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TERRESTRIAL BIODIVERSITY ASSESSMENT STUDY FOR MINING RIGHT APPLICATION

Terrestrial Biodiversity Assessment Study for the proposed Mining Right Application on portion 1 of the Farm Annysspruit 140 HT and remaining extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province

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Project details

Report type	**Terrestrial Biodiversity Assessment Study for a Mining Right Application**
Project title	Terrestrial Biodiversity Assessment Study for the proposed mining right application on portion 1 of the Farm Annysspruit 140 HT and remaining extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief), Mpumalanga Province.
Mineral (s)	Coal
Client	Notre coal (Pty) Ltd
Site location	Portion 1 of the Farm Annysspruit 140 HT and remaining extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief), Mpumalanga Province.
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Project credentials

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Executive Summary

Singo consulting (Pty) Ltd was appointed by Notre coal (Pty) Ltd to conduct a Terrestrial Biodiversity Assessment as part of the Environmental Impact Assessment (EIA) and Authorisation process in support of a Coal Mining Right on portion 1 of the Farm Annysspruit 140 HT and remaining extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief), Mpumalanga Province. The proposed project site covers an extent of 366.606 ha and is situated approximately 5.34km Southeast of Savmore colliery, approximately 3.20km Southwest of Rohrs Farm guesthouse, approximately 1.97km Northeast of Etshondo Primary School, approximately 2.68km Southeast of Annysspruit church. The proposed area can be accessed through gravel roads leading from Provincial Road R543. The proposed mining right activities will be conducted over a period of (30) years. Due to the very high sensitivity rating of the site on the screening report, a Terrestrial Biodiversity Specialist Assessment report has been conducted as part of the Scoping report for the proposed mining right application. The terrestrial ecological diversity information from the desktop study and site assessment collected as part of the investigations will be used to inform the Government's review during the application process. The terrestrial specialist assessment sought to assess the current ecological condition of the proposed area, identify potential sensitive areas, animal and plant species, and potential impacts of the proposed development. The objectives for the ecological assessment are as follows:

- Describe and map the vegetation types in the study area.
- Describe the biodiversity and ecological state of each vegetation unit.
- Establish and map sensitive vegetation areas showing the suitability for development and no-go areas.
- Identify plant and animal species of conservation concern (Red Data List). In the case of the fauna, this was done at a desktop level.
- Identify alien plant species, assess the invasive potential and recommend management procedures.
- Identify and assess the impacts of development on the site's natural vegetation and faunal species in terms of habitat loss, fragmentation and degradation of key ecosystems and, where feasible, provide mitigation measures to reduce these impacts.
- Provide a professional statement on whether the proposed project should be authorised.

A desktop assessment of the site was conducted and upon the completion of the desktop assessment a site visit was conducted on the 09th and 10th of March 2023 to determine the current environmental condition of the proposed area. The terrestrial biodiversity report was compiled based on the findings of the site assessment. During site assessment, Critical Biodiversity Areas such as channelled valley bottom wetlands and rivers were observed onsite. No Critical Biodiversity Areas

in terms of terrestrial biodiversity, floral and faunal species of conservation concern observed onsite. Some of the areas onsite are heavily modified due to plantation, grazing and residential activities. The heavily modified areas are disturbed to an extent that they cannot be reinstated to their natural state. In general, the type and extent of the proposed activities coupled with the current condition of the site to be affected are not expected to have detrimental effects on the overall ecological condition if the proposed mitigation measures are implemented accordingly.

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Definition of terms

Terms	Definition
Alien species	Taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.
Avifauna	The birds of a particular region, habitat, or geological period.
Biodiversity	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
Conservation concern	Species of conservation concern are those species that are important for South Africa's conservation decision making processes and include all plants that are Threatened (see Threatened), Extinct in the wild, Data deficient, Near threatened, Critically rare, Rare and Declining. These plants are nationally protected by the National Environmental Management: Biodiversity Act. Within the context of these reports, plants that are provincially protected are also discussed under this heading.
Conservation status	An indicator of the likelihood of that species remaining extant either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
Community	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
Critically Endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
Declining	A taxon is declining when it does not meet any of the five IUCN criteria and does not qualify for the categories Threatened or Near Threatened,

	but there are threatening processes causing a continuous decline in the population (Raimondo *et al.*, 2009).
Ecological Corridors	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible.
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
Endemic	Naturally only found in a particular and usually restricted geographic area or region.
Exotic species	Taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.
Fauna	The animals of a particular region, habitat, or geological period.
Flora	Flora is the plant life occurring in a particular region or time, generally the naturally occurring or indigenous—native plant life
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live.
Herpetofauna	The reptiles and amphibians of a particular region, habitat, or geological period.
Indigenous	Any species which occurs naturally in South Africa.
In situ	"In the place" In Situ conservation refers to on-site conservation of a plant species where it occurs. It is the process of protecting an endangered plant or animal species in its natural habitat. The plant(s) are not removed but conserved as they are. Removal and relocation could kill the plant and therefore in situ conservation is preferred/ enforced.
Invasive species	Naturalised alien species that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.
Mammals	A warm-blooded vertebrate animal of a class that is distinguished by the possession of hair or fur, females that secrete milk for the nourishment of the young, and (typically) the birth of live young.
Mitigation	The implementation of practical measures to reduce adverse impacts.
Near Threatened	A Taxon is Near Threatened when available evidence indicates that that it nearly meets any of the five IUCN criteria for Vulnerable and is therefore likely to qualify for a threatened category in the near future (Raimondo *et al.*, 2009).

Plant community	A collection of plant species within a designated geographical unit, which forms a relatively uniform patch, distinguishable from neighboring patches of different vegetation types. The components of each plant community are influenced by soil type, topography, climate and human disturbance. In many cases there are several soil types within a given plant community (Gobbat *et al.*, 2004).
Protected Plant	According to Provincial Nature Conservation Ordinances or Acts, no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority. These plants are protected by provincial legislation.
Red Data	A list of species, fauna and flora that require environmental protection - based on the IUCN definitions. Red data plants *now termed Plants of Conservation Concern.*
Reptile	A vertebrate animal of a class that includes snakes, lizards, crocodiles, turtles, and tortoises. They are distinguished by having a dry scaly skin and typically laying soft-shelled eggs on land.
Species diversity	A measure of the number and relative abundance of species.
Threatened	Threatened Species are those that are facing a high risk of extinction, indicated by placing in the categories Critically Endangered (CR), Endangered (E) and Vulnerable (VU) (Raimondo *et al.,* 2009)
Transformation	The removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development. Transformation mostly results in a serious and permanent loss of biodiversity and fragmentation of ecosystems, which in turn lead to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes.
Vegetation Unit	A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels and appear similar in vegetation structure and especially floristic composition".
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but meets any of the five IUCN criteria for Vulnerable and are therefore facing a high risk of extinction in the wild in the future.

Abbreviations

AI	Alien Invasive
AIS	Alien Invasive Species
BGIS	Biodiversity Geographic Information System
CARA	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
CBAs	Critical Biodiversity Areas
CR	Critically Endangered
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act, 1989 (Act No. 73 of 1989)
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMPr	Environmental Management Plan Report
EN	Endangered
EO	Environmental Officer
ESAs	Ecological support areas
FEPA	Freshwater Ecosystem Priority Area
IUCN	International Union for Conservation of Nature
NBA	National Biodiversity Assessment
LC	Least Concern
NEMA	National Environmental Management Act, 107 of 1998
NEMBA	National Environmental Management Biodiversity Act, 10 of 2004
NWA	National Water Act
PA	Protected Area
QDGS	Quarter Degree Grid Square
SABAP	South African Bird Atlas Project
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
SFSD	Strategic Framework for Sustainable Development
TOP (S)	Threatened or Protected (Species)
VMUS	Virtual Museum
WUL	Water Use License
VU	Vulnerable

1 INTRODUCTION AND BACKGROUND

1.1 Project area and description

Singo consulting (Pty) Ltd was appointed by Notre coal (Pty) Ltd to conduct a Terrestrial Biodiversity Assessment as part of the Environmental Impact Assessment (EIA) and Authorisation process in support of a Coal Mining Right on portion 1 of the Farm Annysspruit 140 HT and remaining extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief), Mpumalanga Province. The proposed project site covers an extent of 366.606 ha and is situated approximately 5.34km Southeast of Savmore colliery, approximately 3.20km Southwest of Rohrs Farm guesthouse, approximately 1.97km Northeast of Etshondo Primary School, approximately 2.68km Southeast of Annysspruit church. The proposed area can be accessed through gravel road leading from Provincial Road R543 (**see Figure 1 and Figure 2**). The proposed mining right activities will be conducted over a period of (30) years. The terrestrial ecological diversity information from the desktop study and site assessment that was collected as part of the investigations will be used to inform the Government's review during the application process of the proposed development.

1.2 Purpose of the report

Singo Consulting (Pty) Ltd (Singo Consulting) has been also appointed as an independent Environmental Assessment Practitioner (EAP) to undertake an environmental impact assessment (EIA) for the proposed Mining Right as per the amendments of the Environmental Impact Assessment Regulations. 2014 (GNR 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). This report was compiled to fulfil the requirement for a Terrestrial Biodiversity Assessment as per the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5) (a) and (h) and 44 of NEMA (GNR 320), as gazetted on 20 March 2020. This report is undertaken as supporting information as part of a greater environmental application process and is compliant in terms of the requirements of the above-mentioned regulations in terms of Terrestrial Biodiversity. Preceding to the commencement of a specialist assessment, the current condition/state of the land and the potential environmental sensitivity of the site under consideration as identified by the screening tool, must be confirmed by conducting a site sensitivity verification. The results of the screening tool, together with the site sensitivity verification, eventually determine the minimum report content requirements and recommends mitigation measures.

In terms of the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of sections 24(5) (a) and (h) and 44 of NEMA, gazetted on 30 October 2020, relating to requirements relating specifically to the Terrestrial Plant and Animal (species) themes, this report includes these requirements.

The following is deduced from the National Web-based Environmental Screening Tool (**see Appendix 1**):

- Terrestrial Biodiversity Theme is "Very High" for the proposed project due to traversing ESA: LC, PAES, SWSA, and VE (Ecological support area: local corridor, Protected Areas Expansion Strategy, Strategic Water Source Areas, and Vulnerable Ecosystem).
- Plant Species Theme ranges from Low to Medium for the project (Mostly Medium) with several sensitive species predicted to be present; and
- Animal Species sensitivity ranges from Medium to High (Mostly Medium) due to several sensitive species predicted to be present.

In cases where the National Environmental Screening Tool identifies a site as having 'Very High' sensitivity, there are now only two options:

- Conduct a full terrestrial biodiversity impact assessment, or
- If the EAP or the specialist thinks, based on a site inspection, that the site is in fact not 'Very High' but 'Low' sensitivity, then prepare a 'Terrestrial Biodiversity Compliance Statement' that includes a baseline profile description of biodiversity and ecosystems of the project area.

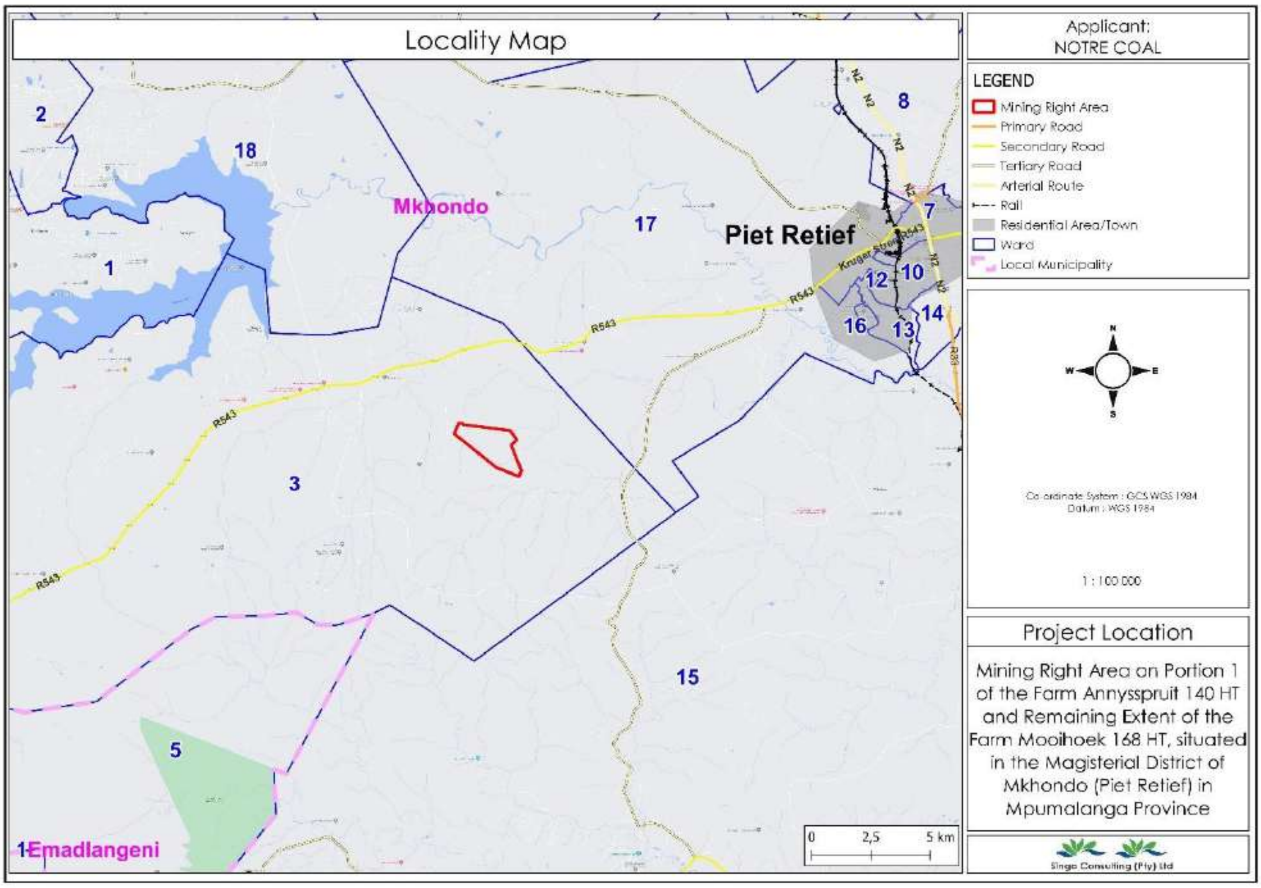


Figure 1: Locality map of the proposed area (*Singo Consulting (Pty) Ltd, 2023*).

Figure 2: Google Earth Map of the proposed area.

1.3 Alternatives Considered

Alternatives to be considered to ensure minimal impacts to the fauna and flora include:

- Reduce surface infrastructure and footprints on areas with a high density of protected flora if identified during preparation of the site.
- Avoid construction and movement of heavy machinery in sensitive vegetation areas such as riparian areas (rivers and wetlands).
- Reduce the amount of water and land for operations and associated infrastructure.
- Implement alien invasive plant management to ensure concurrent rehabilitation is followed.
- Reduce waste materials and waste outputs; and
- Replenish removed indigenous identified vegetation after decommissioning.

1.4 Term of reference

This report was compiled to fulfil the requirement for a Terrestrial Biodiversity Assessment as per the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5) (a) and (h) and 44 of NEMA (GNR 320), as gazetted on 20 March 2020. The findings and recommendations in this report will inform and guide the EAP and regulatory authorities during the Environmental Impact Reporting and adjudicating process for the proposed development on the Farm Annysspruit 140 HT and remaining extent of the Farm Mooihoek 168 HT.

The terms of reference for this investigation are limited to an ecological assessment that aims to:

- Describe and map the vegetation types in the study area.
- Describe the biodiversity and ecological state of each vegetation unit.
- Establish and map sensitive vegetation areas showing the suitability for development and no-go areas.
- Identify plant and animal species of conservation concern (Red Data List). In the case of the fauna, this was done at a desktop level.
- Identify alien plant species, assess the invasive potential and recommend management procedures.
- Identify and assess the impacts of development on the site's natural vegetation and faunal species in terms of habitat loss, fragmentation and degradation of key ecosystems and, where feasible, provide mitigation measures to reduce these impacts.
- Provide a professional statement on whether the proposed project should be authorised.

The following tasks were undertaken by Singo Consulting (Pty) Ltd to achieve the assessment objectives:

- Visual inspection of the study area was done before surveys were conducted.
- During the process different homogenous vegetation units were identified and subsequently surveyed on foot to determine the floristic composition of each unit.
- A plotless sampling method was used to record data.
- Walk transects to identify faunal species.
- Species identification was done following reputable checklists and field guides.
- Photographs taken of specimens for identification purposes.

1.4 Assumptions, Limitations, Uncertainties and Gaps analysis.

- The findings, results, observations, conclusions and recommendations provided in this report are based on the author's best scientific and professional knowledge, and available information regarding the potential impacts of mining right application on the vegetation composition.

- The assessment of impacts was based on the current environmental condition of the proposed project area.

- Singo Consulting (Pty) Ltd relied on Notre coal (Pty) Ltd, as the Applicant, to supply correct information on the site locality and extent, as well as project details which were assumed to be correct.

- It is assumed that the information contained in existing databases, reports and publications is correct.

