bodies present. To ensure that such area remain protected throughout the existence of the project, buffers are put in place to mitigate the impacts which such project will have on the protected area. For the proposed site, there are wetlands such as channelled valley bottom around the research area in the northern directions, however they are more than 500m away from the project area and the measures that will be put in place include, monitoring the stream and making sure that the proposed project does not affect the water bosies.

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Figure 10: Project Area. *(Singo Consulting, 2023)*

3.6 Vegetation and Soil

3.6.1 Vegetation

The proposed area comprises of only one type of vegetation, the moist sandy highveld grassland vegetation type. This type of vegetation can be found everywhere on Earth, there are two main types of grasslands: temperate and tropical. Temperate grasslands appear in areas where the variations in temperature occur when the seasons change. This means that in temperate grasslands, the vegetation changes accordingly because some species prefer to grow during summertime, while others come to life when it is cold. On the other hand, tropical grasslands, also known as savannas, prefer when it is warm and (mostly) dry throughout the year. (Robel, R. J., et al. "Relationships between visual obstruction measurements and weight of grassland vegetation." Rangeland Ecology & Management/Journal of Range Management Archives 23.4 (1970): 295-297.)

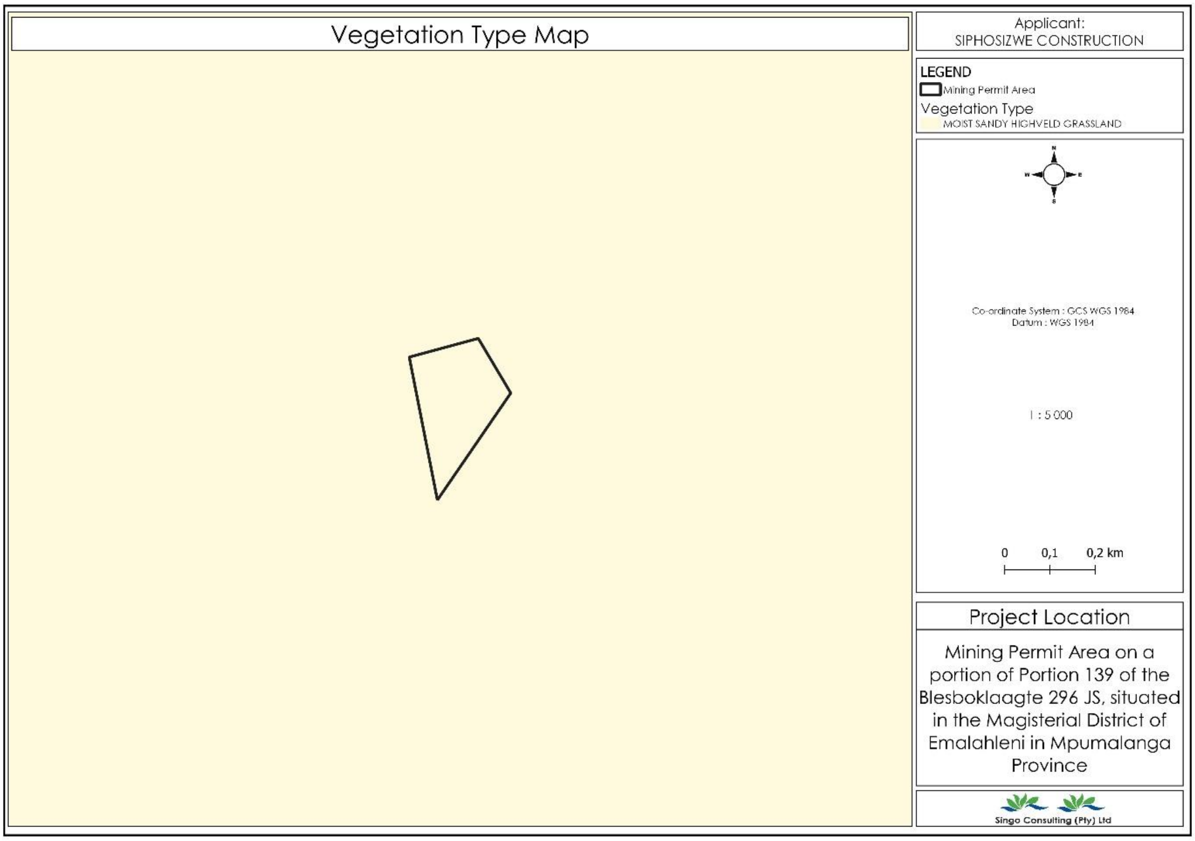

Figure 11: Vegetation Type in the project site. *(Singo Consulting, 2023)*

3.6.2 Soils

The area is dominated by the association of classes 1 to 4: undifferentiated structureless soils. Structureless soils have no observable aggregation and no definite arrangement of the soil particles. Sands and sandy-loam soils are often structureless with a single grain arrangement of the soil particles. Clay soils may also be described as structureless when the particles form a massive structure with no small aggregates within. (Belokas, George, and Michael Kavvadas. "An anisotropic model for structured soils: Part i: Theory." Computers and Geotechnics 37.6 (2010): 737-747.)

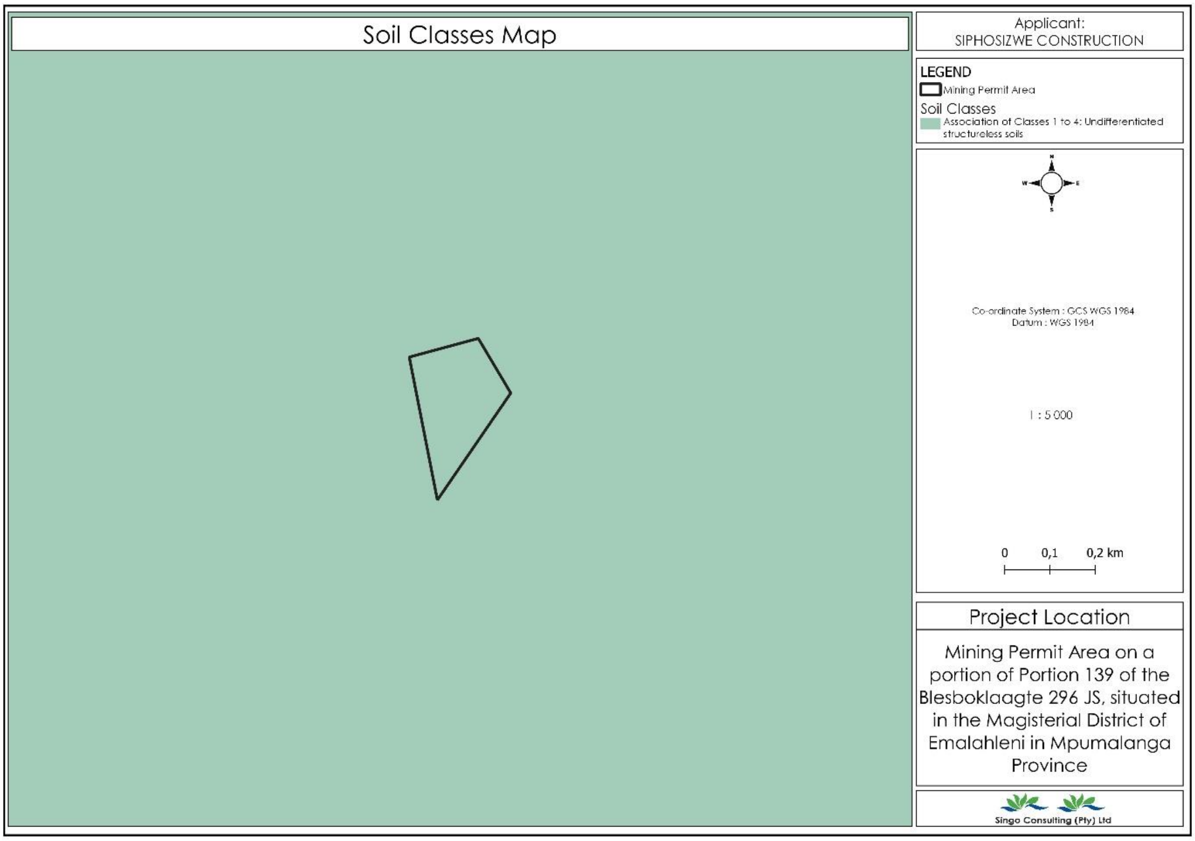

Figure 12: Map showing soil class for the proposed area. (Singo Consulting, 2023)

3.7 Geological setting

The coal deposits in South Africa are largely hosted by the Karoo Supergroup, which was deposited in the Gondwana basin that covered parts of Africa, Antarctica, South America, and Australia. The basal Stratigraphy of the Karoo Supergroup comprises the Dwyka Group which is a Late Carboniferous to Early Permian (~320Ma) sequence of glacial and periglacial sediments including diamictites, till moraine, conglomerate, sandstone, mudstone and varved shale. The Dwyka group is overlain by the Ecca Group which is an Early to Late Permian (~260 Ma) sequence composed of sandstone, siltstone, mudstone, and large deposits of coal seams deposited in a terrestrial basin on a gently subsiding shelf platform. In the surrounding Witbank Coalfield areas, the Ecca Group is overlain by the Beaufort Group, which is Early Triassic (~260 to 210 Ma), comprising multi-coloured mudstone and sandstone with only minor coal accumulation, and was deposited in a fluvial environment.

The Molteno Formation rests unconformably on the Beaufort Group and comprises Late Triassic (~210 Ma) coarse, immature sandstone with minor argillaceous layers derived from braided streams. This in turn is overlain by the Elliot Formation consisting of red mudstone and sandstone and the Clarens Formation comprising Aeolian sandstone. At the top of the Karoo Supergroup stratigraphy is the Drakensburg Group, which comprises Early to Middle Jurassic (~180 Ma) flood basalts.

According to the 2628 East Rand 1:250 000 geology series map the site is situated on Permian (245 000 – 290 000 million years) sandstone, shale, and coal beds of the Vryheid Formation of the Ecca Group, and Karoo Supergroup. Jurassic (145 000 – 208 000 million years) dolerite sills intruded into the older sediments through vertical feeder dykes. Quaternary surficial deposits of alluvium and ferricrete can be found throughout the surrounding area.

The Ecca Group, which is part of the Karoo Supergroup, comprises of sediments deposited in shallow marine and fluvial-deltaic environments with coal accumulated as peat in swamps and marshes associated with these environments. The sandstone and coal layers are normally reasonable aquifers, while the shale trends to act as aquitards. Several layered aquifers perched on the relative impermeable shale are common in such sequences. The Dwyka Formation comprises consolidated products of glaciations (with high amounts of clay) and is normally considered have impermeable qualities.

The general horizontally disposed sediments of the Karoo Supergroup are typically undulating with a gentle regional dip to the south. The extent of the coal is largely controlled by the preKaroo topography. Abundant dolerite intrusions are present in the Ecca sediments. These intrusions comprise sills, which vary from being concordant to transgressive in structure, and feeder dykes. Although these structures serve as aquitards and tend to compartmentalize the groundwater regime, the contact zones with the pre-existing geological formations also serve as groundwater conduits. There are common occurrences of minor slips or faults, particularly near the dolerite intrusions. Within the coalfield, these minor slips, displacing the coal seam by a matter of 1 to 2 meters, are likely to be common in places.

The Vryheid Formation consists mainly of sandstone and shale with some subordinate coal seams associated with it (SACS, 1980). The sediments of the Vryheid Formation probably represent alluvial plain, upper, and lower delta plain deposits with associated shallow lagoon and coastal swamps (Jermy and Bell, 1990). The change from stable margin to subsiding foreland basin confined the Vryheid.

Geology of the portion of portion 139 of the farm Blesboklaagte 296 JS, under the District of Emalahleni, Mpumalanga Province, consist of the Vryheid Formation

The Vryheid Formation contains 5 major coal seams, with locally developed partings and splits in the coal seams increasing the number to 8, within an 85 m thick stratigraphic horizon

(Greenshields,1986) although this horizon can attain thicknesses up to 160 m in the deeper parts of the basin (Cadle et al., 1990). According to Cidle et al. (1990) all five major seams are still present in the thinnest and most proximal parts of the formation.

Greenshields (1986) states that all four cyclothems exhibit aggressive phase where sedimentation occur red influvio-deltaic environments, followed by a transgressive phase where sedimentation was typical of both marine and non-marine transgressive shorelines. A seam is therefore associated with clastic successions comprising carbonaceous shale or siltstone, fine to coarse-grained sandstone and minor conglomerate (Cadle et al.1990)

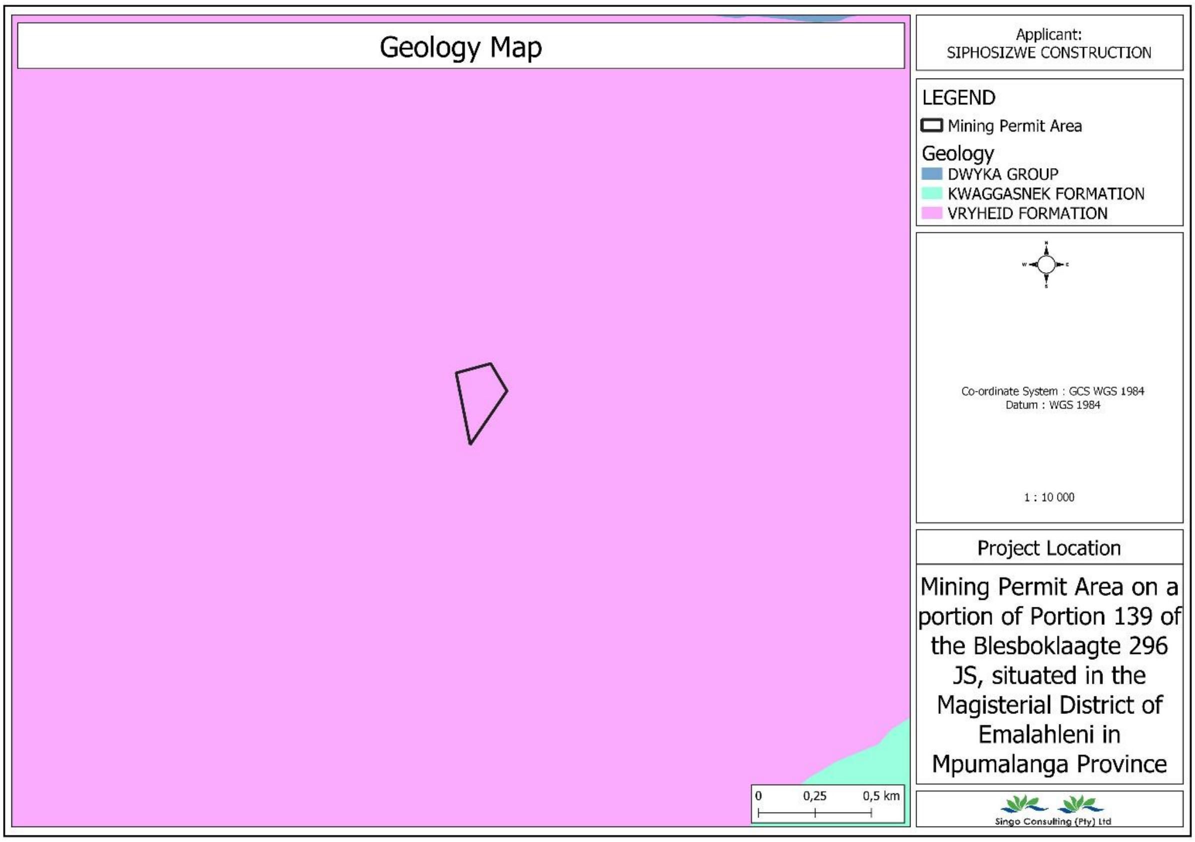

Figure 13: Geological map of the proposed area. (Singo Consulting, 2023)

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4 SITE ASSESSMENT

Site assessment is most probably the most important aspect in any form of study, this is because through site assessment visual observations are made, and proper mitigation measures are ensured.

4.1 Locality setting

The proposed coal mining permit application is situated within portion of portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province.The permit area is located approximately 0.69 km South-East of Klarinet town and approximately 4.90 km North-West of Modelpark town, refer to figure 1 above of the locality map.

4.2 Water Sampling

During the site inspection no water samples were taken. Water quality must be tested on a regular basis as part of maintaining a safe and reliable source. This helps ensure that the water source is being properly managed from potential contamination due to the development of the storage, and appropriate treatment is selected. The water sampling bottles must be rinsed at least 3 times before actual collection of water sample. The pH, temperature, Dissolved oxygen, TDS and electrical conductivity must be measured from the water sample. The samples are then stored in a cooler box at a temperature of 4°c and below, and then taken to the laboratory for further analysis.

Table 2: Classification of water according to its hardness

Water classification	Total hardness concentration as mg/L as CaCO3
Soft water	<50 mg/L as CACO3
Moderately hard	50-150 mg/L as CaCO3
Hard water	150-300 mg/L as CaCO3
Ver hard water	>300 mg/L as CaCO3

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4.3 Current Activities.

Currently there some parts of the area has been mined and the majority of the area is covered by plantation and natural vegetation.

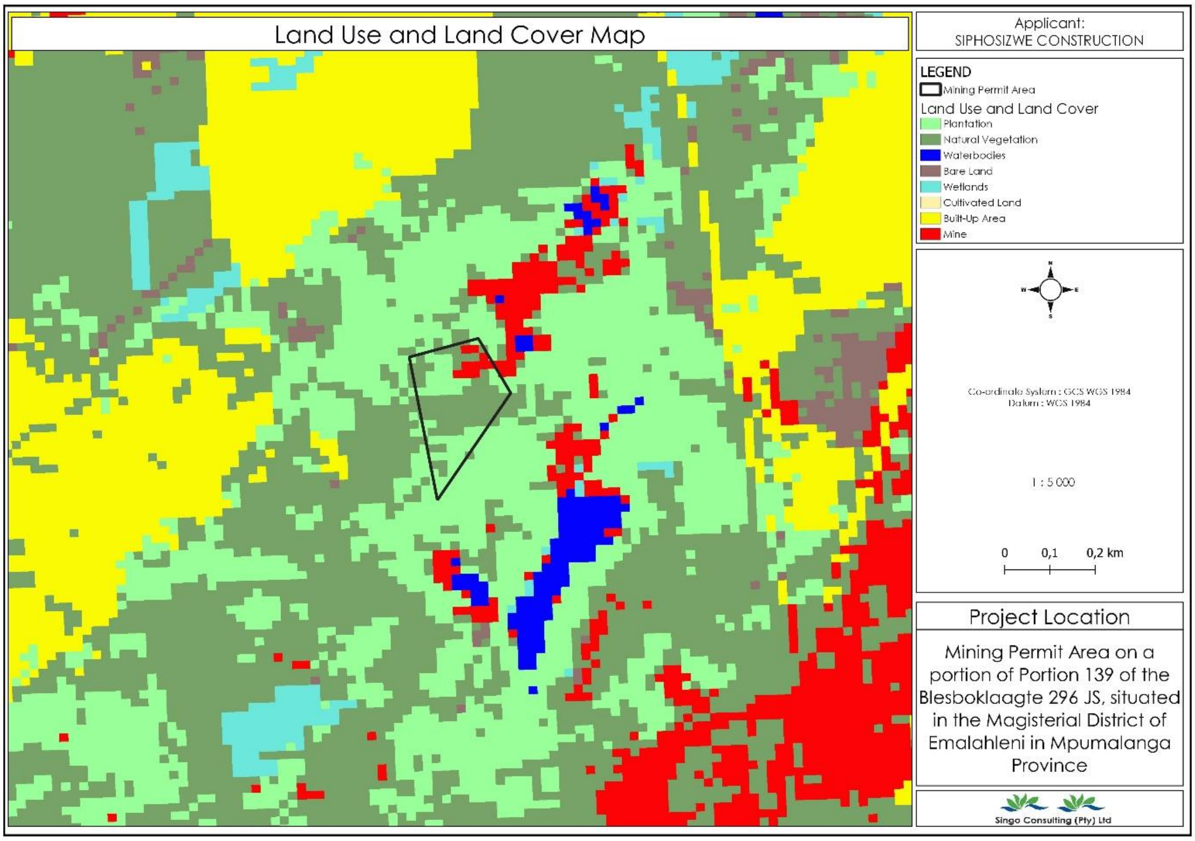

Figure 14: Land use and cover map. (Singo Consulting, 2023)

Figure 15: Diggings observed onsite. *(Singo Consulting, 2023)*

5 FLOODLINE DETERMINATION

Flood risk and flood line determination are an important part of development planning for a wide range of potential developments. For commercial, housing and mining developments, no development may occur within areas that are potentially prone to becoming inundated with water as a result of floods. The need for determination is frequently legislated or included in regulations. Typical examples would be regulations contained in: General notice 704 of the south African national Water Act (Act 36 of 1998), which stipulates that no mining activities may take place within or below a defined 1: 100- year flood line.

5.1. Methodology and Data Sources

National legislation applicable to surface water management includes:

- Constitution of the Republic of South Africa, 1996 (No. 108 of 1996) – The Bill of Rights states that everyone has the right to an environment that is not harmful to their health or well-being.
- National Water Act, 1998 (Act 36 of 1998) – Provides for the protection of the quality of water and water resources in South Africa and provides for the establishment of Water Management.

5.1.1 Elevation Data

Elevation data in the form of 5 m contour intervals covering the project area was sourced from the client. The contour lines were used to generate a 5 m spatial resolution. The contour lines were used to determine change in elevation. The distance between contour lines indicates the slope of the area. The area consists of a gentle slope, when contour lines are further apart from each other, then slope is gentle slope. Refer to figure 7 of the topographic map above.

5.1.2 Manning's Roughness Coefficients

The Manning's roughness coefficients are values that represent the channel and adjacent floodplains resistance to flow. The vegetation and terrain were assessed during the site investigation, to estimate suitable Manning's roughness coefficients. A Manning's roughness coefficient of 0.08 was used for the non-perennial drainage lines, as dense vegetation occurs within and along these watercourses.

5.1.3 Peak Flows

For the non-perennial drainage lines in the vicinity of the project, the Rational method is the preferred method to calculate the peaks.

The Rational method is based on the following equation:

$$QT = \frac{C\ I\ A}{3.6}$$

where: QT = Peak flow for a recurrence interval e.g., a 1:100-year flood (m^3/s)

C = Runoff coefficient (dimensionless)

I = Average rainfall intensity over the catchment (mm/hour)

A = Catchment area contributing to the peak flow (km^2)

3.6 = Conversion factor

5.1.4 Software

The following software's were used:

- ArcMap 10.2 is a GIS software programme used to view, edit, create and analyse geospatial data.
- ArcMap was used to view spatial data and to create maps. Its extension 3D Analyst was used for terrain modelling purposes, for converting the contour data into a DTM grid format.
- HEC-GeoRAS utilises the ArcMap environment and is used for the preparation of geometric data (cross-sections, river profile, banks and flow paths) for input into the HEC-RAS hydraulic model. It is further used in post processing to import HEC-RAS results back into ArcMap, to perform flood inundation mapping; and
- HEC-RAS 4.1 (Brunner, 2010) was used to perform hydraulic modelling. HEC-RAS is a hydraulic programme used to perform one-dimensional hydraulic calculations for a range of applications, from a single watercourse to a full network of natural or constructed channels.

5.1.5 Hydraulic Model Setup

Development of the hydraulic model included the following steps:

- Preparation of geometric data (cross-sections, stream centre line, bank lines and flow paths) in HEC-GeoRAS.
- Importing of geometric data into HEC-RAS.
- Entering HEC-RAS model parameters such as the Manning's roughness coefficients, boundary conditions and peak flows.

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- Performing steady, mixed flow (combination of subcritical, supercritical, hydraulic jumps and drawdowns) modelling within HEC-RAS to calculate the flood water elevations at cross-sections; and
- Importing flood level elevations at cross-sections into HEC-GeoRAS to perform floodplain delineations

5.2 Catchments

The quaternary catchment is shown in the diagram below:

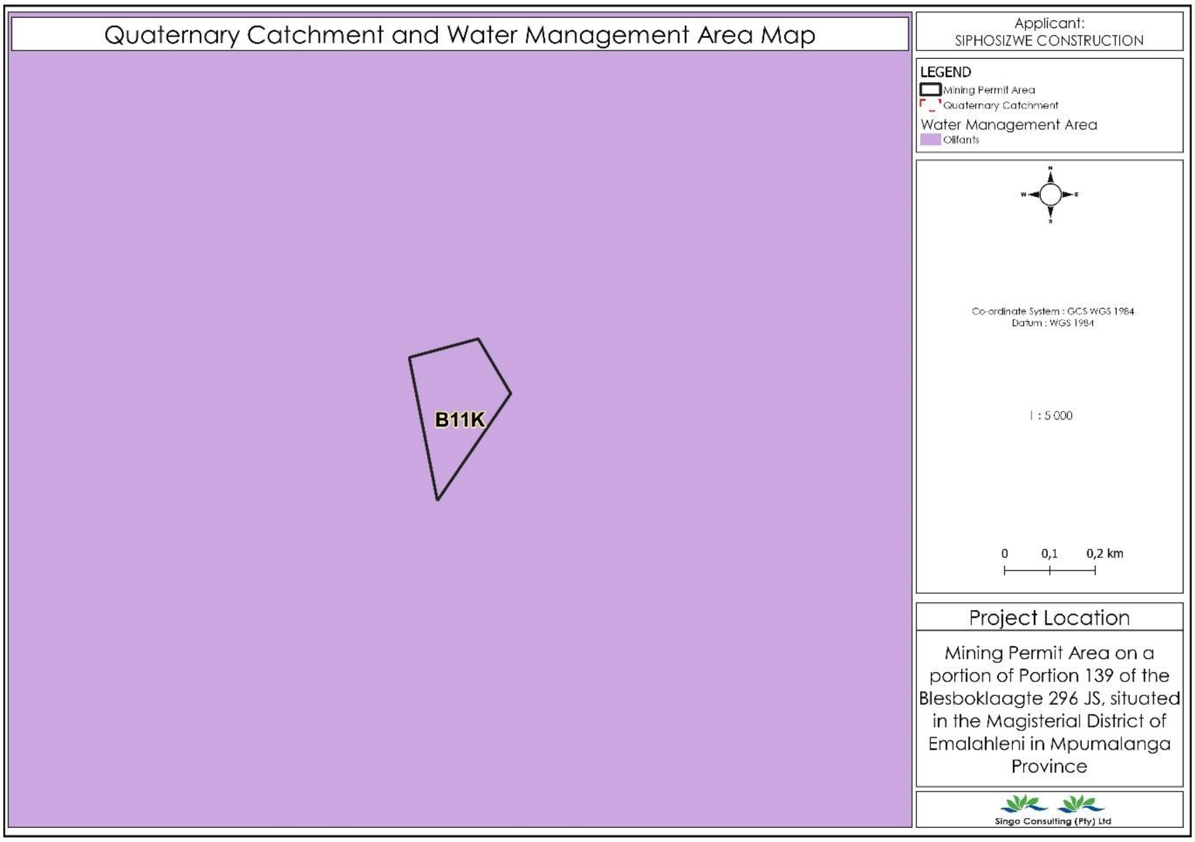

Figure 16: water catchment delineated. *(Singo Consulting, 2023)*

6 SURFACE WATER IMPACT ASSESSMENT

6.1 Methodology

This section evaluates the potential impact of the proposed development on watercourses present within and around the mining site. Watercourse is a term used in the National Water Act (Act No. 36 of 1998) (NWA) that includes various water resources, such as different types of wetlands (both natural and artificial), rivers, riparian habitat, dams and drainage lines (e.g., natural channels in which water flows regularly or intermittently). Results and discussions of delineated watercourses are used as part of the impact assessment that considers both corridor alternatives separately.

Expected watercourse impacts associated with the proposed development is assessed in detail for the construction and operational phases of the project using the approach provided in the Impact Assessment methodology Section below, which includes the provision of recommended mitigation measures. An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

6.1.1 Impact status

- Negative effect (i.e., at a `cost' to the environment)
- Positive effect (i.e., a `benefit' to the environment)
- Neutral effect on the environment

6.1.2 Impact extent

- Site (site only)
- Local (site boundary and immediate surrounds)
- Regional
- National
- International

6.1.3 Impact duration

- Immediate (< 1 year)
- Short term (1-5 years)
- Medium term (5-15 years)
- Long term (ceases after the operational life span of the project),
- Permanent

6.1.4 Impact Probability

- None (the impact will not occur)
- Improbable (probability very low due to design or experience)
- Low probability (unlikely to occur)
- Medium probability (distinct probability that the impact will occur)
- High probability (most likely to occur)
- Definite

6.1.5 Impact intensity

- None
- Minor
- (4) Low
- (6) Moderate (environmental functions altered but continue)
- (8) High (environmental functions temporarily cease)
- (10) Very high / unsure (environmental functions permanently cease)

6.1.6 Impact Significance

Based on the information contained in the points above, the potential impacts are assigned a significance rating (S). This rating is formulated by adding the sum of the numbers assigned to extent (E), duration (D) and magnitude (M) and multiplying this sum by the probability (P) of the impact.

S= (E+D+M) P

The significance ratings are given below:

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

6.2 Impact Assessment Ratings and Mitigation Measures

The evaluation of impacts is conducted in terms of the criteria detailed in Table 3 to Table 7. The various impacts of the project are discussed in terms of impact status, extent, duration, probability and intensity. Impact significance is the sum of the impact extent, duration, probability and intensity, and a numerical rating system is applied to evaluate impact significance. Therefore, an impact magnitude and significance rating are applied to rate.

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6.2.1 Impact Assessment Rating

Table 3: Impact status

Rating	Description	Quantitative Rating
Positive	Benefit to the receiving environment	P
Neutral	No cost or benefit to the receiving environment	-
Negative	A cost to the receiving environment	N

Table 4: Impact extent

Rating	Description	Quantitative Rating
Low	**Site-specific**; occurs within the site boundary	1
Medium	**Local;** extends beyond the site boundary; affects the immediate surrounding environment (i.e., up to 5 km from the project site boundary)	2
High	**Regional**; extends far beyond the site boundary; widespread effect (i.e., 5 km and more from the project site boundary)	3
Very high	**National and/or international**; extends far beyond the site boundary; widespread effect.	4

Table 5: Duration of the impact

Rating	Description	Quantitative Rating
Low	**Short-term**; quickly reversible; less than the project lifespan; 0 – 5 years.	1
Medium	**Medium-term**; reversible over time; approximate lifespan of the project; 5 – 17 years	2
High	**Long-term;** permanent; extends beyond the decommissioning phase; >17 years.	3

Table 6: Probability of the impact

Rating	Description	Quantitative Rating
Improbable	Possibility of the impact materialising is negligible; chance of occurrence <10%	1
Probable	Possibility that the impact will materialise is likely; chance of occurrence 10 – 49.9%.	2
Highly probable	It is expected that the impact will occur; chance of occurrence 50 – 90%	3
Definite	Impact will occur regardless of any prevention measures; chance of occurrence >90%.	4
Definite and Cumulative	Impact will occur regardless of any prevention measures;	5

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	chance of occurrence >90% and is likely to result in in cumulative impacts.	

Table 7: Impact magnitude and Significance rating

Impact	Rating	Description	Quantitative Rating
Positive	High	Of the highest positive order possible within the bounds of impacts that could occur. +	+12 to -16
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. Other means of achieving this benefit are approximately equal in time, cost and effort	+6 to -11
	Low	Impacts is of a low order and therefore likely to have a limited effect. Alternative means of achieving this benefit are likely to be easier, cheaper,	+1 to -5

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		more effective and less time-consuming	
No impact	No impact	Zero impact	
Negative	Low	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged	-1 to -5
	Medium	Impact is real, but not substantial in relation to other impacts that might take effect within the bounds of those that could occur. In the case of adverse impacts, mitigation is both feasible and possible. Social cultural and economic activities of communities are changed but can be continued (albeit in a different form).	-6 to -11

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		Modification of the project design or alternative action may be required	
	High	Of the highest order possible within the bounds of impacts that could occur. In the case of adverse impacts, there is no possible mitigation that could offset the impact, or mitigation is difficult, expensive, time-consuming or a combination of these. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt.	-12 to -17

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7 STORMWATER MANAGEMENT PLAN

7.1 Terminology

Stormwater management involves the control of that surface runoff. The volume and rate of runoff both substantially increase as land development occurs. Construction of impervious surfaces, such as roofs, parking lots, and roadways, and the installation of storm sewer pipes which efficiently collect and discharge runoff, prevent the infiltration of rainfall into the soil. Management of stormwater runoff is necessary to compensate for possible impacts of impervious surfaces such as decreased groundwater recharge, increased frequency of flooding, stream channel instability, concentration of flow on adjacent properties, and damage to transportation and utility infrastructure.