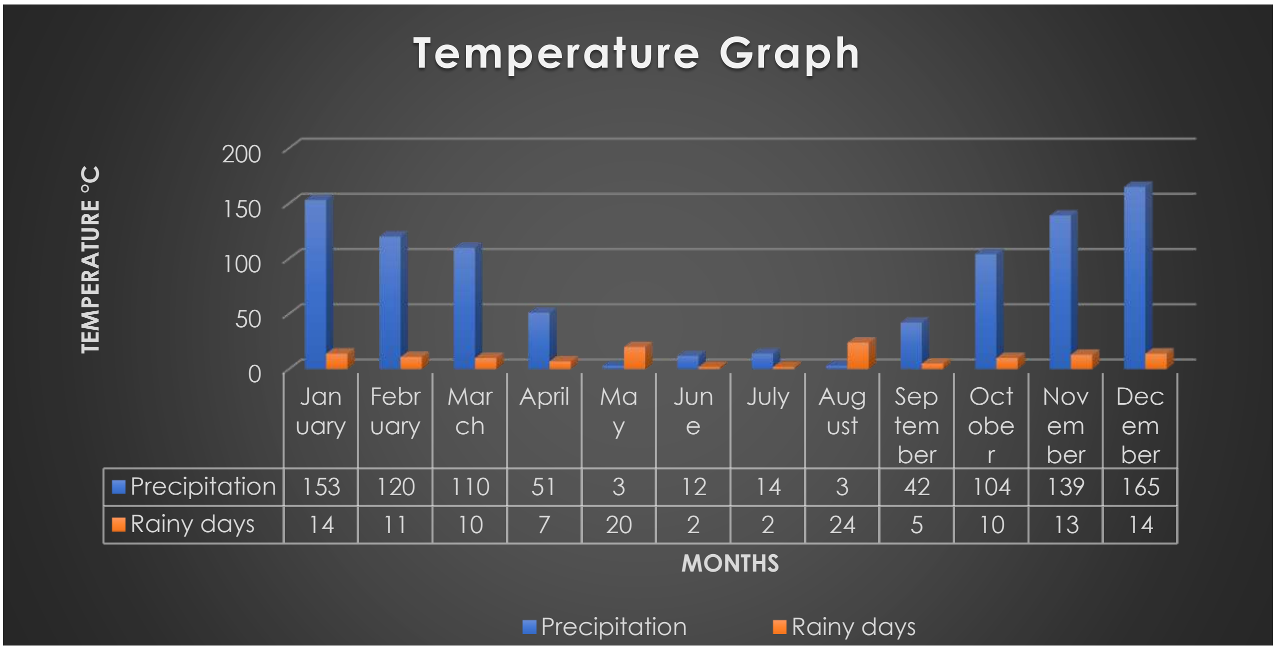
- Singo Consulting (Pty) Ltd reserves the right to amend this report, recommendations and/or conclusions at any stageshould any additional or otherwise significant information come to light.

2 GENERAL DESCRIPTION OF THE RECEIVING ENVIRONMENT

2.1 Climatic conditions

Climate is the state of the atmosphere over long time periods, 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 since 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 here is mild, and generally warm and temperate. According to Köppen and Geiger, this climate is classified as Cwb. In Mkhondo, the average annual temperature is 16.1 °C. About 954 mm of precipitation falls annually.

Precipitation is the lowest in June, with an average of 12 mm. The greatest amount of precipitation occurs in December, with an average of 165 mm. At an average temperature of 19.5 °C, February is the hottest month of the year. The lowest average temperatures in the year occur in July, when it is around 11.0 °C. Between the driest and wettest months, the difference in precipitation is 153 mm (**see Figure 3**). The variation in temperatures throughout the year is 8.4 °C. According to the map produced by Singo Consulting (Pty) Ltd, Database Manager, the mean minimum annual temperature which ranges from 01˚C to 2˚C and 2.1˚C to 4 ˚C (**see Figure 4**). According to the map produced by Singo Consulting (Pty) Ltd, Database Manager, the area receives summer rainfall with a mean annual precipitation of about 801-1000 mm (**see Figure 5**).



	January	February	March	April	May	June	July	August	September	October	November	December
Precipitation	153	120	110	51	3	12	14	3	42	104	139	165
Rainy days	14	11	10	7	20	2	2	24	5	10	13	14

Figure 3: Monthly average temperature of the area.

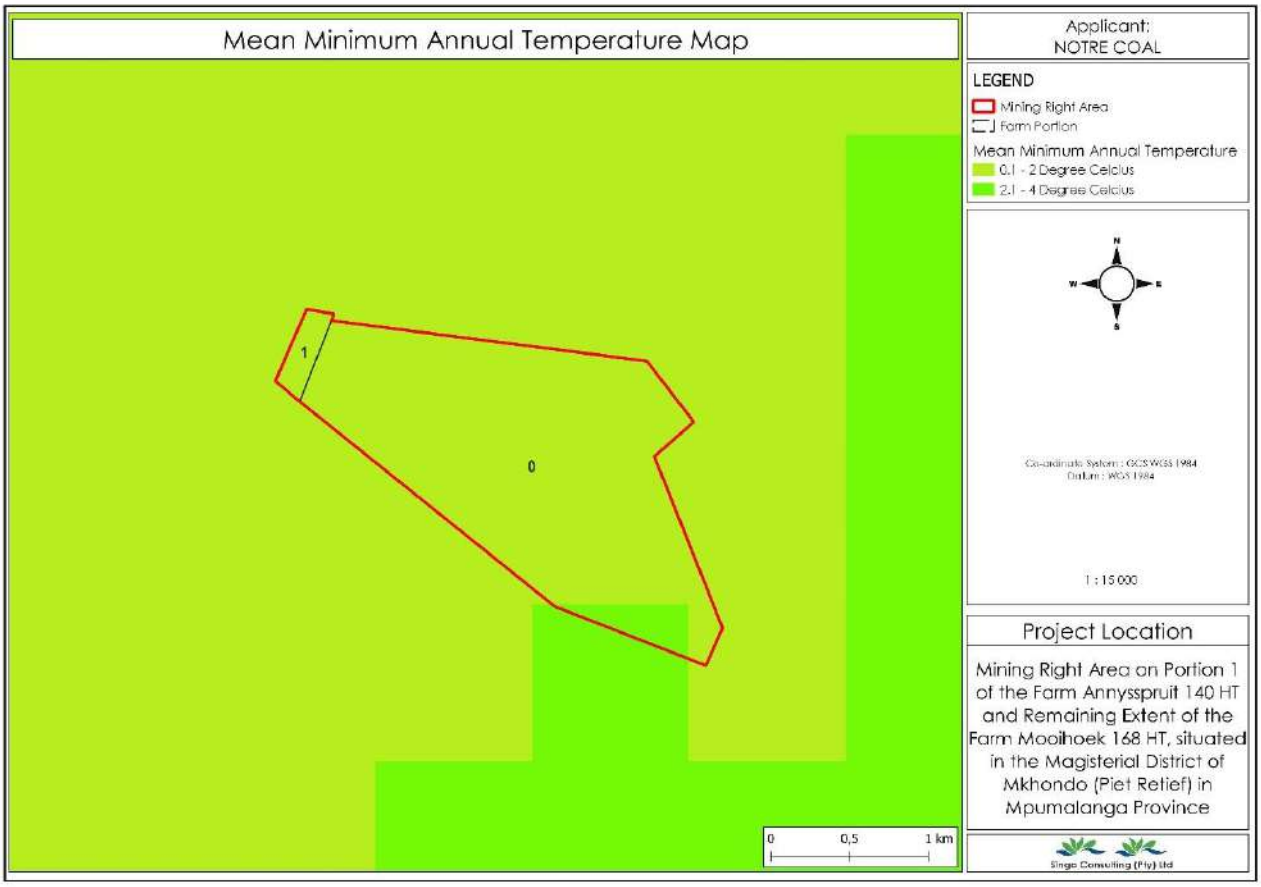


Figure 4: Mean minimum annual temperature map (*Singo Consulting (Pty) Ltd, 2023)*.

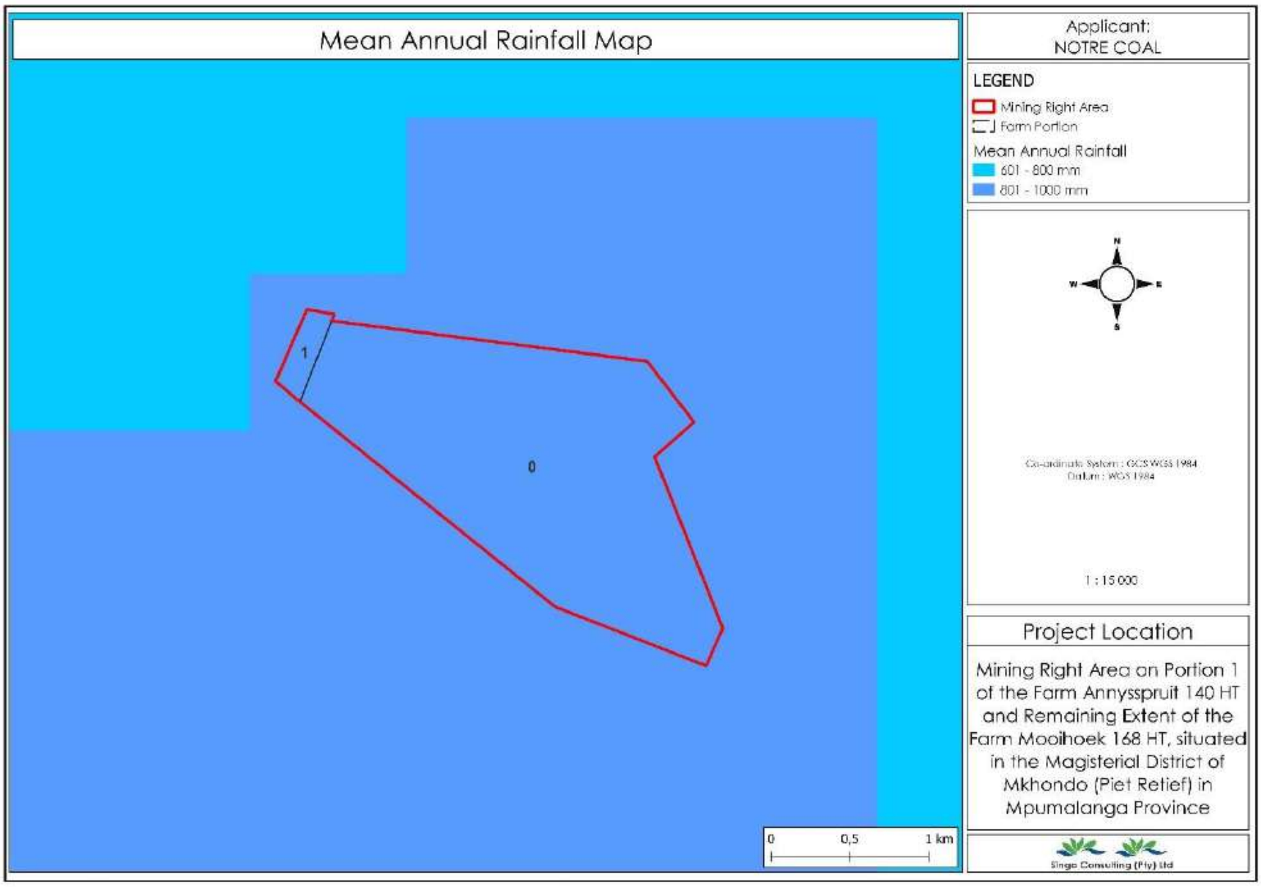


Figure 5: Mean annual rainfall of the area (*Singo consulting (Pty) Ltd, 2023*).

2.2 Land use and land cover

The land use and land cover of the proposed project site is dominated by natural vegetation. The land use and land cover of the proposed area is characterised by waterbodies, wetlands, cultivated land, plantation, bare land, built-up area and natural vegetation (**see Figure 6**). During ground truthing the proposed area was covered with natural vegetation, plantation, built-up area, wetlands and waterbodies.

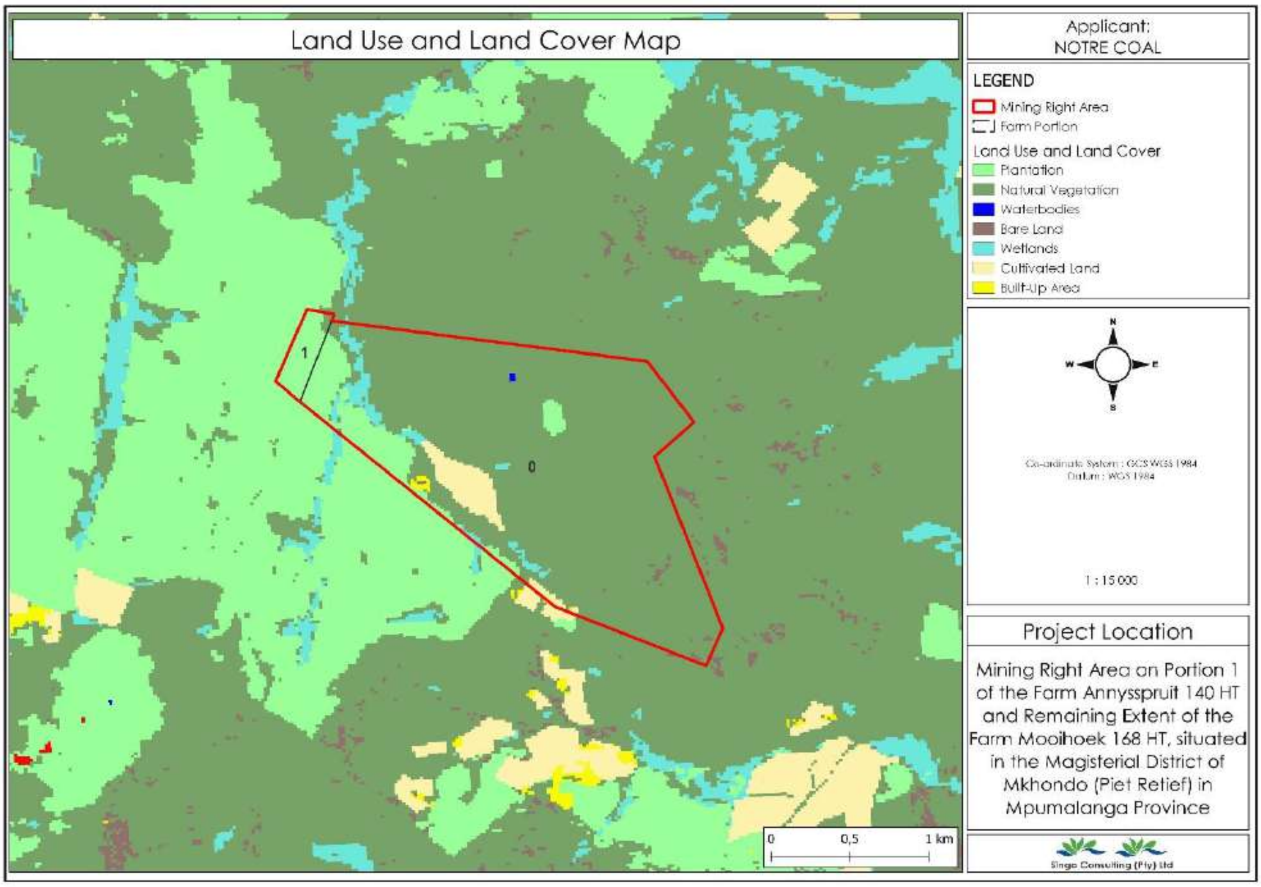


Figure 6: Land use and land cover map (*Singo Consulting (Pty) Ltd), 2023*).

2.3 Biome type and bioregion

Biomes are broad ecological units that represent major life zones extending over large natural areas. Biomes are further divided into bioregions, which are spatial terrestrial units possessing similar biotic and physical features, and processes at a regional scale (Rutherford, 1997). The proposed project area falls in the forest biome (**see Figure 7**). Forest biomes are characterised by a closed canopy and several vegetation strata, usually a canopy of tall trees, a mid-stratum of small trees and shrubs, and a ground layer of herbaceous plants and ferns with grasses usually absent. Forests rarely burn, mainly due to the high humidity - under extremely hot and dry (berg wind) conditions fires may occur and destroy the forest structure. Forests tend to occur in patches, few of which cover areas greater than 1 km 2, with areas greater than this only common along the Garden Route and Lowveld Escarpment. Even added together, forests cover less than 0.25% of southern Africa's surface area, making this the smallest biome on the subcontinent (Sanbi).

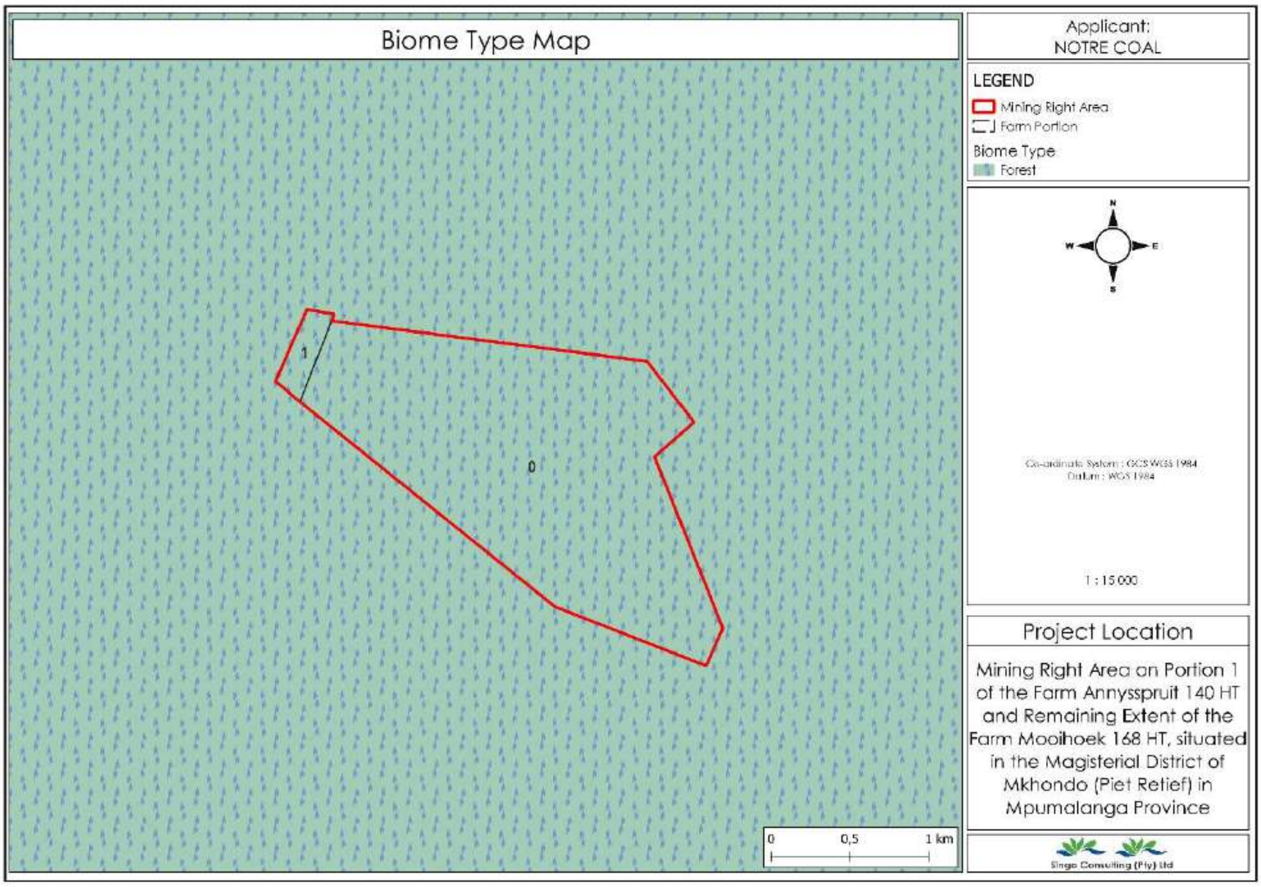


Figure 7: Biome type map of the area (Singo consulting (Pty) Ltd, 2023).

South African Vegetation Map

(Reference to the following section has been made from SANBI BGIS)

According to South African Vegetation Map, the proposed area falls under vegetation Gm 16 KaNgwane Montane Grassland Group. The proposed project area is characterised by North-eastern Mountain Grassland Vegetation Type (Low & Rebelo 1996). The vegetation type map produced by Singo Consulting (Pty) Ltd, Database Manger confirms that the proposed project area falls in the North-eastern Mountain Grassland vegetation (**see Figure 8**).

Distribution Mpumalanga and Swaziland, and marginally into northern KwaZulu-Natal: Occurs along the gentle slopes of the Escarpment, from the Phongolo Valley in the south, northwards to the Usutu Valley and to the uppermost Lomati Valley near Carolina, including the western grassland areas of Swaziland. Altitude 880–1 740 m.

Vegetation & Landscape Features Largely comprised of undulating hills and plains that occur on the eastern edge of the Escarpment. This unit is transitional between the Highveld and Escarpment and contains elements of both. The vegetation structure is comprised of a short closed grassland layer with many forbs, and a few scattered shrubs on the rocky outcrops.

Geology & Soils Mostly on granite of the Mpuluzi Granite (Randian Erathem), Archaean gneiss giving rise to melanic soils, with intrusions of diabase. Land types Ac, Fa and Ba.

Climate Early summer rainfall, with MAP 910 mm, ranging between 800 and 1 250 mm. This unit has a wide range of frost frequency (3–20 days per year), with most frost days occurring in the western regions.

Important Taxa Graminoids: *Alloteropsis semialata* subsp. *eckloniana* (d), *Brachiaria serrata* (d), *Cyperus obtusiflorus* (d), *Diheteropogon amplectens* (d), *D. filifolius* (d), *Eragrostis racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Loudetia simplex* (d), *Monocymbium ceresiiforme* (d), *Rendlia altera* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Andropogon schirensis*, *Bewsia biflora*, *Bulbostylis burchellii*, *Ctenium concinnum*, *Cymbopogon caesius*, *Cyperus obtusiflorus* var. *obtusiflorus*, *Digitaria diagonalis*, *D. tricholaenoides*, *Eragrostis chloromelas*, *E. plana*, *Eulalia villosa*, *Panicum ecklonii*, *P. natalense*, *Paspalum scrobiculatum*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *S. sphacelata*. Herbs: *Ipomoea oblongata* (d), *Acalypha peduncularis*, *A. villicaulis*, *Alepidea setifera*, *Argyrolobium speciosum*, *Aster harveyanus*, *Berkheya setifera*, *Corchorus confusus*, *Cyathula cylindrica*, *Dicoma zeyheri*, *Dimorphotheca jucunda*, *Eriosema cordatum*, *Euryops laxus*, *E. transvaalensis* subsp. *setilobus*, *Helichrysum adenocarpum*, *H. cephaloideum*, *H. nudifolium* var. *nudifolium*, *Mohria caffrorum*, *Pentanisia angustifolia*, *P. prunelloides* subsp. *latifolia*, *Ruellia patula*, *Schistostephium crataegifolium*, *Senecio panduriformis*, *Sonchus wilmsii*, *Thunbergia atriplicifolia*, *Vernonia natalensis*, *V. oligocephala*. Geophytic Herbs: *Agapanthus inapertus* subsp. *inapertus*, *Boophone disticha*, *Cheilanthes deltoidea*, *C. hirta*, *Eucomis montana*, *Gladiolus ecklonii*, *Habenaria dregeana*, *Hypoxis iridifolia*, *H. rigidula* var. *pilosissima*, *Moraea pubiflora*, *Pteridium aquilinum*, *Watsonia latifolia*, *Zantedeschia albomaculata* subsp. *macrocarpa*. Succulent Herbs: *Aloe integra*, *A. kniphofioides*. Small Trees: *Acacia caffra*, *Faurea rochetiana*, *Pachystigma macrocalyx*. Tree Fern: *Cyathea dregei*. Tall Shrubs: *Calpurnia glabrata*, *Cephalanthus natalensis*, *Diospyros lycioides* subsp. *guerkei*, *Vernonia tigna*. Low Shrubs: *Heteromorpha involucrata* (d), *Anthospermum rigidum* subsp. *rigidum*, *Asparagus cooperi*, *A. virgatus*, *Athrixia phylicoides*, *Diospyros scabrida* var. *cordata*, *Gymnosporia heterophylla*, *Indigofera comosa*, *Myrsine africana*, *Rhus discolor*, *Schistostephium rotundifolium*.

Biogeographically Important Taxa (^{BC}Barberton endemic, ^{N}Northern sourveld endemic) Herbs: *Hemizygia modesta*^{BC}, *H. thorncroftii*^{BC}, *Selago stewartii*^{BC}. Geophytic Herb: *Watsonia watsonioides*^{N}. Succulent Herb: *Kleinia galpinii*^{N}. Low Shrub: *Hemizygia albiflora*^{N}.

Endemic Taxa Herbs: *Lotononis difformis*, *L. spicata*, *Streptocarpus occultis*. Low Shrub: *Syncolostemon comptonii*.

Conservation Vulnerable. The conservation target 27% with only 0.4% protected within any formally proclaimed nature reserves (Malalotja, Nooitgedacht Dam and Songimvelo). A number of private conservation areas protect small patches of this unit. It is well suited for afforestation and 30% has

already been converted to plantations of alien trees. A further 6% is under cultivation. Erosion potential very low (55%) and low (7%).

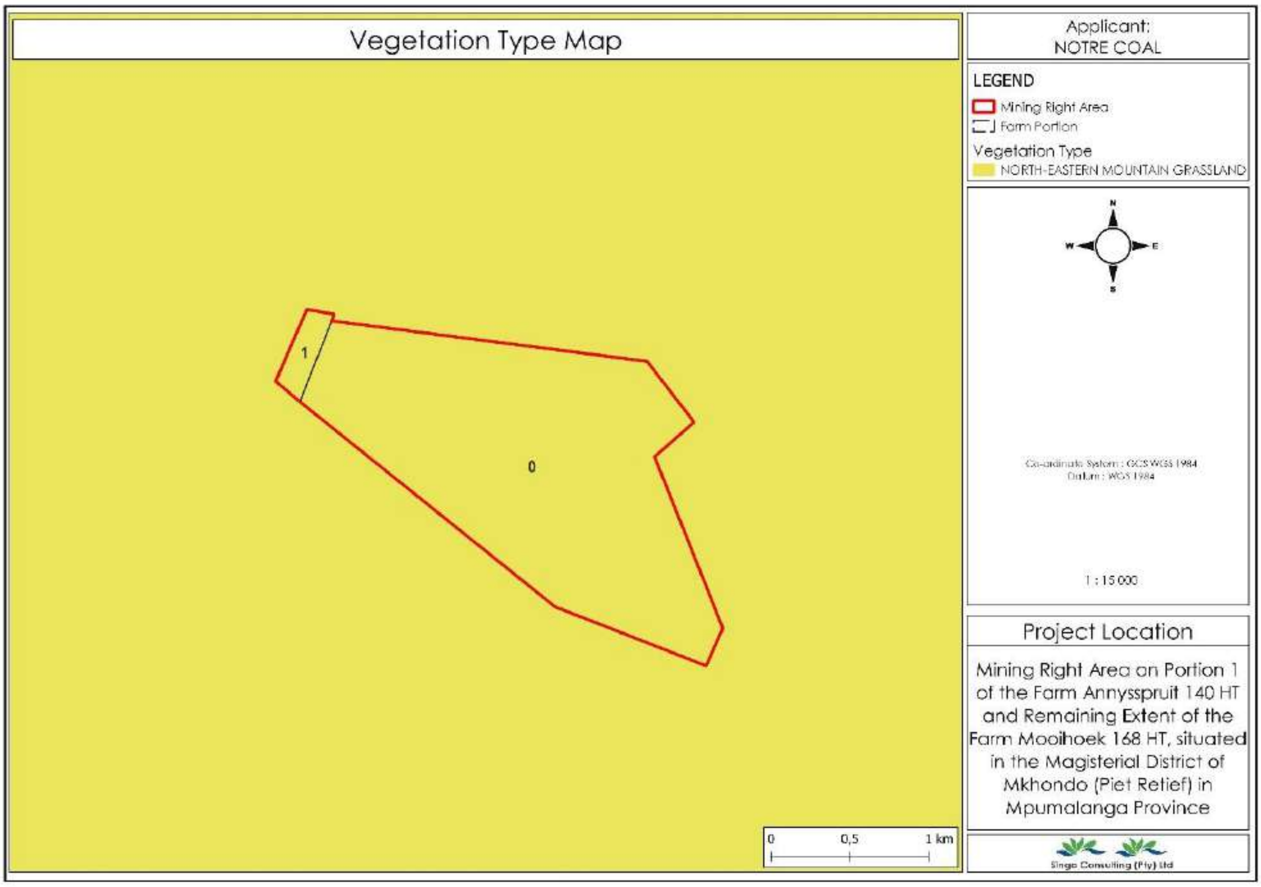


Figure 8: Vegetation type map of the area (*Singo consulting (Pty) Ltd, 2023*).

2.4 Site sensitivity Assessment

Biodiversity is a comprehensive umbrella term for the extent of nature's variety in the natural system; both in number and frequency. It is often understood in terms of the wide variety of plants, animals and microorganisms, the genes they contain and the ecosystem they form. The biodiversity we see today is the result of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans. It forms the web of life of which we are an integral part and upon which we so fully depend. About 2.1 million species have been identified, mostly small creatures such as insects. Scientists believe that there are about 13 million species exist on earth (Rawat and Agarwal 2015).

The DFFE screening tool generated for the proposed mining right area shows that the proposed project area is very high sensitivity for terrestrial biodiversity due to traversing PAES and VU (Ecological support area: local corridor, Protected Areas Expansion Strategy, Strategic Water Source Areas, and Vulnerable Ecosystem). According to the screening tool the area is characterised of medium sensitivity plants and animal species. The area has the following medium plant sensitivity species: *Sensitive species 1252, Melanospermum italae, Sensitive species 1003, Dracosciadium italae, Lotononis amajubica, Sensitive species 691, Sensitive species 998, Sensitive species 1219, Sensitive species 1152, Sensitive species 313 and Gerbera aurantiaca*. The area has the following medium to high sensitivity animal's species *Aves-Balearica regulorum, Aves-Polemaetus bellicosus, Aves-Stephanoaetus coronatus, Aves-Eupodotis senegalensis, Aves-Sagittarius serpentarius, Aves-Geronticus calvus, Mammalia-Chrysospalax villosus, Mammalia-Ourebia ourebi ourebi, Invertebrate-Clonia lalandei, Invertebrate-Clonia lalandei* and *Invertebrate-Doratogonus praealtus* **(see Appendix 1).** However, site assessment revealed that the medium plants and medium to high animal sensitivity is not accurate due to the extent of the habitat disturbance, which include, alien invasion, livestock grazing and plantation activities.

According to the MBSP terrestrial assessment map of 2019, the proposed project area falls in the Other Natural Areas, ESA of Local Corridor and other areas are heavily modified. There are no Critical Biodiversity Areas onsite (**see Figure 9**). The site assessment revealed that the proposed area is heavily modified due to plantation, residential and grazing activities. According to the MBSP freshwater assessment of 2019, the proposed project area falls in the ESA of Strategic Water Source Area (**see Figure 10**). However, the site assessment revealed that there are channeled valley bottom wetlands and rivers on site.

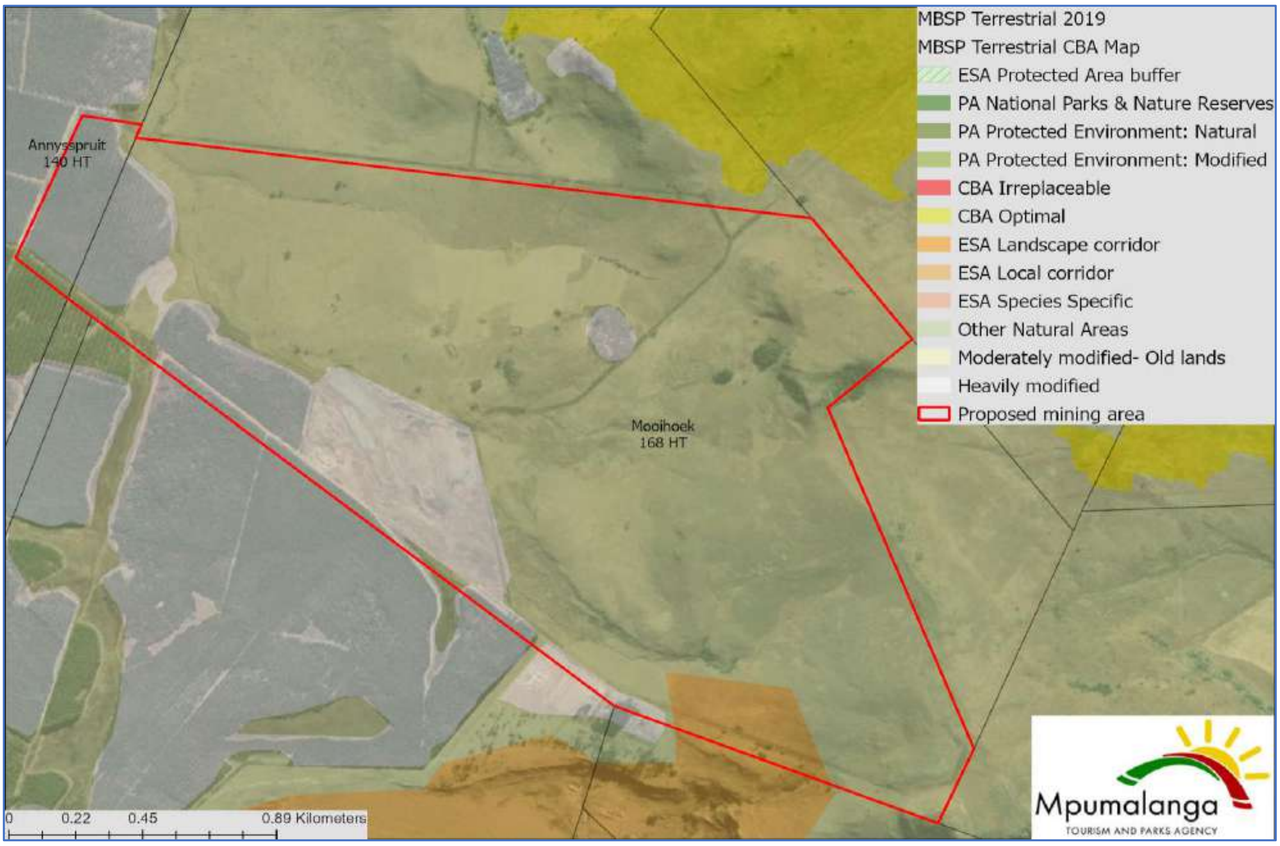


Figure 9: MBSP Terrestrial biodiversity (MTPA, 2019).

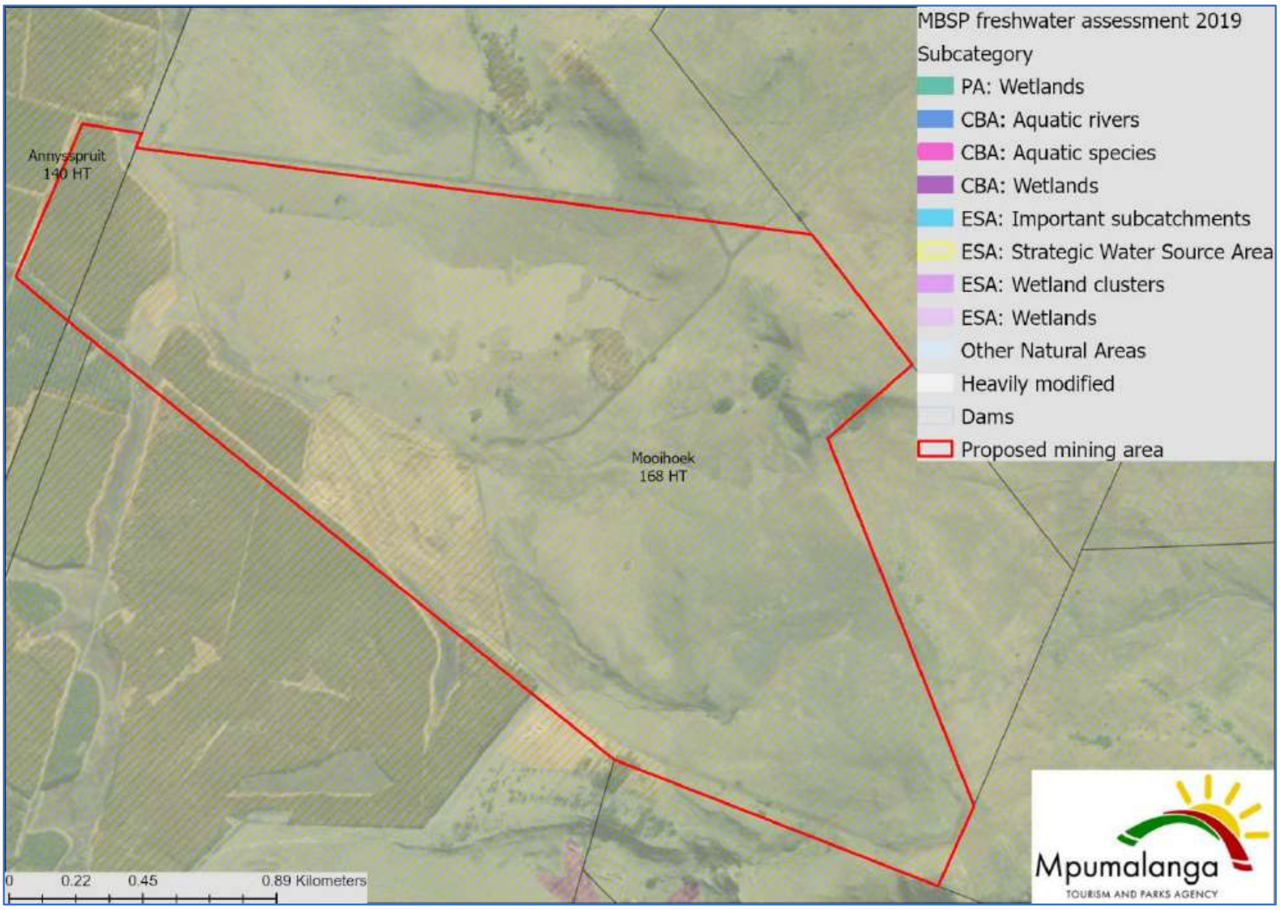


Figure 10: MBSP Freshwater biodiversity map (MTPA, 2019).