- Activity: Any mining related process on the mine including the operation of washing plants, mineral processing facilities, mineral refineries and extraction plants; the operation and the use of mineral loading and off-loading zones, transport facilities and mineral storage yards, whether situated at the mine or not; in which any substance is stockpiled, stored, accumulated, dumped, disposed of or transported.
- Clean area: This refers to any area at or near a mine or activity, which is not impacted by mining activities, but has the potential to become contaminated if not managed appropriately.
- Clean water system: This includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of clean unpolluted water.
- Dam: This includes any return water dam, settling dam, tailings dam, evaporation dam, catchment or barrier dam and any other form of impoundment used for the storage of unpolluted water or water containing waste.
- Dirty area**:** This refers to any area at a mine or activity which causes, has caused or is likely to cause pollution of a water resource (i.e. generate contaminated water as a result of mining activities).
- Partially dirty area: These are areas that are unlikely to produce contaminated runoff other than elevated suspended solids.
- Dirty water system: This includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste; and
- Watercourse: This is defined in the NWA as:
    - A river or spring
    - A natural channel in which water flows regularly or intermittently
    - A wetland, lake or dam into which, or from which, water flows; and

7.2 Stormwater Management Principles

Stormwater pose a risk of flooding to project infrastructure. The aim of stormwater management measures is to mitigate these impacts by fulfilling the requirements of the National Water Act (Act 36 of 1998) and more particularly GN 704

The following principles from GN 704 are appropriate for the design of stormwater management measures site area.

- Capacity: dirty water systems are to be designed, constructed, maintained and operated in a manner that they will not spill into a clean water system or the environment more frequently than once in 50 years.
- Conveyance: All the water systems will be designed, constructed, maintained and operated so that they convey a 1:50 year flood event.
- Freeboard: as a minimum, any dirty water dams are to be designed, constructed, maintained and operated to have 0.8m freeboard above full supply level.
- Collect and re-use: ensure that dirty water is collected and re-used (dust suppression).
- Diversion: minimise flow of any surface water of floodline into mine workings.

7.3 Current Stormwater Management

- Currently there is no stormwater management designed specifically for the site.

7.4 Proposed Stormwater Measures

- Clean stormwater will be prevented from entering dirty catchments by creating perimeter beams around dirty water areas and dirty water collection infrastructure (channels and dams).
- Dirty stormwater from the operation areas (crushers, ore stockpiles, load out stations, workshops, contractors' area etc) must be collected by lined drainage channels and conveyed into dirty water containment facilities, either the dirty water dam or pollution control dam.
- During storm events, the dirty water dam will spill through new channels into a stormwater dam, and this stormwater will be pumped back to the dirty water dam after the storm event for re-use purposes.
- Dirty stormwater and any groundwater collecting within the pit must be collected and pumped to the dirty water dam.

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- Runoff from the waste rock dumps will be prevented from entering any surface water receptors by creating perimeter stormwater retention berms to collect runoff and allow it to infiltrate into the ground and/or evaporate
- The topsoil will be revegetated and any runoff from this will be classified as clean
- Dirty water uses will be dust suppression, wash down or other non-potable uses where water quality permits.

7.4.1 ROM Stockpile Consolidation

Coal stockpiles destroys natural habitats, not only through deforestation and mountain removal, but also by contaminating the surrounding land and water bodies around. This causes a disruption on the entire ecosystem, as it harms or even kills plants and animals.

- There are several mitigation measures to avoid stockpile run of mine such as lining of stockpiles, on a mining permit the height of the stockpile should not exceed 2 meters in height
- Trenches around the stockpile, which will collect dirty water which was in contact with the stockpile.
- Permeable pavement will be constructed around the stockpile.

7.4.2 Open Cast Area

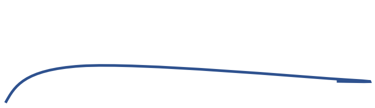
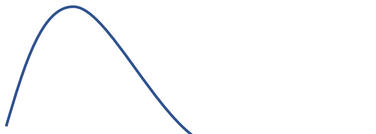
There are two major sub-method within open cast mining, which are area mining and the contour mining. If the topography is relatively flat as illustrated in the left column on table 8, then the area mining is appropriate. If the terrain is hilly or mountainous as indicated by the figure on the right column, then contour mining is appropriate (Ghose, Mrinal K. "Effect of opencast mining on soil fertility." (2004).

- Pump on standby to quickly dewater the mining area, this will reduce the residence time of the water and decrease the infiltration in the mining area.

- The haul roads should be compacted, this will reduce infiltration

- Around the mining area, the area should never be flat, so that the stormwater could be directed to a channel and quickly collected

Table 8: Open cast mining methods

	
Area mining	Contour mining

7.4.3 Water Management Infrastructure

To ensure minimum soil erosion the mining permit area must have trenches to direct dirty water runoff from the mining activity and stormwater to the pollution control dam. The dirty water (mine affected water) runoff from the mine operation can then be captured and properly contained in the pollution control dam and will be managed in a closed system. Detension basin and infiltration tanks can be used to manage water on site.

- Detention basins

Detention basins are the optimal control solution to regulate stormwater flow into the pump stations. These large concrete tanks store stormwater temporarily and drain slowly when the system is ready to pump water to a treatment plant.

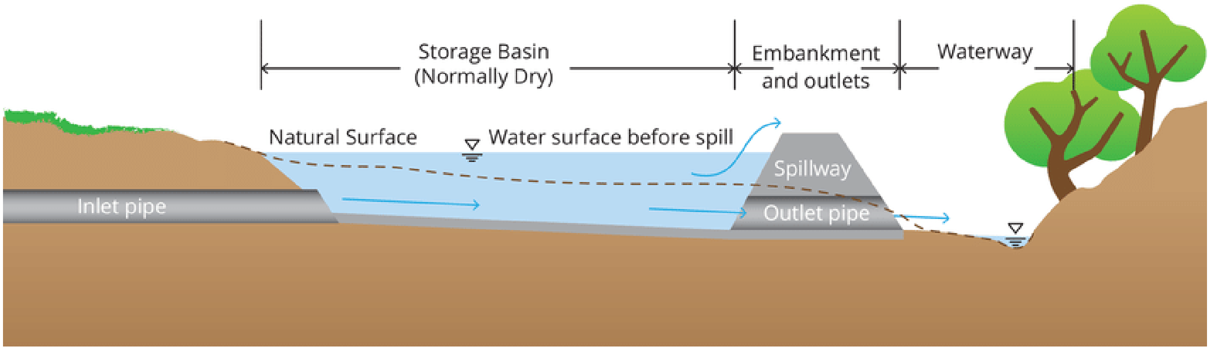


Figure 17: Detention basin.

- Infiltration tanks

These underground storage tanks are commonly made of plastic modules that infiltrate collected rainwater. Their modular system makes infiltration tanks cheaper and faster to construct than concrete detention basins, but they do not have the same capacity for storing and handling large volumes of runoff in short periods of time.

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8. MONITORING PLANS

8.1. Surface Water Quality

Overburden, topsoil, and waste stockpiles are all expected at the mine site. Stockpiles will be distinguished by bare soil, steep side slopes, and significant surface run-off. Run-off from these stockpiles is likely to be sediment-rich, whereas acid rock drainage from carbonaceous stockpiles may occur as pyrites in the overburden are exposed to oxygen.

During the Construction and Operational Phases of the mine project,water body adjacent to the mining permit area should be sampled on a monthly basis.

Monitoring during the Decommissioning Phase will be based on the Operational Phase monitoring, adapted to suit the final works to be implemented during this phase. However, in terms of surface water this will be primarily downstream of the area as for the Operational Phase.

Monitoring during the Post Closure Phase will be undertaken only where required to prove the sustainability of the site. In terms of surface water, this relates primarily to managing the surface topography (monitoring for settlements), and water quality and levels within the mined-out area.

Any infrastructure (PCDs) that will remain on site, post closure, will continue to be included in the surface water monitoring programme and should be monitored in terms of water quality and water levels on a monthly basis.

8.2. Stormwater Infrastructure

Dirty water inside the mine from the mining activities, stormwater drainage or rainfall must be channelled to the pollution control dam through water trenches. The farm must have water trenches, to minimize and prevent possibility of gully erosion inside the mining permit area. Stormwater runs rapidly into storm drains, sewer systems and drainage ditches and can cause flooding, erosion, turbidity (or muddiness), storm and infrastructure damage, however stormwater infrastructure capture and re-use stormwater to maintain or restore natural hydrologies.

Stormwater infrastructure should be monitored together with water quality. It is necessary to monitor these infrastructures because overtime they lose their integrity and or ability to perform their ultimate purpose. It should be based on monthly monitoring which will involve taking notes of the structure and providing recommendations on a monthly basis.

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9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusion and Summary

The application for the mining permit is proposed to be developed on a gentle topography with the project area situated within 1525 and 1544 m above mean sea level, in this project contour lines indicates a gentle slope and a low chance of soil erosion. The project mining permit area falls on portion of portion 139 of the farm Blesboklaagte 296 JS, under the District of Emalahleni, Mpumalanga Province. The identified water bodies in the proximity of the project include the perennial river, non-perennial river and channelled valley-bottom wetland. There are wetlands are more than 500m away from the project area and the measures that will be put in place include, monitoring the steam and making sure that the proposed project does not affect the water bodies.

South Africa is a water scarce country, as such ways to ensure that the quality and quantity is conserved to meet basic needs are of paramount importance. More ways and site-specific measures are needed to ensure that such is possible. Through desktop and site assessment observations, the following conclusions were made:

- During construction, presence of heavy machinery which will result in Hydrocarbon spillage. Clearing of vegetation which will result in decrease in infiltration. Use of VOCs on site, dewatering and leakage of ablution chemicals.
- Operational phase, the adjacent water body will likely be affected by dust settling in the water and possibly leaching of heavy minerals.
- Post mining phase, AMD as a result of non-maintenance of the mined-out area.
- The study area is underlain by the Vryheid formation which is the coal bearing formation in the Witbank coalfield, which is under the Ecca group, part of the karoo supergroup.
- The area is overlain by undifferentiated structureless soil and moist Highveld grassland.

9.2 Recommendations

- Proper stormwater management is recommended to prevent the risk of water resources contamination.
- The study area falls on a fractured aquifer system, the mine planning should take into consideration the fracture zones in the Vryheid formation, drilling activities should not contact the fractures as that is where most groundwater in the area is found and to prevent possible groundwater pollution from residual explosive material used.

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- The numerical model should be recalibrated as soon as more hydrogeological data such as monitoring holes are made available. This would enhance model predictions and certainty.
- It is recommended that there should be regular testing or monitoring of surrounding soil, water resources to detect any change in chemistry so that remedial measures are implemented in time.
- The monitoring process throughout the existence of the project, the chemical and physical parameters of the water samples should be tested and compared with the SANS241: 2015
- There should be soil, water resources and land pollution mitigation measures on site.
- Wastewater source should be identified, and mitigation measures put in place to prevent groundwater contamination.
- The stockpile, there should be regular monitoring of any heavy metal which could be exposed, as such could result in leaching during rainfall.
- Proper and competent structure of the tailings dam should be built, to contain liquid, or solid waste and to prevent such waste from entering the outside environment.
- According to section 21(S21) of the National Water Act 36 of 1998, if a proposed project triggers any of the listed S21 activities, a water use license must be applied for. For this project, there will be activities which includes abstraction of water from groundwater, mining activities within 100 m from the water courses dust suppression, dewatering, and ROM stockpiles. It is therefore recommended that a water use license be applied for.

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10 REFERENCES

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APPENDICES

Appendix A: Specialist's qualifications
(Upon Request)

Appendix B: Laboratory results
(Waiting for the results)

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MINING PERMIT APPLICATION

SOIL, LAND USE AND LAND CAPABILITY STUDY

Soil, Land Use and Land Capability Study for the proposed Mining Permit Application for Siphosizwe Construction CC on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province.

SIPHOSIZWE CONSTRUCTION CC

REPORT PREPARED BY:

Singo Consulting (Pty) Ltd

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DMRE REF: MP 30/5/1/1/3/13338 MP

Report Credentials.

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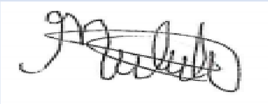
Project details		
Report type	**Soil, Land Use and Land Capability Study for a mining right application**	
Project title	Soil, Land Use and Land Capability Study for the proposed mining permit application on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province.	
Mineral (s)	Coal resources	
Client	Siphosizwe Construction CC	
Site location	on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province, South Africa.	
Version	1	
Date	06 April 2023	
		Electronic signatures
Compiled by	Mutali Guduvheni (Hydrogeologist) Singo Consulting (Pty) Ltd, South African Council for Natural Scientific Professions (SACNASP: Earth Science (Candidate Natural Scientist) Reg. No: 141174)	
Reviewed by	Mutshidzi Munyai (Hydrogeologist) Singo Consulting (Pty) Ltd (Water Resources Science (Candidate Natural Scientist), Environment Science (Candidate Natural Scientist) (SACNASP Registration Number 122464)	
Final review and approval	Dr. Kenneth Singo (Principal Consultant of Singo Consulting (Pty) Ltd)	

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Table 1: Critical Report Information

Critical Information incorporated within the Basic Soil, Land Use and Land Capability Study:	Relevant section in report
Details of the specialist who prepared the report	Project details, P: 3
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A, 46
Project Background Information, including the proposed activities description	Project background information, P: 10
An indication of the scope of, and the purpose for which, the report was prepared	Scope of work, P: 11-12
An indication of the quality and age of base data used for the specialist report	Project details, P: 3
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	N/A
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	
A description of the methodology implemented in preparing the report or carrying out the specialised process comprehensive of equipment and modelling used;	Methodology, P: 14
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	N/A
An identification of any areas to be avoided, including buffers	N/A
A map overlaying the proposed activity including the associated infrastructures on the environmental sensitivities of the site including containing buffer zones	N/A
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Impact assessment, P: 29
Any mitigation and conditions measures for inclusion in the EMPr	Soil management plan, P: 31
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Monitoring, P: 39
An analytic opinion as to whether the proposed activity or portions thereof should be Authorised-i.e. specific recommendations	Recommendations, P: 41
Regarding the acceptability of the proposed activity or activities; and	Refer to bar
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Soil management during the operational phase, P: 33
A description of any consultation process that was undertaken during carrying out the study	Refer to the bar
Any other information requested by the competent authority.	N/A

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1 INTRODUCTION

1.1 Project Background Information

Siphosizwe Construction CC has appointed Singo Consulting (Pty) Ltd as an independent consulting company to conduct a specialist soil, land use and land capability study. The soil, land use and land capability study are being conducted in support of a mining permit application for coal on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province.

This document is a soil study incorporating soil classification and agricultural potential prepared for the Siphosizwe Construction CC. The main aim of conducting this study is to find information with regards to the soil potential, land use as well as land capability.

1.2 Proposed Activities

The activities to take place are categorized based on phases of the life of the mine. The outlined activities have the potential of negatively or positively affecting the groundwater regime in the area.

Construction phase:

- Clearing of vegetation.
- Hardening surfaces to create roads.
- Installation of mobile machinery such as crusher and screening unit.

Operational Phase:

- Movement of machinery.
- Drilling, blasting, and hauling of material.
- Gravel, Aggregate and Sand processing which include but not limited to crushing.

The following infrastructure are required for the establishment of the opencast mining operations:

- Pit access ramps
- Haul roads

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- Waste dump areas for topsoil, soft overburden, and hard overburden (includes inter burden)
- ROM stockpiles for each of the four seams
- Clean water cut-off canals around the: ROM stockpile area, including crushing,
- Contractor's laydown area, along the haul roads, Around the waste dumps and Dirty water catchment drains.
- In-pit sumps for water management
- Pollution control dam (PCD)
- Piping system for water management

The construction of all infrastructure associated with the project will be within the mine project boundary. This report describes the soil types and properties present thereby giving a detailed baseline soil assessment of the undisturbed areas. The major soil types of presents are the association of classes 1 to 4: Undifferentiated structureless soils.

1.3 Scope of Work

Singo Consulting (Pty) Ltd was appointed by Siphosizwe Construction CC to conduct a detailed soil study for the mining permit application on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province.

Singo Consulting (Pty) Ltd was tasked to collect soil samples to test for soil chemistry and the soil fraction percentages within the project area. The soil samples will be collected within the mining permit area.

The mining permit method will be an open cast mining and will be operating for over 2 years lifespan. During site establishment, the applicant must demarcate the site boundaries and clear the topsoil. Thereafter, softs will be removed and stored at the designated material stockpiles.

- The topsoil will be stockpiled elsewhere on site preferably next to the farm boundary and will be used during rehabilitation period.
- Once a box cut has been made, the overburden and mineral resources where necessary will be loosened by blasting.
- The loosened material will then be loaded onto trucks by excavators.

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- A haul road will be situated at the side of the open cast, forming a ramp up which trucks can drive, carrying ore and waste rock.
- Waste rock will be piled up at the surface, near the edge of the open cast (waste dump).
- The waste dump will be tiered and stepped, to minimize degradation.

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2 TERMS OF REFERENCE

- Conduct a detailed soil assessment of the proposed opencast mining areas and infrastructure areas.
- Classify and map soil forms according to the South African Taxonomic Soil Classification System, 1991.
- Derive and map land capability based on soil properties.
- Map all pre-mining and current land uses.
- Determine all possible impacts by the proposed operations and provide associated mitigation measures.

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3 METHODOLOGY

3.1 Desktop study and literature review

This allows soil surveyors to enter and study colour, texture, structure, and other soil properties as well to differentiate between horizons. This allows for classification. Chemical tests can be carried out in the field (e.g., pH, test for carbonates and test for Mn oxides). Classification is done at this stage, which provides information on the chemical, physical and mineralogical characterization of the soil. Soil scientists that map the area, familiarize themselves with soils they expect to find and use characteristics to distinguish them from other soils in the area by doing desktop study.

Delineating soil boundaries

Pits cannot be dug randomly, usually a map of the area is taken and a grid is made on the map to determine where samples will be taken from. An efficient soil mapper looks at changes in vegetation, topography, and soil colour. A bare soil map can also be looked at to see where changes in colour occur indicating differences in soil. Once sites are established, soil samples are taken with a soil auger. Soil auguring is the principal method used but intrusive and labour intensive.

3.2 Site Assessment

Site inspection will be conducted on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province. The holes were drilled up to 30 cm below the ground level. The soil was described and classified according to the South African Taxonomic Soil Classification System.

The following procedure was followed to record soil properties and classify soils accordingly:

- Identification of applicable diagnostic horizons by stating the physical properties such as:
  - Effective depth (depth of soil suitable for root development),
  - Colour (in accordance with Munsell colour chart),
  - Texture (refers to the particle size distribution),
  - Structure (aggregation of soil particles into structural units),
  - Mottling (alterations due to continued exposure to wetness),

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- Concretions (cohesion of minerals into hard fragments), Leaching (removal of soluble constituents by percolating water),
- Gleying (reduction of ferric oxides under anaerobic conditions resulting in grey, low soil colours), and
- Illuviation of colloidal mater from one horizon to another resulting in the development of grey sandy E-horizons and grey clay G-horizon.

- Determine according to above properties the appropriate soil form and soil family

3.3 Analysis of samples at soil laboratory

Equipment's used during the soil sampling includes the GPS, camera, spade, auger, and sampling bags. A soil field form was completed during the sampling procedure, recording the moisture, colour, texture, and origin the soil origin. The soil is uniform within the project area.

Soil samples were collected from all portions of the farm Kwaggafontein 216 JR, and the remaining extent of the farm Mathys Zyn 671 JR, situated in the magisterial district of Thembisile Hani (Mkobola), Mpumalanga Province, where the mining activities will be taking place. The collected soil samples were submitted to ARC-Soil Climate and Water in Pretoria lab to test for soil chemistry and the soil fraction percentages within the project area.

3.4 Land capability classification

The Land capability classification is one of several interpretation groups that was made for agricultural purposes. As with all the interpretation groups, the land capability classification starts with one soil-mapping unit, which is the building block of the system.

The land capability is classified into grazing, arable and wilderness. In this classification the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment. Nonarable soils (soils unsuitable for long time sustained use for cultivated crops) are grouped according to their potentialities and limitations to produce permanent vegetation and according to their risks of soil damage if mismanaged.

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4 PHYSIOGRAPHICAL AND SOIL SETTING

4.1 Project Location

The locality map created by the QGIS illustrates the location of the mining permit area. The project area is situated on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of Emalahleni in Mpumalanga Province. The study area is situated approximately 1 km west of Klarinet.

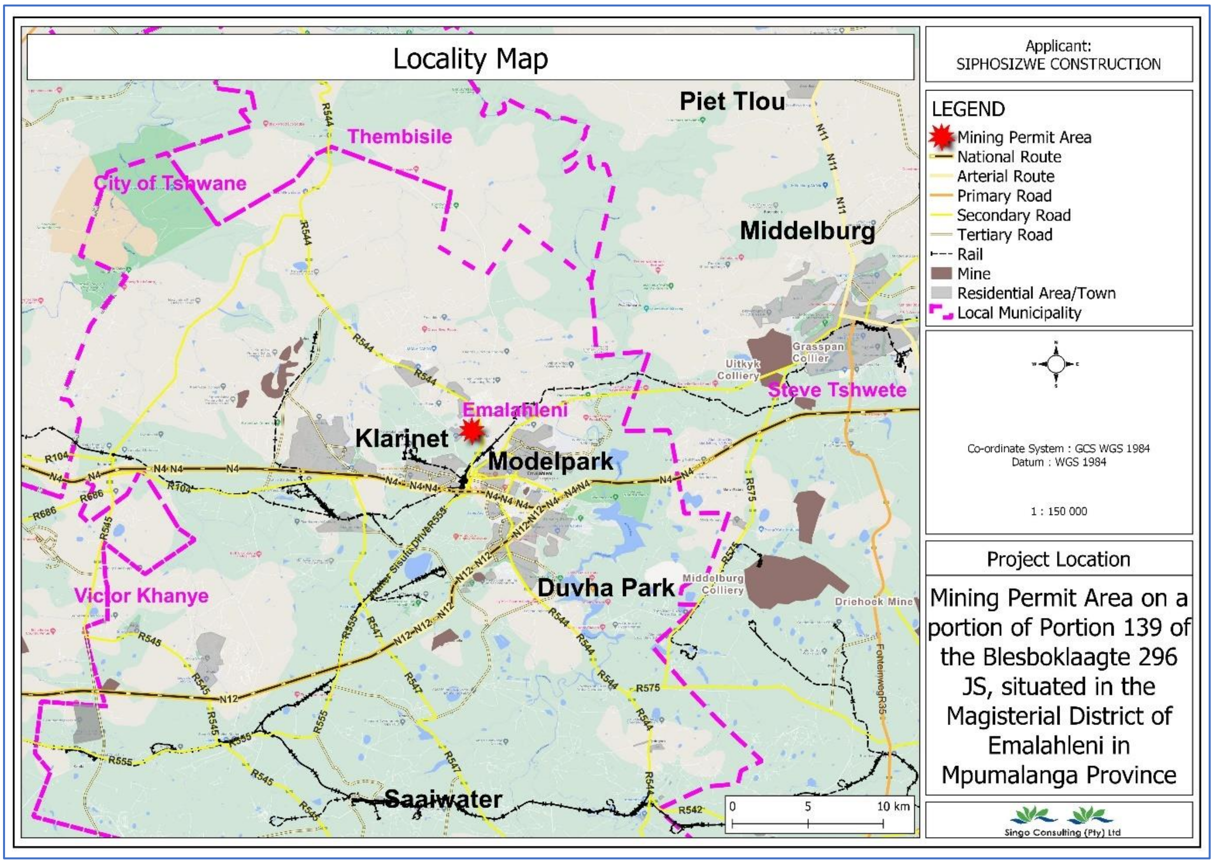

Figure 1: Locality map of the study area

4.2 Climate

In eMalahleni, temperate highland tropical climate with dry winters climate. The summers here have a good deal of rainfall, while the winters have very little. The KÖppen-Geiger climate classification is Cwb. The district's yearly temperature is 22.52°C and it is 1.3% higher than South Africa's averages. In a year, the mean annual rainfall is 600-800 m. The driest month is July. Most of the precipitation here falls in December, averaging 172 mm.

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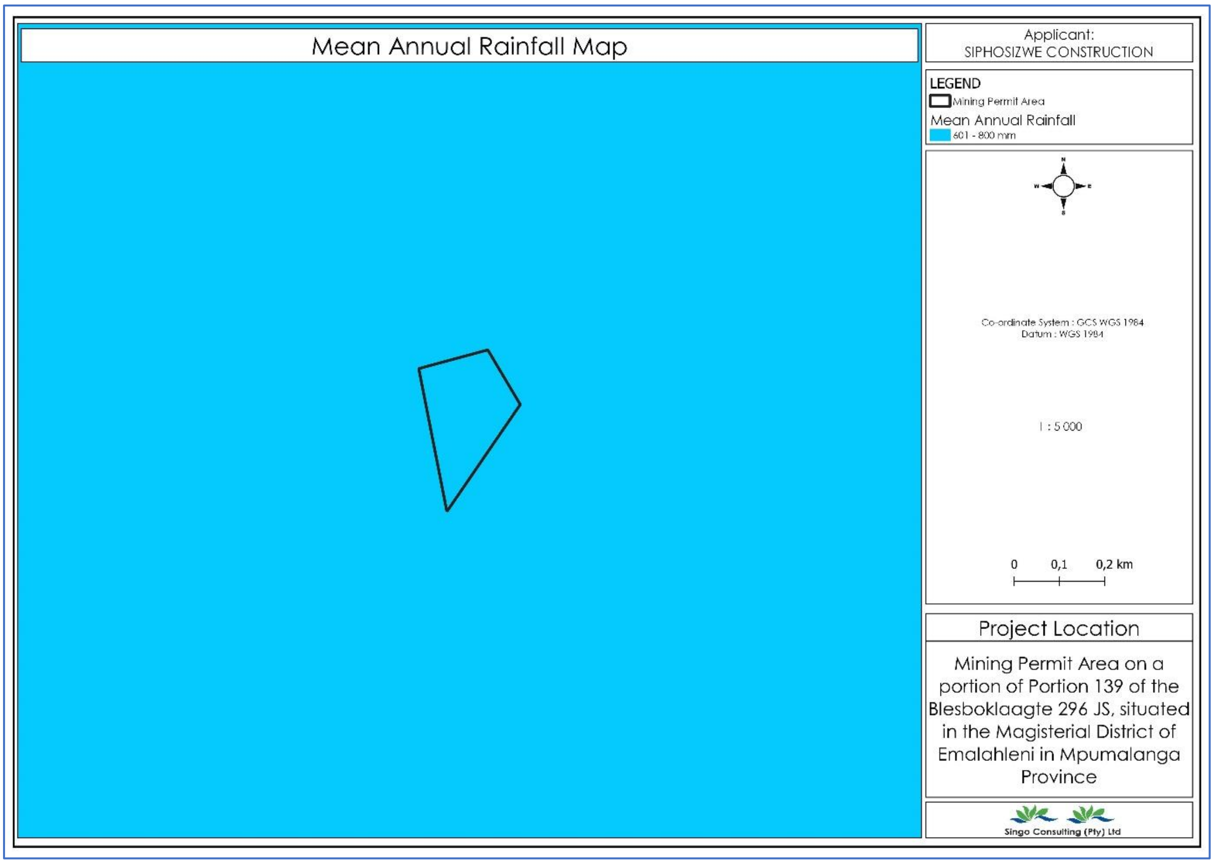

Figure 2: Mean annual rainfall map

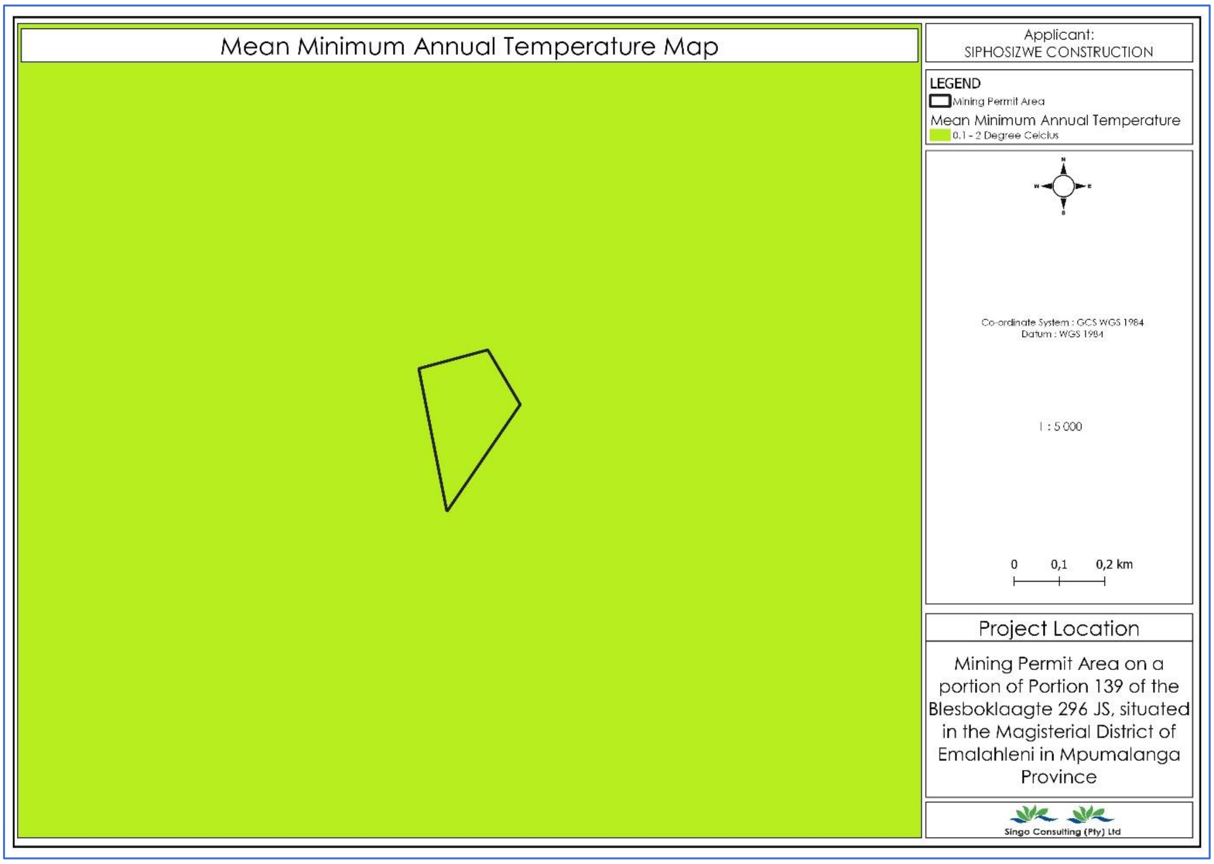

Figure 3: Mean minimum annual temperature map

4.3 Soil forms present in the study area

The soil classes map in below, shows that the mining right area is largely covered with association of classes 1 to 4: Undifferentiated structureless soils

Association of classes 1 to 4: Undifferentiated structureless soils:

The Association of Classes 1 to 4: Undifferentiated structureless soils can be defined based on their soil depth, Soil Drainage and erodibility.

Soil depth

Depth of the soil profile is from the top to the parent material or bedrock. This type of soil can be classified as a restricted soil depth. A restricted soil depth is a nearly continuous layer that has one or more physical, chemical, or thermal properties.

Soil drainage

Soil drainage is a natural process by which water moves across, through, and out of the soil because of the force of gravity. The soils in the proposed area have an excessive drainage due to the soils having very coarse texture. Their typical water table is less than 150.

Erodibility

Erodibility is the inherent yielding or non-resistance of soils and rocks to erosion. The freely drained structureless soils have high erodibility. A high erodibility implies that the same amount of work exerted by the erosion processes lead to a larger removal of material.

Figure 4: types of soil found on the study area

4.4 Soil chemical conditions of the study area

The main aim for soil sampling is to identify the soil moisture, colour, consistency, structure, soil type and origin (MCCSSO) of the soil.

Table 2: Site pictures and description

Site pictures and equipment's	Description

The equipment's used included: • Auger/TLB • plastics, • shovel, • GPS, • Buff tags, • Sampling forms. • Cable ties	Operation of soil Sampling Selecting an acceptable sampling location, then collecting a soil sample with an Auger/ TLB while identifying the different layers of soil in the area are all part of the method. The soil samples are stored in various plastics and recorded before being sent to the lab for analysis. Some of the types of analyses undertaken include pH (alkalinity and acidity), Soil Texture Composition, and Chemical Compositions.
 	The Auger was used to remove ground samples and capture the many different strata found underground. Soil samples were collected to determine chemical composition, soil texture, pH level, and soil nutrients.

4.5 Agricultural potential

The study area consists of arable land capability class. Arable land is any land capable of being ploughed and used to grow crops. Arable land is the land that is being worked regularly, generally under a system of crop rotation.

Table 3: Land capability classification (Scotney et al., 1987)

Land Capability Group	**Limitations**
Arable Land	This land group can be grouped into: • **No or Few limitations:** Very high arable potential and very low erosion hazard. • **Slightly Limitations:** High arable potential, with low erosion hazard.

	• **Severe Limitations:** Low arable potential and high erosion hazard.

4.6 Land use

The proposed area is covered by plantation and natural vegetation. With the nearby land covered by bare land, built-up area, water bodies and is being used for mining activities.

A plantation: is a large-scale estate, generally centred on a plantation house, meant for farming that specializes in cash crops. The crops that are grown include cotton, coffee, tea, cocoa, sugar cane, opium, sisal, oil seeds, oil palms, fruits, rubber trees and forest trees.