2.5 Terrestrial threatened ecosystem

The South African National Biodiversity Institute (SANBI), in conjunction with the Department of Environmental Affairs (DEA), released a draft report in 2009 entitled "Threatened Ecosystems in South Africa: Descriptions and Maps", to provide background information on the List of Threatened Ecosystems (SANBI, 2009). The purpose of this report was to present a detailed description of each of South Africa's ecosystems and to determine their status using a credible and practical set of criteria. The following criteria were used in determining the status of threatened ecosystems:

- Irreversible loss of natural habitat
- Ecosystem degradation and loss of integrity
- Limited extent and imminent threat
- Threatened plant species associations
- Threatened animal species associations
- Priority areas for meeting explicit biodiversity targets as defined in a systematic conservation plan

In terms of section 52 (1) (a), of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA), a new national list of ecosystems that are threatened and in need of protection was gazette on 9 December 2012 (Government Notice 1002 (Driver et. al., 2004). The list classified all threatened or protected ecosystems in South Africa in terms of four categories, namely Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or protected. The purpose of categorising these ecosystems is to prioritise conservation areas to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems. It is estimated that threatened ecosystems make up 9.5% of South Africa, with CR and EN ecosystems accounting for 2.7%, and VU ecosystems 6.8% of the land area. It is therefore vital that Threatened Terrestrial Ecosystems inform proactive and reactive conservation and planning tools, like Biodiversity Sector Plans, municipal Strategic Environmental Assessments (SEAs) and Environmental Management Frameworks (EMFs), EIAs and other environmental applications (Mucina et al., 2006).

3 LEGISLATIVE REQUIREMENTS

The importance of sustainable development and the protection of environmental resources have globally become a driving factor in the construction of new legislation governing industrial practices and their impact on the environment. South Africa has signed and ratified several global treaties, protocols and conventions, agreeing to implement the policies, which endorse sustainable development and promote a positive environmental legacy for future generations. A considerable international convention to which South Africa has in agreement within signatory, namely the Convention on Biological Diversity (CBD). The CBD is notably the key international convention for sustainable development. The CBD has three main objectives which lead and encourage a sustainable future. These are:

- The conservation of biological diversity.
- The sustainable use of its components; and
- The fair and equitable sharing of the benefits from the use of genetic resources.

The convention covers all possible domains that are directly or indirectly related to biodiversity and its role in development, ranging from science, politics and education to agriculture, business and culture. South African environmental law is primarily regulated by the environmental right contained in section 24 of the Constitution9 and the National Environmental Management Act 107 of 1998 (NEMA), which is the framework piece of environmental legislation and provides a basis for a comprehensive set of laws regulating various aspects of the environment. The Terrestrial Biodiversity Assessment and Impact Assessment was prepared in terms of the following but not limited to, regulations, regulatory procedures and guidelines:

Table 1: Legislative requirements.

Legislation/policy	
The Convention of Biological Diversity (Rio de Janeiro, 1992).	The purpose of the Convention on Biological Diversity is to conserve the variability among living organisms, at all levels (including diversity between species, within species and of ecosystems). Primary objectives include (i) conserving biological diversity, (ii) using biological diversity in a sustainable manner and (iii) sharing the benefits of biological diversity fairly and equitably.
South African Constitution 108 of 1996	The Constitution is the supreme law of the land and includes the bill of rights which is the cornerstone of democracy in South Africa and enshrines the rights of people in the country. It includes the right to an environment which is not harmful to human health or well-being and to have the

Legislation/policy	
	environment protected for the benefit of present and future generations through reasonable legislative and other measures.
Strategic Framework for Sustainable Development in South Africa (SFSD)	The development of a broad framework for sustainable development was initiated to provide an overarching and guiding National Sustainable Development Strategy. The draft SFSD in South Africa (September 2006) is a goal orientated policy framework aimed at meeting the Millennium Development Goals. Biodiversity has been identified as one of the key crosscutting trends in the SFSD. The lack of sustainable practices in managing natural resources, climate change effects, loss of habitat and poor land management practices were raised as the main threats to biodiversity.
NEMA	This is a fundamentally important piece of legislation and effectively promotes sustainable development and entrenches principles such as the 'precautionary approach', 'polluter pays' principle, and requires responsibility for impacts to be taken throughout the life cycle of a project NEMA provides the legislative backing (Including Impact Assessment Regulations) for regulating development and ensuring that a risk-averse and cautious approach is taken when making decisions about activities.
EIA regulations	New regulations have been promulgated in terms of Chapter 5 of NEMA and were published on 7 April 2017 in Government Notice No. R. 326. Development and land use activities which require Environmental Authorisation in terms of the NEMA EIA Regulations, 2017, are in Listing Notice 3 (GG No. R.324, LN3) identified via geographic areas with the intention being that activities only require Environmental Authorisation when located within designated sensitive areas. These sensitive/geographic areas were identified and published for each of the nine provinces.
National Environmental Management: Biodiversity Act No 10 of 2004 (NEMBA)	The Biodiversity Act provides listing threatened or protected ecosystems, in one of four categories: CR, EN, VU or Protected (Government Gazette, 2011). The main purpose of listing threatened ecosystems is to reduce the rate of ecosystem and species extinction and includes the prevention of further degradation and loss of structure, function, and composition of threatened ecosystems.
Conservation of Agricultural	The intention of this Act is to control the over-utilisation of South Africa's natural agricultural resources, and to promote the conservation of soil and

Legislation/policy	
Resources Act 43 of 1967 (CARA)	water resources and natural vegetation. The CARA has categorised a large number of invasive plants together with associated obligations of the landowner, including the requirement to remove categorised invasive plants and taking measures to prevent further spread of alien plants.
National Forest Act 84 of 1998	The protection, sustainable management and use of forests and trees within South Africa are provided for under the National Forests Act (Act 84 of 1998).
National Environmental Management: Protected Areas Act 57 of 2003	This Act provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. It seeks to provide for the sustainable use of protected areas and to promote participation of local communities in the management of protected areas.
The RAMSAR Convention	Emphasis is placed on protecting wetlands and implementing initiatives to maintain or improve the state of wetland resources.
Convention on Biological Diversity	Countries are to rehabilitate or restore degraded ecosystem through the formulation of appropriate strategies and plans.
United Nations Convention to Combat Desertification	South Africa has responded to the UN Convention to Combat Desertification by developing a National Action Plan. The aim of the NAP is to implement at current and future policies that affect natural resource management and rural development, and establish partnerships between government departments, overseas development agencies, the private sector and NGOs
Mpumalanga Nature Conservation Act (10 of 1998)	To consolidate and amend the laws relating to nature conservation in the province and to provide for matters connected therewith.

4 METHODOLOGY AND SITE ASSESSMENT

The information provided in this terrestrial biodiversity report is based mainly on the observations that were made during the field survey and a review of the available reports that contain known and predicted ecology and wetland information on the study area. A wide range of spatial data sets were interrogated, and relevant information was extracted for the study area. A basic ecological sensitivity analysis was performed to identify areas of special interest or concern. The various approaches used, and aspects considered are detailed in this section.

4.1 Desktop study

A desktop survey was conducted using maps and reviewing other reports and photography to assemble background information on the different features of and vegetation present in the proposed project area. The site was assessed between 09 March 2023 and 10 March 2023 to record the features present.

4.2 Vegetation

A desktop study of the habitats of the red and orange-listed species was conducted prior to site assessment. The vegetation types identified by Mucina & Rutherford (2012) were used as reference, but where necessary, vegetation communities were named according to the recommendations for a standardised South African syntaxonomic nomenclature system (Brown et al., 2013). By combining the available literature, stratification of vegetation communities was possible.

4.3 Fauna survey

Most mammals and reptiles are very secretive, nocturnal, hibernate (reptiles), migrate (birds) or prefer specific habitats, so sampling and identification was proved difficult.

4.4 Mammals

Mammals are nocturnal, secretive, or seasonal. Their specific habitats, walking trails, faeces, spoor, fur, bones, and carcasses were assessed to document mammal species associated with the proposed site. The site assessment was conducted using direct and indirect methods, including mammal sightings, and identification of burrows and holes, which were verified using the available literature (Skinner and Chimimba, 2005).

4.5 Ecological sensitivity analysis

4.5.1 Critical Biodiversity Areas

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical in retaining biodiversity and supporting continued ecosystem functioning and services (SANBI, 2007). These form the key output of a systematic conservation assessment, and the biodiversity sector inputs into multi-sectoral planning and decision-making tools.

The primary purpose of CBAs is to inform land-use planning and land-use guidelines attached to its aim to promote sustainable development by avoiding loss or degradation of important natural habitat and landscapes in these areas. CBAs can be used to inform protected area expansion and development plans. The use of CBAs here follows the definitions laid out in the guideline for publishing bioregional plans (Anon, 2008):

1. “Critical biodiversity areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses”.

2. “Ecological support areas (ESA’s) are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.” The guideline for bioregional plans defines three basic CBA categories based on three high-level land management objectives.

Table 2: A framework for linking spatial planning categories (CBAs) to land-use planning and decision-making guidelines based on a set of high-level land biodiversity management objectives.

CBA category	**Land management objective**
PA & CBA 1	Natural landscapes: 1. Ecosystems and species fully intact and undisturbed.

	2. Areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost, targets will not be met. 3. Landscapes that are at or past their limits of acceptable change.
CBA 2	Near-natural landscapes: 1. Ecosystems and species largely intact and undisturbed. 2. Areas with intermediate irreplaceability or some flexibility in terms of area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising target achievement. 3. Landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESA)	Functional landscapes: 1. Ecosystems moderately to significantly disturbed but still able to maintain basic functionality. 2. Individual species or other biodiversity indicators may be severely disturbed or reduced. 3. Areas with low irreplaceability with respect to biodiversity pattern targets only.
Other Natural Areas (ONA) and transformed	Production landscapes: manage land to optimise sustainable utilisation of natural resources.

Following the site visit, an ecological sensitivity analysis of the site was conducted based on the Mpumalanga Biodiversity Sector Plan (MBSP) which shows Critical Biodiversity Areas (CBAs) and Ecological Support Areas. The ecological sensitivity of the different units identified in the sensitive analysis procedure was rated according to the following scales:

Table 3: sensitive analysis rating scales.

Low	Units with low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. This category is reserved specifically for areas where the natural vegetation has already been transformed, usually for intensive agricultural purposes like cropping. Most types of development can proceed in these areas with little ecological impact.

Medium	Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact like erosion low. Development in these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
High	Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity, or important ecological role of the area. Development in these areas is highly undesirable and should proceed with caution as it may not be possible to mitigate all impacts appropriately.
Very high	Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided at all costs.

4.6 Methodology adapted in assessing impacts.

Impacts significance will be assessed using the following descriptors:

Table 4: Impact assessment table.

Nature of the impact		
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		
Minor	2	Negligible effects on biophysical or social functions/processes. Includes areas/environmental aspects that 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		
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		
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 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		
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 ecological impact significance is 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 of each impact is rated as High (SP≥60), Medium (SP = 31-60) and Low (SP<30) (see Table 5).

Table 5: Definition of significance rating.

Significance of predicted NEGATIVE impacts		
Low	0-30	Where the impact will have a relatively small effect on the environment and will require minimum/no mitigation and will have a limited influence on the decision
Medium	31-60	Where the impact can influence the environment and should be mitigated and could influence the decision unless it is mitigated.
High	61-100	Where the impact will influence 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.

5 ASSESSMENT RESULTS

5.1 Floral species

a) Floral species recorded onsite.

The proposed project area falls in the northeastern mountain grassland which was confirmed during site assessment. The area is covered with mixture of grass species, plantation and floral species were observed scattered onsite. The floral species observed in this area are of least concern, this is due to heavily modified of some areas by plantation, residential and grazing activities. Due to the complete transformation of some areas of the proposed site, the area has medium ecological function and medium conservation importance. **Figure 11** depicts some of the floral species observed onsite, namely, **(A)** *Diospyros Lycioides Desf*, **(B)** *Hyparrhenia hirta (L) Stapf*, **(C)** *Cyperus esculentus L. var. esculentus*, **(D)** *Imperata cylindrica*.

Figure 11: Some of the floral species observed onsite (site visit, 2023).

Table 6: Plant species recorded onsite.

Scientific names	Common names	Threat Status (SANBI, 2017)	SA Endemic
Hyparrhenia hirta (L) Stapf	South African bluestem	Least concern	Not Endemic
Cynodon dactylon (L) pers	Bermuda Grass	Least concern	Not Endemic
Sporobolus Africanus	Ratstailgrass	Least concern	Not Endemic
Melinis repens	Natal Red Top	Least concern	Not Endemic
Diospyros Lycioides Desf	bluebush	Least concern	Not Endemic
Themeda triandra	Red Grass	Least concern	Not Endemic
Cymbopogon excavatus	Common turpentine grass	Least concern	Not Endemic
Leonotis nepetifolia (L.)R.Br	Klipa Dagga	Least concern	Not Endemic
Imperata cylindrica	Bedding Grass	Least concern	Not Endemic
Gomphocarpus fruticosus (L.) Aiton f. subsp. fruticosus	Cotton Milkweed	Least concern	Not Endemic
Dryopteris cristata (L) A. Gray	Crested buckler fern		
Cyperus esculentus L. var. esculentus	Earth Almond	Least concern	Not Endemic
Tamarix parviflora DC	Salt-cedar	Not Evaluated	Naturalized exotics
Pellaea viridis (Forssk.) Prantl	Green cliffbrake		
Acanthospermum autrale (Loefl.) Kuntze	Sheepbur		
Paspalum dilatatum pior	Dallis grass	Least concern	Not Endemic
Pteridium aquilinum (L.) Kuhn	Northern bracken fern	Least concern	Not Endemic

b) Floral species of conservation concern

Species of conservation concern (SCC) are either categorized as Red Data Listed species (RDL species), according to specific scientifically researched criteria and administered by the South African National Biodiversity Institute (SANBI), as protected trees by the National Forests Act (NFA)(Act No. 84 of 1998), or as Protected Trees and Plants by The NEMBA Threatened or Protected Species Regulations 152 of 2007 ("TOPS Regulations") and the Lists of Critically Endangered, Vulnerable and Protected Species (TOPS Lists) and the provincial nature conservation legislation, in the context of this report the Mpumalanga Nature Conservation (Act No. 10 of 1998).

During ground truthing, no floral species of conservation concern observed, only floral species of least concern were observed onsite. This might be because some areas of the proposed site are

heavily modified due to plantation, residential and grazing activities. Some areas are heavily modified to an extent that they cannot be reinstated to their natural state. According to the list of protected species under Schedule 11; no person may cut, disturb, damage, or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate, or in any other manner acquire or dispose of any protected plant unless he or she is the holder of a permit which authorises him or her to do so.

c) Alien invasive plant species

Declared weeds and invaders tend to dominate or replace the herbaceous layer of natural ecosystems, transforming the structure, composition, and function of natural ecosystems. It is important that all these transformers be eradicated and controlled by means of an eradication and monitoring programme. Some invader plants may degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

The NEM:BA is the most recent legislation pertaining to alien invasive plant species. In August 2014, the list of alien invasive species was published in terms of the NEM:BA. The Alien and Invasive Species Regulations were published in the Government Gazette No. 43726 on 18 September 2020. The legislation calls for the removal and/or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 m of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam, or wetland. Category 3 plants are also prohibited from occurring close to a watercourse. The following describes the three categories in terms of the NEM:BA:

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy, or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the restricted activities (import, possess, grow, breed, move, sell, buy, or accept as a gift) involving Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

According to the regulations, a person who has under their control a Category 1b listed invasive species must immediately:

- Notify the competent authority in writing
- Take steps to manage the listed invasive species in compliance with:
    - Section 75 of the Act
    - The relevant invasive species management programme developed in terms of regulation 4
    - Any directive issued in terms of section 73(3) of the Act

During ground truthing, four species categorised as Category 1b and three species NEMBA Category 2 were recorded. Table 7 lists exotic floral species identified during ground truthing. Figure 12 depicts some of the invaders listed under NEMBA and that are not listed that were observed onsite, namely **(A)** *Acacia mearnsii,* **(B)** *Eucalyptus camaldulensis*, **(C)** *Verbena bonariensis L, and* **(D)** *Tagetes minuta L*.

Table 7: Alien and Invaders species recorded in the study area.

Scientific name	**Common name**	**Threat Status (SANBI, 2017)**	**SA Endemic**	**Alien Category**
Bidens Pilosa	Blackjack	NE	Not Indigenous	Naturalized exotic weed
Conyza canadensis (L.) Cronquist	Canadian horse	Not Evaluated	Naturalized Exotics	Naturalized Exotics
Solanum elaeagnifolium Cav	Silverleat nightshade	Not Evaluated	Naturalized exotics	NEMBA Category 1b
Pinus patula	Jelecote Pine	NE	Naturalized exotic weed	NEMBA Category 2
Verbena bonariensis L	Argentine vervain	NE	Naturalized exotics	NEMBA Category 1b
Silver wattle	*Acacia dealbata Link*	Least Concern	Not Endemic	NEMBA Category 2
Datura stramonium L	*Common Thorn Apple*	Not Evaluated	Naturalized exotics	NEMBA Category 1b
Tagetes minuta L	*Aztec marigold*	Not Evaluated	Naturalized exotics	Naturalized exotics
Eucalyptus camaldulensis	*Red River Gum*	Not Evaluated	Not Indigenous	NEMBA Category 1b
Acacia mearnsii	black wattle	Not Evaluated	Naturalized exotics	NEMBA Category 2
Amaranthus spinosus L.	Soldier Weed	Not Evaluated	Naturalized Exotics	Naturalized Exotics
Solanum viarum Dunal	Tropical soda-apple	Not Evaluated	Naturalized exotics	Naturalized exotics

Figure 12: Invasive alien floral species observed onsite (site visit, 2023).

5.2 Mammals

During site assessment, no mammal species of conservation concern were observed; only domestic animals like cattle's, goats, and horses were observed grazing onsite (**see Figure 13**). Burrows were also observed onsite which indicate that there might be mammal species onsite (**see Figure 14**). Some areas are heavily modified due to plantation, residential and grazing activities. Some areas are heavily modified to an extent that it might led to relocation of mammal species. However, during desktop study, the VMUS website displays a list of potential mammal species that may be present in the proposed mining right area which was last recorded in 2016 (**see Appendix 2**). Pouching and hunting is prohibited onsite if any mammal species might be identified during mine operation.

Figure 13: Domestic animals observed onsite (site visit, 2023).

Figure 14: Burrows observed onsite (site visit, 2023).

5.3 Birds

Birds are considered good ecological indicators, since their presence or absence indicate whether the ecosystem is functioning properly or not. During ground truthing, no medium to high sensitivity of birds species observed, only birds of least concern and nests were observed onsite (**see Figure 15 and Figure 16**). Bird communities and ecological condition are linked to land cover, as the types of

bird species in the area change when land cover changes. Habitat-specific species are sensitive to environmental change, with habitat destruction being the leading cause of species decline worldwide. It is widely accepted that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (Harrison et al., 1997). Due to their erratic flight patterns and short sighting intervals, birds are challenging to photograph. For a list of potential birds species that may be present in the proposed mining right area which was last recorded in 2022 (**see Appendix 3**).

Figure 15: Red-bishop birds observed onsite (site visit, 2023).

Figure 16: Nests observed onsite (site visit, 2023).

5.4 Herpetofauna

Herpetofauna diversity onsite is considered low, with no reptile or amphibian species observed during ground truthing. This is likely due to the inherently secretive nature of reptile species, and seasonality. During desktop study, the VMUS website displays a list of potential reptile species that may be present in the proposed mining right area. For a list of potential reptile species which were last recorded in 2014 (**see Appendix 4**). The reptiles should not be disturbed during mine operation if observed onsite. Termitaria was observed during site assessment on site (**see Figure 17**).

Figure 17: Termitaria observed onsite (site visit, 2023).

5.5 Site sensitivity

5.5.1 Wetland habitat

During ground truthing, channeled valley bottom wetlands and rivers were observed onsite (**see Figure 18**). The wetlands and rivers observed onsite are of high ecological function and high conservation importance. A 500m buffer zone should be applied from the identified wetlands and 100m buffer zone should be applied from the rivers identified onsite to avoid unnecessary disturbance of water resources. Wetlands and rivers are sensitive areas which provide habitat for aquatic animals as well as a source of freshwater in South Africa. Water resources should be protected for the services they render to the environment. No mining activities should be conducted in the buffer zone without considering water use license conditions from DWS.

Figure 18: Wetlands and rivers observed onsite (site visit, 2023).

5.5.2 Grassland habitat

Ground truthing revealed that, most of the areas are heavily modified due to plantation, residential and grazing activities. No sensitive areas like CBAs observed onsite. Pine and eucalyptus plantation, and large area covered with silver wattle were observed onsite (**see Figure 19**). The proposed area is of medium ecological importance and medium conservation importance. No floral species of conservation concern observed onsite. The area is currently used as grassing area for livestock, residential and plantation activities. The plantation and grazing activities provided the necessary conditions for alien and invasive plant (AIP) species to proliferate and dominate some disturbed areas onsite. The dominant alien and invasive plant (AIP) species in the disturbed area include *Silver wattle, Eucalyptus camaldulensis, Acacia mearnsii, Verbena bonariensis L and Solanum elaeagnifolium Cav.*

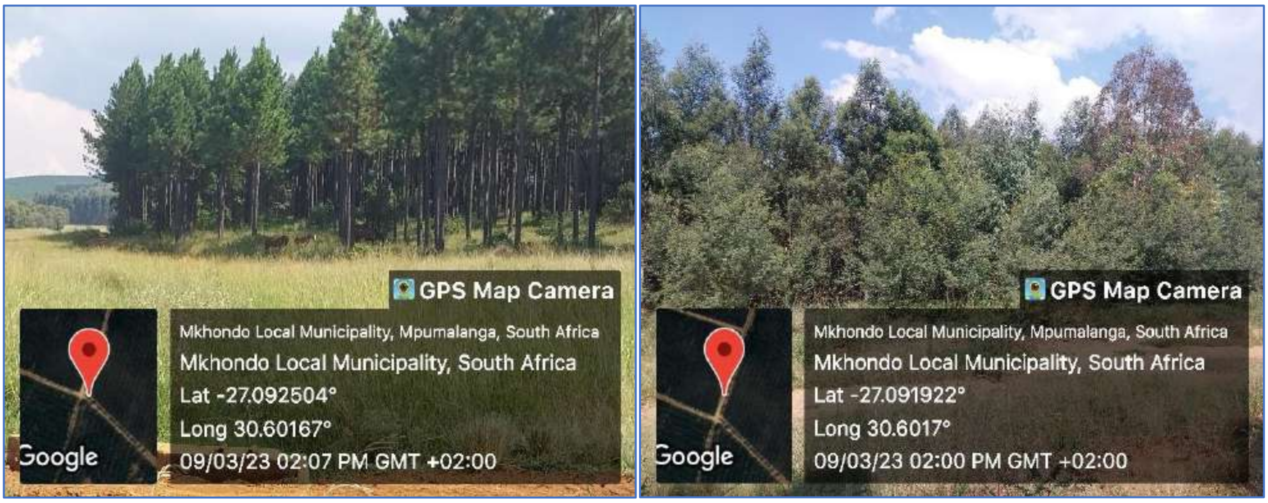


Figure 19: Plantation observed onsite (site visit, 2023).

6 IMPACT ASSESSMENT

6.1 Introduction

The regulations in terms of Chapter 5 of the NEMA requires a description of the potential impacts the proposed development will have on the environment. The following tables present details of the potential impacts of the proposed project activities, as well as the proposed mitigation measures.

6.2 Vegetation species

Table 8: Loss of vegetation and natural habitat during mining.

Impact phase	Mining phase				
Possible impact	Loss of vegetation and natural habitat				
Type of impact	Direct and indirect impact				
Rating criteria	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**
Calculation	3	5	8	4	High (61-90)
Can the impact be reversed					No
Will impact cause irreplaceable loss of resources					Yes
Can impact be avoided, managed, or mitigated					Yes
Impact mitigation measures • Limit vegetation clearing to what is necessary for mining activities. • Prioritise development in low sensitive/already disturbed areas. • Offer environmental awareness and training before mining commences. • Implement a biodiversity action plan prior to mining and ensure adherence thereto. • Fence-off mining site to demark working extent and prevent mining impacts on biodiversity. • Minimise areas affected during mining and establish buffer zones. • Use available farm roads to avoid unnecessary disturbance of natural and indigenous vegetation. • Supervise (to be done by an ecologist) the rescue operation to ensure its success. • Disturbed areas must be rehabilitated with indigenous plants as soon as mining concludes.					

6.3 Alien invasive species

Table 9: Introduction of alien invasive species during rehabilitation.

Impact phase	Rehabilitation phase after mining activities
Possible impact	Introduction of alien invasive species

Type of impact	Direct and indirect impact				
Rating criteria	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**
Calculation	2	5	8	4	Medium (30-60)
Can the impact be reversed					No
Will impact cause irreplaceable loss of resources					Yes
Can impact be avoided, managed, or mitigated					Yes
Impact mitigation measures • Establish buffer zones and implement strict measures to prevent mining in these zones. Do not clear vegetation in buffer zones. • The best mitigation measure for alien and invasive species is early detection and eradication of these species using a monitoring programme. • An alien invasive management programme should be developed and implemented to control alien invasive species. • Disturbed area should be rehabilitated with indigenous plant species to avoid colonisation of the area by invasive species.					

6.4 Birds

Table 10: Impacts of mining on birds and its associated roosting site.

Impact phase	Mining phase				
Possible impact	The fragmentation, clearing, and alteration of natural habitat have a huge impact on birds breeding and roosting sites.				
Type of impact	Direct Impact				
Rating criteria	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**
Calculation	3	5	8	4	High (61-90)
Can the impact be reversed					No
Will impact cause irreplaceable loss of resources					Yes
Can impact be avoided, managed, or mitigated					Yes
Impact mitigation measures • Ensure that there is no-alteration of vegetation patches that will provide space for breeding and roosting site for birds. • Ensure that there is no disturbance to bird species, nests, breeding sites if identified and create artificial site for birds. • Prohibit activities like trapping, hunting, and killing of birds onsite during mining. • ECO to conduct regular site inspections and remove any snares erected onsite.					

• A conservation-orientated plan should be developed personally for contractors so that there will be a penalty clause for non-compliance.

6.5 Mammals

Table 11: Loss of mammals due to mining.

Impact phase	Mining phase				
Possible impact	Loss of mammals due to habitat fragmentation and degradation				
Type of impact	Direct Impact				
Rating criteria	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**
Calculation	3	5	8	4	High (61-90)
Can the impact be reversed					No
Will impact cause irreplaceable loss of resources					Yes
Can impact be avoided, managed, or mitigated					Yes
Impact mitigation measures • Pre-mining walk to be carried out onsite to ensure the absence of mammal habitats. • Hunting weapons are prohibited onsite. • Dogs are prohibited on the worksite as they are threats to wild animals. • A low-speed limit should be enforced onsite to reduce animal-vehicle collisions • No animals should be intentionally killed/poached if identified, and hunting is not permitted on site. • Relocate any threatened mammal species identified before commencement of mining. • Offer environmental induction for all employees to raise awareness on the value of wild animals (if identified) and the importance of their conservation. • ECO to conduct regular site inspections and remove any traps erected onsite. • Contractual fines to be imposed and contract employees to be immediately dismissed if found attempting to snare or otherwise harm faunal species identified. • Ensure that sensitive mammal habitats like drainage lines and wetlands area avoided.					

6.6 Sensitive areas

Table 12: Impacts of the mining on sensitive areas.

Impact phase	Mining phase				
Possible impact	Destruction of streams and wetlands and its associated vegetation				
Type of impact	Direct Impact				
Rating criteria	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**

Calculation	3	5	8	5	High (61-90)
Can the impact be reversed					No
Will impact cause irreplaceable loss of resources					Yes
Can impact be avoided, managed, or mitigated					Yes
Impact mitigation measures • No disturbance in drainage lines, rivers, and wetlands, including mining across wetlands and rivers, fill dumping, road construction, and all forms of temporary disturbance. • Mining activities to be approved by water use license (WUL) and carefully monitored to avoid unnecessary impacts on waterbodies/riparian areas (particularly in-stream habitat). • Storm water and erosion control measures to be implemented and monitored as per EMPr to prevent siltation or erosion of sensitive environment identified onsite. • No mining activities may occur within 100 m of drainage lines or wetland without determining conditions for WUL from the DWS. • Do not lower the original stream bed/profile of the wetland, as this may result in scouring in an upstream direction and further alteration of bed conditions. • Prioritise development in low sensitive/already disturbed areas. • Immediately and appropriately clean any accidental chemical, fuel, and oil spill from machines. • Store all materials appropriately to prevent contamination of sensitive sites.					

6.7 Potential erosion

Table 13: Potential erosion of the site and its surroundings during mining.

Impact phase	Mining phase				
Possible impact	Potential erosion of the mining area				
Type of impact	Direct Impact				
Rating criteria	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**
Calculation	2	4	8	5	High (61-90)
Can the impact be reversed					No
Will impact cause irreplaceable loss of resources					Yes
Can impact be avoided, managed, or mitigated					Yes
Impact mitigation measures • Rehabilitate the disturbed areas after mining. • Conduct mining only on the low sensitive area of the proposed site. • Implement erosion and storm water runoff management measures according to EMP requirements to prevent erosion on the prospected areas and surroundings.					

- Monitor the mined areas for signs of erosion and implement erosion rectification and prevention measures if required.

6.8 Waste generation

Table 14: Waste generation during mining.

Impact phase	Mining phase				
Possible impact	Pollution due to oil and fuel spills, erosion, and ablution facilities.				
Type of impact	Direct Impact				
Rating criteria	**Extent**	**Duration**	**Magnitude**	**Probability**	**Significance**
Calculation	3	4	6	5	High (61-90)
Can the impact be reversed					No
Will impact cause irreplaceable loss of resources					Yes
Can impact be avoided, managed, or mitigated					Yes

Impact mitigation measures

- Monitor all mining activities and ensure alignment with the pollution prevention strategies in place.
- Collect and dispose of all the waste generated during mining in accordance with the waste management plan (WMP).
- Recycle or reuse waste where possible.
- Enforce low speed limits to reduce dust and noise.
- Implement regular dust suppression during mining.
- Provide proper ablution and storage facilities onsite during mining.
- Implement proper Standard Operating Procedures to regulate refueling and other pollution.
- Implement a rehabilitation strategy as part of EMPr, like a clean-up plan/strategy if spills occur and proper facilities (ablution) to ensure no sewage spills into drainage lines and streams.
- Prohibit illegal waste dumping to avoid contamination of waterbodies which might impact mammals using waterbodies.

7 CONCLUSION AND RECOMMENDATIONS

This study aims to provide sufficient transparent and technically robust information on the impacts of mining to enable informed decision-making by the authorities. During site assessment, Channelled valley bottom wetlands and rivers were observed on site. The identified water resources have high ecological function and high conservation importance. They provide habitat for aquatic animals, water source for livestock, wild animals, and form part of the sources of freshwater in South Africa. Since wetlands and rivers are highly sensitive area or no-go areas, no mining should occur within 500 m of the identified wetlands and 100 m from the identified rivers without determining the conditions for WUL from the DWS. In case if mining must occur in the regulated area, a permit application needs to be lodged with DWS prior to any disturbance of the water resources. A permit application should be lodged in terms of Section 21 (I) and (C) of the (National water Act No. 36 of 1998).

The proposed project area falls in the northeastern mountain grassland, and is covered with plantation, mixture of grasses, alien invasive plants and plant species of least concern. Floral species of least concern were observed scattered in the proposed project area. The area is covered with mixture of alien invasive and floral species of least concern due to heavily modified by plantation, grazing and residential activities. No sensitive areas like Critical Biodiversity Areas in terms of terrestrial biodiversity observed onsite. No floral species of conservation concern observed onsite. The area provides livestock with area for grazing. When choosing areas to be mined, the applicant should prioritize development in low sensitive/already heavily modified areas. The applicant must ensure that animals should not be intentionally killed/poached if identified. There should be a relocation of any threatened mammal species which might be identified onsite before commencement of mining.

Proper rehabilitation and after-care of the disturbed area during mining should take place to prevent colonisation by invader species. All mitigation measures proposed in this report must be implemented during all phases of the proposed project. It is recommended that the management measures stipulated in this report be included in the proposed project's official EMPr and that these be assessed for efficacy during all phases of the project and adapted accordingly to ensure minimal disturbance of the study area ecology. The significance of the impacts will be determined by the success of the mitigation measures implemented and the rehabilitation programme for the mining area.

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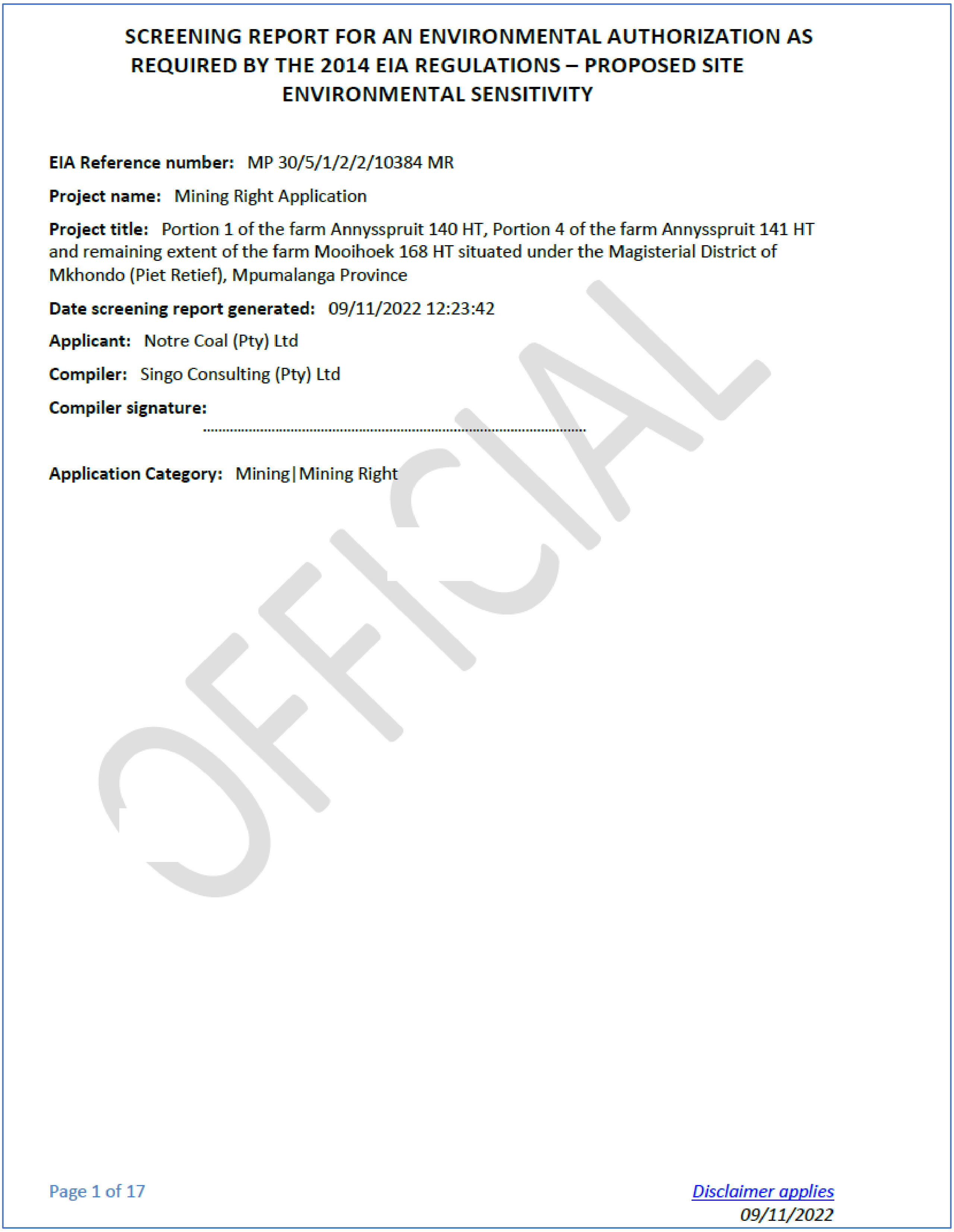
Appendix 1: Screening report.



SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED SITE ENVIRONMENTAL SENSITIVITY

EIA Reference number: MP 30/5/1/2/2/10384 MR

Project name: Mining Right Application

Project title: Portion 1 of the farm Annysspruit 140 HT, Portion 4 of the farm Annysspruit 141 HT and remaining extent of the farm Mooihoek 168 HT situated under the Magisterial District of Mkhondo (Piet Retief), Mpumalanga Province

Date screening report generated: 09/11/2022 12:23:42

Applicant: Notre Coal (Pty) Ltd

Compiler: Singo Consulting (Pty) Ltd

Compiler signature:

……………………………………………………………………………………………

Application Category: Mining|Mining Right

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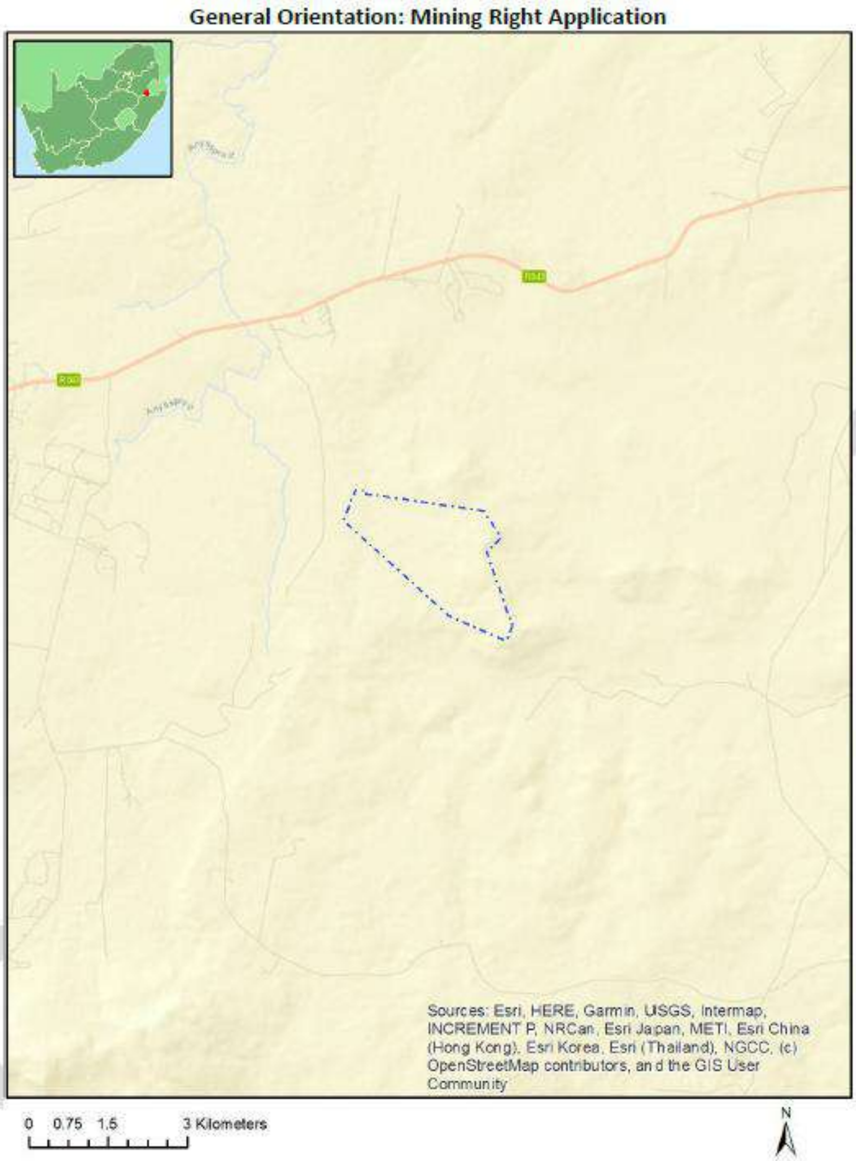
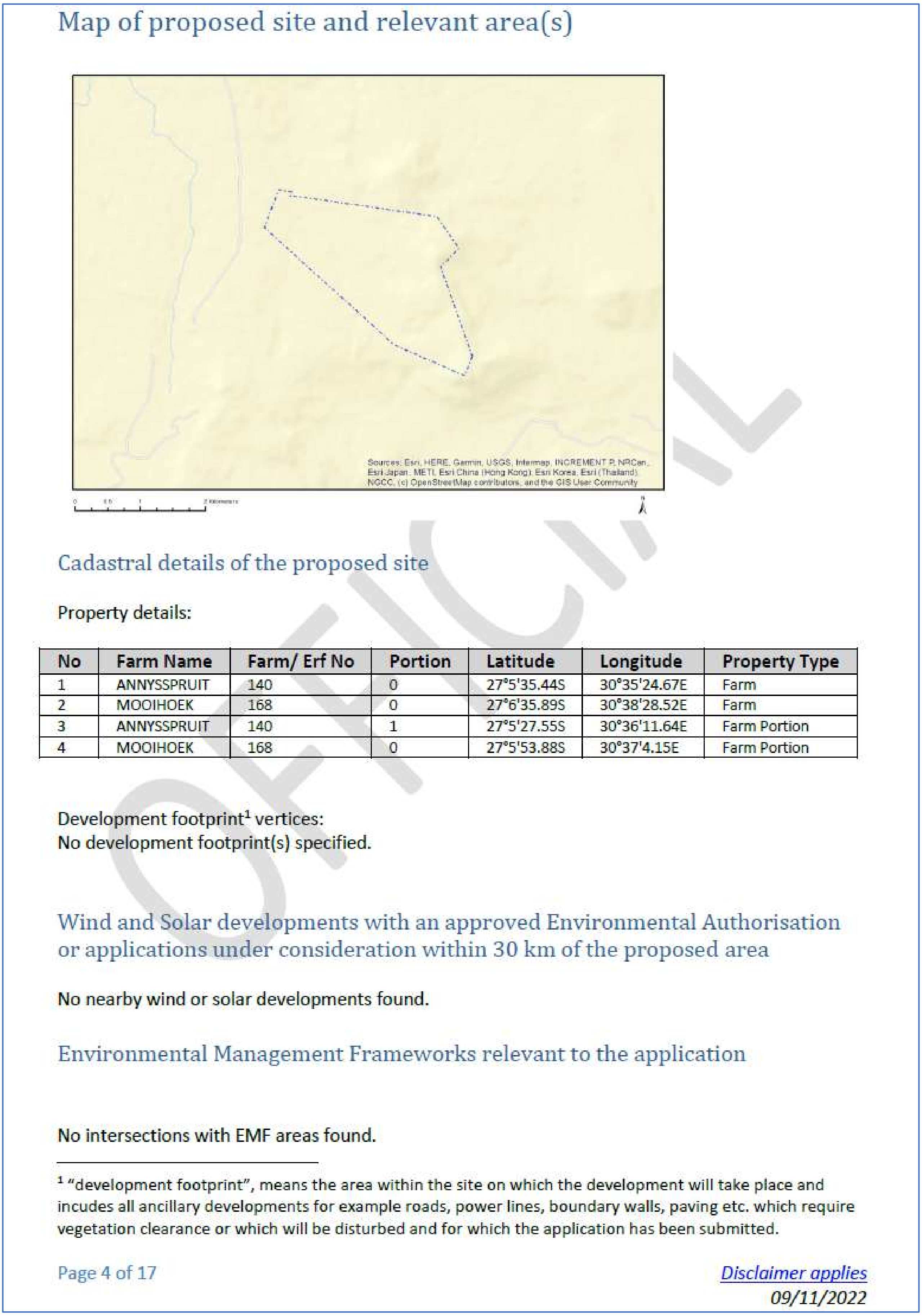
Proposed Project Location

Orientation map 1: General location



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Map of proposed site and relevant area(s)

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	ANNYSSPRUIT	140	0	27°5'35.44S	30°35'24.67E	Farm
2	MOOIHOEK	168	0	27°6'35.89S	30°38'28.52E	Farm
3	ANNYSSPRUIT	140	1	27°5'27.55S	30°36'11.64E	Farm Portion
4	MOOIHOEK	168	0	27°5'53.88S	30°37'4.15E	Farm Portion

Development footprint[1] vertices:
No development footprint(s) specified.

Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No nearby wind or solar developments found.

Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

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[1] "development footprint", means the area within the site on which the development will take place and incudes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.

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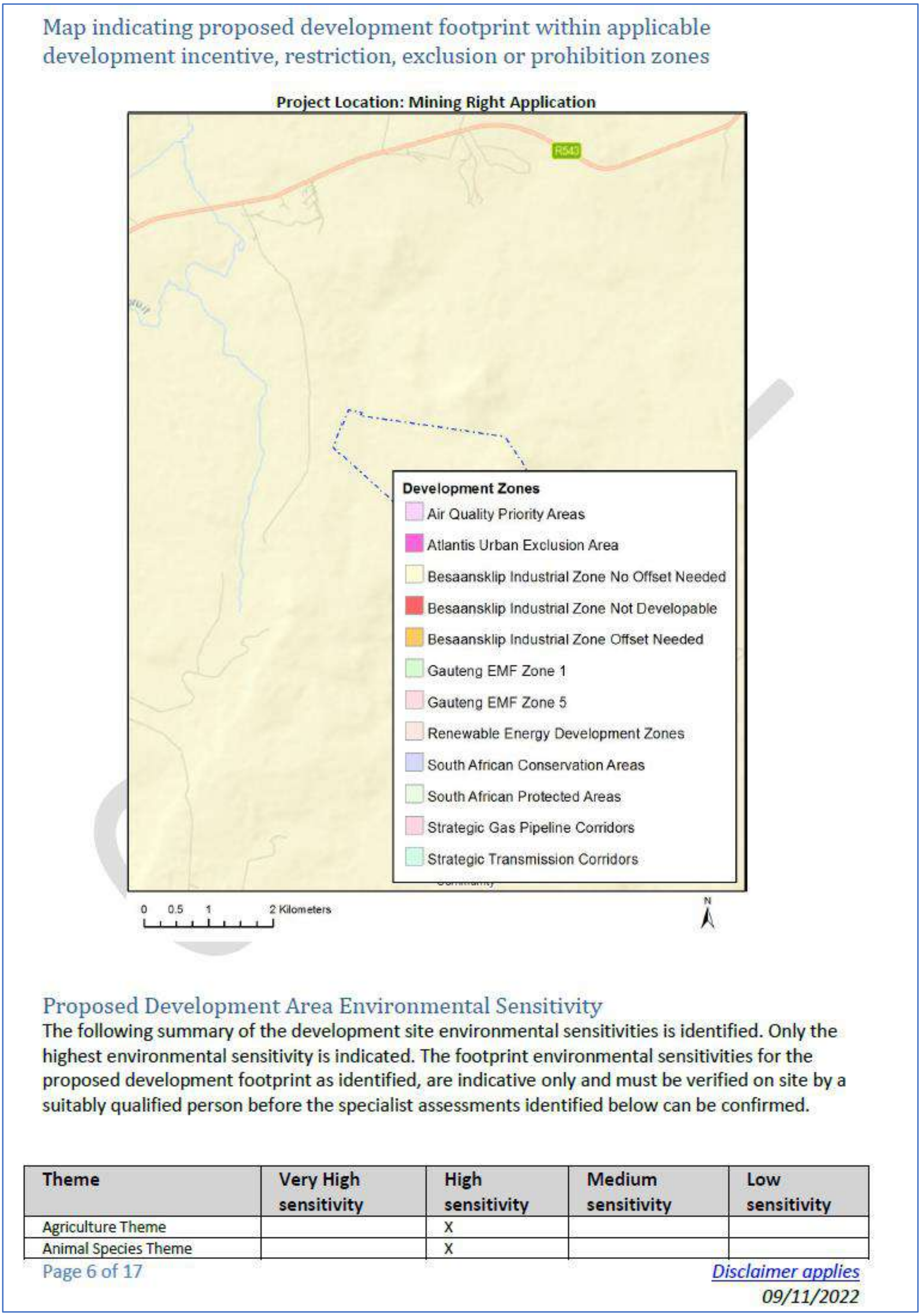
Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development site as well as the most environmental sensitive features on the site based on the site sensitivity screening results for the application classification that was selected. The application classification selected for this report is: **Mining|Mining Right**.

Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this site are indicated below.

No intersection with any development zones found.



Map indicating proposed development footprint within applicable development incentive, restriction, exclusion or prohibition zones

Proposed Development Area Environmental Sensitivity

The following summary of the development site environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme		X		
Animal Species Theme		X		

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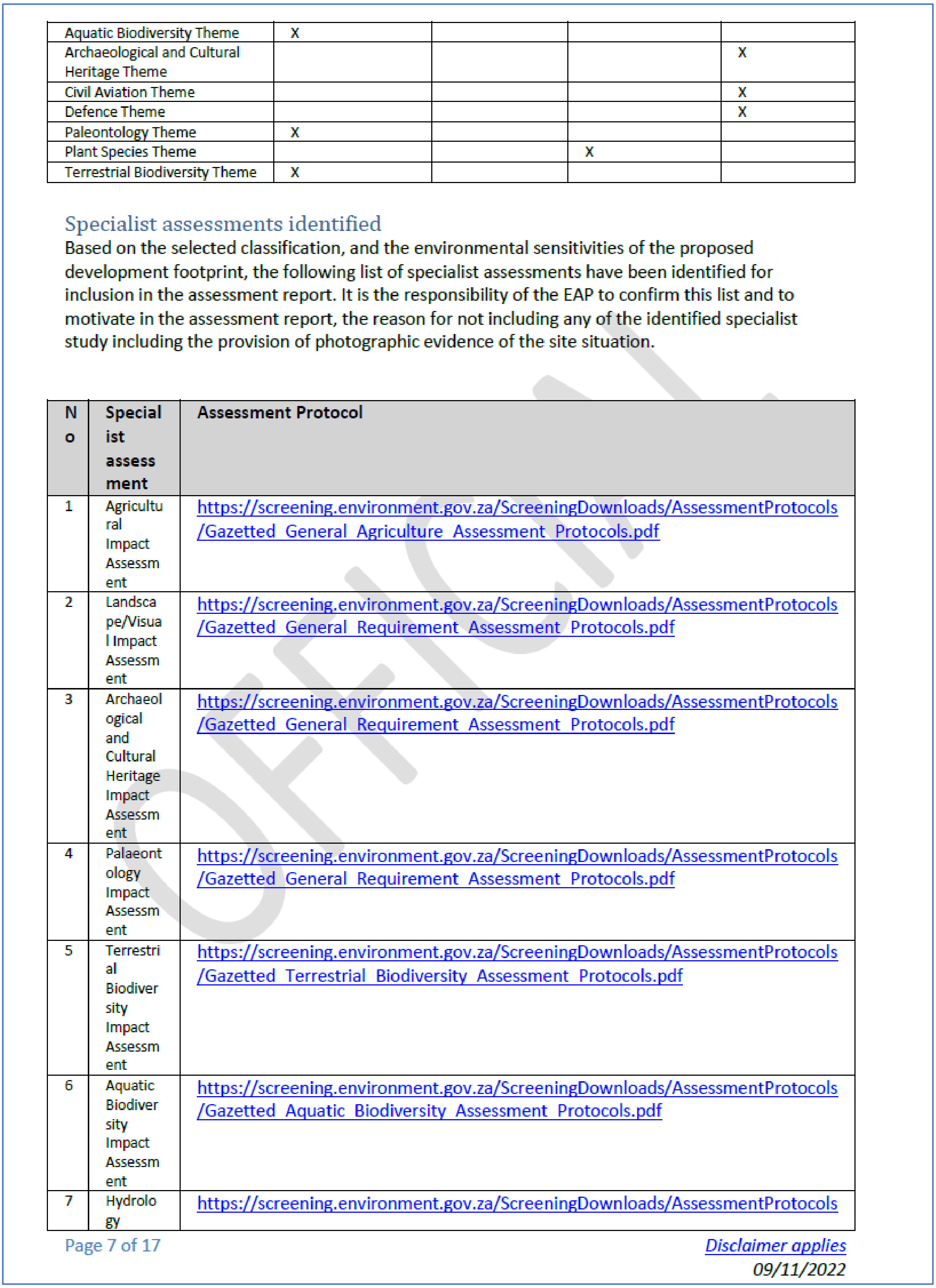

Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme				X
Defence Theme				X
Paleontology Theme	X			
Plant Species Theme			X	
Terrestrial Biodiversity Theme	X			

Specialist assessments identified

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the site situation.