Natural vegetation: refers to a plant community, which has grown naturally without human aid and has been left undisturbed by humans for a long time.

Mine: A **mine** is a hole or tunnel in the earth or a surface excavation where mineral substances or valuable things like coal.

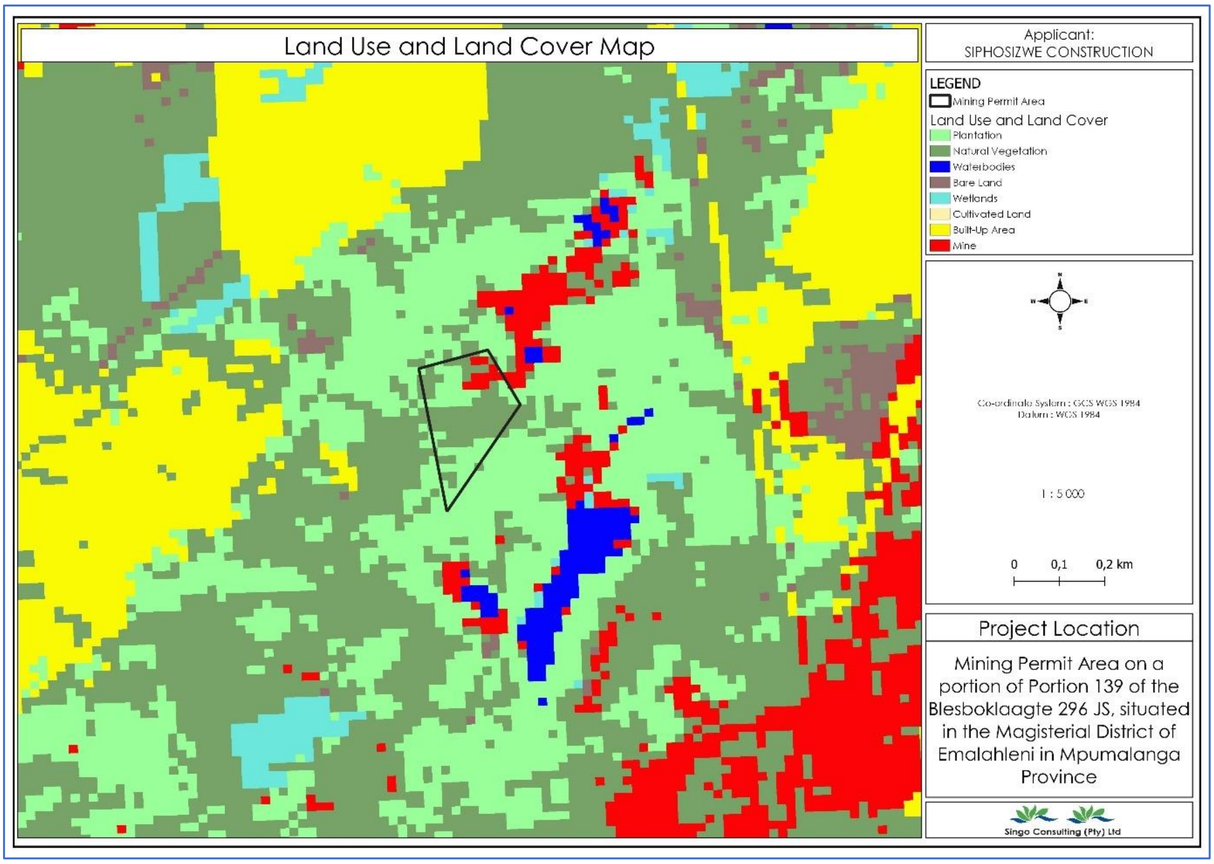

Figure 5: Land use and Land cover map

4.7 Land capability

The Land capability classification is one of several interpretation groups that was made for agricultural purposes. As with all the interpretation groups, the land capability classification starts with one soil-mapping unit, which is the building block of the system.

The land capability is classified into grazing, arable and wilderness. In this classification the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops that do not require specialized site conditioning or site treatment. Nonarable soils (soils unsuitable for long time sustained use for cultivated crops) are grouped according to their potentialities and limitations to produce permanent vegetation and according to their risks of soil damage if mismanaged. The land capability of the proposed area is classified as an arable land and grazing. Arable land is any land capable of being ploughed and used to grow crops.

The mining permit area is situated within the arable land capability group.

The capability grouping of soils is designed:

0. To help landowners and others use and interpret the soil maps,
1. To introduce users to the detail of the soil map itself, and
2. To make possible broad generalizations based on soil potentialities, limitations in use, and management problems'

The capability classification provides three major categories of soil groupings:

0. Capability unit,
1. Capability subclass, and
2. Capability class.

The first category, capability unit, is a grouping of soils that have about the same responses to systems of management of common cultivated crops and pasture plants. Soils in any one capability unit are adapted to the same kinds of common cultivated and pasture plants and require similar alternative systems of management for these crops. Long-time estimated yields of adapted crops for individual soils within the unit under comparable management do not vary more than about 25 percent.

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The second category, the subclass, is a grouping of capability units having similar kinds of limitations and hazards. Four general kinds of limitations or hazards are recognized: (1) Erosion hazard, (2) wetness, (3) rooting zone limitations, and (4) climate.

The third and broadest category in the capability classification places all the soils in eight capability classes. The risks of soil damage or limitations in use become progressively greater from class I to class VIII. Soils in the first four classes under good management can produce adapted plants, such as forest trees or range plants, and the common cultivated field crops ^ and pasture plants. Soils in classes V, VI, and VII are suited to the use of adapted native plants. Some soils in classes V and VI are also capable of producing specialized crops, such as certain fruits and ornamentals, and even field and vegetable crops under highly intensive management involving elaborate practices for soil and water conservation. Soils in class VIII do not return on-site benefits for inputs of management for crops, grasses, or trees without major reclamation.

The grouping of soils into capability units, subclasses, and classes is done primarily based on their capability to produce common cultivated crops and pasture plants without deterioration over a long period of time. To express suitability of the soils for range and woodland use, the soil mapping units are grouped into range sites and woodland-suitability group.

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Table 4: Relationship of soil-mapping unit to capability classification (Source: Kellogo, 1961)

Soil-mapping unit	**Capability unit**	**Capability subclass**	**Capability class**
A soil mapping unit is the part of the landscape' that has the same qualities and characteristics and whose limits are static by accurate definitions. Within the cartographic limitations and considering the purpose for which the map is made, the soil mapping unit is the unit at which the highest number of accurate statements and predictions can be done. The soil mapping units gives more information about the details of soils. The basis for all the interpretation is the basic mapping units. They provide the information required for the	A group of one or more individual soil mapping units having similar potentials and continuing limitations or hazards is termed as capability unit. The soils in a capability unit are sufficiently uniform to (1) produce similar kinds of cultivated crops and pasture plants with similar management practices, (2) require similar conservation treatment and management under the same kind and condition of vegetative cover, (3) have comparable potential productivity. The capability unit condenses and simplifies soils information for planning individual tracts of land,	are the groupings of capability units that have the same major conservation problem are called Subclasses. The problems include— 1.E>Erosion and runoff. 2. W>Excess water. 3.S>Root-zone limitations. 4.C>Climatic limitations. The information about the involved limitations and the kind of problems related to conservation are provided by capability Subclass. The information about the map user relating to the limitation degree and the kind of problems involved in	Capability classes are groups of capability subclasses or capability units that have the same relative degree of hazard or limitation. The limitation and risks of soil damage in use become more from class I to class VIII. The capability classes are useful as a means of introducing the map user to the more detailed information on the soil map. The classes show the location, amount, and general suitability of the soils for agricultural use. Only information concerning general agricultural limitations in soil use are obtained at the capability class level.

development of capability units, forest site groups, crop suitability groups, range site groups, engineering groups, and other interpretation groups. The most specific management ways and estimated yields relates to the individual mapping unit.	field by field. Capability units with the class and subclass furnish information about the degree of limitation, kind of conservation problems and the management practices needed.	broad program planning, conservation need studies, and similar purposes are provided by the class and sub class.	

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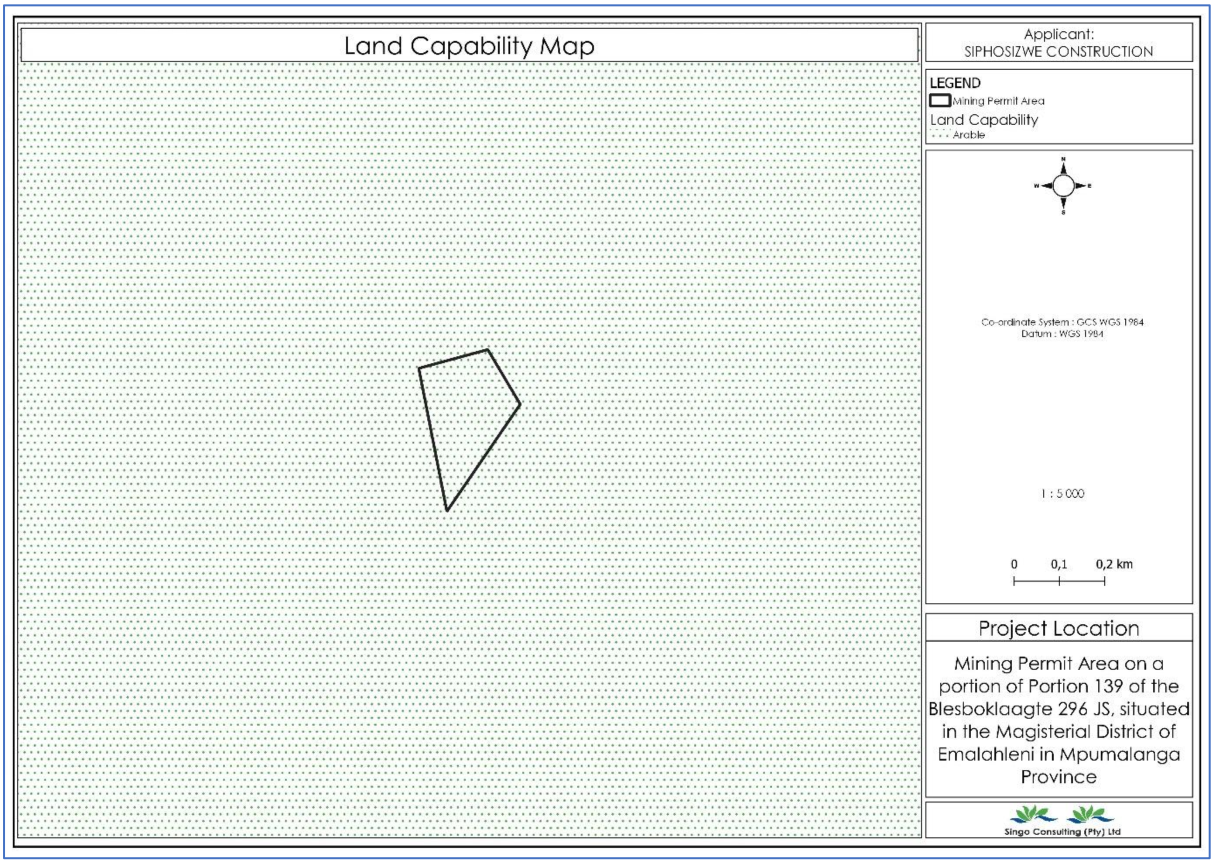

Figure 6: Land capability map of the study area

5 IMPACT ASSESSMENT

5.1 Assessment methodology

Pits cannot be dug randomly, usually a Soil map of the area is taken and a grid is made on the map to determine where samples will be taken from. An efficient soil mapper looks at changes in vegetation, topography, and soil colour. A bare soil map can also be looked at to see where changes in colour occur indicating differences in soil. Once sites are established, soil samples are taken with a soil auger. Soil auguring is the principal method used but intrusive and labour intensive.

5.2 Impact assessment per project phase

5.2.1 Construction phase

During the construction phase of the above listed mining activities, the work carried out will mainly be the construction of the beneficiation plants and associated infrastructure, and expansion of stock yard and stockpiles.

This will entail the clearing of areas and the disturbance of the topsoil through excavations as well as the construction of a soil stockpile. The topography and natural drainage lines may also be disturbed. The overall impact will be loss of topsoil because of erosion and possible contamination of the soil by gravel, aggregate and sand dust, fuel, and oils (hydrocarbons) as a result of general construction activities. Soil compaction caused by heavy vehicles and machinery may also be a problem.

Construction activities will change the land use from uncategorised to mining, beneficiation plants and associated infrastructure, conveyors, power line, new roads and expansion of stock yard and stockpile sites, there will be no substantial change to the land use within these areas. Areas that have been categorised as uncategorised land use will change and will be unsuitable for any further farming or game farming use during the life of the project.

5.2.2 Operational phase

Soil erosion through wind and storm water run-off and soil pollution by means of hydrocarbon contamination and potentially gravel, aggregate and sand dust may be encountered during the operational phase. Water runoff from roads and plant areas must be controlled and managed by means of proper storm water management facilities in order to prevent soil erosion. Diesel and oil spills are common at mine sites due to the large volumes of diesel and

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oil consumed by construction vehicles. Pollution may however be localized. Small pockets of localized pollution may be cleared up easily using commercially available hydrocarbon emergency clean-up kits.

An additional impact that could occur is when soils are stripped and stockpiled as the natural sequence of the soil horizons is lost when stripping and stockpiling is undertaken. An associated impact could be compaction of soil stockpiles, if they are repeatedly driven over, which would result in compaction of soil stockpiles if the appropriate dumping techniques were not adopted. This can be mitigated against by demarcating soil stockpiles and minimise or prevent driving over stockpiles should be avoided were possible to avoid compaction. End tipping as a method of creating stockpiles can be adopted to avoid unnecessary compaction.

5.2.3 Decommissioning and rehabilitation phase

Mining infrastructure must be removed during the deconstruction phase. All foundation excavations must be backfilled and then covered with subsoil material and topsoil on the top layer, fertilised and re-vegetated. Backfilling of soil will impact on the land capability by restoring the land capability because vegetation can be supported and therefore returned to its original land use. As open cast mining progresses and enough space is available concurrent rehabilitation should be undertaken, this would include backfilling, contouring, re-vegetation of impacted areas and this would typically be done during the operational phase, as concurrent rehabilitation, and during the decommissioning phase.

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6. SOIL MANAGEMENT PLAN

6.1 Soil management during the construction phase

6.1.1 Minimise mining infrastructure footprint

- The footprint of the proposed infrastructure area should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint.
- The construction of all infrastructure associated with the project will be within the mine project boundary.

6.1.2 Management and supervision of construction teams

On both large and small construction sites, supervision is critical in preventing accidents. Planning and distributing work, making decisions, monitoring performance and compliance, giving leadership and teamwork, and ensuring staff involvement are all typical supervisory duties. As a result, supervision plays a significant role in the success of a typical construction project, particularly in terms of ensuring that health and safety is successfully managed.

6.1.3 Location of stockpiles

- Ensure stockpiles are placed on a free draining location to limit erosion loss

6.1.4 Topsoil stripping

- Soils will be stripped according to the soil types and recommended depths.
- strip the topsoil from all areas that will be disturbed by construction activities or driven over by vehicles.
- The topsoil will be stripped and loaded onto dump trucks.
- Topsoil is to be stripped when the soil is dry (as far as practical possible), as to reduce compaction; and
- To be stripped according to the stripping guideline and management plan, contained within this report and further recommendations contained within the rehabilitation plan, and stockpiled accordingly.

6.1.5 Stockpiling of topsoil

- Stockpiles are to be maintained in a fertile and erosion free state by sampling them annually for macro nutrients and pH.
- Prevent unauthorised borrowing of stockpiled soil.

6.1.6 Demarcation of topsoil stockpiles

- Berms should be placed around stockpiled soil to prevent soil loss due to erosion.
- The stockpiles area should be clearly demarcated.

6.1.7 Prevention of stockpile contamination

- The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate.
- Prevent any spills from occurring.
- If a spill occurs, it is to be cleaned up immediately and reported to the appropriate authorities.

6.1.8 Terrain stability to minimise erosion potential

- Stockpiles are to be maintained in a fertile and erosion free state by sampling them annually for macro nutrients and pH.
- Berms should be placed around stockpiled soil to prevent soil loss due to erosion.
- The stockpiles will be vegetated where the natural establishment of vegetation by the natural occurring seed bank is not sufficient (details contained in rehabilitation plan) in order to reduce the risk of erosion, prevent weed growth and to reinstitute the ecological processes within the soil.

6.1.9 Management of access and haulage roads

- strict access control practiced preventing vehicles driving on the stockpile.
- Compaction of the removed topsoil should be avoided by prohibiting traffic on stockpiles.

6.1.10 Prevention of soil contamination

- Landfilling, sometimes known as "dig and haul," is the most basic method of soil restoration. This method involves removing contaminated soil from its original location and transporting it to a secure landfill, which is a constructed structure with impermeable liners, leachate drains, and dike enclosures. Landfilling is a well-known method of cleaning up hazardous waste sites.
- Soil washing refers to the size separation, gravity separation, or attrition scrubbing of pollutants absorbed to discover soil particles in an aqueous solution. Soil washing relies on the ionic strength, soil acidity, redox potential, and complexation of washing

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solutions to mobilize heavy metals. An ideal washing solution would boost the solubility and mobility of heavy metal pollutants while interacting only weakly with soil constituents and being biodegradable and harmless.

6.2 Soil management during the operational phase

6.2.1 Managing potential soil contamination during the operational phase

- Prevent any spills from occurring.
- If a spill occurs, it is to be cleaned up immediately and reported to the appropriate authorities.
- All storage areas (for fuels and lubricants) will be compacted and have bunded containers to prevent soil pollution and appropriate oil separators installed.
- Water runoff traps should be constructed at the vehicle service sites to prevent polluted water runoff into areas that are not impacted upon.
- All vehicles are to be serviced regularly in a correctly bunded area.
- Hydrocarbon management procedure to contain details of emergency clean-up procedures and
- Leaking vehicles will have drip trays place under them where the leak is occurring.
- Pipelines conveying waste material must be monitored for leaks on a regular basis.

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Table 5: Soil management during operational phase

OPERATIONAL PHASE									
Impact		Management	Severity	Duration	Spatial Scale	Consequence	Probability	Significance
Activity	Establishment of the open cast pit areas							
• Operation of the open cast pit will highly likely result in a loss of soil depth and volume since the ore material will be transported off-site and sold as product.		Unmanaged	H	H	M	H	H	H
		Managed	M	L	L	L	L	L
• Potential leakages of hydrocarbons resulting from machinery / construction vehicles, and spillage of other heavy metals leading to soil contamination		Unmanaged	M	M	L	M	H	M
		Managed	M	L	L	L	L	L
• Movement of heavy machinery / construction vehicles off existing/demarcated roads, leading to soil compaction		Unmanaged	M	M	L	M	H	M
		Managed	M	L	L	L	L	L
Activity	Development of waste facilities (i.e., Waste Rock Dump)							

*Stockpiling on Waste Rock Dump (WRD) areas alongside the open cast pit area. Waste rock will potentially result in soil compaction of underlying soil material.	Unmanaged	M	M	L	M	H	M
	Managed	M	L	L	L	L	L
Mitigation Measures	• An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur. • The footprint areas of the ore stockpiles as well waste rock dumps should be lined to prevent seepage of contaminants. The footprint areas should also be rehabilitated post closure to a manner that will allow for land use such as housing or industrial development. • Stockpiles should be revegetated to establish a vegetation cover as an erosion control measure. These stockpiles should also be always kept alien vegetation free to prevent loss of soil quality; and • Compacted soil associated footprint areas can be lightly ripped to at least 25 cm below ground surface to alleviate compaction prior to re-vegetation.						

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6.3 Soil management during the decommissioning and rehabilitation phase

6.3.1 Management and supervision of decommissioning teams

6.3.2 Infrastructure removal

- During the decommissioning phase the footprint should be thoroughly cleaned, and all building material should be removed to a suitable disposal facility.
- Remove buildings to foundation level.
- All rubble to be relocated to a specified approved rubble dump.
- Rip all roads.

6.3.3 Site preparation

- Backfill foundations using stockpiled soil material.
- Rip all roads.

6.3.4 Seeding and re-vegetation

- Undertake inspection of rehabilitated area to ascertain level of success of rehabilitation efforts and effectiveness (vegetation growth, erosion monitoring);
- Additional top soiling and revegetation of affected areas should be undertaken if required.
- Re-vegetate the entire site.

6.3.5 Prevention of soil contamination

Toxic chemical compounds, salts, radioactive agents, toxins, and other waste contribute to soil contamination/pollution, and these results in severe negative impact on plant and animal health.

Table 6: Soil management during closure phase

<table>
<tr><th colspan="9">Closure phase</th></tr>
<tr><th colspan="2">Impact</th><th>Management</th><th>Severity</th><th>Duration</th><th>Spatial Scale</th><th>Consequence</th><th>Probability</th><th>Significance</th></tr>
<tr><td>Activity</td><td colspan="8">Backfilling of the open cast pit areas</td></tr>
<tr><td colspan="2" rowspan="2">• Demolition of structures such as shaft complexes and ripping of soil and hard surfaces, leading to further soil disturbances leading to compaction</td><td>Unmanaged</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td>Managed</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td colspan="2" rowspan="2">• Restoration of natural topography and revegetation leading to further soil erosion, compaction, and contamination. Resurfacing may lead to water ponding if not done properly</td><td>Unmanaged</td><td>M</td><td>M</td><td>L</td><td>M</td><td>H</td><td>M</td></tr>
<tr><td>Managed</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td>Mitigation Measures</td><td colspan="8">• The landscape should be backfilled and re-profiled to mimic the natural topography (if possible) for potential post mining activities including housing and industrial development.
• Soil amelioration should be done according to soil analyses as recommended by a soil specialist, to correct the pH and nutrition status before revegetation.
• The footprint should be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season.</td></tr>
</table>

	• The footprint should be ripped to alleviate compaction post closure before revegetation;

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7 MONITORING

7.1 Monitoring Locations

- Monitoring of backfilled sites should be undertaken to ensure that the landscape is free draining to prevent water logging condition.
- Undertake inspection of rehabilitated area to ascertain level of success of rehabilitation efforts and effectiveness (vegetation growth, erosion monitoring)
- The topsoil should be ameliorated according to soil chemical analysis and monitoring data.
- Monitoring of erosion must take place throughout the life of mine, in order to prevent the formation of erosion gullies as a result of altered flow paths, and the possible sedimentation of the freshwater resources.
- Soil monitoring should be undertaken to ensure that the natural chemical status of the soil is re-instated.

7.2 Monitoring Methodology

Soil monitoring is essential for preserving soil quality. Monitoring is done using indicators (also known as soil characteristics) of soil condition at various stages over time. It includes studying the soil through soil testing and field observations, as well as observing how the soil changes following intervention. Following the implementation of an intervention plan, soil changes must be monitored using indicators. This necessitates soil sampling and analysis on a seasonal/yearly basis.

7.3 Monitoring Records

For maintaining soil quality, soil monitoring is critical. It includes studying the soil through soil testing and field observations, as well as monitoring how the soil responds to intervention. It is vital to monitor the change in the soil by measuring indicators once an intervention plan has been implemented.

7.4 Analytical Parameters

Physical, chemical, and biological components exist in soil. Indicators derived from these elements should be quantitative, straightforward, and sensitive enough to be managed using interventions aimed at bringing an indicator or a collection of indicators to an acceptable level. Many soil quality indicators are critical to the system's successful operation. For the system to perform successfully, all indicators of soil quality must be at optimal levels. For sandy, silty, and clayey soils, the ideal bulk density levels are 0.92, 0.81, and 0.64 oz/in3, respectively (Table 1). Any value that is higher (than) the reference or standard value is regarded as undesirable.

The use of an indicator to determine soil quality necessitates a thorough understanding of the indication. Some measured variables have optimum values, and any value higher or lower than that is unsatisfactory. Several field crops, for example, tolerate pH values between 5.8 and 7.2. Organic carbon (C) and total nitrogen (N) levels in the soil should be high, but sodium (Na) adsorption ratio (SAR) values should be low.

7.5 Reporting

A soil test is used to determine the position and shape of a hidden mineralised structure, as well as to identify any better grade areas within the structure. This information is important for establishing soil fertility levels and making good nutrient management decisions.

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8 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion and Summary

A specialist from Singo Consulting (Pty) Ltd was appointed to conduct a soil, land use, land capability and agricultural potential assessment as part of the Environmental Impact Assessment process for the proposed mining permit application.

Based on observations during the site assessment and scrutiny of satellite imagery, the area is overlain by the association of classes 1 to 4: Undifferentiated structureless soils.

The land capability map of the study area shows that the area is situated on arable land and is suitable for being ploughed and used to grow crops.

8.2 Recommendations

- The proposed mining land should be returned to its origin as before mining activities and the rehabilitation performance assessment in the proposed land must be done progressively (annually) during the operational phase by a soil specialist
- Final surface rehabilitation of all disturbed areas during mining activities. Rehabilitation of unnecessary water management facilities once appropriate to do so.
- Specialists should be used to evaluate the erosion and other possible impacts during the entire mining process
- Limit impacts to the footprints to keep physical impacts as small as possible. Areas for road, site lay-out should be minimized, dust generation.
- Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined no-go areas.
- Stockpile height should be restricted, A maximum height of 2-3 m is therefore proposed.
- Stockpiles should also be always kept free of alien vegetation to prevent loss of soil quality.
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure.

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9 REFERENCES

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- Soil Classification Working Group, 1991. Soil Classification – a taxonomic system for South Africa. ARC-Institute for Soil, Climate and Water, Pretoria
- Land Type Survey Staff. 1972 – 2006. Land Types of South Africa: Digital map (1:250 000 scale) and soil inventory databases. ARC-Institute for Soil, Climate and Water, Pretoria

APPENDICES

Appendix A: Specialist's qualifications

Available upon request

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Integrated Specialist Services (Pty) Ltd

PHASE 1 ARCHAEOLOGICAL AND HERITAGE IMPACT ASSESSMENT REPORT FOR THE PROPOSED MINING PERMIT APPLICATION FOR COAL ON PORTION OF PORTION 139 OF THE FARM BLESBOKLAAGTE 296 JS, SITUATED IN THE MAGISTERIAL DISTRICT OF EMALAHLENI IN MPUMALANGA PROVINCE.

DOCUMENT SYNOPSIS (EXECUTIVE SUMMARY)

Item	Description
Proposed development and location	Mining Permit Application for Coal on portion of Portion 139 of the Farm Blesboklaagte 296 JS, situated in the Magisterial District of eMalahleni in Mpumalanga Province.
Purpose of the study	The Phase 1 Archaeological Impact Assessment for the proposed Mining Permit Application in Mpumalanga Province
Coordinates	26°22'30.67"S, 29°29'28.17"E
Municipalities	eMalahleni Local Municipality, eMalahleni District Municipality
Predominant land use of surrounding area	Residential and mining
Applicant	Contact Person: Masuku Goodwill Zwelithini Siphosizwe Construction CC 1410 Tshaka, Street, Lynnville, Mpumalanga, 1035 Cell: +27 79 152 3473 Fax: +27 86 514 4103 Email: siphosizwecons@gmail.com
DMRE Reference	MP 30/5/1/1/3/13338 MP
EAP	Ms Dineo Makhubela Singo Consulting (Pty) Ltd Office 870, 5 Balalaika Street, Tasbet Park Ext 2, Witbank, 1040 Tel: +27 13 6920 041Cell: +27 71 8952 436 Email: admin@singoconsulting.co.za
Heritage Practitioner	Integrated Specialist Services (Pty) Ltd Cell: 071 685 9247 Email: trust@issolutions.co.za
Authors	Trust Mlilo
Date of Report	19 April 2023

This report serves to inform and guide the applicant and contractors about the possible impacts that the proposed coal mining may have on heritage resources (if any) located in the study area. In the same light, the document must also inform the South African heritage authorities (SAHRA) about the presence, absence and significance of heritage resources located on a portion of Portion 139 of the Farm Blesboklaagte 296 JS situated in eMalahleni Local Municipality earmarked for mining. Siphosizwe Construction CC requires a Mining Permit in terms of the Mineral and Petroleum Resources Development Act (Act No. 22 of 2002) (MPRDA). Before the Mining Permit will be granted, Siphosizwe Construction CC must undertake an EIA and WML application process in terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEM: WA). The competent authority for the environmental authorisation process is the Mpumalanga Department of Mineral Resources (DMRE). This report is submitted in terms of Section 38 (8) of the National Heritage Resources Act 25 of 1999 as part of the Mining Permit Application. The purpose of this study is to identify, record and if necessary, salvage the irreplaceable heritage resources that may be impacted upon by the proposed coal mining. In compliance with these laws, Singo Consulting (Pty) Ltd tasked Integrated Specialist Services (Pty) Ltd to conduct a Phase 1 Archaeological and Heritage Impact Assessment (AIA/HIA) for the proposed Mining Permit Application. Desktop studies, drive-throughs and fieldwalking were conducted in order to identity heritage landmarks within the Mining Permit Application site. The study site is not on pristine ground, having seen significant transformations owing to previous and current land use activities. The general mining area is known for occurrence of Late Iron Age archaeological and historical sites. It should be noted that archaeological material and unmarked graves may exist beneath the surface and when encountered during mining, work must be stopped forth-with, and the finds must be reported to the South African Heritage Resource Agency (SAHRA) or the heritage practitioner. This report must be submitted to the SAHRA for review in terms of Section 38 (4) of the NHRA.

The report makes the following observations:

- The findings of this report have been informed by desktop data review, field survey and impact assessment reporting which include recommendations to guide heritage authorities in making decisions with regards to the proposed Mining Permit Application.
- The immediate project area is mining.
- Some sections of the proposed Mining Permit site are severely degraded from previous and current land use activities.

- The dense vegetation cover compromised the visibility of subsurface Archaeological material.

The report sets out the potential impacts of the proposed mining on heritage matters and recommends appropriate safeguard and mitigation measures that are designed to reduce the impacts where appropriate. The Report makes the following recommendations:

1. It is recommended that SAHRA endorse the report as having satisfied the requirements of Section 38 (8) of the NHRA requirements.
2. From a heritage perspective supported by the findings of this study, the Mining Permit Application is supported. However, the Mining Permit Application should be approved under observation that mining does not extend beyond the area considered in this report/affect the identified heritage sites.
3. Should chance archaeological materials or human remains be exposed during mining on any section of the site, work should cease on the affected area and the discovery must be reported to the heritage authorities immediately so that an investigation and evaluation of the finds can be made. The overriding objective, where remedial action is warranted, is to minimize disruption in mining scheduling while recovering archaeological and any affected cultural heritage data as stipulated by the NHRA regulations.
4. Subject to the recommendations herein made and the implementation of the mitigation measures and adoption of the project EMP, there are no significant cultural heritage resources barriers to the proposed Mining Permit Application. The Heritage authority may approve the Mining Permit Application as planned with special commendations to implement the recommendations here in made.

This report concludes that the impacts of the proposed coal mining on the cultural environmental values are not likely to be significant on the entire site if the EMP includes recommended safeguard and mitigation measures identified in this report.

NATIONAL LEGISLATION AND REGULATIONS GOVERNING THIS REPORT

This is a specialist report' and is compiled in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and the Environmental Impact Assessment Regulations, 2014.

DECLARATION OF INDEPENDENCE

In terms of Chapter 5 of the National Environmental Management Act of 1998 specialists involved in Impact Assessment processes must declare their independence.

I, **Trust Mlilo**, do hereby declare that I am financially and otherwise independent of the client and their consultants, and that all opinions expressed in this document are substantially my own, notwithstanding the fact that I have received fair remuneration from the client for preparation of this report.

Expertise:

Trust Mlilo, PhD *cand* (Wits), MA. (Archaeology), BA Hons, PDGE and BA & (Univ. of Pretoria) ASAPA (Professional affiliation member) and more than 15 years of experience in archaeological and heritage impact assessment and management. Mlilo is an accredited member of the Association for Southern African Professional Archaeologists (ASAPA), Amafa akwaZulu Natali and Eastern Cape Heritage Resources Agency (ECPHRA). He has conducted more than hundred AIA/HIA Studies, heritage mitigation work and heritage development projects over the past 15 years of service. The completed projects vary from Phase 1 and Phase 2 as well as heritage management work for government, parastatals (Eskom) and several private companies such as BHP Billiton/South32/Seriti Power and Rhino Minerals.

Independence

The views expressed in this document are the objective, independent views of Mr Trust Mlilo and the survey was carried out under Integrated Specialist Services (Pty) Ltd. The company has no business, personal, financial or other interest in the Mining Permit Application apart from fair remuneration for the work performed.

Conditions relating to this report.

The content of this report is based on the author's best scientific and professional knowledge as well as available information. Integrated Specialist Services (Pty) Ltd reserves the right to modify the report in any way deemed fit should new, relevant or previously unavailable or undisclosed information become known to the author from on-going research or further work in this field or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author and Integrated Specialist Services (Pty) Ltd. This also refers to electronic copies of the report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

Authorship: This AIA/HIA Report has been prepared by Mr Trust Mlilo (Professional Archaeologist). The report is for the review of the Heritage Resources Agency (PHRA).

Geographic Co-ordinate Information**:** Geographic co-ordinates in this report were obtained using a hand-held Garmin Global Positioning System device. The manufacturer states that these devices are accurate to within +/- 5 m.

Maps**:** Maps included in this report use data extracted from the NTS Map and Google Earth Pro.

Disclaimer**:** The Authors are not responsible for omissions and inconsistencies that may result from information not available at the time this report was prepared.

The Archaeological and Heritage Impact Assessment Study was carried out within the context of tangible and intangible cultural heritage resources as defined by the SAHRA Regulations and Guidelines as to the approval of the Mining Permit Application being submitted by Siphosizwe Construction CC.

Signed by

19/ 04/ 2023

ACKNOWLEDGEMENTS

The author acknowledges Singo Consulting (Pty) Ltd for their assistance with the project details and responding to technical queries related to the project.

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ABBREVIATIONS

AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
EIA	Environmental Impact Assessment
EIA	Early Iron Age *(EIA refers to both Environmental Impact Assessment and the Early Iron Age but in both cases the acronym is internationally accepted.*
EIAR	Environmental Impact Assessment Report
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
ICOMOS	International Council of Monuments and Sites
LIA	Late Iron Age
LFC	Late Farming Community
LSA	Late Stone Age
MIA	Middle Iron Age
MSA	Middle Stone Age
NEMA	National Environmental Management Act 107 of 1998
NHRA	National Heritage Resources Act 25 of 1999
PHRA	Provincial Heritage Resource Agency
SAHRA	South African Heritage Resources Agency
ToR	Terms of Reference

KEY CONCEPTS AND TERMS

Periodization

Periodization Archaeologists divide the different cultural epochs according to the dominant material finds for the different time periods. This periodization is usually region-specific, such that the same label can have different dates for different areas. This makes it important to clarify and declare the periodization of the area one is studying. These periods are nothing a little more than convenient time brackets because their terminal and commencement are not absolute and there are several instances of overlap. In the present study, relevant archaeological periods are given below.

Early Stone Age (~ 2.6 million to 250 000 years ago)

Middle Stone Age (~ 250 000 to 40-25 000 years ago)

Later Stone Age (~ 40-25 000, to recently, 100 years ago)

Early Iron Age (~ AD 200 to 1000)

Late Iron Age (~ AD1100-1840)

Historic (~ AD 1840 to 1950, but a Historic building is classified as over 60 years old)

Definitions

Definitions Just like periodization, it is also critical to define key terms employed in this study. Most of these terms derive from South African heritage legislation and its ancillary laws, as well as international regulations and norms of best practice. The following aspects have a direct bearing on the investigation and the resulting report:

Cultural (heritage) resources are all non-physical and physical human-made occurrences, and natural features that are associated with human activity. These can be singular or in groups and include significant sites, structures, features, ecofacts and artefacts of importance associated with the history, architecture, or archaeology of human development.

Cultural significance is determined by means of aesthetic, historic, scientific, social, or spiritual values for past, present, or future generations.

Value is related to concepts such as worth, merit, attraction or appeal, concepts that are associated with the (current) usefulness and condition of a place or an object. Although significance and value are not mutually exclusive, in some cases the place may have a high level of significance but a lower level of value. Often, the evaluation of any feature is based on a combination or balance between the two.

Isolated finds are occurrences of artefacts or other remains that are not in-situ or are located apart from archaeological sites. Although these are noted and recorded, but do not usually constitute the core of an impact assessment, unless if they have intrinsic cultural significance and value.

In-situ refers to material culture and surrounding deposits in their original location and context, for example an archaeological site that has not been disturbed by farming.

Archaeological site/materials are remains or traces of human activity that 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. According to the National Heritage Resources Act (NHRA) (Act No. 25 of 1999), no archaeological artefact, assemblage or settlement (site) and no historical building or structure older than 60 years may be altered, moved or destroyed without the necessary authorisation from the South African Heritage Resources Agency (SAHRA) or a provincial heritage resources authority.

Historic material are remains resulting from human activities, which are younger than 100 years, but no longer in use, including artefacts, human remains and artificial features and structures.

Chance finds means archaeological artefacts, features, structures or historical remains accidentally found during development.

A grave is a place of interment (variably referred to as burial) and includes the contents, headstone or other marker of such a place, and any other structure on or associated with such place. A grave may occur in isolation or in association with others where upon it is referred to as being situated in a cemetery (contemporary) or burial ground (historic).

A site is a distinct spatial cluster of artefacts, structures, organic and environmental remains, as residues of past human activity.

Heritage Impact Assessment (HIA) refers to the process of identifying, predicting and assessing the potential positive and negative cultural, social, economic and biophysical impacts of any proposed project which requires authorisation of permission by law, and which may significantly affect the cultural and natural heritage resources. Accordingly, an HIA must include recommendations for appropriate mitigation measures for minimising or circumventing negative impacts, measures enhancing the positive aspects of the proposal and heritage management and monitoring measures.

Impact is the positive or negative effects on human well-being and / or on the environment.

Mitigation is the implementation of practical measures to reduce and circumvent adverse impacts or enhance beneficial impacts of an action.

Mining heritage sites refer to old, abandoned mining activities, underground or on the surface, which may date from the prehistorical, historical or the relatively recent past.

Study area or '**project area'** refers to the area where the developer wants to focus its development activities (refer to plan).

Phase I studies refer to surveys using various sources of data and limited field walking in order to establish the presence of all possible types of heritage resources in any given area.

Assumptions and disclaimer

The investigation has been influenced by the unpredictability of buried archaeological remains (absence of evidence does not mean evidence of absence) and the difficulty in establishing intangible heritage values. It should be remembered that archaeological deposits (including graves and traces of mining heritage) usually occur below the ground level. Should artefacts or skeletal material be exposed during mining activities, such activities should be halted immediately, and a competent heritage practitioner and SAHRA must be notified in order for an investigation and evaluation of the find (s) to take place (see NHRA (Act No. 25 of 1999), Section 36 (6). Recommendations contained in this document do not exempt the applicant from complying with any national, provincial, and municipal legislation or other regulatory requirements, including any protection or management or general provision in terms of the NHRA. Integrated Specialist Services (Pty) Ltd assumes no responsibility for compliance with conditions that may be required by SAHRA in terms of this report.

1 INTRODUCTION

Integrated Specialist Services (Pty) Ltd was retained by Singo Consulting (Pty) Ltd on behalf of Siphosizwe Construction CC to carry out a Phase 1 AIA/ HIA for the Mining Permit Application on a portion of Portion 139 of the Farm, Blesboklaagte 296 JS under the Magisterial District of eMalahleni, Mpumalanga Province earmarked for coal. This study was conducted to fulfil the requirements of Section 38 (8) of the NHRA. The purpose of this heritage study is to identify, assess any heritage resources that may be located within the proposed mining site in order to make recommendations for their appropriate management. To achieve this, we conducted background research of published literature, maps, and databases (desktop studies) which was then followed by ground-truthing by means of drive-through surveys and field walking. Desktop studies revealed that the general project area is rich in Late Iron Age (LIA) and historical sites. It should be noted that while heritage resources may have been located in the entire study area, subsequent developments such as agriculture, settlements have either obliterated these materials or reduced them to isolated finds that can only be identifiable as chance finds during mining. The Mining Permit Application may be approved subject to adopting recommendations and mitigation measures proposed in this report. Based on the findings there is no archaeological and heritage reasons why the Mining Permit Application cannot be approved, taking full cognizance of clear procedures to follow in the event of chance findings.

1.1 Terms of Reference (ToR)

Integrated Specialist Services (Pty) Ltd was requested by Singo Consulting (Pty) Ltd to conduct an AIA/HIA study addressing the following issues:

- Archaeological and heritage potential of the proposed coal mining site including any known data on affected areas.
- Provide details on methods of study; potential and recommendations to guide the SAHRA to make an informed decision in respect of authorisation of the Mining Permit Application
- Identify all objects, sites, occurrences and structures of an archaeological or historical nature (cultural heritage sites) located within the project site;
- Assess the significance of the cultural resources in terms of their archaeological, historical, scientific, social, religious, aesthetic and tourism value;
- Describe the possible impact of the proposed mining on these cultural remains, according to a standard set of conventions;
- Propose suitable mitigation measures to minimize possible negative impacts on the cultural resources; and
- Review applicable legislative requirements.

1.2 Project Location

The proposed Mining Permit site is located Coal on a portion of Portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of eMalahleni, Mpumalanga Province.

1.3 Project Description

Mining Permit Application has been submitted for the extraction of Coal resource on the property mentioned above. The Mining Permit is situated approximately 435m east of Klarinet Industrial, approximately 616 m west of Klarinet, approximately 419 north of Blesbok Colliery and approximately 1.35 km south of Siyanqoba refer to Figure 1 and Figure 2 for project location. Mining activities will be undertaken over a period of two (2) years. This project will entail an open cast method of excavation. The mine design will be developed according to the dimension of the applied mineral deposit within the project area, but overall mining activities will be limited to an area of 5 Ha as per mining permit requirements. The topsoil will be stockpiled elsewhere on site preferably next to the farm boundary and will be used during rehabilitation period. Once a box cut has been made, the overburden and mineral resources where necessary will be loosened by blasting. The loosened material will then be loaded onto trucks by excavators. A haul road will be situated at the side of the open cast, forming a ramp up which trucks can drive, carrying ore and waste rock. Waste rock will be piled up at the surface, near the edge of the open cast (waste dump). The waste dump will be tiered and stepped, to minimize degradation. All the activities will be guided by the project's EMPr such that the project does not impact the environment negatively.

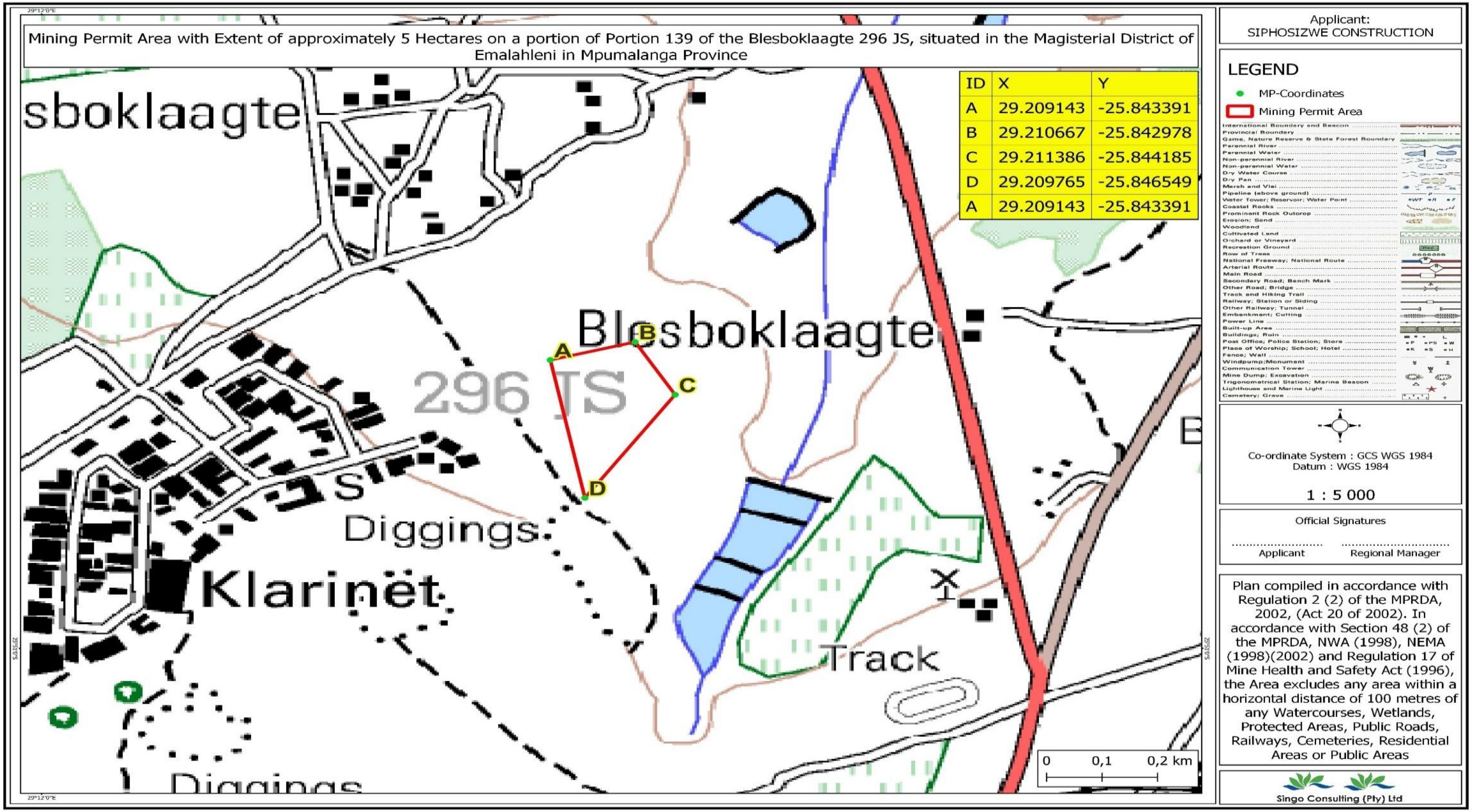

Figure 1: Location of the proposed project site (Singo, 2023)

Figure 2: Proposed mining area (Mlilo, 2023)

Figure 3: Location of identified burial site in the vicinity of the proposed mining site (Mlilo, 2023)

Figure 4: Tracklogs for the surveyed area (Mlilo, 2023)

2 LEGISLATIVE CONTEXT

Three main pieces of legislations are relevant to the present study. The Mining Permit Application is submitted in terms of the National Environmental Management Act, 1998 (NEMA) and the 2017 EIA Regulations for activities that trigger the Mineral and Petroleum Resources Development Act, 2002 (MPRDA) (As amended). Therefore, this is in fulfilment of the assessment of the impact to heritage resources as required by section 24(4)(b)(iii) of NEMA and section 38(8) of the National Heritage Resources Act, Act 25 of 1999 (NHRA). An AIA or HIA is required as a specialist sub-section of the Basic Assessment (BA) process. This study was conducted in terms of Section 38(8) as part of environmental authorisation. The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regards to such development have been taken into account prior to the granting of the consent.

Thus, any person undertaking any development in the above categories, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. Section 38 (2) (a) of the same act also requires the submission of a heritage impact assessment report for authorization purposes to the responsible heritage resources agencies (SAHRA/PHRAs). Because the proposed development will change the character of a site exceeding 5000 m², then an HIA is required according to this section of the Act.

Related to Section 38 of the NHRA are Sections 34, 35, 36 and 37. Section 34 stipulates that no person may alter damage, destroy and relocate any building or structure older than 60 years, without a permit issued by SAHRA or a provincial heritage resources authorit**y**. This section may not apply to present study since none were identified. Section 35 (4) of the NHRA stipulates that no person may, without a permit issued by SAHRA, destroy, damage, excavate, alter, or remove from its original position, or collect, any archaeological material or object. This section may apply to any significant archaeological sites that may be discovered before or during construction. This means that any chance find must be reported to the heritage practitioner or SAHRA/PHRA, who will assist in investigating the extent and significance of the finds and inform the applicant about further actions. Such actions may entail the removal of material after documenting the find site or mapping of larger sections before destruction. Section 36 (3) of the NHRA also stipulates that no person may, without a permit issued by the South African Heritage Resources Agency (SAHRA), destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority. This section may apply in case of the discovery of chance burials and the procedure for reporting chance finds also applies to the unlikely discovery of burials or graves by the applicant or his contractors. Section 37 of the NHRA deals with public monuments and memorials but this may not apply to this study because no protected monument will be physically affected by the proposed coal mining.

In addition, the EIA Regulations of 2014 (as amended in 2017) promulgated in terms of NEMA (Act 107 of 1998) stated that environmental assessment reports will include cultural (heritage) issues. The new regulations in terms of Chapter 5 of the NEMA provide for an assessment of development impacts on the cultural (heritage) and social environment and for Specialist Studies in this regard. The end purpose of such a report is to alert the applicant (Siphosizwe Construction CC), SAHRA/ PHRA and interested and affected parties about existing heritage resources that may be affected by the proposed mining, and to recommend mitigatory measures aimed at reducing the risks of any adverse impacts on these heritage resources.

Table 1: Evaluation of the proposed development as guided by the criteria in NHRA and NEMA

ACT	Stipulation for developments	Requirement details
NHRA Section 38(8)	The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent	Yes
NHRA Section 34	Impacts on buildings and structures older than 60 years	Subject to identification during Phase 1
NHRA Section 35	Impacts on archaeological and palaeontological heritage resources	Subject to identification during Phase 1
NHRA Section 36	Impacts on graves	Subject to identification during Phase 1
NHRA Section 37	Impacts on public monuments	Subject to identification during Phase 1
Chapter 5 (21/04/2006) NEMA	HIA is required as part of an EIA	Yes
Section 39(3)(b) (iii) of the MPRDA	AIA/HIA is required as part of an EIA	Yes

3 METHODOLOGY

This document aims at providing an informed heritage-related opinion about the Mining Permit Application in Mpumalanga Province. This is usually achieved through a combination of a review of any existing literature and a site inspection. As part of the desktop study, published literature and cartographic data, as well as archival data on heritage legislation, the history and archaeology of the area were studied. The desktop study was followed by field surveys. The field assessment was conducted according to generally accepted AIA/HIA practices and aimed at locating all possible objects, sites, and features of cultural significance on the mining footprint. Initially a drive-through was undertaken around the proposed mining site as a way of acquiring the archaeological impression of the general area. This was then followed by a walk down survey in the study area, with a handheld Global Positioning System (GPS) for recording the location/position of each possible site. Detailed photographic recording was also undertaken where relevant. The findings were then analysed in view of the Mining Permit Application in order to make recommendations to the competent authority. The result of this investigation is a report indicating the presence/absence of heritage resources and how to manage them in the context of the proposed Mining Permit Application.

3.1 The Fieldwork survey

The fieldwork survey was undertaken on the 19th of April 2023. The focus of the survey involved a pedestrian survey which was conducted within the proposed mine site. The pedestrian survey focused on parts of the project area where it seemed as if disturbances may have occurred in the past, for example bald spots in the grass veld; strands of grass which are taller than the surrounding grass veld; the presence of exotic trees; evidence of building rubble, existing buildings and ecological indicators such as invader weeds.

The literature survey suggests that prior to the 20th century modern agriculture development; the general area would have been a rewarding region to locate heritage resources related to the Iron Age and historical sites (Bergh 1999: 4). However, the situation today is completely different. The study area now lies on a clearly modified landscape that is dominated by ongoing mining activities.

3.2 Visibility and Constraints

The proposed mining site was accessible although visibility was compromised in some sections due dense vegetation cover. It is conceded that due to the subterranean nature of cultural remains this report should not be construed as a record of all archaeological and historic sites in the area.

3.3 Consultations

The Public Participation process is conducted by the EAP. The Public Participation Process will also invite and address comments from the public and any registered heritage bodies on any matter related to the Mining Permit Application including heritage concerns that may arise relating to the mining activities. The heritage issues and concerns raised by the public will also be included in the Mining Permit Application to be submitted to DMRE.

The following photographs illuminate the nature and character of the Project Site

Plate 1: showing the proposed Mining Permit Application Site

Plate 2: showing dense vegetation cover within the proposed coal mining site.

Plate 3: Showing the proposed mining site.

Plate 4: showing the proposed coal mining site.

Plate 5: showing the proposed Mining Permit Application site.

Plate 6: showing the proposed mining development site

Plate 7: showing reminants of entrance to the proposed mining permit application site.

Plate 8: showing proposed mining site

Plate 9: showing the proposed mining development site

Plate 10: showing mining application site.

Plate 11: showing proposed Mining Application Site

Plate 12: showing the proposed mining site

Plate 13: showing the proposed mining site

Plate 14: showing the proposed mining site

Plate 15: showing the proposed mining site

Plate 16: showing the proposed mining site

Plate 17: showing the proposed mining site

Plate 18: showing the proposed mining site

Plate 19: showing the proposed mining site

Plate 20: showing the proposed mining site

Plate 21: showing the proposed mining site

Plate 22: showing the proposed mining site

4 ARCHAEOLOGICAL CONTEXT

Stone Age sites are marked by stone artefacts that are found scattered on the surface of the earth or as parts of deposits in caves and rock shelters. The Stone Age is divided into the Early Stone Age (covers the period from 2.5 million years ago to 250 000 years ago), the Middle Stone Age (refers to the period from 250 000 years ago to 22 000 years ago) and the Late Stone Age (the period from 22 000 years ago to 200 years ago). The Later Stone Age is also associated with rock paintings and engravings which were done by the San, Khoi Khoi and in more recent times by Iron Age farmers. Heritage surveys up to now have recorded few outstanding Stone Age sites, rock paintings and engravings in the Eastern Highveld - primarily as a result of limited extensive archaeological surveys. Stone tools have been recorded around some of the pans which occur on the Eastern Highveld.

In the larger geographical area, there is material manifestation of Stone Age people but generally, Highveld area did not attract much of habitation in these early times due to lack of rock-shelters and domination of exposed environments. Thus, it is mostly in the vicinity of large watercourses and lower parts of mountains that some ESA (~ 2.6 million to 250 000 years ago) materials (crude chopper and other unifacial tools of the Oldowan industry and the characteristic Acheulian hand axes and cleavers) and MSA (~ 250 000 to 40-25 000 years ago) materials are generally found. The MSA is a flake-technological stage characterized by faceted platforms, produced from prepared cores, as distinct from the core tool-based ESA technology. More technological and behavioural changes than those witnessed in the MSA, occurred during the LSA (~ 40-25 000, to recently, 100 years ago), which is also associated with Homo Sapiens (Barham and Mitchell 2008). For the first time we get evidence of people's activities derived from material other than stone tools (ostrich eggshell beads, ground bone arrowheads, small, bored stones and wood fragments) (Deacon and Deacon 1999). The LSA people are also credited with the production of rock art (engravings and paintings), which is an expression of their complex social and spiritual beliefs (Parkington *et al.* 2008). However, it is important to note that no Stone Age materials were recorded during the field walking, perhaps due to the presence of tall grass. Nonetheless, it is possible to encounter isolated finds of these objects in the study area, even though these would most likely be out of context due to the modern disturbances.

4.1 Iron Age Archaeology

The Iron Age of the Mpumalanga region dates back to the 5th Century AD when the Early Iron Age (EIA) proto-Bantu-speaking farming communities began arriving in this region which was then occupied by hunter-gatherers. These EIA communities are archaeologically referred to as the Mzonjani Facies of the Urewe EIA Tradition (Huffman, 2007: 127-9). They occupied the foot-hills and valley lands along the general Indian Ocean coastland introducing settled life, domesticated livestock, crop production and the use of iron (also see Maggs 1984a; 1984b; Huffman 2007). Alongside the Urewe Tradition was the Kalundu Tradition whose EIA archaeological sites have been recorded along the Mpumalanga areas. From AD 650 to 750 the EIA sites in the region were classified as the Msuluzi facies which was replaced by the Ndondondwane and Ntsekane facies from AD 750 to 950 and AD 950 to 1050 respectively (Huffman, 2007).

By 1050 AD proto-Nguni Bantu-speaking groups associated with the Late Iron Age (LIA) called the Blackburn sub-branch of the Urewe Tradition had arrived in the eastern regions of South Africa, including modern day Mpumalanga, migrating from the central African region of the Lakes Tanganyika and Victoria (Huffman 2007: 154-5). According to archaeological data available, the Blackburn facies ranged from AD 1050 to 1500 (ibid. p.155). The Mpumalanga and the Natal inland regions saw the development of the LIA Moor Park facies between AD 1350 and 1750. These archaeological facies are interpreted as representing inland migration by LIA Nguni speaking groups (Huffman 2007). Moor Park is associated with settlements marked by stonewalling. The period from AD 1300 to 1750 saw multiple Nguni dispersal from the coastland into the hinterland and eventually across the Drakensberg Escapement into central and eastern South Africa (ibid).

No Iron Age sites are indicated in a historical atlas around the town of Witbank, but this may only indicate a lack of research. The closest known Iron Age occurrences to the surveyed area are Late Iron Age sites that have been identified to the west of Bronkhorstspruit and in the vicinity of Bethal (Bergh 1999: 7-8). The good grazing and access water in the area would have provided a good environment for Iron Age people although building material seem to be reasonably scarce. One would therefore expect that Iron Age people may have utilized the area. This is the same reason why white settlers moved into this environment later on.

4.2 Historical Background

The Late Iron Age Nguni communities engaged in the Indian Ocean Trade exporting ivory and importing consumables such as cloth and glass beads. The exporting point was Delagoa. This brought the Nguni speaking community in touch with the Indo-Asian and first Europeans (Portuguese). It was the arrival of the Dutch and the English traders that opened up Delagoa Bay to more trade did the Nguni engaged in extensive trade with the international traders (Huffman 2007). From the late 1700s, trade in supply of meat to passing ship had increased substantially to an extent that by 1800 meat trade is estimated to have surpassed ivory trade. At the same time population was booming following the increased food production that came with the introduction of maize that became the staple food. Naturally, there were signs that population groups had to compete for resources especially along the east coastal regions. The KwaZulu Natal coastal region has a special place in the history of the region and country at large. This relates to the most referenced Mfecane (wandering hordes) period of tremendous insecurity and military stress which eventually affected the entire Southern Africa including the modern-day Mpumalanga area. Around the 1830s, the region also witnessed the massive movements associated with the Mfecane. The causes and consequences of the Mfecane are well documented elsewhere (e.g. Hamilton 1995; Cobbing 1988). In this context, new African kingdoms emerged such as the Zulu Kingdom under Shaka in the second quarter of the 1800s AD. Military pressure from Zululand spilled onto the Highveld by at least 1821. Various marauding groups of displaced Sotho-Tswana moved across the plateau in the 1820s. Mzilikazi raided the plateau extensively between 1825 and 1837. For example, at the beginning of the 19th century, the Phuthing, a South Sotho group, stayed to the east of eMalahleni. During the Difaquane they fled to the south from the Ndebele of Mzilikazi who established several settlement complexes in Eastern Bankveld between Pretoria and Witbank (Bergh 1999: 10-11; 109).

At the same time the Boers trekked into this area in the 1830s. And throughout this time settled communities of Tswana people also attacked each other. As a result of this troubled period, Sotho-Tswana people concentrated into large towns for defensive purposes. Their settlements were built of stone because of the lack of trees in the project area. These stone-walled villages were almost always located near cultivatable soil and a source of water. Such sites are known to occur near Kriel (e.g., Pelser, *et al* 2006) and to the south (Taylor 179). However stonewalled sites associated with Sotho Tswana clans have not been reported in the Witbank area as yet.

White farmers only settled in the Witbank area after 1850 (Bergh 1999: 16). One may therefore expect to find farm buildings, structures and objects from this period in time in the area. Many graveyards from this period have indeed been identified in surrounding areas during past surveys.

4.3 Mining History

The project is located within the historical town of Witbank. Witbank came into being as the railway line between Pretoria and Lourenço Marques which was built in 1894 passed close to where Witbank is located today. Witbank was established in 1903 on a farm known as Swartbos which belonged to Jacob Taljaard (Pistorius 2006, 2008). eMalahleni, formerly known as Witbank, is situated on the highveld of Mpumalanga, South Africa. The name Witbank is Afrikaans for "White Ridge" and is named after a white sandstone outcrop where wagon transport drivers rested. Witbank Colliery was established by Sameul Stanford and the Neumann group as Zeraatsfontein (Leraatsfontein) and the name Witbank was derived from a white quartz outcrop, which according to Thomas Bains, loomed like a wagon tent in the distance". Samuel Stanford erected the first wood and iron building consisting of a shop and hotel at the new town laid by Witbank Colliery in 1903 and became a municipality in 1914. In 2006 the town was renamed eMalahleni, the Nguni word for "the place of coal". eMalahleni is in the coal mining area with 22 collieries in an area no more than 40km in any direction (Pistorius 2008). There are also a number of power stations as well as a steel mill, Highveld Steel and Vanadium Corporation nearby, which all require coal (Van Warmelo, *Preliminary survey of the Bantu Tribes of South Africa*, 87-108).

Witbank was established in 1890 and early attempts to exploit the coal deposits failed until the railway from Pretoria reached the area in 1894 (Pistorius 2008). The establishment of the NZASM railway line in the 1880s, linking Pretoria with Lourenço Marques and the world at large, brought much infra-structural and administrative development to the area. This railway line also became the scene of many battles during the Anglo-Boer *Heritage Impact Assessment Vlakfontein Mine* War and after the battle of Bakenlaagte (30 October 1901) the Clewer station served as hospital for the wounded British soldiers. A concentration camp was established near the Balmoral station, northwest of the study area (Cloete 2000). In line with the 'scorched earth' policy, most farmsteads were destroyed by the British during the latter part of the hostilities. Coal mining occurred only sporadically in the area. However, with the discovery of the Witwatersrand gold fields, the need for a source of cheap energy became important, and coal mining developed on a large scale in various regions. By 1899, at least four collieries were operating in the Middelburg-Witbank district, supplying the gold mining industry (Praagh 1906).

4.4 Intangible Heritage

As defined in terms of the UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003) intangible heritage includes oral traditions, knowledge and practices concerning nature, traditional craftsmanship and rituals and festive events, as well as the instruments, objects, artefacts and cultural spaces associated with group(s) of people. Thus, intangible heritage is better defined and understood by the particular group of people that uphold it. In the present study area, very little intangible heritage is anticipated on the development footprint because most historical knowledge does not suggest a relationship with the study area per se, even though several other places in the general area.

4.5 SAHRIS Database and Impact assessment reports in the proposed project area

Several archaeological and heritage studies were conducted in the project area since 2002 and these presents the nature and heritage character of the area. The HIA conducted in the area also provide some predictive evidence regarding the types and ranges of heritage resources to be expected in the proposed project area: (see reference list for HIA reports). The studies include mining, water pipeline and powerline projects completed by van Vollenhoven (2010, 2011, 2016, 2020, 2021), Coetzee (2021), Pistorius (2012). No sites were recorded, but the reports mention that structures older than 60 years occur in the area, Pelser and Van Vollenhoven (2010, 2011, 2014, 2015) for mining and infrastructure development survey also recorded no sites. Van Schalkwyk did extensive work in the project area, mostly for mining and infrastructure developments for example Van Schalkwyk, (2002, 2004, 2006, 2006, and 2010). Other than burial sites and buildings older than 60 years the studies did not record any significant archaeological sites in the area.

5 RESULTS OF THE FIELD STUDY

5.1 Archaeology

The site was surveyed for archaeological remains, but given the previous and current land use activities, no archaeological remains were identified during the survey (see Figure 1 &Plates 1-8). Based on the field study results and field observations, the receiving environment for the proposed mining site is low to medium potential to yield previously unidentified archaeological sites during mining. Literature review also revealed that no Stone Age and LIA sites are not shown on a map contained in a historical atlas of this area. This, however, should rather be seen as a lack of research in the area and not as an indication that such features do not occur.

5.2 Burial grounds and Graves

Human remains and burials are commonly found close to archaeological sites and abandoned settlements; they may be found in abandoned and neglected burial sites or occur sporadically anywhere because of prehistoric activity, victims of conflict or crime. It is often difficult to detect the presence of archaeological human burials on the landscape as these burials, in most cases, are not marked at the surface and concealed by dense vegetation cover. Human remains are usually identified when they are exposed through erosion, earth moving activities and construction. In some instances, packed stones or bricks may indicate the presence of informal burials. If any human bones are found during the course of mining work, then they should be reported to an archaeologist and work in the immediate vicinity should cease until the appropriate actions have been carried out by the archaeologist. Where human remains are part of a burial, they would need to be exhumed under a permit from either SAHRA (for pre-colonial burials as well as burials later than about AD 1500) or Department of Health for graves younger than 60 years.

The field survey identified one burial site with approximately 24 graves. The burial site is located at GPS Coordinates S25º 50¹ 45.63, E029º 12¹ 37.29 on the edge of the Mining Permit Application site (see Figure 3&4). However, it should be mapped because it may be affected by auxiliary mining activities especially drainage systems. The survey team noted that the site is barely 50m from the boundary of the mining permit site. Effectively the planners for the mine must provide for a 100m buffer zone to ensure that the graves are protected while permanent mitigations measures are being sought. It should be noted that burial grounds and gravesites are accorded the highest social significance threshold (see Appendix 3). They have both historical and social significance and are considered sacred. Wherever they exist, they may not be tempered with or interfered with without a permit from SAHRA. It should also be borne in mind that the possibility of encountering human remains during subsurface earth moving works anywhere on the landscape is ever present. The possibility of encountering previously unidentified burial sites is low within the proposed mining site, however, should such sites be identified during mining, they are still protected by applicable legislations, and they should be safeguarded.

Plate 23: showing graves at the edge of the proposed mining site

Plate 24: showing graves at the edge of the proposed mining site

Plate 25: showing burial site on the edge of the proposed mining site

Plate 26: showing burial site located on the edge of the proposed mining site

Plate 27: showing graves located on the edge of the proposed mining site

5.3 Public Monuments and Memorials

The study did not record any public memorials and monuments within the proposed mining site that require protection. As such the Mining Permit Application may be approved without any further investigation and mitigation in terms of Section 27of the NHRA.

5.4 Buildings and Structures

The study did not record structures and buildings within the proposed mining development site. In terms of Section 34 of the NHRA, the Mining Permit Application may be approved without any further investigation and mitigation.

5.5 Impact Statement

The main cause of impacts to archaeological sites is direct, physical disturbance of the archaeological remains themselves and their contexts. It is important to note that the heritage and scientific potential of an archaeological site is highly dependent on its geological and spatial context. This means that even though, for example a deep excavation may expose buried archaeological sites and artefacts, the artefacts are relatively meaningless once removed from their original position. The primary impacts are likely to occur during clearance and mining, indirect impacts may occur during movement of heavy mining and haulage vehicles. Any additional excavation for foundations of buildings and structures as well as fence line posts will result in the relocation or destruction of all existing surface heritage material (if any are present). Excavation and construction of storm water drainage systems may affect the identified burial site although it is located outside the mining permit site.

Similarly, the clearing of access roads will impact material that lies buried in the topsoil. Since heritage sites, including archaeological sites, are non-renewable, it is important that they are identified, and their significance assessed prior to mining. It is important to note that due to the localised nature of archaeological resources, that individual archaeological sites could be missed during the survey, although the probability of this is very low within the proposed mining site. Further, archaeological sites and unmarked graves may be buried beneath the surface and may only be exposed during surface clearance. The purpose of the AIA is to assess the sensitivity of the area in terms of archaeology and to avoid or reduce the potential impacts of mining by means of mitigation measures (see appended Chance Find Procedure). There is still a possibility of finding archaeological remains buried beneath the ground. It is the considered an opinion of the author that the chances of recovering significant archaeological materials is present within the mining site.

Table 2: Summary of Findings

Heritage resource	**Status/Findings**
Buildings, structures, places and equipment of cultural significance	None exist within the proposed mining site.
Areas to which oral traditions are attached or which are associated with intangible heritage	None recorded
Historical settlements and townscapes	None survives in the proposed area
Landscapes and natural features of cultural significance	None
Archaeological and palaeontological sites	None recorded
Graves and burial grounds	None recorded within the Mining Permit site, but one burial site is located within 50m from the boundary of the mining permit site.
Movable objects	None recorded
Overall comment	The Mining Permit Application may be approved. However, the applicant must provide for protection of a burial site that is located within 50m from the boundary of the site

5.6 Assessment of development impacts

An impact can be defined as any change in the physical-chemical, biological, cultural, and/or socio-economic environmental system that can be attributed to human activities related to the project site under study for meeting a project need. The significance of the impacts of the process will be rated by using a matrix derived from Plomp (2004) and adapted to some extent to fit this process. These matrixes use the consequence and the likelihood of the different aspects and associated impacts to determine the significance of the impacts.

The significance of the impacts will be assessed considering the following descriptors:

Table 3: Criteria Used for Rating of Impacts

Nature of the impact (N)		
Positive	+	Impact will be beneficial to the environment (a benefit).
Negative	-	Impact will not be beneficial to the environment (a cost).
Neutral	0	Where a negative impact is offset by a positive impact, or mitigation measures, to have no overall effect.
`Magnitude(M)		
Minor	2	Negligible effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been altered significantly and have little to no conservation importance (negligible sensitivity*).
Low	4	Minimal effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been largely modified, and / or have a low conservation importance (low sensitivity*).
Moderate	6	Notable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been moderately modified and have a medium conservation importance (medium sensitivity*).
High	8	Considerable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been slightly modified and have a high conservation importance (high sensitivity*).
Very high	10	Severe effects on biophysical or social functions / processes. Includes areas / environmental aspects which have not previously been impacted upon and are pristine, thus of very high conservation importance (very high sensitivity*).
Extent (E)		
Site only	1	Effect limited to the site and its immediate surroundings.
Local	2	Effect limited to within 3-5 km of the site.
Regional	3	Activity will have an impact on a regional scale.
National	4	Activity will have an impact on a national scale.
International	5	Activity will have an impact on an international scale.
Duration (D)		
Immediate	1	Effect occurs periodically throughout the life of the activity.
Short term	2	Effect lasts for a period 0 to 5 years.
Medium term	3	Effect continues for a period between 5 and 15 years.

Long term	4	Effect will cease after the operational life of the activity either because of natural process or by human intervention.
Permanent	5	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability of occurrence (P)		
Improbable	1	Less than 30% chance of occurrence.
Low	2	Between 30 and 50% chance of occurrence.
Medium	3	Between 50 and 70% chance of occurrence.
High	4	Greater than 70% chance of occurrence.
Definite	5	Will occur, or where applicable has occurred, regardless or in spite of any mitigation measures.

Once the impact criteria have been ranked for each impact, the significance of the impacts will be calculated using the following formula:

Significance Points (SP) = (Magnitude + Duration + Extent) x Probability

The significance of the ecological impact is therefore calculated by multiplying the severity rating with the probability rating. The maximum value that can be reached through this impact evaluation process is 100 SP (points). The significance for each impact is rated as High (SP≥60), Medium (SP = 31-60) and Low (SP<30) significance as shown in the below.

Table 4: Criteria for Rating of Classified Impacts

Significance of predicted NEGATIVE impacts		
Low	0-30	Where the impact will have a relatively small effect on the environment and will require minimum or no mitigation and as such have a limited influence on the decision
Medium	31-60	Where the impact can have an influence on the environment and should be mitigated and as such could have an influence on the decision unless it is mitigated.
High	61-100	Where the impact will definitely have an influence on the environment and must be mitigated, where possible. This impact will influence the decision regardless of any possible mitigation.
Significance of predicted POSITIVE impacts		
Low	0-30	Where the impact will have a relatively small positive effect on the environment.
Medium	31-60	Where the positive impact will counteract an existing negative impact and result in an overall neutral effect on the environment.
High	61-100	Where the positive impact will improve the environment relative to baseline conditions.

Table 5: Operational Phase

Impacts and Mitigation measures relating to the proposed project during Mining Phase														
Activity/Aspect	**Impact /**	**Aspect**	**Nature**	**Magnitude**	**Extent**	**Duration**	**Probability**	**Impact before mitigation**	**Mitigation measures**	**Magnitude**	**Extent**	**Duration**	**Probability**	**Impact after mitigation**
Clearing and mining	Destruction of archaeological remains	Cultural heritage	-	2	1	1	2	8	• Use chance find procedure to cater for accidental finds	2	1	1	2	8
	Disturbance of graves	Cultural heritage	-	4	1	4	3	27	• Mitigation required to protect burial site which may be affected by auxiliary mining activities such as storm water drainage systems. • Barricade the site by danger warning tape. • Inform custodians about potential impacts of mining to the graves. • Use appended Chance find procedure to cater for accidental finds.	2	1	1	1	4
	Disturbance of buildings and structures older than 60 years old	Operational	-	2	1	1	1	4	• Construction management and workers must be educated about the value of historical buildings and structures.	2	1	1	1	4
Haulage	Destruction public monuments and plaques	Operational	-	2	1	1	1	4	• Mitigation is not required because there are no public monuments within the project site	2	1	1	1	4

5.7 Cumulative Impacts

Cumulative impacts are defined as impacts that result from incremental changes caused by other past, present, or reasonably foreseeable actions together with the project. Therefore, the assessment of cumulative impacts for the proposed coal mining is considered the total impact associated with the proposed mining project when combined with other past, present, and reasonably foreseeable future developments projects. The impacts of the proposed mining development were assessed by comparing the post-project situation to a pre-existing baseline. This section considers the cumulative impacts that would result from the combination of the proposed mining development.

The proposed mining development will see the entire site being destroyed and will have significant impact on the visual and sense of place. This proposed mine combined with other proposed mining activities will effectively transform a natural agriculture area into a mining area. The mining and other proposed infrastructure developments will have a combined visual impact on the landscape. The cumulative impact will negatively affect the landscape quality of the area which are ordinarily considered to be source. The frequency of mining and other proposals in the area has a potential of collectively changing the character of the landscape. The once isolated landscape will see volumes of people establishing low settlement or enlarging the existing to provide accommodation for workers and office facilities. In the long run the accumulative impact will be of high significance in terms of its potential to change the characteristics and quality of the landscape in the long run. The field survey focused on potential LIA sites, historical buildings and structures as well as burial grounds and graves.

5.8 Mitigation

Mitigation for the Mining Permit site is required for the protection of the burial site located on the edge of the mining site. It is the responsibility of the applicant to protect the burial site and ensure that custodian are not blocked from accessing their family graves.

6 ASSESSING SIGNIFICANCE

The Guidelines to the SAHRA Guidelines and the Burra Charter define the following criterion for the assessment of cultural significance:

6.1 Aesthetic Value

Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria may include consideration of the form, scale, colour, texture, and material of the fabric; sense of place, the smells and sounds associated with the place and its use.

6.2 Historic Value

Historic value encompasses the history of aesthetics, science, and society, and therefore to a large extent underlies all the terms set out in this section. A place may have historic value because it has influenced, or has been influenced by, an historic figure, event, phase, or activity. It may also have historic value as the site of an important event. For any given place, the significance will be greater where evidence of the association or event survives in situ, or where the settings are substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of subsequent treatment.

6.3 Scientific value

The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality, or representativeness, and on the degree to which the place may contribute further substantial information. Scientific value is also enshrined in natural resources that have significant social value. For example, pockets of forests and bushvelds have high ethnobotany value.

6.4 Social Value

Social value embraces the qualities for which a place has become a focus of spiritual, religious, political, local, national, or other cultural sentiment to a majority or minority group. Social value also extends to natural resources such as bushes, trees and herbs that are collected and harvested from nature for herbal and medicinal purposes.

7 DISCUSSION

Several archaeologists conducted Phase 1 Archaeological/ Heritage studies for various infrastructure developments in the project area since 2006. The surveys did not record any archaeological sites within the proposed mining site, however, the lack of confirmable archaeological sites recorded on the Mining Permit Application site is thought to be a result of limited ground surface visibility due dense grass cover. This may have impended the detection of other physical cultural heritage remains, or archaeological signatures immediately associated with the mining site. It should be noted that the absence of confirmable and significant archaeological cultural heritage site is not evidence in itself that such sites did not exist within the proposed project site.

Based on the significance assessment criterion employed for this report, the proposed mining development site was rated low from an archaeological perspective due to previously and current land use activities. However, in terms of Section 36 of the NHRA, the applicant must ensure that graves located in the vicinity of the mining site must be protected. The burial site may be exposed to impacts as a result of auxiliary mining activities such haulage, access roads and storm water drainage systems. It should be noted that significance of the sites of Interest is not limited to presence or absence of physical archaeological sites. Significant archaeological remains may be unearthed during mining. (See appended chance find procedure).

8 CONCLUSION

Integrated Specialist Services (Pty) Ltd was tasked by Singo Consulting (Pty) Ltd to carry out a HIA for the proposed Mining Permit Application for coal on a portion of Portion 139 of the Farm, within the Magisterial District of eMalahleni, Mpumalanga Province. Desktop research revealed that the project area is rich in LIA archaeological sites and historical sites, however, the field study did not identify any sites within the Mining Permit Site. In terms of the archaeology, there are no obvious 'Fatal Flaws' or 'No-Go' areas. However, in terms of Section 36 of the NHRA, the recorded burial site must be treated as a No Go Area. It is the responsibility of the applicant to protect the site from any potential impacts as a result of the proposed mining. It should be remembered that the potential for chance finds, remains and the applicant and contractors are urged to be on the lookout for any potential chance finds during mining. The procedure for reporting chance finds has clearly been laid out and if this report is adopted by SAHRA, then there are no archaeological reasons why the Mining Permit Application cannot be approved.

9 RECOMENDATIONS

Report makes the following recommendations:

1 It is recommended that SAHRA endorse the report as having satisfied the requirements of Section 38 (8) of the NHRA requirements.

2. It is recommended that SAHRA make a decision in terms of Section 38 (4) of the NHRA to approve the proposed Mining Permit Application on condition that the applicant protects the burial site from any potential impacts as a result of the proposed mining development

3. The planners of the project must provide for a 100m buffer zone from the recorded burial site while permanent mitigation measures are being sought. In addition, the applicant must ensure that the burial site is barricaded to avoid any accidental impacts from any mining activities.

4. From a heritage perspective supported by the findings of this study, the Mining Permit Application is supported. However, the Mining Permit Application should be approved under observation that mining does not extend beyond the area considered in this report/affect the identified heritage sites.

5. Should chance archaeological materials or human remains be exposed during mining on any section of the site, work should cease on the affected area and the discovery must be reported to the heritage authorities immediately so that an investigation and evaluation of the finds can be made. In addition, a 100m buffer zone bust be set for the site. The overriding objective, where remedial action is warranted, is to minimize disruption in mining scheduling while recovering archaeological and any affected cultural heritage data as stipulated by the NHRA regulations.

6. Subject to the recommendations herein made and the implementation of the mitigation measures and adoption of the project EMP, there are no significant cultural heritage resources barriers to the proposed Mining Permit Application. The Heritage authority may approve the Mining Permit Application as planned with special commendations to implement the recommendations made herein.

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11 APPENDIX 1: CHANCE FIND PROCEDURE FOR THE PROPOSED MINING PERMIT APPLICATION ON A PORTION OF PORTION 139 OF THE FARM 296 JS UNDER THE MAGISTERIAL DISTRICT OF EMALAHLENI, MPUMALANGA PROVINCE.

19 APRIL 2023

ACRONYMS

BGG	Burial Grounds and Graves
CFPs	Chance Find Procedures
ECO	Environmental Control Officer
HIA	Heritage Impact Assessment
ICOMOS	International Council on Monuments and Sites
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
SAHRA	South African Heritage Resources Authority
SAPS	South African Police Service
UNESCO	United Nations Educational, Scientific and Cultural Organisation

11.1 CHANCE FIND PROCEDURE

11.1.1 Introduction

An Archaeological Chance Find Procedure (CFP) is a tool for the protection of previously unidentified cultural heritage resources during mining. The main purpose of a CFP is to raise awareness of all construction, mine workers and management on site regarding the potential for accidental discovery of cultural heritage resources and establish a procedure for the protection of these resources. Chance Finds are defined as potential cultural heritage (or paleontological) objects, features, or sites that are identified outside of or after Heritage Impact studies, normally as a result of mining monitoring. Chance Finds may be made by any member of the project team who may not necessarily be an archaeologist or even visitors. Appropriate application of a CFP on development projects has led to discovery of cultural heritage resources that were not identified during archaeological and heritage impact assessments. As such, it is considered to be a valuable instrument when properly implemented. For the CFP to be effective, the site manager must ensure that all personnel on the proposed development site understand the CFP and the importance of adhering to it if cultural heritage resources are encountered. In addition, training or induction on cultural heritage resources that might potentially be found on site should be provided. In short, the Chance find procedure details the necessary steps to be taken if any culturally significant artefacts are found during mining.

11.1.2 Definitions

In short, the term ‘heritage resource’ includes structures, archaeology, meteors, and public monuments as defined in the South African National Heritage Resources Act (Act No. 25 of 1999) (NHRA) Sections 34, 35, and 37. Procedures specific to burial grounds and graves (BGG) as defined under NHRA Section 36 will be discussed separately as this require the implementation of separate criteria for CFPs.

11.1.3 Background

The proposed Mining Permit Application on a portion of Portion 139 of the Farm Blesboklaagte, under the Magisterial District of eMalahleni, Mpumalanga Province. The proposed mining development is subject to heritage survey and assessment at planning stage and Mining Permit Application in accordance with Section 38(8) of NHRA. These surveys are based on surface indications alone and it is therefore possible that sites or significant archaeological remains can be missed during surveys because they occur beneath the surface. These are often accidentally exposed in the course of mining or any associated construction work and hence the need for a Chance Find Procedure to deal with accidental finds. In this case an extensive Archaeological Impact Assessment was completed by Mlilo (2023) on the proposed coal mining development site. The AIA/HIA conducted was very comprehensive covering the entire site. The current study (Mlilo 2023) did not record any significant heritage site within the proposed mining site.

11.1.4 Purpose

The purpose of this Chance Find Procedure is to ensure the protection of previously unrecorded heritage resources within the Mining Permit site. This Chance Find Procedure intends to provide the applicant and contractors with appropriate response in accordance with the NHRA and international best practice. The aim of this CFP is to avoid or reduce project risks that may occur as a result of accidental finds whilst considering international best practice. In addition, this document seeks to address the probability of archaeological remains finds and features becoming accidentally exposed during mining and movement of mining equipment. The current mining activities have the potential to cause severe impacts on significant tangible and intangible cultural heritage resources buried beneath the surface or concealed by tall grass cover. Integrated Specialist Services (Pty) Ltd developed this Chance Find Procedure to define the process which governs the management of Chance Finds during mining. This ensures that appropriate treatment of chance finds while also minimizing disruption of the mining schedule. It also enables compliance with the NHRA and all relevant regulations. Archaeological Chance Find Procedures are to promote preservation of archaeological remains while minimizing disruption of mining scheduling. It is recommended that due to the moderate archaeological potential of the project area, all site personnel and contractors be informed of the Archaeological Chance Find procedure and have access to a copy while on site. This document has been prepared to define the avoidance, minimization and mitigation measures necessary to ensure that negative impacts to known and unknown archaeological remains as a result of project activities and are prevented or where this is not possible, reduced to as low as reasonably practical during mining.

Thus, this Chance Finds Procedure covers the actions to be taken from the discovering of a heritage site or item to its investigation and assessment by a professional archaeologist or other appropriately qualified person to its rescue or salvage.

11.2 GENERAL CHANCE FIND PROCEDURE

11.2.1 General

The following procedure is to be executed in the event that archaeological material is discovered:

- All construction/clearance activities in the vicinity of the accidental find/feature/site must cease immediately to avoid further damage to the find site.

- Briefly note the type of archaeological materials you think you have encountered, and their location, including, if possible, the depth below surface of the find
- Report your discovery to your supervisor or if they are unavailable, report to the project ECO who will provide further instructions.
- If the supervisor is not available, notify the Environmental Control Officer immediately. The Environmental Control Officer will then report the find to the Site Manager who will promptly notify the project archaeologist and SAHRA.
- Delineate the discovered find/ feature/ site and provide 100m buffer zone from all sides of the find.
- Record the find GPS location, if able.
- All remains are to be stabilised *in situ.*
- Secure the area to prevent any damage or loss of removable objects.
- Photograph the exposed materials, preferably with a scale (a yellow plastic field binder will suffice).
- The project archaeologist will undertake the inspection process in accordance with all project health and safety protocols under direction of the Health and Safety Officer.

- **Finds rescue strategy**: All investigation of archaeological soils will be undertaken by hand, all finds, remains and samples will be kept and submitted to a museum as required by the heritage legislation. In the event that any artefacts need to be conserved, the relevant permit will be sought from the SAHRA.
- An on-site office and finds storage area will be provided, allowing storage of any artefacts or other archaeological material recovered during the monitoring process.
- In the case of human remains, in addition, to the above, the SAHRA Burial Ground Unit will be contacted and the guidelines for the treatment of human remains will be adhered to. If skeletal remains are identified, an archaeological will be available to examine the remains.
- The project archaeologist will complete a report on the findings as part of the Mining Permit Application process.
- Once authorisation has been given by SAHRA, the Applicant will be informed when activities can resume.

11.2.2 Management of chance finds

Should the Heritage specialist conclude that the find is a heritage resource protected in terms of the NRHA (1999) Sections 34, 35, 36, 37 and NHRA (1999) Regulations (Regulation 38, 39, 40), Integrated Specialist Services (Pty) Ltd will notify SAHRA and/or PHRA on behalf of the applicant. SAHRA/PHRA may require that a search and rescue exercise be conducted in terms of NHRA Section 38, this may include rescue excavations, for which ISS will submit a rescue permit application having fulfilled all requirements of the permit application process.

In the event that human remains are accidently exposed, SAHRA Burial Ground Unit or ISS Heritage Specialist must immediately be notified of the discovery in order to take the required further steps:

a. Heritage Specialist to inspect, evaluate and document the exposed burial or skeletal remains and determine further action in consultation with the SAPS and Traditional authorities:

b. Heritage specialist will investigate the age of the accidental exposure in order to determine whether the find is a burial older than 60 years under the jurisdiction of SAHRA or that the exposed burial is younger than 60 years under the jurisdiction of the Department of Health in terms of the Human Tissue Act.

c. The local SAPS will be notified to inspect the accidental exposure in order to determine where the site is a scene of crime or not.

d. Having inspected and evaluated the accidental exposure of human remains, the project Archaeologist will then track and consult the potential descendants or custodians of the affected burial.

e. The project archaeologist will consult with the traditional authorities, local municipality, and SAPS to seek endorsement for the rescue of the remains. Consultation must be done in terms of NHRA (1999) Regulations 39, 40, 42.

f. Having obtained consent from affected families and stakeholders, the project archaeologist will then compile a Rescue Permit application and submit to SAHRA Burial Ground and Graves Unit.

g. As soon as the project archaeologist receives the rescue permit from SAHRA he will, in collaboration with the company/contractor, arrange for the relocation in terms of logistics and appointing of an experienced undertaker to conduct the relocation process.

h. The rescue process will be done under the supervision of the archaeologist, the site representative and affected family members. Retrieval of the remains shall be undertaken in such a manner as to reveal the stratigraphic and spatial relationship of the human skeletal remains with other archaeological features in the excavation (e.g., grave goods, hearths, burial pits, etc.). A catalogue and bagging system shall be utilised that will allow ready reassembly and relational analysis of all elements in a laboratory. The remains will not be touched with the naked hand; all Contractor personnel working on the excavation must wear clean cotton or non-powdered latex gloves when handling remains in order to minimise contamination of the remains with modern human DNA. The project archaeologist will document the process from exhumation to reburial.

i. Having fulfilled the requirements of the rescue/burial permit, the project archaeologist will compile a mitigation report which details the whole process from discovery to relocation. The report will be submitted to SAHRA and to the client.

Note that the relocation process will be informed by SAHRA Regulations and the wishes of the descendants of the affected burial.

12 APPENDIX 2: HERITAGE MANAGEMENT PLAN INPUT INTO THE PROPOSED MINING PERMIT APPLICATION

Objective	• Protection of archaeological sites and land considered to be of cultural value. • Protection of known physical cultural property sites against vandalism, destruction and theft; and • The preservation and appropriate management of new archaeological finds should these be discovered during mining						
No.	**Activity**	**Mitigation Measures**	**Duration**	**Frequency**	**Responsibility**	**Accountable**	**Contacted**	**Informed**
Pre-Mining Phase								
1	Planning	Ensure all known sites of cultural, archaeological, and historical significance are demarcated on the site layout plan and marked as no-go areas.	Throughout Project	Weekly Inspection	Contractor [C] CECO	SM	ECO	EA EM PM
Mining Phase								
1	Emergency Response	Should any archaeological or physical cultural property heritage resources be exposed during excavation for the purpose of construction, construction in the vicinity of the finding must be stopped until heritage authority has cleared the development to continue.	N/A	Throughout	C CECO	SM	ECO	EA EM PM
		Should any archaeological, cultural property heritage resources be exposed during excavation or be found on development site, a registered heritage specialist or PHRA official must be called to site for inspection.		Throughout	C CECO	SM	ECO	EA EM PM
		Under no circumstances may any archaeological, historical or any physical cultural property heritage material be destroyed or removed form site;		Throughout	C CECO	SM	ECO	EA EM PM
		Should remains and/or artefacts be discovered on the development site during earthworks, all work will cease in the area affected and the Contractor will immediately inform the Mine Manager who in turn will inform Mpumalanga PHRA		When necessary	C CECO	SM	ECO	EA EM PM
		Should any remains be found on site that is potentially human remains, the Mpumalanga PHRA and South African Police Service should be contacted.		When necessary	C CECO	SM	ECO	EA EM PM
Rehabilitation Phase								
		Same as mining phase.						
Operational Phase								
		Same as mining phase.						

13 APPENDIX 4: LEGAL PRINCIPLES OF HERITAGE RESOURCES MANAGEMENT IN SOUTH AFRICA

Extracts relevant to this report from the National Heritage Resources Act No. 25 of 1999, (Sections 5, 36 and 47):

General principles for heritage resources management

5. (1) All authorities, bodies and persons performing functions and exercising powers in terms of this Act for the management of heritage resources must recognise the following principles:

(a) Heritage resources have lasting value in their own right and provide evidence of the origins of South African society and as they are valuable, finite, non-renewable and irreplaceable they must be carefully managed to ensure their survival;

(b) every generation has a moral responsibility to act as trustee of the national heritage for succeeding generations and the State has an obligation to manage heritage resources in the interests of all South Africans.

(c) heritage resources have the capacity to promote reconciliation, understanding and respect, and contribute to the development of a unifying South African identity; and

(d) heritage resources management must guard against the use of heritage for sectarian purposes or political gain.

(2) To ensure that heritage resources are effectively managed

(a) the skills and capacities of persons and communities involved in heritage resources management must be developed; and

(b) provision must be made for the ongoing education and training of existing and new heritage resources management workers.

(3) Laws, procedures and administrative practices must

(a) be clear and generally available to those affected thereby;

(b) in addition to serving as regulatory measures, also provide guidance and information to those affected thereby; and

(c) give further content to the fundamental rights set out in the Constitution.

(4) Heritage resources form an important part of the history and beliefs of communities and must be managed in a way that acknowledges the right of affected communities to be consulted and to participate in their

management.

(5) Heritage resources contribute significantly to research, education and tourism and they must be developed and presented for these purposes in a way that ensures dignity and respect for cultural values.

(6) Policy, administrative practice and legislation must promote the integration of heritage resources conservation in urban and rural planning and social and economic development.

(7) The identification, assessment and management of the heritage resources of South Africa must—

(a) take account of all relevant cultural values and indigenous knowledge systems;

(b) take account of material or cultural heritage value and involve the least possible alteration or loss of it;

(c) promote the use and enjoyment of and access to heritage resources, in a way consistent with their cultural significance and conservation needs;

(d) contribute to social and economic development;

(e) safeguard the options of present and future generations; and

(f) be fully researched, documented and recorded.

13.1 Burial grounds and graves

36. (1) Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit.

(2) SAHRA must identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with the grave referred to in subsection (1), and must maintain such memorials.

(3) (a) No person may, without a permit issued by SAHRA or a provincial heritage resources authority

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of

the applicant and in accordance with any regulations made by the responsible heritage resources authority.

(5) SAHRA or a provincial heritage resources authority may not issue a permit for any activity under subsection (3)(b) unless it is satisfied that the applicant has, in accordance with regulations made by the responsible heritage resources authority

(a) made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and

(b) reached agreements with such communities and individuals regarding the future of such grave or burial ground.

(6) Subject to the provision of any other law, any person who in the course of development or any other activity discovers the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible heritage resources authority which must, in co-operation with the South African Police Service and in accordance with regulations of the responsible heritage resources authority

(a) carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this Act or is of significance to any community; and

(b) if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangements as it deems fit.

(7) (a) SAHRA must, over a period of five years from the commencement of this Act, submit to the Minister for his or her approval lists of graves and burial grounds of persons connected with the liberation struggle and who died in exile or as a result of the action of State security forces or agents provocateur and which, after a process of public consultation, it believes should be included among those protected under this section.

(b) The Minister must publish such lists as he or she approves in the Gazette.

(8) Subject to section 56(2), SAHRA has the power, with respect to the graves of victims of conflict outside the Republic, to perform any function of a provincial heritage resources authority in terms of this section.

(9) SAHRA must assist other State Departments in identifying graves in a foreign country of victims of conflict connected with the liberation struggle and, following negotiations with the next of kin, or relevant authorities, it may re-inter the remains of that person in a prominent place in the capital of the Republic.

13.2 General policy

47. (1) SAHRA and a provincial heritage resources authority—

(a) must, within three years after the commencement of this Act, adopt statements of general policy for the management of all heritage resources owned or controlled by it or vested in it; and

(b) may from time to time amend such statements so that they are adapted to changing circumstances or in accordance with increased knowledge; and

(c) must review any such statement within 10 years after its adoption.

(2) Each heritage resources authority must adopt for any place which is protected in terms of this Act and is owned or controlled by it or vested in it, a plan for the management of such place in accordance with the best environmental, heritage conservation, scientific and educational principles that can reasonably be applied taking into account the location, size and nature of the place and the resources of the authority concerned, and may from time to time review any such plan.

(3) A conservation management plan may at the discretion of the heritage resources authority concerned and for a period not exceeding 10 years, be operated either solely by the heritage resources authority or in conjunction with an environmental or tourism authority or under contractual arrangements, on such terms and conditions as the heritage resources authority may determine.

(4) Regulations by the heritage resources authority concerned must provide for a process whereby, prior to the adoption or amendment of any statement of general policy or any conservation management plan, the public and interested organisations are notified of the availability of a draft statement or plan for inspection, and comment is invited and considered by the heritage resources authority concerned.

(5) A heritage resources authority may not act in any manner inconsistent with any statement of general policy or conservation management plan.

(6) All current statements of general policy and conservation management plans adopted by a heritage resources authority must be available for public inspection on request.

MINING PERMIT APPLICATION

REHABILITATION AND CLOSURE PLAN

REPORT PREPARED BY:

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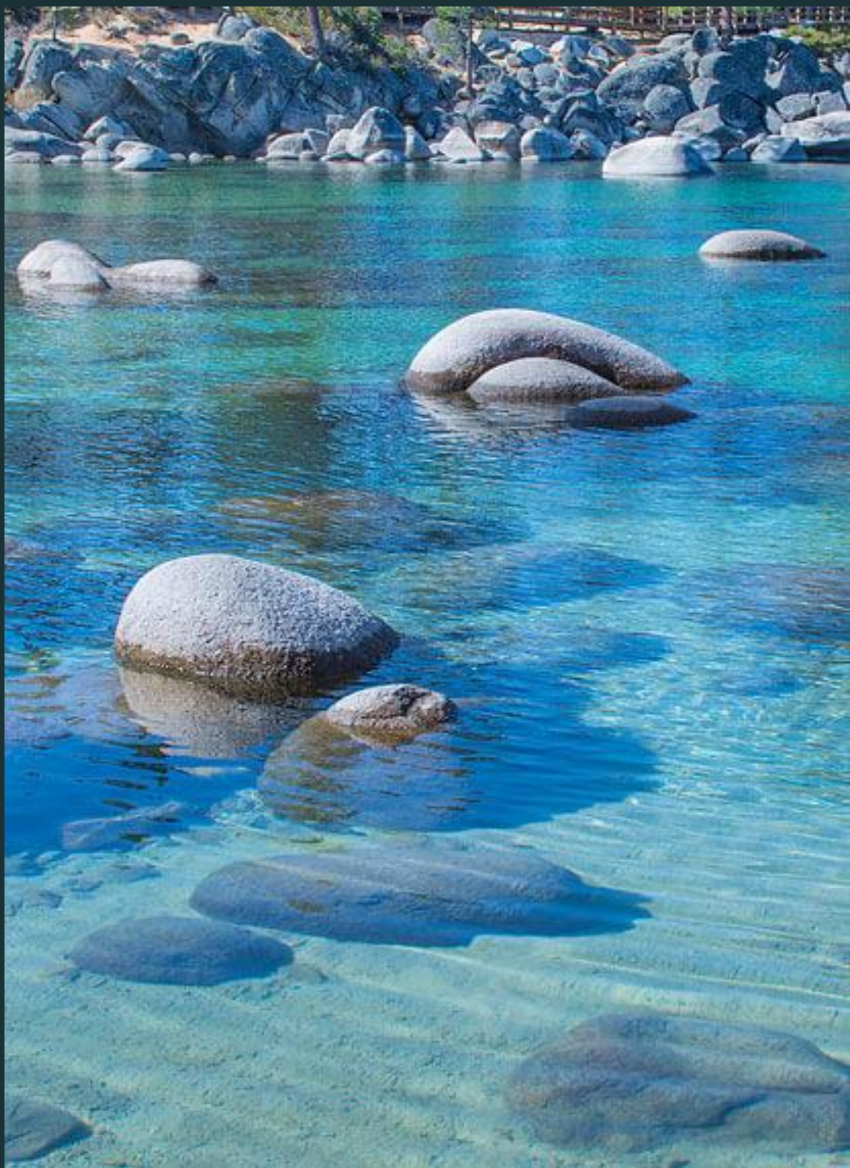
Rehabilitation and Closure Plan for the proposed Mining Permit application for Siphosizwe Construction cc on Portion of Portion 139 of the Farm Blesbokglaagte 296 JS, situated in the Magisterial District of eMalahleni, Mpumalanga Province.



SIPHOSIZWE CONSTRUCTION CC

DMRE REF: MP 30/5/1/3/1/13338 MP

Report Credentials.

Disclaimer	**The opinion expressed in this and associated reports are based on the information provided by SIPHOSIZWE CONSTRUCTION CC to Singo Consulting (Pty) Ltd ("Singo Consulting") and is specific to the scope of work agreed with Notre Coal (Pty) Ltd. Singo Consulting acts as an advisor to the SIPHOSIZWE CONSTRUCTION CC and exercises all reasonable skill and care in the provision of its professional services in a manner consistent with the level of care and expertise exercised by members of the environmental profession. Except where expressly stated, Singo Consulting has not verified the validity, accuracy or comprehensiveness of any information supplied for its reports. Singo Consulting shall not be held liable for any errors or omissions in the information given or any consequential loss resulting from commercial decisions or acts arising from them. Where site inspections, testing or fieldwork have taken place, the report is based on the information made available by SIPHOSIZWE CONSTRUCTION CC or their nominees during the visit, visual observations and any subsequent discussions with regulatory authorities. The validity and comprehensiveness of supplied information has not been independently verified and, for the purposes of this report, it is assumed that the information provided to Singo Consulting is both complete and accurate. It is further assumed that normal activities were being undertaken at the site on the day of the site visit(s), unless explicitly stated otherwise. These views do not generally refer to circumstances and features that may occur after the date of this study, which were not previously known to Singo Consulting (Pty) Ltd or had the opportunity to assess.**
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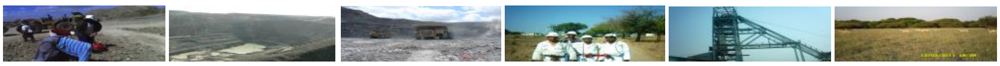
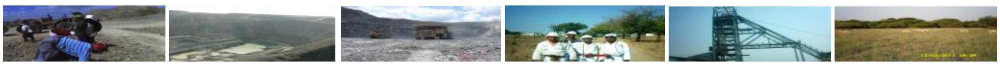


Project details

Report type	**Rehabilitation Plan for a Mining Permit application**
Project title	Rehabilitation Plan for Mining Permit application for SIPHOSIZWE CONSTRUCTION CC on Portion of Portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province.
Mineral (s)	Coal Resources
Client	SIPHOSIZWE CONSTRUCTION CC
Site location	Portion of Portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province.
Version	01
Date	12 April 2023

		Electronic signatures
Compiled by	Khulekani Zwane (Hydrogeologist) Singo Consulting (Pty) Ltd	
Reviewed by	Mutshidzi Munyai (Hydrogeologist) Singo Consulting (Pty) Ltd (Water Resources Science (Professional Natural Scientist), Environment Science (Candidate Natural Scientist) (SACNASP Registration Number 122464)	
Final review and approval	Dr. Kenneth Singo (Principal Consultant of Singo Consulting (Pty) Ltd)	



EXECUTIVE SUMMARY

Singo Consulting Pty Ltd has been requested by **SIPHOSIZWE CONSTRUCTION CC** to compile a Rehabilitation and Closure Plan, as well as financial provision for mining operation which will involve opencast mining on Portion of Portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province, in South Africa to support the Environmental Authorisation Process.

The document supplies the Department of Mineral Resources & Energy (DMRE) with information pertaining to closure planning for the mining activities as required in terms of the National Environmental Management Act 107 of 1998 (NEMA) and the Mineral and Petroleum Resources Development Act 28 of 2002. The contents of this Rehabilitation and Closure Plan have been prepared as per the requirements of Appendix 5 of the NEMA EIA Regulations of 2014 (GNR 517) and as stipulated under Appendix 4 of GNR 1147.

The Mining activities would be conducted in phases:

Site Preparation	Topsoil, subsoil, overburden, discard and ROM stockpiles
Opencast mining	Hauling and transportation
Invasive Drilling	Integrated discard
Blasting	Final decommissioning and Rehabilitation and closure

DESCRIPTION OF THE SCOPE OF THE OVERALL ACTIVITY

The method of mining preferred for this proposed mining permit is the opencast method, which involves removal of ore from seam relatively near the surface by means of open cast. Open cast method is a surface mining technique of extracting rock or minerals from the earth by their removal of rock from an Open cast or borrow. Open-cast mines are typically enlarged until either the mineral resource is exhausted, or an increasing ratio of overburden to ore makes further mining uneconomic. The pit at the site will be worked by cutting a bench which will be progressed further north-easterly direction. The mining method will make use of blasting and will make use of ripper since it is close to the surface by means of explosives to loosen the hard rock (overburden) when necessary; the material (i.e. overburden) will then be loaded by excavators and hauled to the area designated for overburden stockpile on site Coal will be loaded and hauled to a mobile crushing and screening plant that will be established within the boundaries of the mining area or elsewhere out of the mining area. Once crushed and screened the Coal will be then stockpiled and transported to clients via trucks and trailers. All activities will be contained within the boundaries of the mining site of the mining permit.

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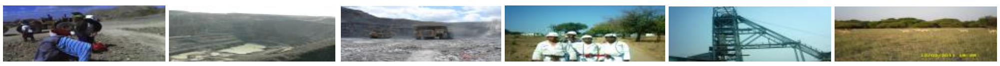

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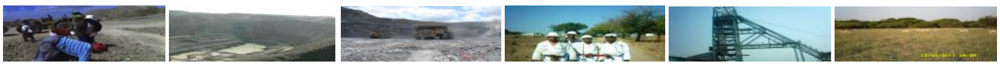

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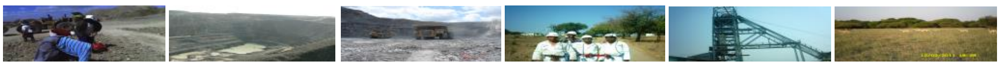


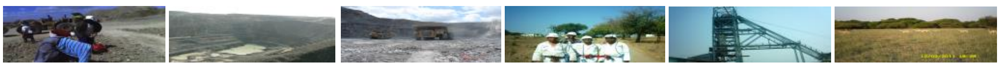
1 INTRODUCTION

South Africa's legislation unambiguously places the responsibility of mitigating environmental damage as a result of mining operations on mining companies. The liability exists throughout the life of the mine, and beyond in terms of residual impacts. It includes commitments for remediation and/or rehabilitation. There now have been full police from the department of mineral which encourage to pay rehabilitation before mining activities commence, where the South African mining industry and mining companies now fully accept the concept and responsibility of mine site rehabilitation and decommissioning.

According to the Chamber of Mines Guidelines for the rehabilitation of mined land 'effective rehabilitation', is defined as "rehabilitation that will be sustainable, in the long term, under normal land management practices" (Chamber of Mines, 2007; Department of Minerals and Energy, 2008). Mine rehabilitation therefore must be considered as an on-going process aimed at restoring the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to a state acceptable to the regulators and to post mining land users (Whitehorse Mining Initiative, 1994).

Singo Consulting Pty Ltd has been tasked by **SIPHOSIZWE CONSTRUCTION CC** to compile a Rehabilitation and Closure Plan, as well as financial provision for its mining activities in support of the Environmental Authorisation Process. Contained herein is the conceptual rehabilitation plan, which is one of the specialist studies that have been compiled for the project. The objective of the rehabilitation plan is to ensure activities associated with mine construction, operation and closure will be designed to prevent, minimize, or mitigate adverse long-term environmental and social impacts and create a self-sustaining ecosystem.

The conceptual rehabilitation plan should be used to guide construction, operation and decommissioning phases of the project and guide the final rehabilitation of the project area. The report must be updated with the mine plan as often as needed to ensure that it is fully applicable to the activities associated with the operations. Rehabilitation report aims to provide standardized guidance for setting corporate standards and policies, and site-specific land rehabilitation plans. It will also provide technically sound, simple, and practical approaches for implementation by all levels of land rehabilitation practitioners, mine planning teams, and administrating regulators; all of whom are responsible for mining-related land.



2. ASSUMPTIONS AND LIMITATIONS

For the compilation of the rehabilitation plan, it is assumed that:

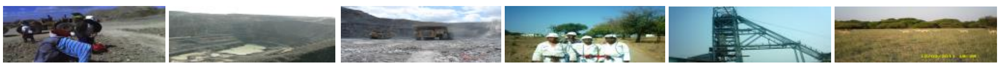
- All relevant information will be made available, including designs for the waste rock facilities and tailings facility.
- All maps for the area will be made available, including the most up to date mine.
- All engineering inputs appointed contractor's responsibility and are thus not included in this report.
- The rehabilitation guidelines and plan are dependent on the specialist studies done for the area and the full mine plan for the project.

3 STUDY AREA AND DESCRIPTION

3.1 Project Area

Farm name	Portion of Portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province.
Application area (ha)	5 hectares
Magisterial district	EMalahleni
Distance and direction from nearest town	Situated approximately 4 km North of Witbank town and approximately 25 km South-West of Middelburg town.

Figure 1 below shows the locality of the Coal mining permit application on Portion of Portion 139 of the Farm Blesboklaagte 296 JS, under the Magisterial District of EMalahleni, Mpumalanga Province, South Africa. It is situated approximately 4 km North of Witbank town and approximately 25 km South-West of Middelburg town. The surrounding land use on the proposed study area is associated with plantation and natural vegetation Figure 4. The project site covers an area approximately 5 hectares.



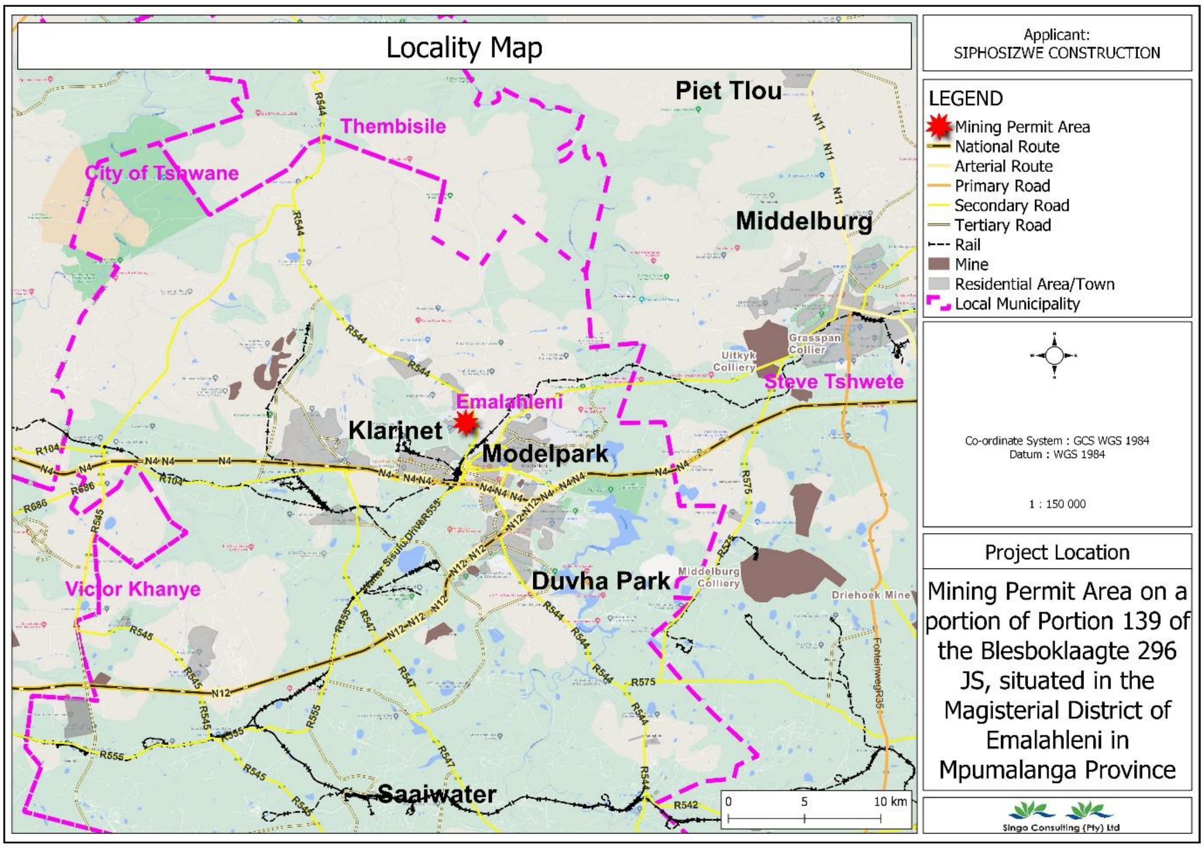


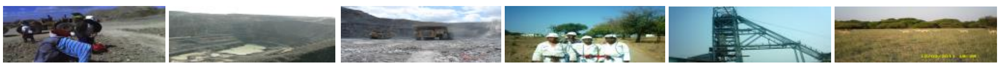
Figure 1: Locality map of the proposed mining area.

Anticipated Infrastructure relating to the mine include but not limited to the following:

- Temporary offices
- Earth moving equipment.
- Drainage systems and PCD
- Roads
- Excavating equipment ROM stockpiling
- Mobile crushing plant
- Fencing
- Parking area
- Workshops
- Chemical mobile toilets (Males and Females)
- Dirty Water Trench
- Clean Water Trench

3.2 Description of The Scope of the Overall Activity

The method of mining preferred for this proposed mining permit by SIPHOSIZWE CONSTRUCTION CC Open cast method, which involves removal of ore from seam relatively near the surface by means of Open cast. Open cast method is a surface mining technique of extracting rock or minerals from the earth by their removal of rock from an Open cast or borrow. Open-cast mines



are typically enlarged until either the mineral resource is exhausted, or an increasing ratio of overburden to ore makes further mining uneconomic. The open cast at the site will be worked by digging from topsoil to the until our reaching productive material from top layer. The mining method will make use of blasting and make use of ripper since it is close to the surface by means of explosives to loosen the hard rock (overburden) when necessary; the material (i.e. overburden) will then be loaded by excavators and hauled to the area designated for overburden stockpile on site while Coal will be loaded and hauled to a mobile crushing and screening plant that will be established within the boundaries of the mining area or elsewhere out of the mining area. Once crushed and screened the Coal will be then stockpiled and transported to clients via trucks and trailers. All activities will be contained within the boundaries of the mining site of the mining permit.

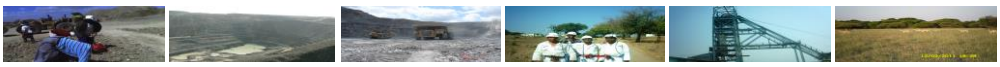
4 REHABILITATION OBJECTIVES

The scope and objectives of this report aims to ensure the Department of Mineral Resources & Energy (DMRE) is presented with a document that addresses all the legal requirements. As per Annexure 4 of the GNR 1147 regulations, "The minimum content of a final rehabilitation, decommissioning and mine closure plan", the objective of the final rehabilitation, decommissioning and mine closure plan, which must be measurable and auditable, is to identify a post-mining land use that is feasible. Internationally and in the South African context, the broad rehabilitation objectives include, explained below:

- Restoration of previous land capability and land use
- No net loss of biodiversity
- What the affected community wants, the affected community gets.

Rehabilitation objectives need to be tailored to the project at hand and be aligned with the Environmental Management Programme (EMPr) and Mine Closure Plan. And thus, the overall rehabilitation objectives for the project are as follows:

- Re-establishment of the pre-mining land capability to allow for a suitable post mining land use
- Maintain and minimise impacts to the functioning wetlands and water bodies within the area
- Implement progressive rehabilitation measures where possible
- Prevent soil, surface water and groundwater contamination
- Comply with the relevant local and national regulatory requirements; and
- Maintain and monitor the rehabilitated areas



5 BASELINE ENIRONMENT

5.1 Soils and Land Capability

Land capability is the ability of land to support a given land use without causing damage. It depends on soil capability in combination with climate. The land capability depends on soil depth which was determined at soil survey positions. Survey positions were recorded as waypoints using a handheld (Global Positioning System (GPS).

5.2 Soil profiles Interpretation

The soil classes map in Figure 2 below, shows that the mining permit area is covered with Association of Classes 1 to 4: undifferentiated structureless soils. This type of soil means that water is removed from the soil very rapidly. Soils commonly are coarse textured and have very high permeability or are very shallow.

Soil depth

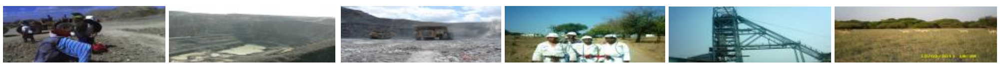
Depth of the soil profile is from the top to the parent material or bedrock. This type of soil can be classified as a restricted soil depth. A restricted soil depth is a nearly continuous layer that has one or more physical, chemical, or thermal properties.

Soil Drainage

Soil drainage is a natural process by which water moves across and out of the soil because of the force of gravity. The soils in the proposed area have an excessive drainage due to the soils having very coarse texture.

Erodibility

Erodibility factor (K-factor) is the inherent yielding or non-resistance of soils and rocks to erosion by runoff and rainfall impact. The association of Classes 1 to 4: undifferentiated structureless soils have high erodibility. A high erodibility implies that the same amount of work exerted by the erosion processes lead to a larger removal of material.



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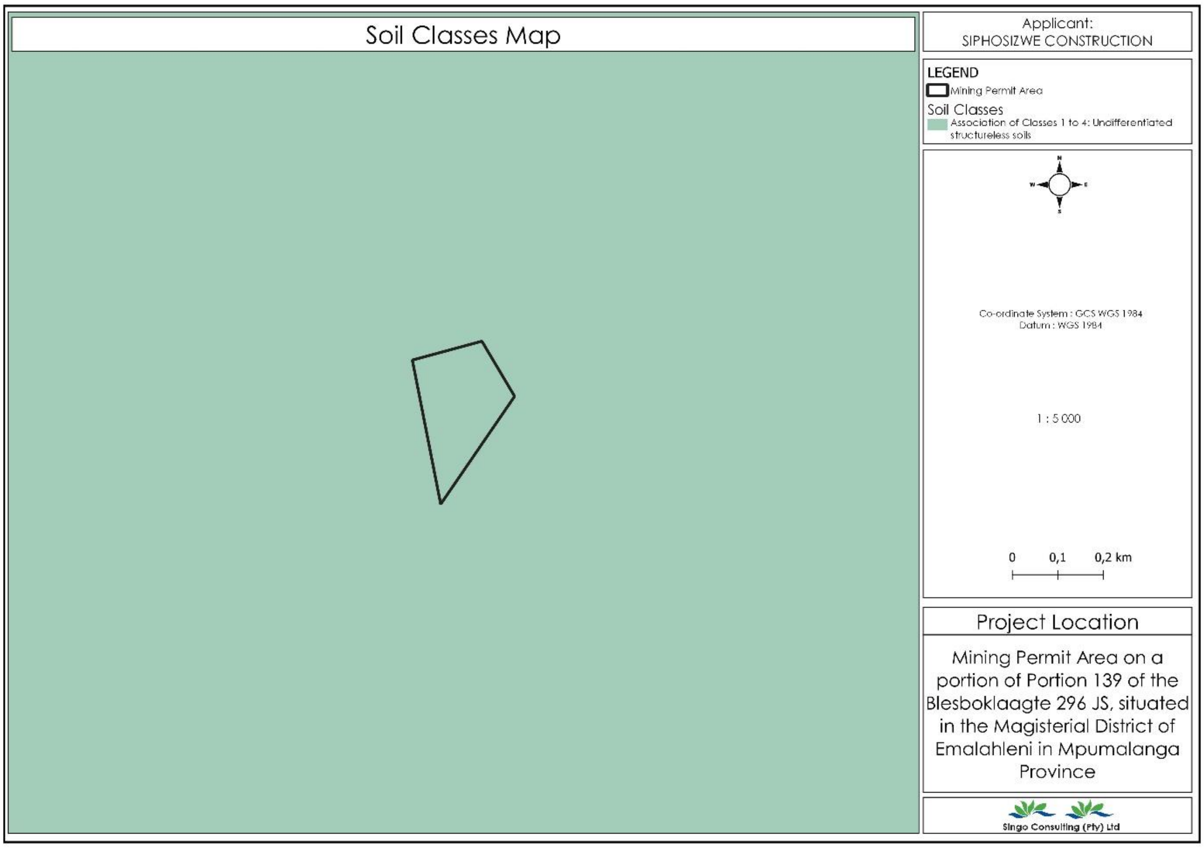


Figure 2: soil class map of the project area.

5.3 Land Capability and Land Use

The proposed project area is associated with an arable land, this is the type of land that does not qualify as a wetland and the soil has less than 10% (by volume) rocks or pedocrete fragments lager than 1000 mm (refer to Figure 3). The land within which the proposed project area is located in a plantation and natural vegetation land cover, and it is not associated with critical or sensitive biodiversity areas Figure 4.

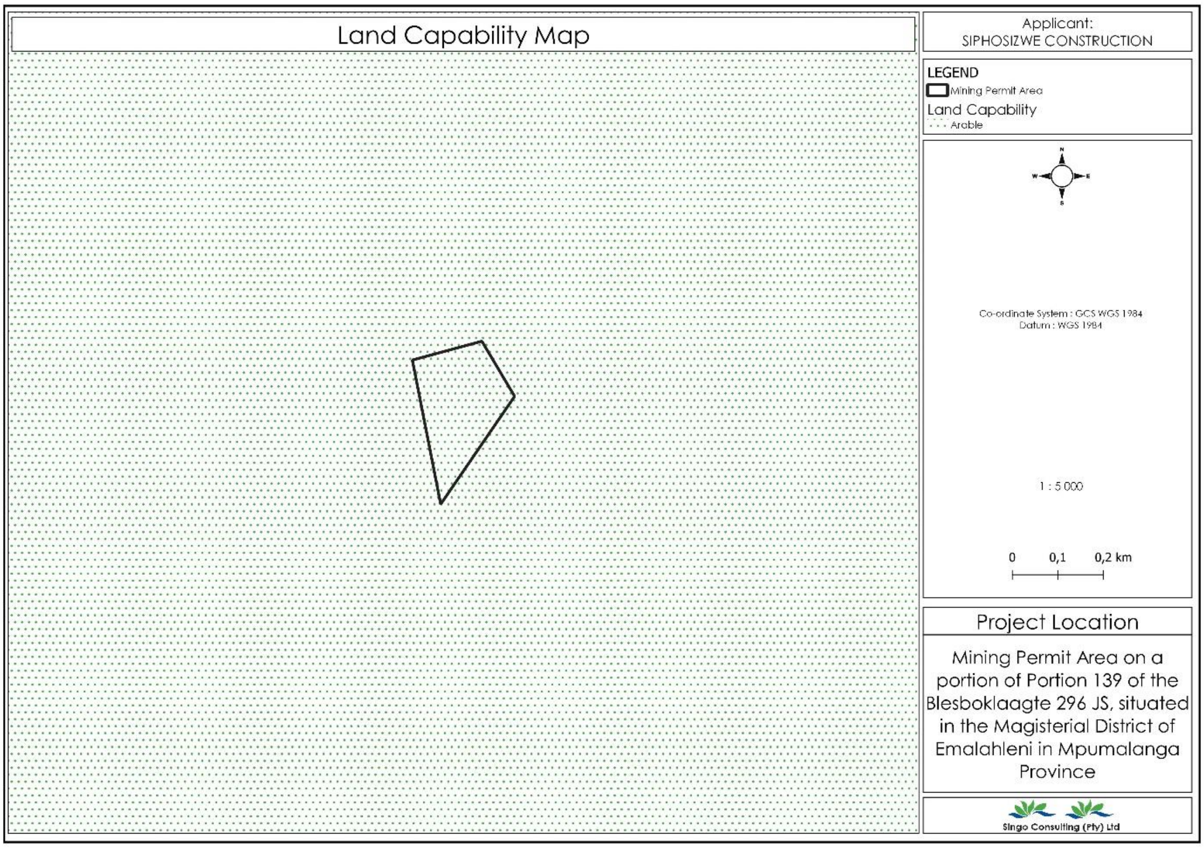


Figure 3: Land capability map of the area

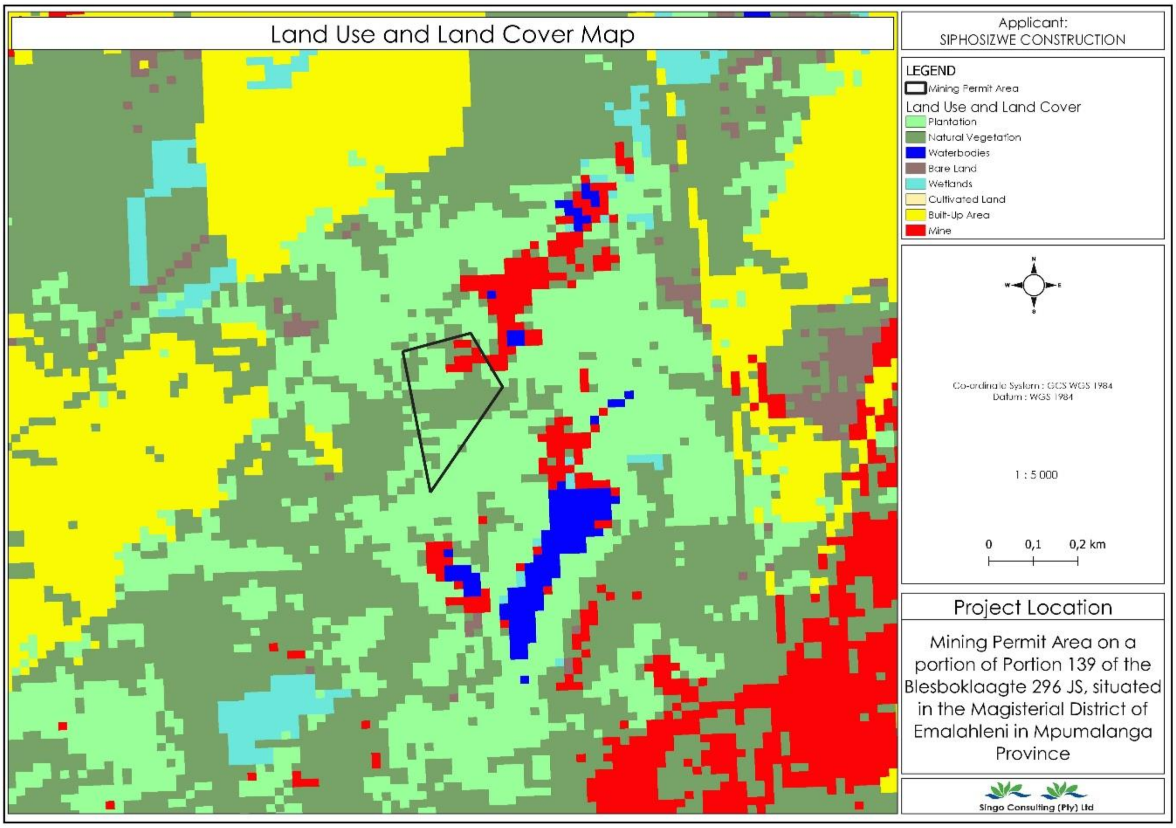
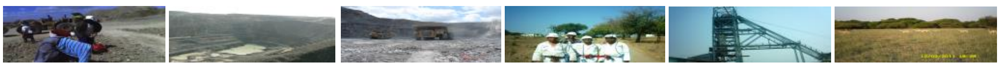


Figure 4: Land use map



5.4 Fauna and Flora

5.4.1 Flora

The study area is located within the Grassland Biome of South Africa. The Grassland Biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. Urbanization is a major additional influence on the loss of natural areas - the Witwatersrand is centred in this biome. The Grassland Biome is considered to have an extremely high biodiversity, second only to the Fynbos Biome. Rare plants are often found in the grasslands, especially in the escarpment area. These rare species are often endangered, comprising mainly endemic geophytes or dicotyledonous herbaceous plants. Figure 5 below shows that the study area is located in **Moist Sandy Highveld Grassland vegetation**. The topography is mainly flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level. Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing.

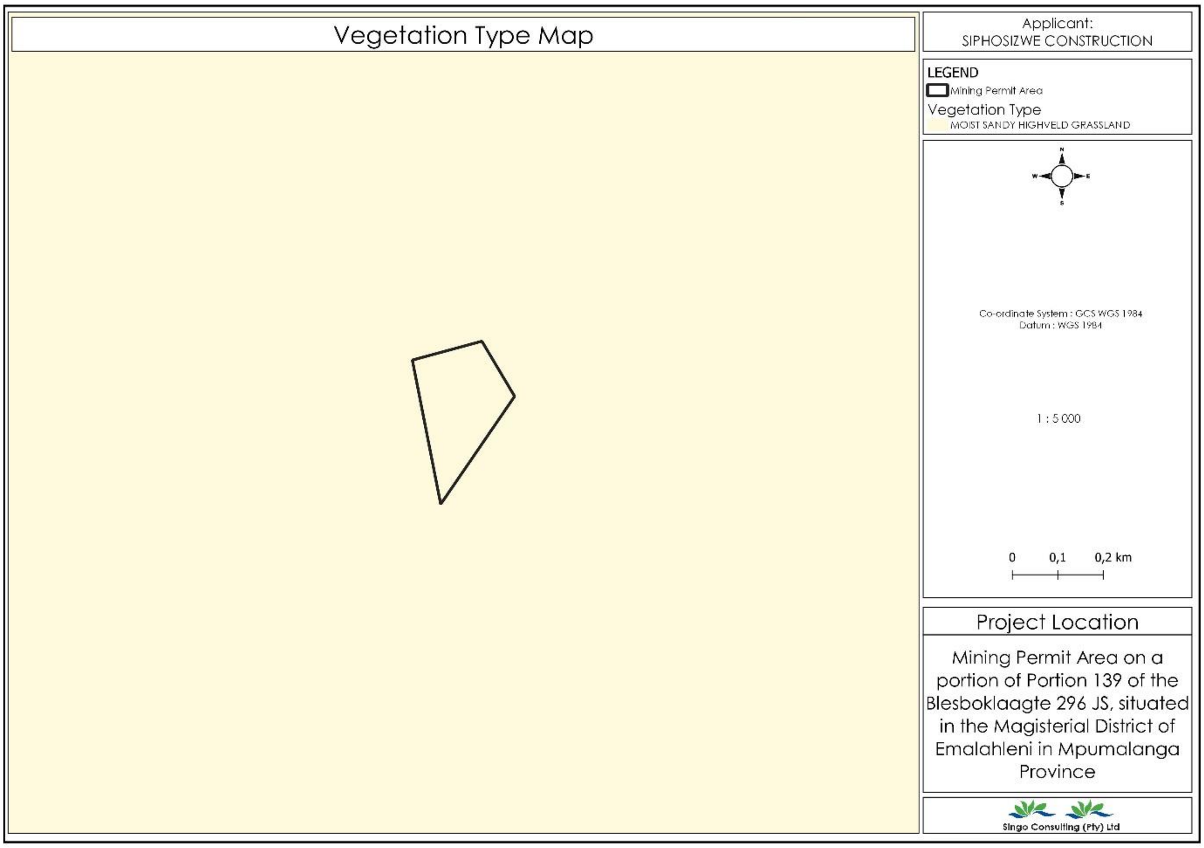


Figure 5: Vegetation map within the proposed area

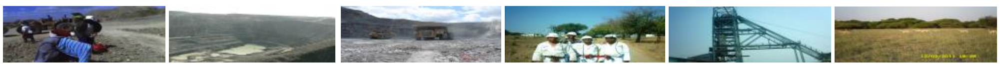
5.4.2 Fauna

Grassland biomes consist of large open areas of grass. Trees can be present, but they are infrequent. The animals found in grasslands range from African elephants (Loxodonta africana) to various species of prairie dogs (Cynomys spp.) including many endangered taxa. The majority of the proposed area has been transformed by livestock grazing and is considered to be at a low ecological sensitivity. No Red Data List (RDL) mammals were observed during the site survey within the study area. In terms of conservation, the likelihood that any threatened mammal species that are listed by the Mpumalanga Province should be encountered within the study area is deemed low due to the high levels of human activity, use of land for grazing by communities, limited favorable faunal habitat availability, transformed habitat within the study area and the existing mining infrastructure within the study area. During the assessment period low faunal species diversity was thus encountered within the proposed area.

5.5 Surface and Ground Water

The topographical map of the study area is depicted as shown on Figure 6 below which shows the elevation changes and landforms. Elevation is represented by contour lines and a contour interval of 5 m was used and the study area has a slightly to moderately undulating plains. In this environmental project, topography is used to determine how surface water flows during rainy seasons or how it would flow during the existence of the project.

The assessment area falls within the B11K quaternary catchment of the Upper Olifants Water Management Area. The main drainage feature of the catchment is the Klip River which drains northwards onto the Olifants River. Two major tributaries are found in the catchment including the Blesbokspruit and Klipspruit. According to DWAF's water management area delineations, proposed mining permit area falls within the Olifants water management area, delineated as water management area No. 4, which subsequently falls under the B Primary drainage area. The Olifants water management area is divided into four major river catchments i.e. the Elands, Wilge, Steelpoort and Olifants catchments. The proposed mining permit falls within the Olifants catchment. Within the Olifants catchment, the proposed mining permit occurs within the B11 and B11K tertiary and quaternary drainage regions respectively, which drains into the Blesbokspruit.



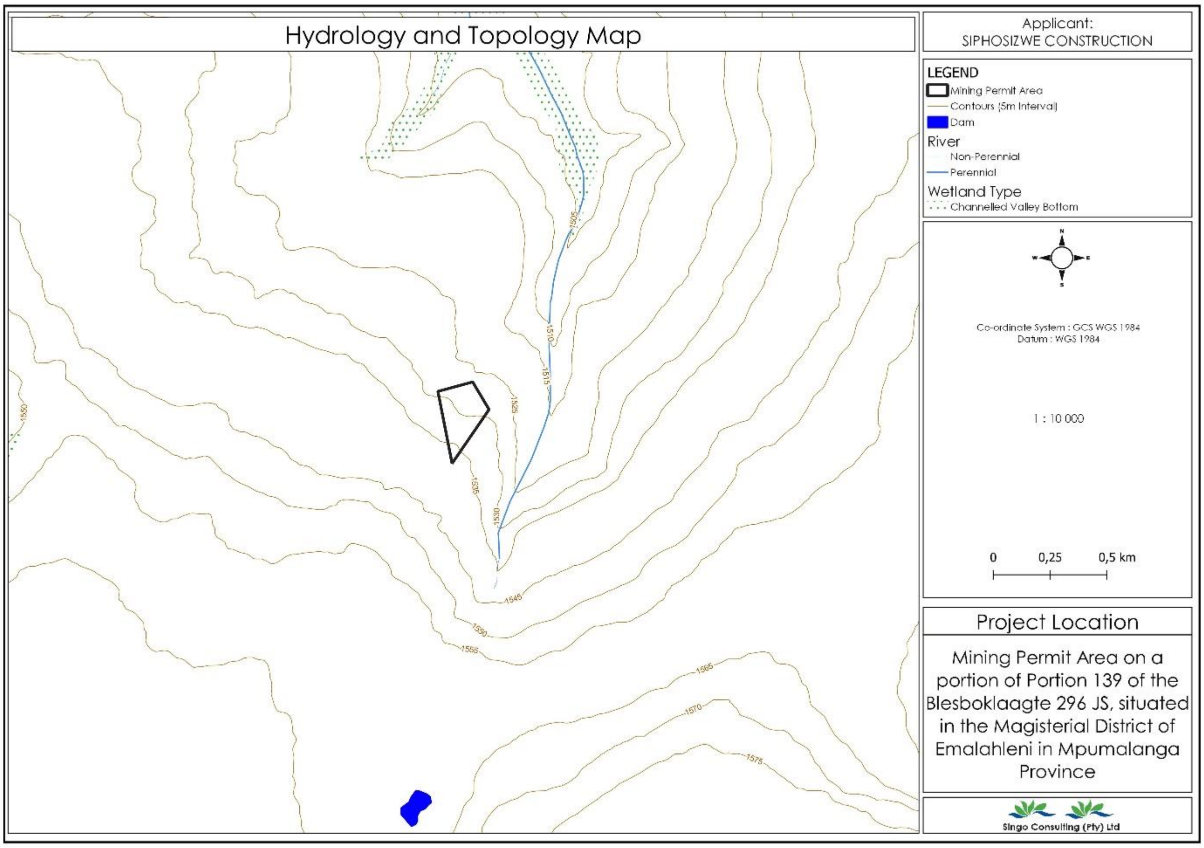


Figure 6: Hydrological map of the study area

6 LEGISLATIVE REQUIREMENTS

South Africa's legislation unambiguously places the responsibility of mitigating environmental damage as a result of mining operations on mining companies. The liability exists throughout the life of the mine, and beyond in terms of residual impacts. It includes commitments for remediation and/or rehabilitation.

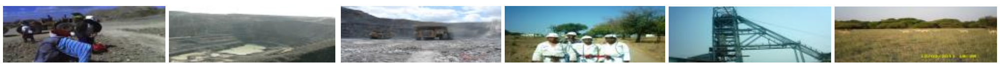
The key legislation governing the requirements for legislation for rehabilitation is contained in the following acts:

- The Constitution of the Republic of South Africa (Act 108 of 1996) ("The Constitution")
- The National Environmental Management Act (Act 107 of 1998, NEMA)
- The Mineral and Petroleum Resources Development Act (Act 28 of 2002, MPRDA)
- The National Water Act (Act of 1998, NWA)
- The National Environmental Management: Biodiversity Act (Act No. 10 of 2004, NEMBA)
- Conservation of Agricultural Resources Act (Act 43 of 1983, CARA)
- National Forests Act (Act 84 of 1998, NFA)
- Mine Health and Safety Act (Act 29 of 1996)
- National Heritage Resources Act (Act 25 of 1999)
- Occupational Health and Safety Act of 1994
- Atmospheric Pollution Prevention Act (Act 45 of 1965)
- Hazardous Substances Act (Act 15 of 1973)
- National Environmental Management: Air Quality (Act 39 of 2004, NEM: AQA)
- National Environmental Management: Waste Management (Act 50 of 2008);
- National Veld and Forest Fire Act (Act 101 of 1998)
- Promotion of Access to Information Act (Act 2 of 2000)

6.1 The Constitution

The Constitution, whilst it does not contain specific provisions for rehabilitation, does enshrine the right of every citizen to an environment that is not harmful to health or wellbeing (Section 24). The inclusion of environmental rights as part of fundamental human rights ensures that environmental considerations are recognised and respected during the administrative and legal processes implemented during the closure and rehabilitation of mined land.

The Bill of Rights, which is an aspect of the Constitution, also provides for rights pertaining to administrative justice, capacity or standing to institute legal proceedings and access to information. These all become relevant within the context of protection and management of the environment during all stages of the mine's life cycle.



6.2 The National Environmental Management Act (Act 107 of 1998)

NEMA aims to establish overarching general guidelines and principles to facilitate environmental management. It promotes Integrated Environmental Management (IEM) (Sections 23 and 24), which aims to integrate environmental management with development.

The concept of rehabilitation has become an imperative part of South African environmental law. Section 28 of NEMA imposes a duty of care to prevent, or where authorised, to minimise environmental degradation. It also provides examples of steps that should be taken to prevent environmental degradation, including the provision for rehabilitation in Section 28 (3) (f), which states that the measures may include measures to "remedy the effects of pollution and degradation. Section 2 of the Act lists a set of principles, with which environmental management must comply and to which Section 37 (1) of the MPRDA refers directly as follows: "The principles set out in Section 2 of the National Environmental Management Act, 1998 (Act No.107 of 1998)

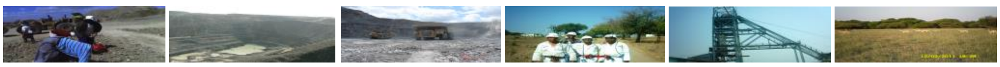
(a) apply to all prospecting and mining operations, as the case may be, and any matter relating to such operation; and

(b) serve as guidelines for the interpretation, administration and implementation of the environmental requirements of this Act.

Section 2 (b) of NEMA states that they "serve as the general framework within which environmental management and implementation plans must be formulated.

The principles of Section 2 of NEMA that are particularly applicable to rehabilitation are:

- The precautionary principle (2 (4) (a) (vii)), which lays the onus on the developer or operator to take a risk averse and cautious approach during decision making, that recognised the "limits of current knowledge about the consequences of decisions and actions". Where uncertainty exists action must be taken to limit the risk.
- The cradle-to-grave (or lifecycle responsibility) principle (2 (4) (e)) states that "responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle
- The project must comply with the requirements for sustainable development (2 (3)), which requires consideration of all relevant factors (2 (4) (a)). A holistic, integrated approach must be followed and the "best practicable environmental option (defined as being "the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term") must be selected.
- The polluter-pays principle (2 (4) (p)) is generally regarded as an important guiding principle for environmental management. The White Paper A Minerals and Mining Policy for South Africa October 1998 state that mining must internalise its external costs.



In Paragraph 4.4 (ii) it states that "The mining entrepreneur will be responsible for all costs pertaining to the impact of the operation on the environment.

6.3 The Minerals and Petroleum Resources Development Act (Act 28 of 2002)

The MPRDA is the principal legislation governing the mining industry and along with its regulations (GN R.517) has several provisions relating to rehabilitation. The objectives of the act in terms of rehabilitation are to give effect to environmental rights as outlined in the constitution. The cradle-to-grave principle (described above) is applied by means of the above-mentioned provisions, which cover the various stages of the project that apply from the period prior to mining through the construction, operation to closure and beyond.

6.4 Integrated Environmental Management and Responsibility to Remedy (Sections 38 and 39, Regulations 51 and 55 of GN R527)

The mining permit holder must give effect to the principles of IEM as laid down in Chapter 5 of NEMA. An annual review for financial provision and a biennial review (or as stipulated in the EMP, or as agreed to in writing by the Minister of Minerals and Energy) for auditing to ensure that the requirements of IEM are being met, are required (Regulation 55 (2) of GN R.527).

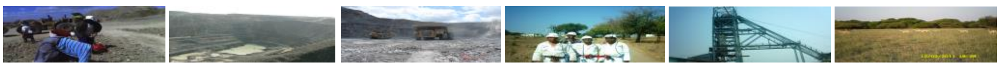
6.4.1 Rehabilitation

Furthermore, Section 38 (1) (d) states that the environment that has been affected by prospecting or mining operations must be rehabilitated to its natural or predetermined state or land use according to the principle of sustainable development (cf. Sections 2 (3) and 2 (4) (a) of NEMA as discussed above as well as Regulation 56, GN R.527 of the MPRDA).

6.4.2 Responsibility for and Management of Adverse Impacts

Section 38 (1) (e) of the MPRDA states that the holder of the mining permit is responsible for any adverse environmental impact resulting from the mining operations, "which may occur inside and outside the boundaries of the area to which such right, permit or permission relates." In addition, section 39 (3) (d) provides for a description in the EMPr of the manner whereby remediation of adverse environmental impacts and compliance with prescribed waste management standards are to be implemented.

This along with the provisions in Section 28 (1) of NEMA regarding care of duty and Regulation 56 of GN R527, which also provides for the land being rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard of land use which conforms with the concept of sustainable development means that the land used by applicant as the permit holder must be restored to its previous state where appropriate, pending stakeholder approval.



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6.5 Financial Provision (Sections 23 and 41 and Regulations 10, 52 – 54 of GN R527)

The applicant for a mining permit must make financial provision for the prevention, management, or rehabilitation of adverse environmental impacts before mining commences. In terms of Section 23, a mining permit is granted only if a number of conditions are met including the requirement that mining will not result in unacceptable pollution, ecological degradation, or damage to the environment. Regulation 10 requires that detailed documentary proof must be submitted to show that the applicant for a mining permit has the technical ability or access thereto to conduct the mining activities and to mitigate and rehabilitate relevant environmental impacts.

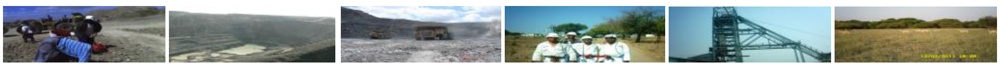
Section 41 stipulates that approval of an EMPr can only be granted once financial provision for rehabilitation or management of negative environmental impacts has been made.

The obligation for financial provision encompasses the entire life cycle of the mining operation from the stage prior to prospecting and/or mining operations through the various phases to closure and beyond as per the cradle-to-grave principle of NEMA. It remains in force until the Minister issues a closure certificate in terms of Section 43. Once the closure certificate has been issued the Minister "may" return the remaining portion of the financial provision. In the event that rehabilitation and closure are not done properly, the Minister may seize assets of the mineral rights holder to defray costs. In the event that this cannot be done then the cost of fixing the problem has to be paid from the Government fund. As a result, this is why there is such a strong focus on rehabilitation and closure plans and the financial provision for closure.

Regulation 54 deals with the quantum of financial provision and stipulates that it must be updated and reviewed annually. It must include, amongst others, a detailed breakdown of the cost required for post-closure management of residual and latent environmental impacts.

6.6 Financial Provision of the Project

The amount for financial provision was calculated for the mining application. Financial provision was made in the form of a bank guarantee upon the successful granting of the mining permit.



CALCULATION OF THE QUANTUM

Ref No.: MP 30/5/1/1/3/1333 8 MP
Date: 23-MAR-2

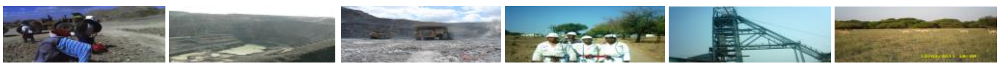
Applicant: **SIPHOSIZWE CONSTRUCTION CC**
Evaluator: **DANIEL**

No.	Description	Unit	A Quantity	B Master Rate	C Multiplication factor	D Weighting factor 1	E=A*B*C*D Amount (Rands)
1	Dismantling of processing plant and related structures (including overland conveyors and powerlines)	m3	0	19	1	1	0
2 (A)	Demolition of steel buildings and structures	m2	0	271	1	1	0
2(B)	Demolition of reinforced concrete buildings and structures	m2	0	400	1	1	0
3	Rehabilitation of access roads	m2	100	49	1	1	4900
4 (A)	Demolition and rehabilitation of electrified railway lines	m	0	471	1	1	0
4 (A)	Demolition and rehabilitation of non-electrified railway lines	m	0	257	1	1	0
5	Demolition of housing and/or administration facilities	m2	0	542	1	1	0
6	Opencast rehabilitation including final voids and ramps	ha	0	284292	1	1	0
7	Sealing of shafts adits and inclines	m3	0	146	1	1	0
8 (A)	Rehabilitation of overburden and spoils	ha	0,32	189528	1	1	60648,96
8 (B)	Rehabilitation of processing waste deposits and evaporation ponds (non-polluting potential)	ha	0	236054	1	1	0
8 (C)	Rehabilitation of processing waste deposits and evaporation ponds (polluting potential)	ha	0	685612	1	1	0
9	Rehabilitation of subsided areas	ha	0	158701	1	1	0
10	General surface rehabilitation	ha	5	150138	1	1	750690
11	River diversions	ha	0	150138	1	1	0
12	Fencing	m	0	171	1	1	0
13	Water management	ha	0,08	57087	1	1	4566,96
14	2 to 3 years of maintenance and aftercare	ha	4,4	19980	1	1	87912
15 (A)	Specialist study	Sum	0			1	0
15 (B)	Specialist study	Sum				1	0
					Sub Total 1		908717,92

1	Preliminary and General	109046,1504	**weighting factor 2** 1	109046,1504
2	Contingencies		90871,792	90871,792
			Subtotal 2	1108635,86
			VAT (15%)	166295,38
			Grand Total	**1274931**

Sign Daniel Tshinavhe
Date 23/03/2023

Figure 7: Financial provision



7 Mine Closure

7.1 Principles of Mine Closure

Regulation 56 of the Regulations provides that the holder of a prospecting right, mining permit, retention permit or mining permit must ensure (amongst others) that:

- The land is rehabilitated, as far as is practicable, to its natural state, or to a predetermined and agreed standard of land use which conforms with the concept of sustainable development; and
- Prospecting or mining operations are closed efficiently and cost effectively.

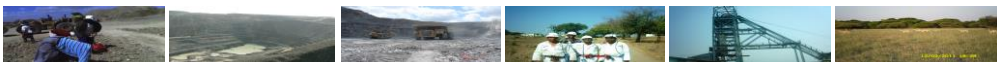
7.2 The National Water Act (Act 36 of 1998)

The NWA aims to regulate the protection, use, development, conservation, integrated management and control of water resources in the Republic of South Africa in an equitable, sustainable and efficient manner (a full description is given in Section 2 of the Act). An important principle of the Act is that water belongs to the state, which holds it in trust for the nation.

Section 19 of the NWA which imposes a duty of care on the holder of the mining permit in a similar way to Section 28 of NEMA, states that "An owner of land, a person in control of land or a person who occupies or uses the land on which any activity or process is or was performed or undertaken; or any other situation exists, which causes, has caused or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring.". This implies that before any mining or related activity is opened, or closed, whether temporarily or permanently, the necessary pollution control measures should be in place.

The regulations contained in GN R704 published in terms of the NWA consist of regulations on the "use of water for mining and related activities" and are "aimed at the protection of water resources". GN R704 acknowledges the principle of co-operative governance and the respective roles for the DMRE, the Department of Environmental Affairs (DEA) and the DWA in regulating pollution from mining activities.

Regulation 9 of GN R704 promulgated in terms of the NWA, which deals with temporary or permanent mine closure, provides that any person in control of a mine or related activity must at the cessation of mining operations and its related activities, ensure that all pollution control measures have been designed, modified, constructed and maintained so as to comply with the regulations contained in GN R 704. Furthermore, the in-stream and riparian habitat of any water resource, which may have been affected or altered by the mine or activity, must be rehabilitated in accordance with the regulations contained in GN R. 704. Further applicable regulations in terms of GN 704 are discussed in Regulation 5 and Regulation 7.



Regulation 5 – Restrictions on Use of Material

The regulation provides that material that could potentially impact on a water resource should not be used for the construction of any feature. Consideration should also be given to the influence on pollution potential by the manner in which certain materials are used. The person in control of the mining activity will be responsible for proving that material used will have no impact.

Regulation 7 – Protection of Water Resources

Regulation 7 (b) applies to the prevention of pollution of any water resource by residue deposits near a water body (such as a pan) or a water course and the provision in Regulation 10(2) (b) provides that stockpiles or sand dumps established on the bank of any watercourse or estuary must be stockpiled or dumped outside of the 1:50 year flood-line or more than a horizontal distance of 100 metres from any watercourse or estuary.

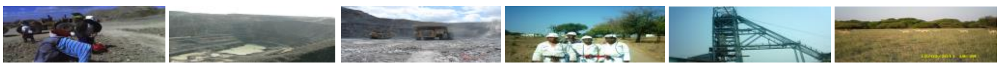
Regulation 7 (f) states that: "Every person in control of a mine or activity must take reasonable measures to- ensure that water used in any process at a mine or activity is recycled as far as practicable, and any facility, sump, pumping installation, catchment dam or other impoundment used for recycling water, is of adequate design and capacity to prevent the spillage, seepage or release of water containing waste at any time.

7.3 Conceptual Rehabilitation Plan

The rehabilitation of the SIPHOSIZWE CONSTRUCTION CC project area is simultaneously a continuous and timeframe operation. In order to gain the best possible rehabilitation outcomes from the mining processes in the relatively sensitive area, different actions are required to occur at different times within the life of mining (expected to be two years) to closure. Similarly, there are management and monitoring actions that will be required throughout the life of the mine project and for years after the project has been closed.

Traditional mining phases include Construction, Operational and Closure phases. Prior to construction and preparation of the land for mining, best practices need to be implemented and compliance to legislation needs to be adhered to.

The SIPHOSIZWE CONSTRUCTION CC is no exception and outlined below are the actions to occur through the three phases that are needed to ensure successful rehabilitation, see Figure *8*.



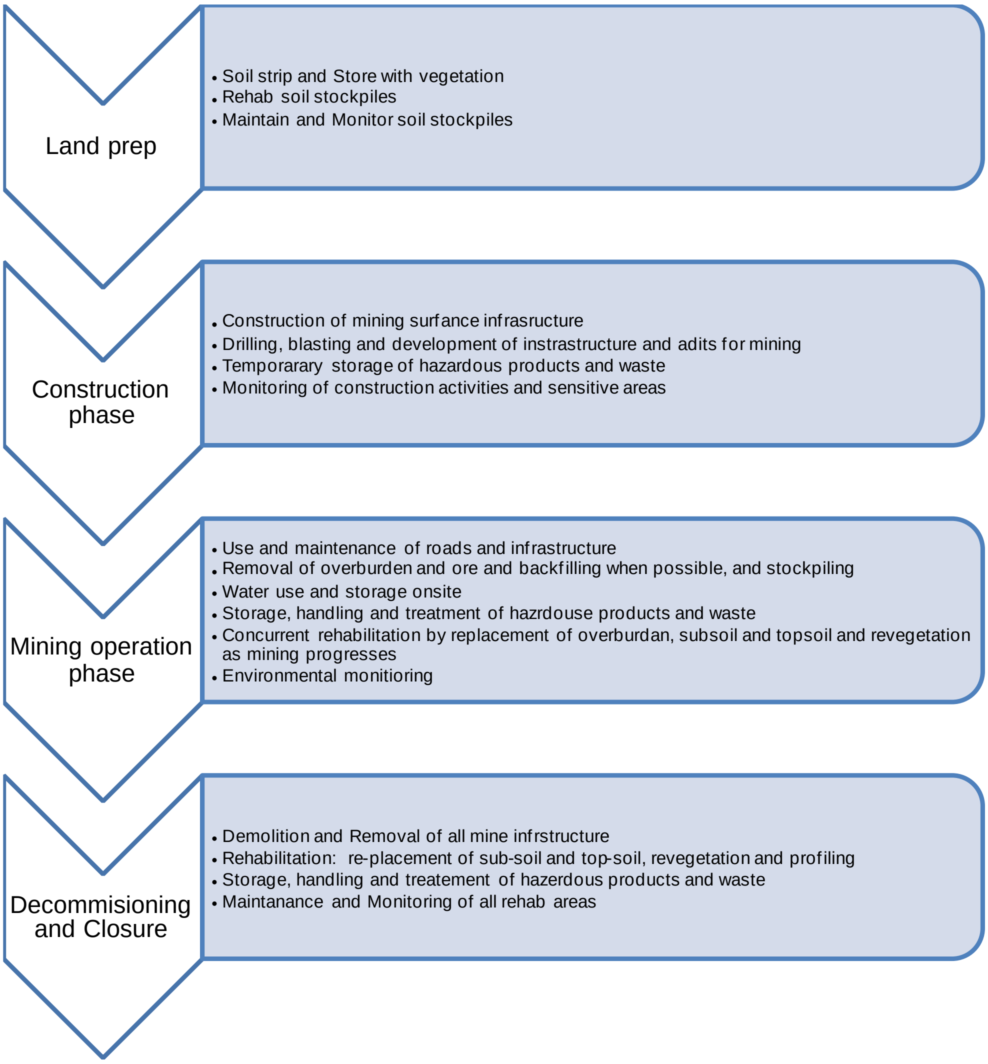
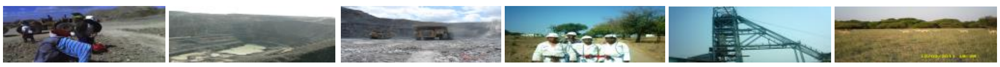


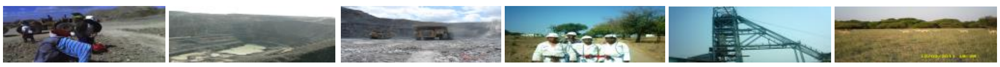
Figure 8: Actions to occur through the Life of Mine



The following points on the table below should be considered during the construction phase of the project:

Table 1: Highlighted points that should be considered during construction phase

Activity	**Recommended Control Measures**
Mine Planning	➢ Mine planning should minimize the area to be occupied by mine infrastructure. The affected area should be kept as small as practically possible and should be clearly defined and demarcated.
Sensitive Landscapes	➢ Care should be taken around sensitive landscapes e.g. wetlands to ensure that impacts to them are none to minimal and that the buffer zones around these sensitive landscapes are considered.
Construction	➢ Construction crews should restrict their activities to planned areas. Clear instructions and control systems should be in place and compliance to the instructions should be policed.
Stockpiles	➢ All stockpiles should be located in areas where they will not have to be removed prior to final placement. Materials should thus be placed in their final closure location or as close as practicable to it.
	➢ All stockpiles should be clearly and permanently demarcated and located in defined no-go areas, re-vegetated and monitored on an annual basis.
Infrastructure	➢ Infrastructure should be designed with closure in mind. Infrastructure should either have a clearly defined dual purpose or should be easy to demolish. This aspect of rehabilitation should be considered if changes in the mine design are made.
Soil Stripping	➢ Soil stripping is a very important process which determines rehabilitation effectiveness. It should be done in strict compliance with the soil stripping guidelines, which should define the soil horizons to be removed.



Rock quarry/burrow pit	➢ If rock quarries or borrow pits are required include them into the environmental plans, however it is suggested that other material could be utilised to avoid further impacts to soil.

7.5 Soil Management Plan

7.5.1 Soil Stripping

This section explains the correct measures that should be followed during the stripping of soil. This is a key rehabilitation activity as soils lost cannot be regenerated in the lifetime of the mine. Correct stripping of soils will firstly ensure that enough soils are available for rehabilitation and secondly, that the soils are of adequate quality to support vegetation growth and thus ensure successful rehabilitation.

It is proposed that topsoil removal will be restricted to the exact footprint of areas required during the operational phase of the activity. The topsoil will be stockpiled at a designated signposted area within the mining boundary to be replaced during the rehabilitation of the area. It will be part of the obligations of site management to prevent the mixing of topsoil heaps with overburden/other soil heaps.

Confirmed sites within the project area that require soil stripping in preparation for mining activity included the infrastructure areas, the landfill area and the TSF area.

The soil depth to be stripped where the Red apedal and Yellow apedal soil occurs is generally 1 m or deeper. This depth includes both the topsoil (depth where plant roots are most active) and the subsoil. It is recommended that a 1.5m soil layer is stripped and stored in a stockpile with slopes of 1:5 to 1:7 (mainly for erosion protection).

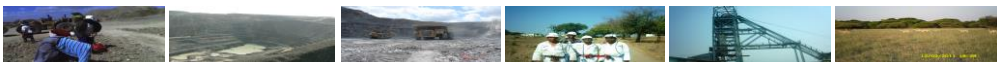
The positions of the soil stockpiles should be indicated on a map and the soil stockpiles should be protected using a fence because soil loss due to unauthorized use can and will occur. The topsoil stockpile should be re-vegetated to protect the soil from water and wind erosion.

Restrictive stockpile heights are usually recommended because soil quality is affected negatively by anaerobic conditions occurring in large stockpiles. The stockpile height in the case of the **SIPHOSIZWE CONSTRUCTION CC** Project can be adjusted according to the space needed because the soil will be stored for a long time before used for rehabilitation purposes.

The remainder of material excavated deeper than 1.5 meter should be stored in a separate stockpile for later use such as to fill up the borrow pit.

The steps that should be taken during soil stripping are as follows:

- ➢ Soil should be stripped making use of the mining area soil plan.



- Removal of hydromorphic soil should be avoided where possible. In the event wetlands have to be impacted upon, then hydromorphic soil should be stripped to a depth defined by the pre-mining soil survey. Typically, 0.3 m to 0.5 m of usable soil material can be stripped from wetland areas
- Well-drained soil should be stripped to a depth of 1.5 m
- Demarcate the boundaries of the different soil types
- Define the cut-off horizons in simple terms that they are clear to the stripping operator (avoid mixing of different horizons and try to ensure horizons and soil types are stockpiled separately)
- Stripping should be supervised to ensure that the various soils are not mixed
- Soil should only be stripped when the moisture content will minimise the compaction risk (i.e. when they are dry)
- The subsoil clay layers which can be found under certain hydromorphic soil need to be stripped and stockpiled separately. This clay material can be used as a compacted clay cap over rehabilitated areas that will become wetlands post-rehabilitation (stripping of wetland soils should be avoided, however if stripping does occur the above is recommended for stripping and stockpiling)
- Where possible, minimise soil handling, i.e. soil should only be handled once instead of moving it around two or more times. However, it is paramount that the correct soil types are replaced at the correct locations in the post-mining topography and accordingly there will always be a need to stockpile some soil; and
- Truck and shovel should preferably be used as a means of moving soil, instead of bowl scrapers.

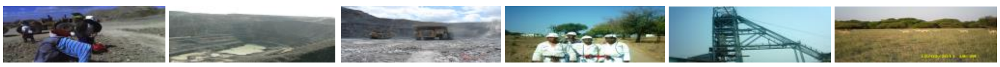
7.6 Soil Plan

A soil assessment was conducted during the EIA phase of the project. The information from the soils report was used to provide information regarding the recommended depth of soil stripping. This plan should be used to map and peg out the various soil types prior to the commencement of construction activities.

The soil, land use and land capability assessment report by Singo Consulting (Pty) Ltd describes the baseline soil conditions, the physical and chemical characteristics, land capability and current land uses of the mining area. This report should be consulted before areas are cleared in preparation for the placement of infrastructure.

7.6.1 Soil Stripping Guidelines

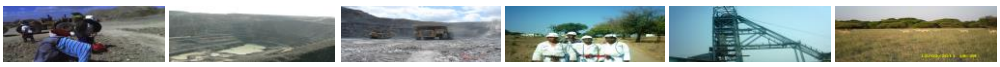
The soil survey that was conducted for the project must be utilized to generate the soil stripping guideline. The boundaries of the different soil types should be demarcated, and each soil horizon (within each soil type's suitability for rehabilitation) should be defined. If possible, the



stripped soils should be replaced immediately in a similar location in the topographical slope to their natural location (for the project soil will be stripped and used to construct a berm and the unused balance stockpiled. After vegetation has been stripped, soil types need to be pegged out accurately (pegging out soils types ahead of stripping). The topsoil and subsoil should also be removed from the areas associated with the mine infrastructure and dumps. Table below provides measures that should be considered during the stripping of soil during the construction phase of the project.

Table 2: Soil stripping measures during construction and operation

Soil Stripping measures during construction and operation	
Construction **(Including Site Preparation)**	➢ Plan site clearance and alteration activities for the dry season (May to October)
	➢ Minimise the period of exposure of soil surfaces through dedicated planning
	➢ Stripping operations should only be executed when soil moisture content is low as this will minimise the risk of compaction (during dry season)
	➢ During stockpiling, preferably use the 'end-tipping' method to keep the stockpiled soils loose
	➢ Ensure stockpiles are placed on a free draining location to limit waterlogging; and
	➢ Limit stockpile height – a safe height can be regarded as the height at which material can be placed without repeated traffic over already placed material.
Operation	➢ Preserve looseness of stockpiled soil by executing Fertilisation and seeding operations by hand
	➢ Soil stockpiles should be monitored for fertility via sampling and testing
	➢ Monitoring of the condition of all unpaved roads is necessary due to the high rainfall and potential water runoff. Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road



	surface. Weekly inspections need to be carried out of all unpaved roads especially during the rainy season.

7.6.2 Supervision

A particularly important aspect is the supervision and monitoring during the stripping process. Close supervision will ensure that soil being stripped from the correct areas and to the correct depths and placed on the correct stockpiles with a minimum of compaction. Monitoring requires an assessment of the depth of the soil, the degree of mixing of soil materials and the volumes of soil that are being replaced directly or being placed on stockpiles. Contracts for the stripping of soils should not only be awarded on the volumes being stripped but also on the capability to strip and place soil accurately.

A soil balance sheet needs to be developed to record all soil types and stripping volumes transported to the stockpiles. This soil balance sheet will aid in the management of the soil stockpiles in addition to keeping record of available soil volumes for rehabilitation.

7.6.3 Moisture Content

Soil is most susceptible to compaction when the moisture content is high. The dry winter months (April - August) are thus more suitable for the stripping and replacement of soils. If soils have to be moved during wet months, then special care should be taken to adopt methods that cause minimum compaction.

7.6.4 Stripping Method

Soil should be stripped and replaced using the truck and shovel method as far as possible. This method will limit the compaction of soils. If bowl scrapers are used, then the soils must be dry during stripping to minimise compaction (it is recommended that bowl scrapers are not used).

7.6.5 Stockpiling

This section explains the correct measures to be followed during the stockpiling of soil. Stockpiling should be minimised as far as possible since it increases compaction and decreases the viability of the seed bank.

The steps that should be taken during soil stockpiling are as follows:

- Mark stockpile locations accurately on a plan to ensure that re-handling is minimised (i.e. soils will not have to be moved a second or third time).
- Ensure that the location is free draining to minimise erosion loss and waterlogging.

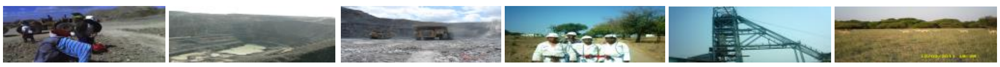
- ➢ Minimise compaction during stockpile formation. The soils should be kept loose by, preferably, tipping at the edge of the stockpile not driving over the stockpile (avoid end tipping as this causes compaction).
- ➢ The positions of the soil stockpiles should be indicated on a map and the soil stockpiles should be protected by means of a fence because soil loss due to unauthorized use can and will occur.
- ➢ Restrictive stockpile heights are usually recommended because soil quality is affected negatively by anaerobic conditions occurring in large stockpiles. The stockpile height in the case of the mining project can be adjusted according to the space needed because the soil will be stored for a long time before used for rehabilitation purposes. Limit the stockpile height so as to prevent internal compaction (soil stockpiles should be <2 m in height)
- ➢ Re-vegetate with a seed mixture similar to the final rehabilitation seed mixture
- ➢ Ensure that the stockpiled soil is only used for the intended purposes.

7.6.6 Stockpile Location

The materials that will be removed from the areas where infrastructure will be placed should be placed as close as possible to where it will be placed in the final landscape. Appropriate mitigation measures for the management of topsoil stockpiles needs to be implemented to ensure that wetlands and drainage paths are not affected and that the loss of topsoil is mitigated against. Progressive monitoring of stockpiles and replacing of topsoil will ensure successful post-mining land and soil reclamation. Assessing post-mining soil characteristics and associated land capability and land uses is necessary to ensure that the end land uses goals can be met. The following information needs to be recorded when stripping and stockpiling of soils:

- ➢ Location of same soil types can be stripped and stockpiled together
- ➢ Stripping depths of different soil types
- ➢ The location, dimensions and volume of planned stockpiles for different soil types

Soil stripped from the tailings facility will be stored near the facility. Soil stripped from the remaining infrastructure areas will need to be stockpiled for use during rehabilitation. This includes soil that will be removed to construct the access shafts and vents. It is envisaged that a berm (screening berm) will be constructed around the plant area. This berm will be constructed from waste material removed from the underground workings. Once the berm has been constructed, soil will be placed on the berm and vegetated. It is envisaged that the berm will remain post closure. It has been assumed that an additional stockpile will be required for the excess topsoil that will not be placed on the berm. This area will be 200 m by 200 m and should not exceed 2 m in height.



7.6.7 Free Draining Locations

Soil should normally be replaced in the landscape positions it was stripped from. Well drained soil should therefore be replaced in high landscape positions while the wet soil is replaced in lower lying landscape positions.

The locations of the soil stockpiles should be on a topographical crest to ensure free drainage in all directions. If this is not possible then an alternative is a side-slope location with suitable cut-off berms constructed upslope.

Stockpiles that are placed in drainage lines result in soils becoming waterlogged and a loss of desirable physical and chemical characteristics. Such situations also result in a loss of soils due to erosion. If stockpiles need to be placed in drainage lines, hydromorphic soils should be stockpiled in the wetter sections.

7.6.8 Soil Reclamation

Rehabilitation and soil reclamation of the property affected by the placement of infrastructure; mining should take into consideration that during stockpiling soil's natural carbon content deteriorates over time.

The following should be reserved:

- The stripping and stockpiling of topsoil should be handled in a responsible way. Organic material should be retained in the topsoil by stripping and stockpiling the topsoil with the vegetation.
- Shallow rooted vegetation will not pose any problem but deeper-rooted vegetation like shrubs and trees should be chipped first then incorporated into the topsoil through the stripping and stockpiling process.
- Rehabilitated land should be reconstructed to pre-mining arable land capabilities within the areas where the initial surface infrastructure will be.
- The topsoil and subsoil materials should not be mixed during stockpiling or reclamation.
- Compaction by vehicle traffic should be avoided when reclamation takes place. Soil physical problems are of real concern as impacts, such as compaction, on reclaimed vegetation are severe due to restricted root growth, low water penetration and low water holding capacity.
- Soil fertility and acidity status should be established through representative soil sampling and analyses to ensure optimal post reclamation vegetative growth. Any nutritional problems should be corrected prior to any vegetation establishment on reclaimed soil.

7.6.9 Compaction

Pertaining to Compaction:

- Soils should be stockpiled loosely. Achieving this will depend on the equipment being used during the stripping and stockpiling process.
- Soils should be dumped in a single lift if truck and shovel methods are used. If the dumps are too low, then the height could be increased by using a dozer blade or back actor bucket to raise the materials.
- The use of heavy machinery should be avoided as it results in the compaction of soils and destruction of the soil structure. It is not recommended that a bowl scraper or grader be used to level and shape the stockpiles. If heavy machinery must be used, then compaction can be reduced by stripping and dumping as thick a cut as possible. Deposition of soils in a single track line may also reduce the compaction of the dumped or replaced soil.

7.6.10 Stockpile Management

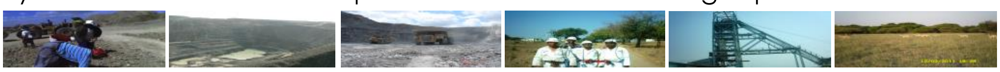
Established stockpiles should be managed to ensure that soil losses are minimised and that additional damage to the physical, chemical or biotic content is minimised. Stockpile soil health, volume and biotic integrity can potentially be harmed by factors including erosion, 'borrowing' for other purposes, contamination and water logging.

Stockpiles should be re-vegetated to avoid soil loss due to erosion and weed colonisation if stockpiles remain in the same location for more than one growing season and have not revegetated naturally. A similar seed mixture to the final mixture recommended for rehabilitation should be used. The looseness of the soil in stockpiles should be preserved (assuming stripping and construction of the stockpiles are done correctly) by fertilising and seeding by hand, hydroseeding (is the norm in the industry) or seeding aerially to minimise the introduction of compaction. If stockpiles are already compacted, standard agricultural equipment can be used to establish grass cover. Weed infestation should also be controlled on the stockpiles by approved methods and herbicides (e.g., Roundup).

It is important that soil only used for the intended purposes. The dumping of waste materials next to or on stockpiles and the pumping out of contaminated water from infrastructure areas are hazards to stockpiles. Employees must be made aware of these hazards and a detailed management and monitoring programme should be put in place.

7.6.11Compaction and Equipment

Compaction limits the effectiveness of replaced soils. The equipment used during the replacement of the soils has a major impact on the compaction levels. Ideally heavy machinery should not be used to spread and level soils during replacement. The truck and



shovel method should be used since it causes less compaction than, for example, a bowl scraper.

When using trucks to deposit soils, the full thickness of the soil required can be placed in one lift. This does, however, require careful management to ensure that the correct volumes of soil are replaced. The soil piles deposited by the trucks will have to be smoothed before re-vegetating the area.

7.6.12 Compaction and Soil Moisture

The soil moisture content is a determining factor in the degree to which the soils are subject to compaction. Each soil type has a moisture content at which the compaction is maximized. The aim during the replacement (and removal) of soils should be to avoid the moisture content of maximum compaction when moving soils. The best time for stripping and replacement of soils is thus when soil moisture content is lowest which will be during the dry season.

7.6.13 Smoothing Equipment

The soils that are deposited with trucks need to be smoothed before re-vegetation can take place. A dozer (rather than a grader) should preferably be used to smooth the soils since it exerts a lower bearing pressure and thus compacts less than wheeled systems. If the top- and sub-soils have been mixed during the stripping process, then the seed-bank has been diluted excessively and the creation of a seed-bed for planting purposes will be required. For stockpiles that have stood for several years will need to be seeded and thus the preparation of the seed bed is important to the success of re-vegetation.

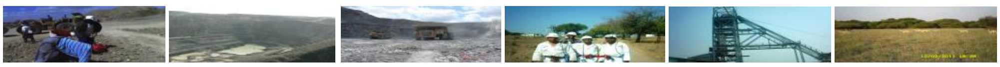
8.7 Amelioration

The steps that should be taken during the improvement of soils are as follows:

- The deposited soils must be ripped to ensure reduced compaction
- An acceptable seed bed should be produced by surface tillage
- Restore soil fertility (if top and sub-soils have been mixed) using the soil analytical data as a guideline
- Incorporate the immobile fertilisers into the plant rooting zone before ripping
- Apply maintenance dressing of fertilisers on an annual basis until the soil fertility cycle has been restored.

8.7.1 Soil Ripping

Deep ripping should be applied to loosen compacted soils (if they occur), preferably done in areas where hard compaction has occurred, to a depth of at least 1 m (this should be limited to sections occurring out of the wetlands, for example along haul roads).



The soil moisture content for maximum disturbance and the desired spacing between the rip lines must be established before ripping starts. In general terms, ripping effectiveness is greatest when soils are slightly moist throughout, and not too wet or dry. The ripping process normally requires the use of a dozer with one or two (maximum) ripper tines that operate to a depth of at least 1 m. The desired rip pattern will be determined by the breakout pattern of the disturbance caused by each ripper tine. Usually, this breakout pattern is at 45 degrees to the tine tip, so if spacing between lines is 1 m, then shattering effect between tines is only to 500 mm. Note that standard agricultural equipment has proved to be ineffective for this task. Soil bulk density should be measured to establish the degree of compaction in the rehabilitation areas, and ripping should be carried out accordingly.

8.8 Infrastructure Removal

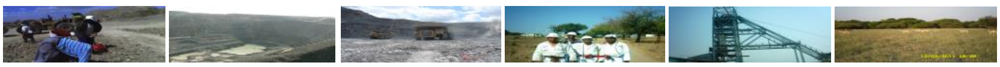
After mining has stopped the processing facilities, administration, mining, transport, and storage facilities should be removed in order to meet the requirements of the post closure land use (Cultivation). In some cases, portions of the existing infrastructure can be used by land users after closure. These structures should be identified and protected prior to commencement of decommissioning. Attention should be paid to managing safety risks during the removal of infrastructure since is it a dangerous occupation.

The following steps should be followed during infrastructure removal:

- Identify infrastructure items that may be of use to the future land users
- In association with those users and the authorities, define what could be left, how it would be used and how sustainable that use would be
- The remaining infrastructure should be assessed for its suitability for reuse/recycling
- The re-usable items should be removed from the site
- Hazardous material locations and deposits require specialized assessment and analysis to determine how these materials should be decontaminated and to ensure that all residual hazardous materials are deposited in officially-sanctioned hazardous waste deposit sites
- Mining infrastructure that will be left on site must be rendered safe
- Remaining structures should be demolished, and the demolition rubble removed
- The final landform agreed for the infrastructure areas should be created
- Soil should be replaced on the disturbed area and revegetated

8.8.1 Infrastructure for Future Use

All the structures on site should be assessed in conjunction with the ultimate land users, and the authorities, to determine which items could be used in future. Care should be taken when this assessment is undertaken to ensure that the infrastructure left behind will not become



abandoned due to unsuccessful enterprises. In cases where the retention of services (e.g. roads, electricity supply, and sewage plants) is requested, the ability of the land users to maintain the various structures should be assessed.

8.8.2 Decontamination of Hazardous Material Locations

The storage and use of hazardous materials such as degreasers and hydrocarbons could result in the contamination of the environment during the life of the operation. During the life of the mine these substances will be off loaded and stored in bunded concrete lined facilities with oil/water traps for storm water management. Care should always be taken when handling and storing hazardous materials and spillages should be cleaned up and remediated immediately. During closure, the mine site should be assessed for contaminated areas. These areas should then be cleaned up by removing the contaminated soil and overburden materials and disposing of it in an officially registered hazardous waste site.

In the event that large areas have become contaminated, the required Authorisation and permit must be obtained for the disposal of this waste as a registered/authorised landfill site. Cognisance must be taken that the decommissioning of hazardous storage areas (such as the Hydrocarbon Storage Areas).

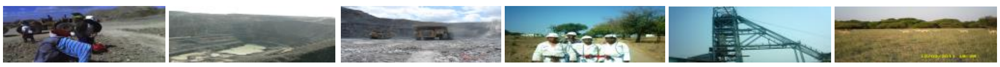
8.8.3 Removal of Infrastructure

Infrastructure that will be demolished should be assessed for its suitability to be re-used or recycled. Items such as cladding, roofing, electrical components and equipment should be removed from the site before demolition of the structures starts. All foundations should be removed to a depth of 1 m. The hard surfaces of roads should also be ripped to a depth of 1 m. Concrete structures contaminated with hazardous materials should be isolated and disposed of at hazardous waste disposal sites. All other inert material can be disposed of in the shafts during the decommissioning phase of the project.

8.8.4 Final Landform

Once the mine site has been cleared of all infrastructure and rubble the exposed underlying materials should be reshaped to create a gently sloping, free-draining topography. The topsoil that was removed during the construction phase should be replaced, fertilized and ripped.

In cases where the foundations of the structures are impractical to remove, the foundations should be covered with a combination of soft overburden or B horizon material topped with a layer of topsoil. This layer should be at least 1 m thick. After these tasks have been completed the infrastructure sites can be included in the rehabilitation process for the rest of the mining area for re-vegetation, monitoring and maintenance.



8.8.5 Reshaping

During the reshaping of the disturbed areas the overburden (waste rock) material, which is being replaced should be compacted by the action of the trucks running repeatedly over the replaced materials. This will compact the surface to a certain degree. The soft overburden material should be placed on top of the overburden material to a depth of at least 1 m and shaped to produce the final landform. Compaction that will occur during the placement of this soft material will be sufficient. Compaction of the topsoil layer (or top- and sub- soils, where soil is stripped in layers) should be avoided by using the truck and shovel method. The slopes, where present, should be designed to minimise erosion potential.

8.8.6 Landform Design

Areas where specific land capabilities need to be achieved should be considered when the final landform is designed. The topography and soils are two of the most important factors which will determine the land capability classification. The final land capability should be in accordance with the commitments made in the approved EMPr. The maximum ideal slope to achieve grazing should be between 1:5 or 1:7 if grazing is the pre–determined end land use. When determining the final slope factors such as regional rainfall intensity and soil type should be considered since they will affect the erodibility rate. Excessively steep slopes will also reduce the land capability class. A general rule of thumb is not to have diagonal slopes of more than 5 m. Contour drains or log pegging can be used to break erosional force of runoff water.

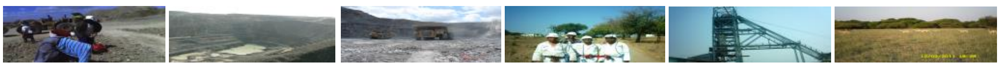
8.8.7 Rehabilitation to Arable Land

Consideration must be taken that rehabilitation is much more difficult during opencast mining and that underground mines impact on smaller areas and are easier to rehab so the impacts are smaller. To determine the success of rehabilitation post mining it is important to understand the current land use and the land capability of the area in question prior to mining. For this it is recommended that pre-mining land capability is proportionally emulated by post mining rehabilitation.

The classification system is made up of four orders and eight classes namely:

- Order A: Arable land – high potential land with few limitations (Classes I and II)
- Order B: Arable land – moderate to severe limitations (Classes III and IV);
- Order C: Grazing and forestry land (Classes V, VI and VII) – applicable land use
- Order D: Land not suitable for agriculture (Class VIII).

The following criteria are used for rehabilitated land capabilities mentioned above:

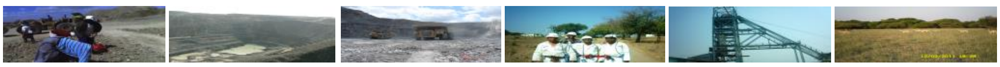


- ARABLE: The soil depth exceeds 0.6 m, the soil material must not be saline or sodic and the slope (%) will be such that when multiplied by the soil erodibility factor K, the product will not exceed 2.0
- GRAZING: The soil depth will be at least 0.25 m – applicable for the location of site infrastructure
- WILDERNESS: The soil depth is less than 0.25 m but more than 0.15 m
- WETLAND: The soil depths as for grazing are used but wetland soils must be used for the construction of wetlands. Wetland soils must be separately stockpiled with other stockpiled soil

8.8.8 Drainage Channel Designs

The construction of erosion management channels on the rehabilitated areas should be avoided as much as possible. This could be done if reshaping and soil replacement are done throughout the dry months, the slopes are short and helpful vegetation cover establishes in the first rains. In areas wherever surface water drainage systems are unavoidable, care should be taken that these structures do not create erosion worse.

The consolidation of mine spoils takes many years to complete and once mining stops the water table re-establishes and also the wetting-up of the overburden materials could end in any settlement. This could be countered by constructing slopes within the contour banks that are significantly steeper than their equivalents on un-mined land and by ensuring that the batters are higher. The steeper slopes would possibly result in scouring within the channel however the risk of contour banks or drains breaking are greatly reduced. All evacuation channels, if needed, ought to be designed by a "competent person" (usually an engineer), who has experience in planning such structures on rehabilitated ground.



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9. VEGETATION AND FERTILISERS MANAGEMENT PLAN

9.1 Vegetation Management

9.1.1 Vegetation Establishment

This section explains the procedure that should be followed during the re-vegetation of rehabilitated areas.

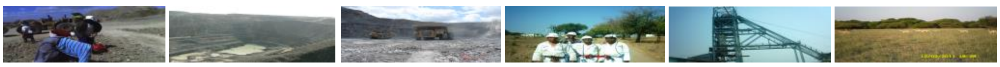
The common ways that used to establish vegetation include seeding and hydroseeding. Flat areas should be seeded using tractor implements and slopes too steep for tractors should be hydroseeded. among the event where soils are stripped and came back directly (i.e. no stockpiling) and therefore the areas stripped have good vegetation cover with applicable species present, natural re-colonization would possibly occur and there'll be no need for re-seeding. during this case, it should be best to easily replace the stripped soils, gently level and rip thoroughly, and leave for one season to assess the extent and quality of the natural re-vegetation, however, this methodology isn't appropriate for any areas previously troubled with alien trespasser species like wattle.

The objectives for the re-vegetation of reshaped and top-soiled land are to:

- Prevent erosion
- Re-establish eco-system processes to ensure that a sustainable land use can be established without requiring fertilizer additions
- Restore the biodiversity of the area as far as possible.

9.1.2 Re-vegetation Steps

- Ensure that the soils have been replaced correctly according to the soil replacement guideline
- All soils are to be ripped to full potential rooting depth to correct compaction induced by the soil replacement activity
- Analysed the topsoil to determine the lime and fertilizers requirements
- Prepare the soil by adding lime and fertilizer and ploughing the area, followed by tillage to prepare the seed bed
- Plant a grass seed mixture consisting of a range of indigenous or non-invasive naturalised species. For wetland areas, *Imperata cylindrica* (Cotton Wool Grass) can be hand planted and hydrophilic species can be worked into the seed mix. Recommendations regarding the seed mixtures for both grassland areas and wetland areas is provided further on in the report (Where good quality grazing land or wilderness land soil is replaced by direct transfer – this will be avoiding the need to plant grass mixtures. The majority of plant species present in the un-mined areas will re-establish naturally, provided the soils are replaced correctly and the tillage is done correctly



- Inspect the area after a good rainfall event
- Control and remove weeds where necessary
- Repeat the procedure for the next growing season
- Application of fertilisers is crop and site specific, analysis of the soils and stockpiles should be undertaken to determine the appropriate fertilisers to be used, if required
- Define and establish the long-term land management system (grass needs regular defoliation if it is to be sustainable)
- Leave pasture to allow natural grasses to become re-established
- Conduct annual monitoring (repeatable demarcated transect surveys).

9.1.3 Species Selection

Some of the criteria that should be considered during the selection of the appropriate species for rehabilitation include:

(i) Use species which are perennial and adapted to the area
(ii) The species should be tolerant of adverse soil conditions
(iii) Species should have a large biomass and prolific root system
(iv) As areas of rehabilitation expand, maintenance costs increase, so species selected should be those with minimal maintenance cost, or with production and financial returns that exceed the cost.

9.1.4 Re-vegetation Methods

The common ways in which used to establish vegetation include seeding and hydroseeding. Flat areas should be seeded using tractor implements and slopes too steep for tractors should be hydroseeded. within the event where soils are stripped and came back directly (i.e. no stockpiling) and therefore the areas stripped have good vegetation cover with appropriate species present, natural re-colonisation might occur and there will be no want for re-seeding. during this case, it's attending to be best to simply replace the stripped soils, gently level and rip completely, and leave for one season to assess the extent and suitableness of the natural re-vegetation, however, this methodology isn't suitable for any areas previously infested with alien invader species like wattle.

9.1.5 Climatic Condition for Plantation

The most successful plantation is done after the first rains and freshly prepared fine tilled seedbeds. Water seed zone will stimulate germination and can be supported by the application of light vegetation.

9.1.6 Vegetation Maintenance and Conservation

Once the plants are planted, they need regular maintenance. If the growth medium consists of low fertility soils (i.e. dirt and dirt mixed) and overburden material, then regular application of plant nutrients is required until the natural fertility cycle has been restored. Annual fertilizer application should continue for three to five years.

Grasses should be defoliate initially through grazing for the first three years so mowing to prevent it from becoming moribund which may increase soil erosion risk. Some ecosystems may have fire at strictly outlined intervals for their propagation and perpetuation. Mowing typically desires less supervision than grazing but this results in giant quantities of plant nutrient (especially potassium) being removed through the hay (this will only occur if the hay is removed, then the nutrients are lost). Larger dressing of fertilizer will need to be applied to maintain the soil fertility establishment. Grazing desires, a lot of management but it ensures nutrient recycling which organic matter returns to the soil. Close superintendence is required for land that is used out to make sure that overgrazing doesn't manifest itself. Management and management of alien vegetation will contribute to the conservation of the natural vegetation. The alien species ought to, therefore, be removed from site and management measures should be implemented to form certain spreading of these species does not occur to alternative elements of the project area or the encompassing lands.

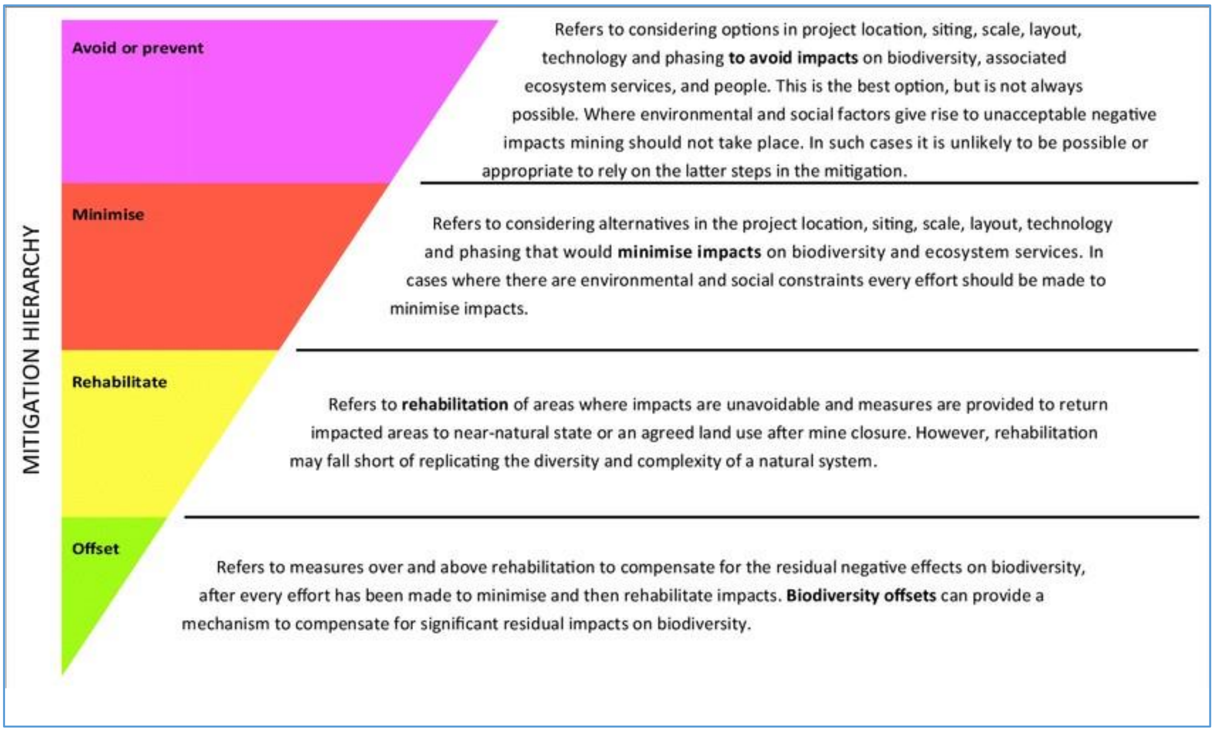


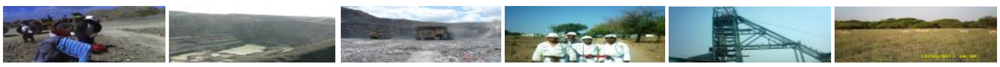
Figure 9: The mitigation hierarchy for dealing with negative impacts on biodiversity

9.2 Fertilizers Management

9.2.1 Soil Fertilization

Deterioration of the fertility regime of soils may well be minimised if the surface soils are stripped separately from the sub-soils and have been replaced at the surface throughout the replacement method, however, once topsoil has been mixed with sub-soil in the removal and replacement method, the end product could be a soil with low fertility. Topsoil fertility should be reinstated in order to determine and maintain good plant growth. The soil should be sampled throughout mining closure and analysed to work out the soil nutrient content as this varies from site to site. Fertilizer should then be applied to boost the soil nutrient content to the required levels if it's recommended to do so by the specialist.

The fertiliser mixture needs to be determined throughout rehabilitation and should vary from site to site. It's recommended that soil analysis is conducted to work out the acceptable application of fertilisers. Normally once fertilisers are applied, the first couple of years sensible vegetation cover will be established as a result of the high fertility, but as time passes there's the chance that the grass cover starts to deteriorate due to misdirection and lack of nutrients.



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10 WEED CONTROL

Alien invasive species tend out-compete the indigenous vegetation; this is due to the fact that they are energetic growers that are adaptable and able to invade a wide range of ecological niches (Bromilow, 1995). They are tough, can withstand unfavorable conditions and are easily spread. Alien species in South Africa are categorised according to CARA and NEMBA.

Declared alien and invasive species have been divided according to Conservation of Agriculture Resources Act 1983 (Act 43 of 1983)198 Invasive Alien Plants (IAPs) are legislated in three categories:

- **Category 1**: Declared weeds that are prohibited on any land or water surface in South Africa. These species must be controlled, or eradicated where possible
- **Category 2:** Declared invader species that are only allowed in demarcated areas under controlled conditions and prohibited within 30m of the 1:50 year flood line of any watercourse or wetland
- **Category 3**: Declared invader species that may remain but must be prevented from spreading. No further planting of these species is allowed.

The draft NEMBA categories for invasive species according to Section 21 are as follows:

- **Category 1a**: Species requiring compulsory control
- **Category 1b:** Invasive species controlled by an invasive species management programme
- **Category 2**: Invasive species controlled by area
- **Category 3**: Invasive species controlled by activity.

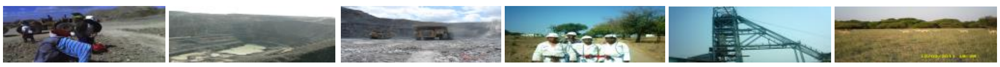
10.1 Alien Invasive Control Plan

Alien invasive species tend to out-compete the indigenous vegetation. Invasive alien plants are a major threat to biodiversity in catchment areas, potentially disrupting the delicate natural balance in ecosystems. As we depend on biodiversity for water, food, wood, clean air, medicine and much more, it is vitally important that we protect this resource.

10.2 Alien Species Control

Invasive alien plant species are problematic to control. Methods should be used that are appropriate for the species concerned, as well as to the ecosystem in which they occur. When controlling weeds and invaders, damage to the environment must be limited to a minimum.

There are four basic methods by which encroachers or weeds are controlled: Physical (mechanical), Chemical and Soil treatment.



10.3 Integrated Control Strategies

The satisfactory management of weeds and alternative invasive species is usually only achieved when several complementary strategies, together with biological management, improved land management practices, herbicides and mechanical strategies, are carefully integrated. Before beginning new management operations on new infestations, all needed follow-up management and rehabilitation work should be completed in areas that are originally prioritized for clearing and rehabilitation.

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11 MONITORING AND MAINTENANCE

The main purpose of monitoring is to make sure that the objectives of rehabilitation are met, and that the rehabilitation process is followed. The physical aspects of rehabilitation should be carefully monitored as well as during the progress of establishment of desired final ecosystems.

The following items should be monitored continuously:

- Vegetation basal cover and vegetation species diversity
- Fauna species recolonized
- Groundwater quality at agreed locations
- Surface drainage systems and surface water quality
- Chemical, physical, and biological status of replaced soil
- Depth of topsoil stripped and placed
- Final topography alignment to agreed planned landform
- Monitoring of erosion status

11.1 Vegetation basal cover and vegetation species diversity

Basal cover refers to the proportion of ground at root level which is covered by vegetation and by the rooting portion of the cover plants. The line-transect (or the quadrat bridge) method can be used to establish sampling positions. A target of 15% basal cover should be set for fully established vegetation. Biodiversity assessments and surveys should be undertaken by external experts to establish the full range of plants that have become established. Summer and winter samplings should be done during these assessments.

11.2 Fauna species recolonized

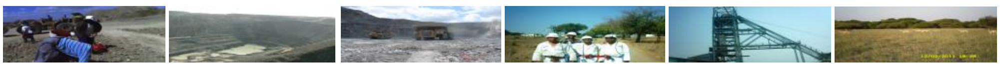
The growth and recolonization of fauna on rehabilitated land should be recorded in relation to climatic conditions. This should be done in order to gather evidence of the relative capability of the new profile to support the pastures in relation to unmined conditions. This can be done by recording the number of grazing days, hay bales produced.

11.3 Groundwater & Surface Water

The groundwater levels and quality should be measured and monitored in a similar way to the surface water to determine the impact of the mining activities on the groundwater resources. A hydrogeologist, together with the relevant authorities, should determine the locations of the monitoring boreholes. The monitoring frequency will be determined by the regulator.

11.4 Surface Water

The functionality of the surface water drainage systems should be assessed on an annual basis. This could preferably be done when the first major rains of the season so after any major storm. An assessment of those structures can ensure that the drainage on the recreated profile



matches the rehabilitation plan as well on find early on when any drainage structures are not functioning efficiently. These will then be repaired or replaced before it causes vital erosion harm.

The quality of all water departure the property should be monitored on a daily basis (as per the EMP) to ensure compliance of the various constituents with the standards approved by the DWA. Extra monitoring should include aquatic biomonitoring (invertebrates, habitat, water quality and fish) on a bi-annual basis (high and low flow) to determine the ecological functioning and health of the rivers and streams, in and around the restored areas. The ecological functioning of the wetlands ought to similarly be assessed on an annual basis.

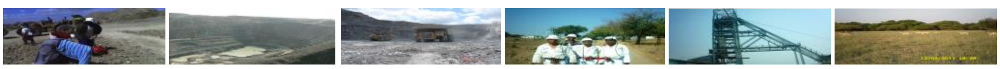
11.5 Chemical, Physical and Biological Status of Replaced Soils

Assess the depth of the replaced soils using a soil auger in a very regular grid pattern. The standard spacing of auger holes is 100 m by 100 m which results in one hole per hectare. Make sure that every auger hole is geo-referenced and that the results are plotted. The auger points are used to identify compact soil layers, the degree of disturbance of the soil and also the plant rooting pattern. Undertake soil fertility sampling independently of the auger survey. The land should be split into logical land use units and should not be bigger than 100 ha. These assessments should be conducted pre-establishment to ensure that immobile nutrients are applied and incorporated deep into the plant rooting zone throughout the initial tillage process.

11.6 Depth of Topsoil Stripped and Replaced

The recovery and effective use of the usable topsoil available is extremely important. It's also important to undertake regular reconciliation of the volumes stripped, stockpiled, and returned to the rehabilitated areas. A topsoil balance can be used to keep track of soil resources on the mine. A final post-mining rehabilitation performance assessment should be done, and information should be adequate for closure applications that involve:

- Assessment of rehabilitated soil thickness and soil characteristics by means of auger observations using a detailed grid
- A post-mining land capability map based on soil thickness and characteristics
- A post-mining land use map
- Erosion occurrences
- Fertility analysis and soil analysis
- Representative bulk density analysis



11.7 Final Topography

The topography that is achieved during rehabilitation should be monitored and compared to the planned topography. The final profile achieved should be acceptable in terms of the surface water drainage requirements and also the end land use objectives. The survey department should do an assessment of the reshaping applied on the site and signoff should be obtained from the rehabilitation specialist before the topsoil is replaced.

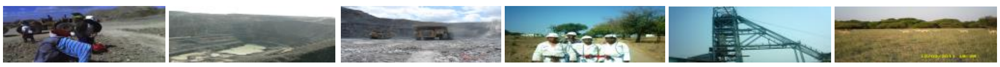
11.8 Monitoring of Erosion

If there is any sign of erosion known during operation monitoring should be implemented to avoid more erosion to the site. Continuous erosion monitoring of rehabilitated areas should be undertaken and zones with excessive erosion should be identified. Erosion will either be quantified or the occurrence there-of simply recorded for the particular location.

12 CONCLUSION AND RECOMMENDATIONS

12.1 Conclusion

- Life of the mine is expected to last a period of two years.
- Topsoil needs to be stripped and stockpiled for later use in mine site rehabilitation particularly from the stockyards, laydown.
- The use of stripped stockpiled soil for rehabilitation purposes has to include detailed post rehabilitation however pre-vegetation soil analysis as well as detailed liming and fertilizer recommendations based on the soil analytical results, as well as the type of vegetation to be established.
- The surrounding land uses are associated with Plantation and Natural vegetation.
- These planned project activities that may be implemented within the applied land will change the land capability for the lifetime of mine, whereas land use is modified from wild to mining among the mine sites.
- Be that as it may, rehabilitation and mitigation will change the land capability at the best back to cultivation.
- This pre-assessment of the soil condition before mining is more important when post-closure analysis will be conducted in the future, to know exactly how much the mine has impacted the area.



12.2 Recommendations

The following recommendations regarding rehabilitation of the mine site are applicable:

- It is recommended that the financial provision for closure and rehabilitation be annually updated as per the requirements of the MPRDA
- Surface water monitoring of the pans and associated wetlands surrounding the project area is to be undertaken to determine the impacts associated with operations of the mine
- Regular audits should be undertaken by a soil scientist during the soil stripping process. This will guarantee that soil is stripped and stockpiled correctly
- Regular audits should be undertaken to monitor the progress of areas that have been rehabilitated
- Long term management of the rehabilitated areas will be required via contractual agreements with landowners in the area and rehabilitation should also be undertaken to best practice
- An independent Environmental Assessment Practitioner shall be appointed to ensure compliance with requirements of the Final Rehabilitation, decommissioning and Closure Plan.