No	Specialist assessment	Assessment Protocol
1	Agricultural Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Agriculture_Assessment_Protocols.pdf
2	Landscape/Visual Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
3	Archaeological and Cultural Heritage Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
4	Palaeontology Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
5	Terrestrial Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf
6	Aquatic Biodiversity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf
7	Hydrology	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols

	Assessment	/Gazetted_General_Requirement_Assessment_Protocols.pdf
8	Noise Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Noise_Impacts_Assessment_Protocol.pdf
9	Radioactivity Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
10	Traffic Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
11	Geotechnical Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
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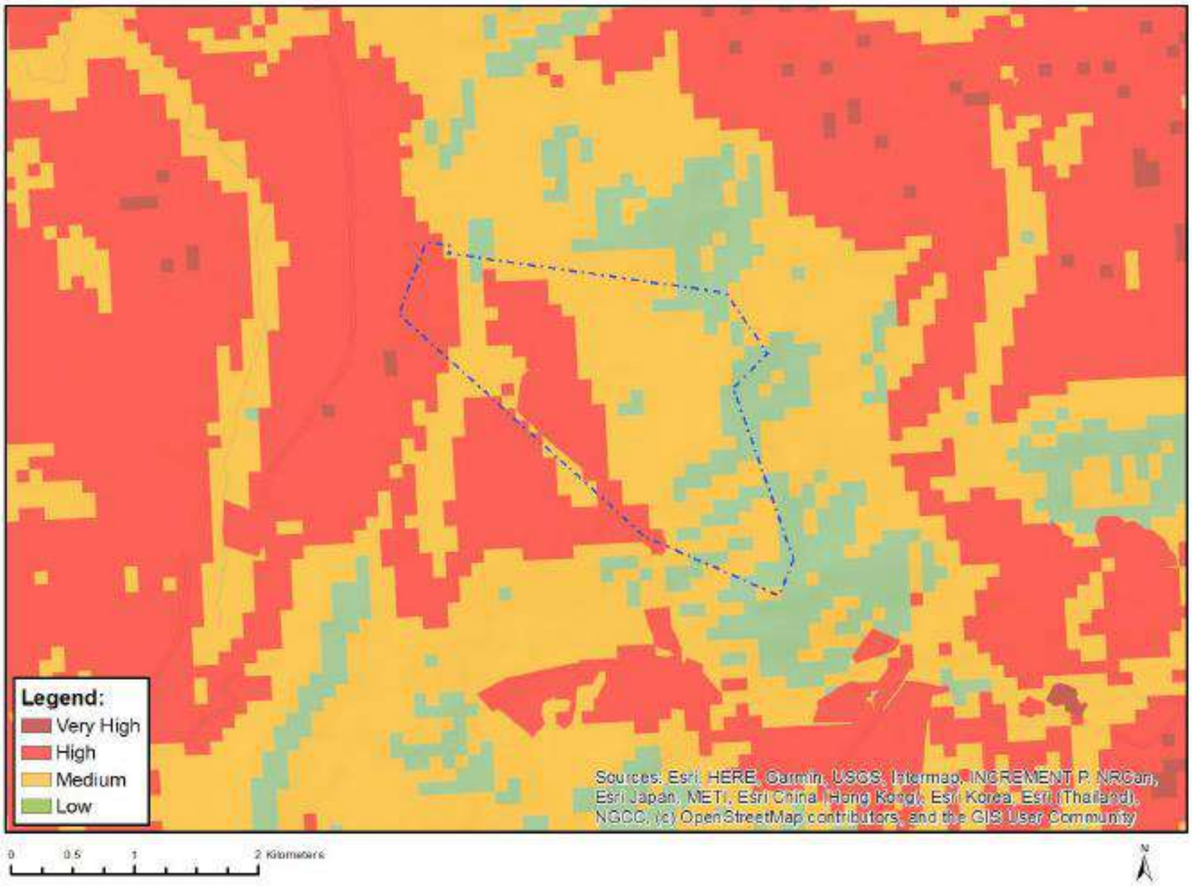
14	Socio-Economic Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
15	Ambient Air Quality Impact Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
16	Seismicity Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf
17	Plant Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Plant_Species_Assessment_Protocols.pdf
18	Animal Species Assessment	https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Animal_Species_Assessment_Protocols.pdf

Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

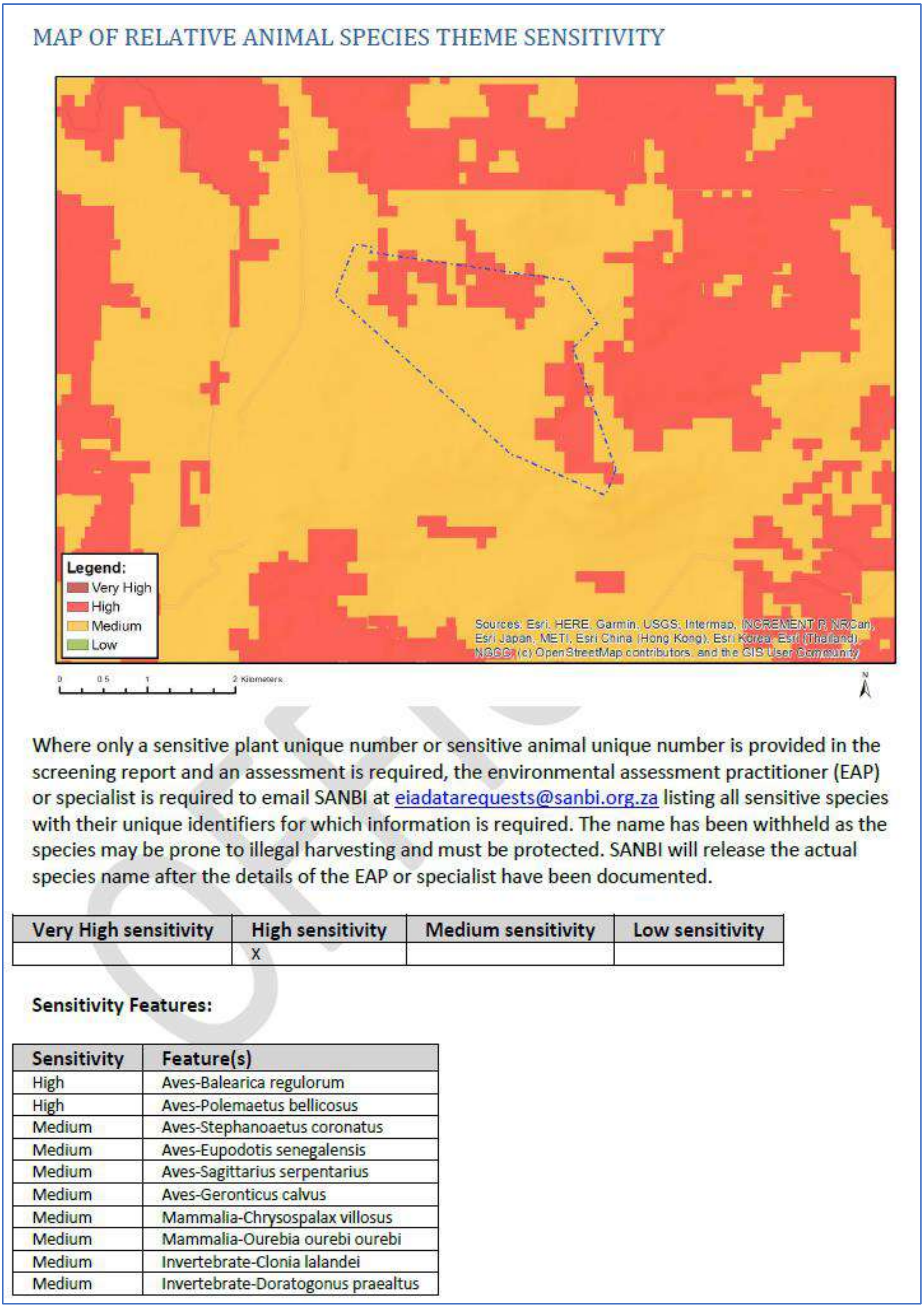
MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
High	Subsistence Farming 1;Land capability;09. Moderate-High/10. Moderate-High
High	Subsistence Farming 1;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Low	Land capability;01. Very low/02. Very low/03. Low-Very low/04. Low-Very low/05. Low
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate



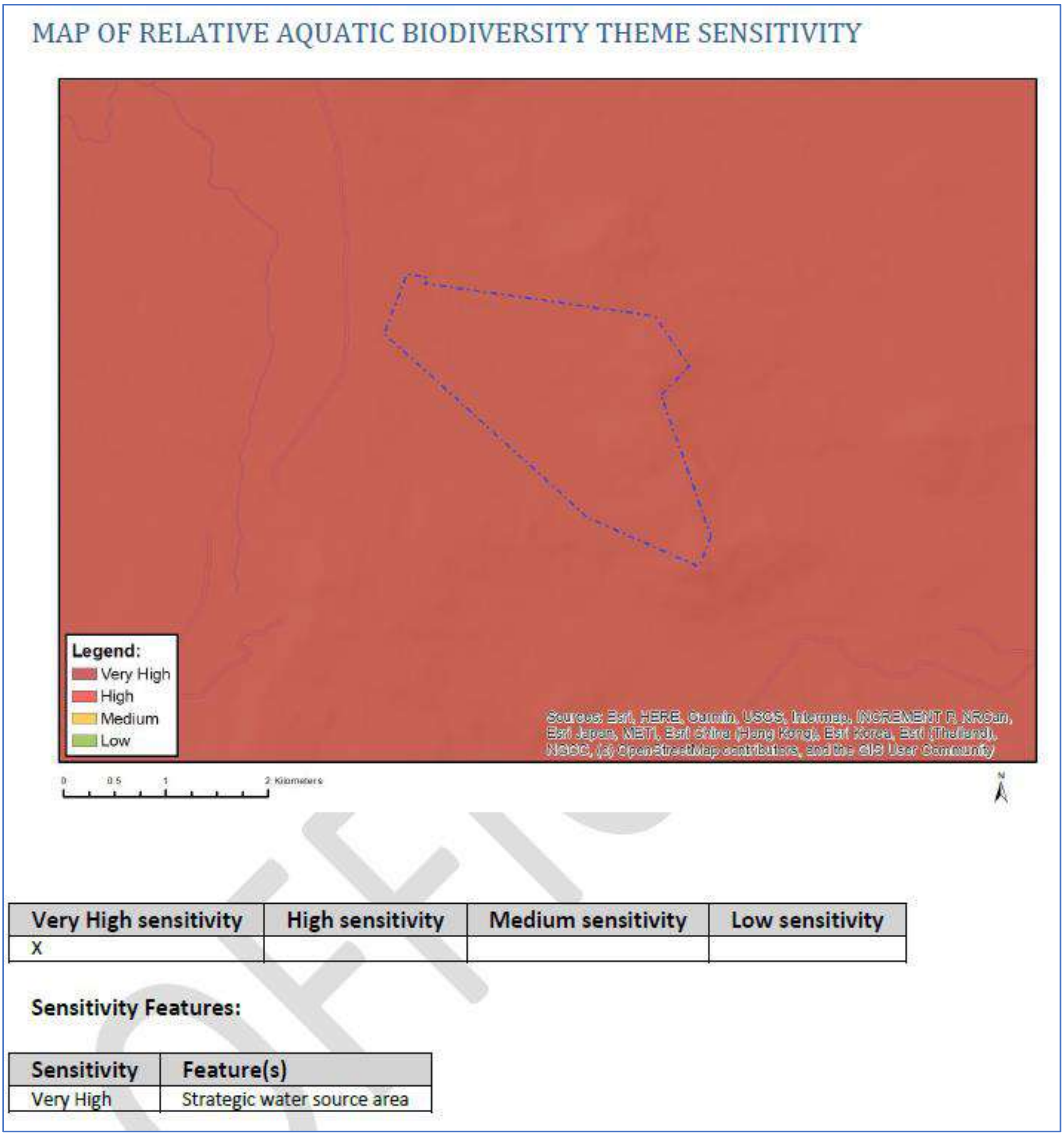
MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY

Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Balearica regulorum
High	Aves-Polemaetus bellicosus
Medium	Aves-Stephanoaetus coronatus
Medium	Aves-Eupodotis senegalensis
Medium	Aves-Sagittarius serpentarius
Medium	Aves-Geronticus calvus
Medium	Mammalia-Chrysospalax villosus
Medium	Mammalia-Ourebia ourebi ourebi
Medium	Invertebrate-Clonia lalandei
Medium	Invertebrate-Doratogonus praealtus

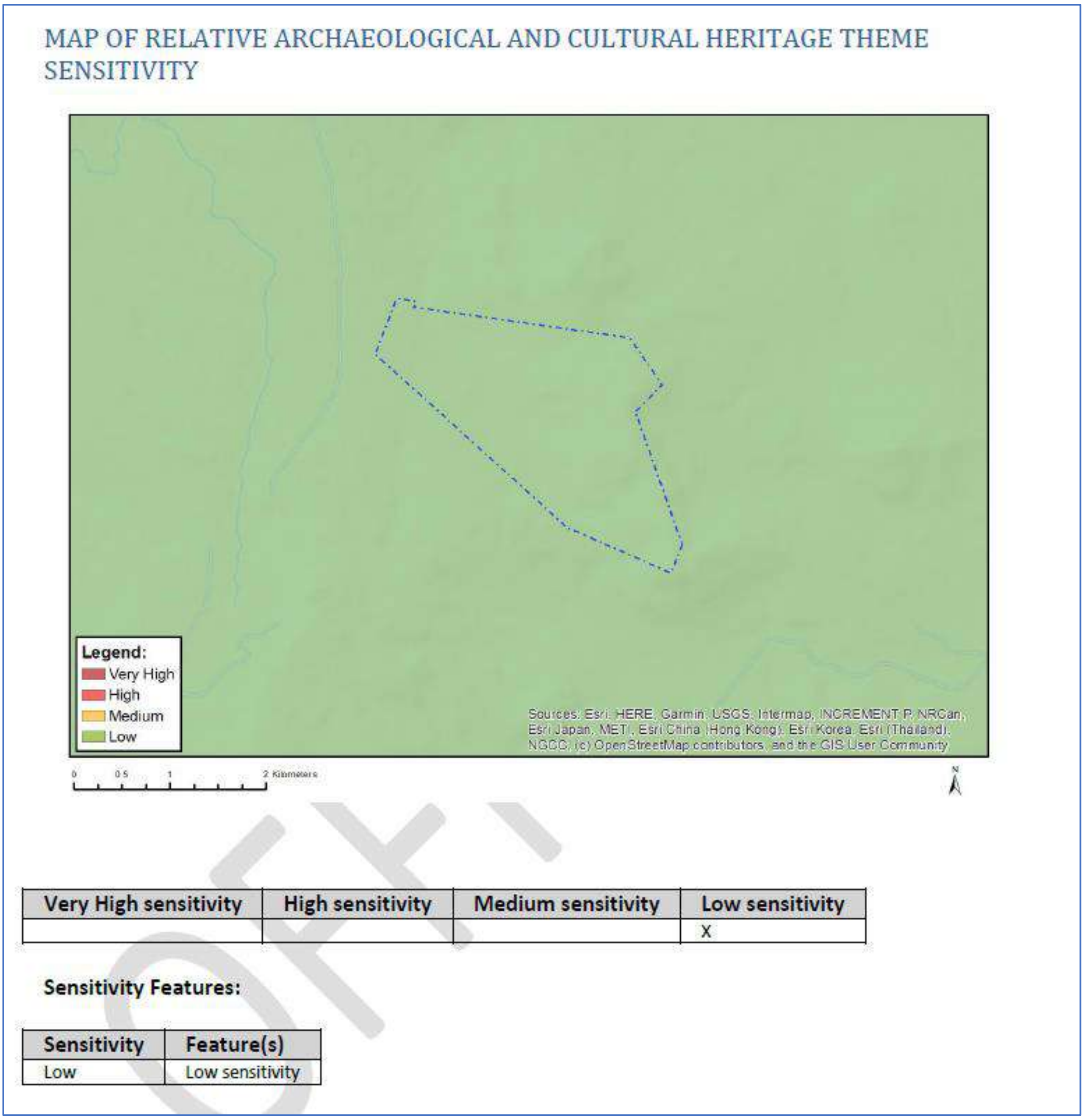


MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Strategic water source area



MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

Legend:
- 🟥 Very High
- 🟥 High
- 🟨 Medium
- 🟩 Low

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

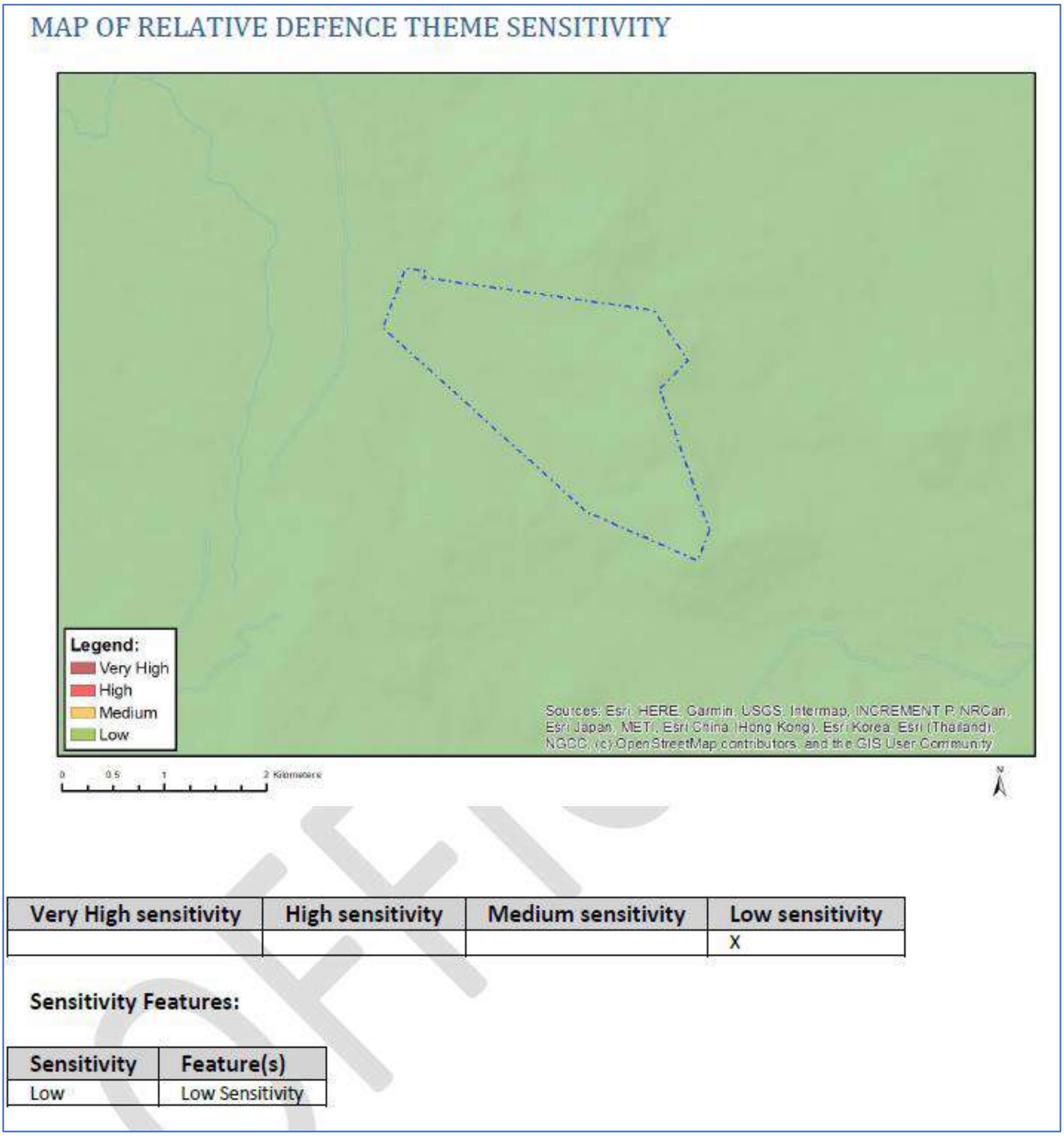
MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity



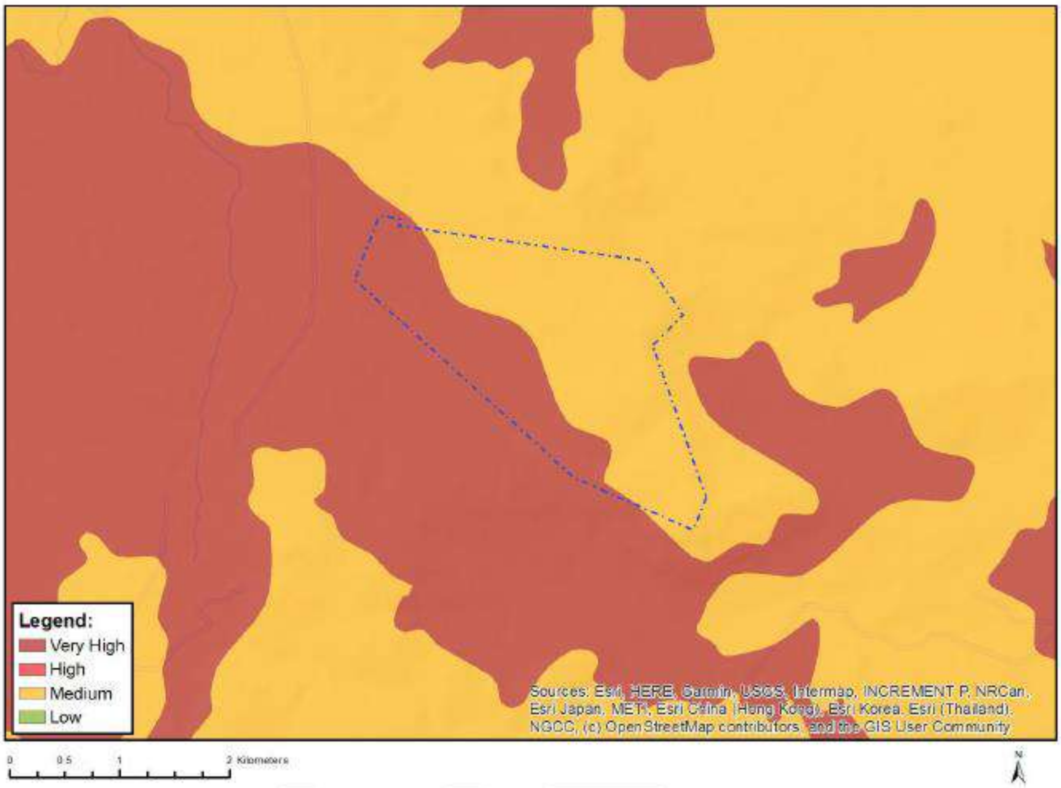
MAP OF RELATIVE DEFENCE THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

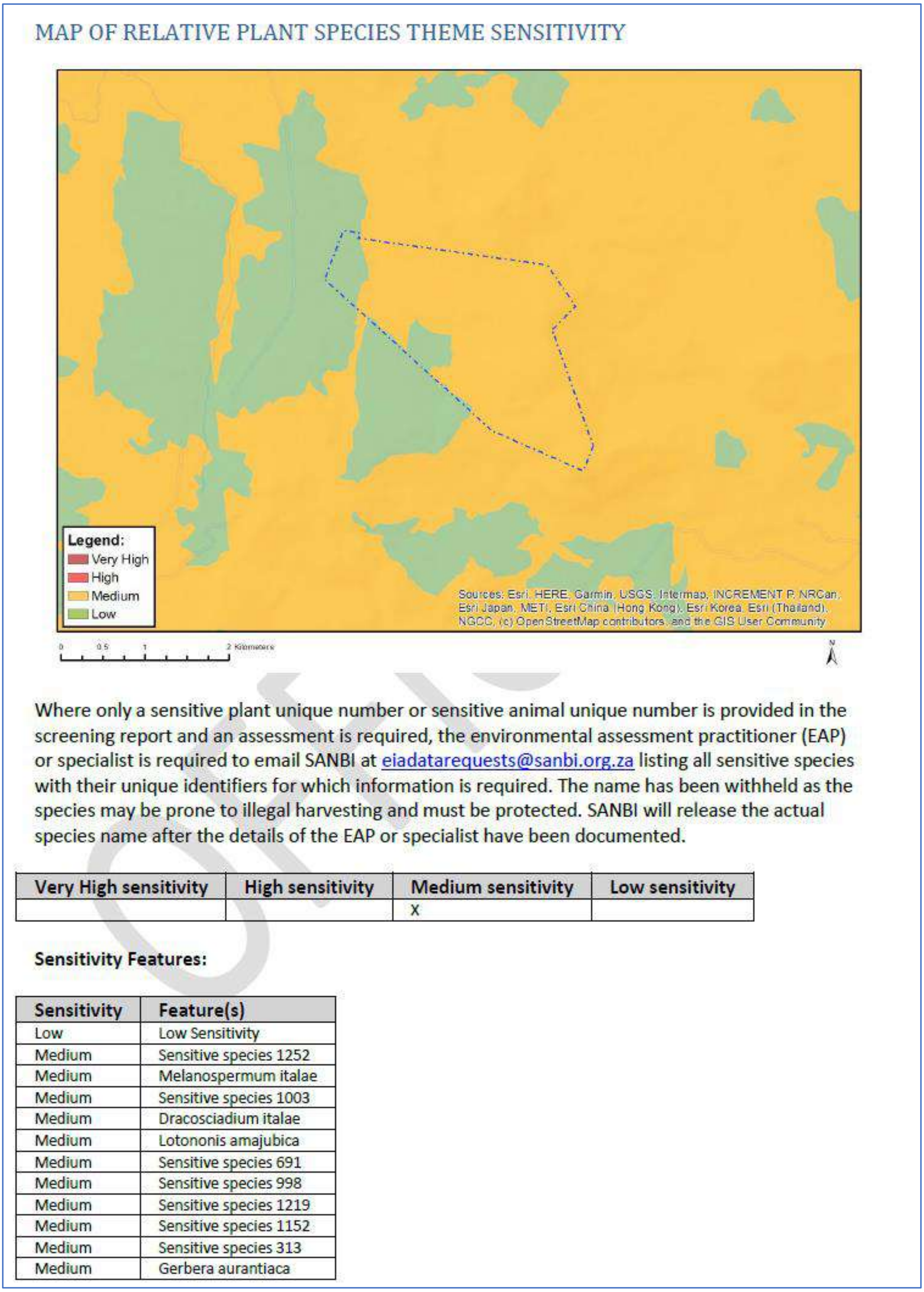
MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity



MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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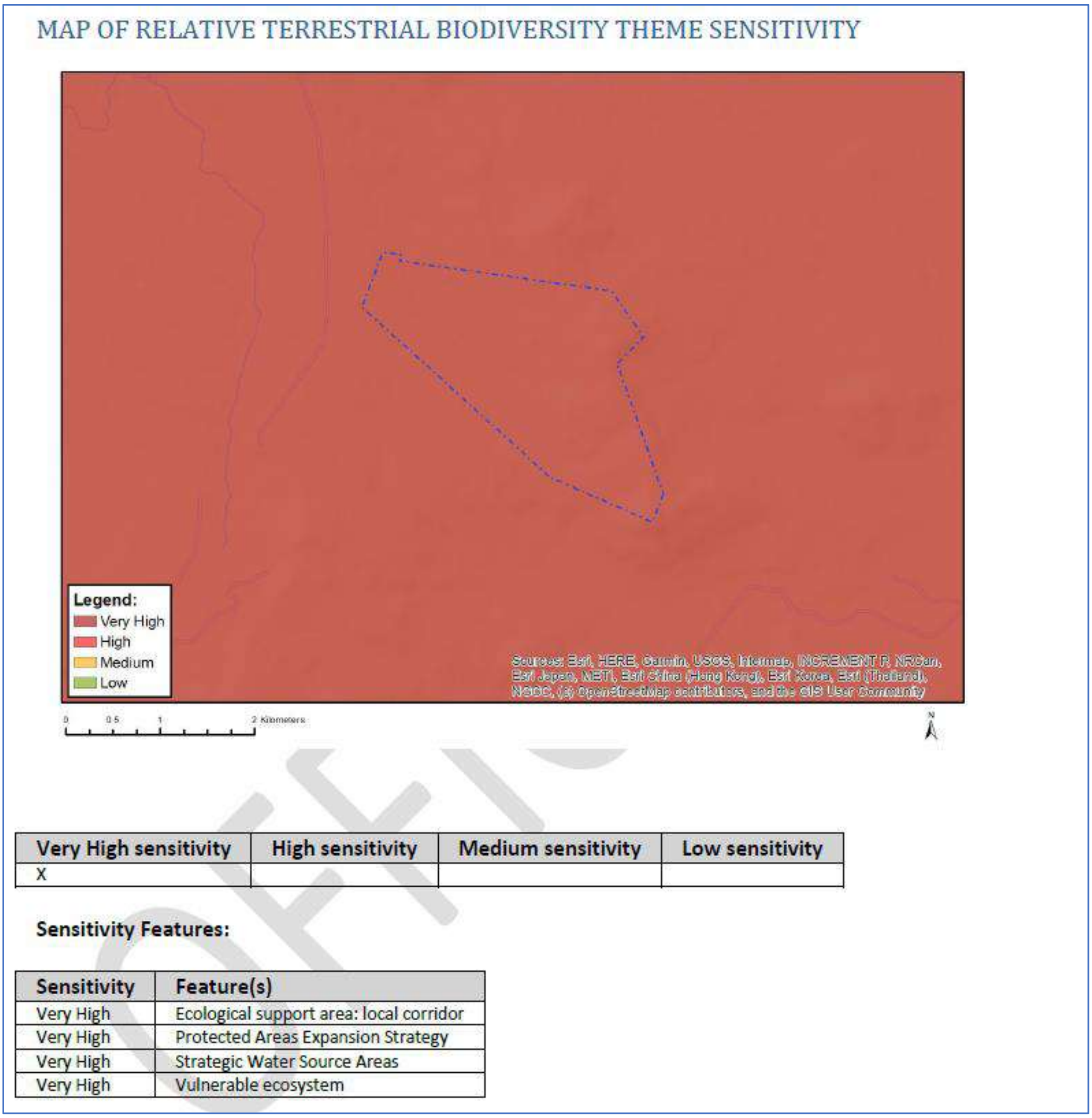
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Sensitive species 1252
Medium	Melanospermum italae
Medium	Sensitive species 1003
Medium	Dracosciadium italae
Medium	Lotononis amajubica
Medium	Sensitive species 691
Medium	Sensitive species 998
Medium	Sensitive species 1219
Medium	Sensitive species 1152
Medium	Sensitive species 313
Medium	Gerbera aurantiaca



MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Very High	Ecological support area: local corridor
Very High	Protected Areas Expansion Strategy
Very High	Strategic Water Source Areas
Very High	Vulnerable ecosystem

Appendix 2: Historical mammal species records from the broader study area (VMUS)

#	Species code	Family	Scientific name	Common name	Red list category	Number of QDSs	Number of records	Last recorded
1	212160	Bovidae	Damaliscus pygargus phillipsi	Blesbok	Least Concern (2016)	1	1	2022-06-08
2	213180	Bovidae	Ourebia ourebi	Oribi	Endangered	1	10	2001-05-12
3	150690	Muridae	Thallomys paedulcus	Acacia Thallomys	Least Concern (2016)	1	1	1999-12-11
4	106780	Orycteropodidae	Orycteropus afer	Aardvark	Least Concern (2016)	1	11	2001-05-18
	Total					**4**	**23**	**2001-05-15*** **1999-12-11****

Appendix 3: SABAP 2 bird list of the area (Birdlife South Africa).

	Ref	Common group	Common species	Genus	Species	FP (RR %)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
1	722		Bokmakierie	Telophorus	zeylonus	81.8	9	2015-02-20	0.0	0	-
2	72		Hamerkop	Scopus	umbretta	9.1	1	2012-11-17	0.0	0	-
3	637		Neddicky	Cisticola	fulvicapilla	72.7	8	2017-01-30	0.0	0	-
4	844		Quailfinch	Ortygospiza	atricollis	18.2	2	2010-11-30	0.0	0	-
5	622	Apalis	Bar-throated	Apalis	thoracica	9.1	1	2015-02-20	0.0	0	-
6	439	Barbet	Crested	Trachyphonus	vaillantii	54.5	6	2017-01-30	0.0	0	-
7	672	Batis	Cape	Batis	capensis	18.2	2	2012-09-28	0.0	0	-
8	808	Bishop	Southern Red	Euplectes	orix	72.7	8	2017-01-30	0.0	0	-
9	812	Bishop	Yellow-crowned	Euplectes	afer	9.1	1	2012-01-09	0.0	0	-
10	709	Boubou	Southern	Laniarius	ferrugineus	81.8	9	2015-02-20	0.0	0	-
11	545	Bulbul	Dark-capped	Pycnonotus	tricolor	100.0	11	2017-01-30	0.0	0	-
12	874	Bunting	Golden-breasted	Emberiza	flaviventris	27.3	3	2012-11-17	0.0	0	-
13	222	Bustard	White-bellied	Eupodotis	senegalensis	9.1	1	2010-11-09	0.0	0	-
14	154	Buzzard	Common	Buteo	buteo	36.4	4	2012-11-17	0.0	0	-
15	152	Buzzard	Jackal	Buteo	rufofuscus	0.0	0	-	25.0	1	2019-04-16

	Ref	Common group	Common species	Genus	Species	FP (RR%)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
16	857	Canary	Cape	Serinus	canicollis	63.6	7	2017-01-30	0.0	0	-
17	859	Canary	Yellow-fronted	Crithagra	mozambica	45.5	5	2012-09-28	0.0	0	-
18	575	Chat	Ant-eating	Myrmecocichla	formicivora	18.2	2	2015-02-20	0.0	0	-
19	569	Chat	Buff-streaked	Campicoloides	bifasciatus	9.1	1	2009-12-06	0.0	0	-
20	647	Cisticola	Croaking	Cisticola	natalensis	45.5	5	2015-02-20	0.0	0	-
21	648	Cisticola	Lazy	Cisticola	aberrans	9.1	1	2010-11-30	0.0	0	-
22	646	Cisticola	Levaillant's	Cisticola	tinniens	63.6	7	2015-02-20	0.0	0	-
23	635	Cisticola	Pale-crowned	Cisticola	cinnamomeus	9.1	1	2015-02-20	0.0	0	-
24	639	Cisticola	Wailing	Cisticola	lais	9.1	1	2012-09-28	0.0	0	-
25	634	Cisticola	Wing-snapping	Cisticola	ayresii	18.2	2	2015-02-20	0.0	0	-
26	629	Cisticola	Zitting	Cisticola	juncidis	45.5	5	2015-02-20	0.0	0	-
27	212	Coot	Red-knobbed	Fulica	cristata	36.4	4	2012-11-17	0.0	0	-
28	50	Cormorant	Reed	Microcarbo	africanus	36.4	4	2015-02-20	0.0	0	-
29	277	Courser	Temminck's	Cursorius	temminckii	9.1	1	2010-11-30	0.0	0	-
30	214	Crane	Grey Crowned	Balearica	regulorum	9.1	1	2015-02-20	0.0	0	-
31	523	Crow	Cape	Corvus	capensis	36.4	4	2012-11-17	0.0	0	-

	Ref	Common group	Common species	Genus	Species	FP (RR%)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
32	522	Crow	Pied	Corvus	albus	54.5	6	2012-11-17	0.0	0	-
33	344	Cuckoo	Black	Cuculus	clamosus	36.4	4	2012-11-17	0.0	0	-
34	352	Cuckoo	Diederik	Chrysococcyx	caprius	63.6	7	2017-01-30	0.0	0	-
35	351	Cuckoo	Klaas's	Chrysococcyx	klaas	18.2	2	2017-01-30	0.0	0	-
36	343	Cuckoo	Red-chested	Cuculus	solitarius	54.5	6	2017-01-30	0.0	0	-
37	52	Darter	African	Anhinga	rufa	9.1	1	2010-11-09	0.0	0	-
38	316	Dove	Cape Turtle	Streptopelia	capicola	100.0	11	2017-01-30	0.0	0	-
39	314	Dove	Red-eyed	Streptopelia	semitorquata	81.8	9	2017-01-30	0.0	0	-
40	517	Drongo	Fork-tailed	Dicrurus	adsimilis	63.6	7	2017-01-30	0.0	0	-
41	96	Duck	Yellow-billed	Anas	undulata	54.5	6	2012-11-17	0.0	0	-
42	58	Egret	Great	Ardea	alba	9.1	1	2010-11-09	0.0	0	-
43	59	Egret	Little	Egretta	garzetta	9.1	1	2010-11-09	0.0	0	-
44	61	Egret	Western Cattle	Bubulcus	ibis	36.4	4	2012-01-09	0.0	0	-
45	119	Falcon	Amur	Falco	amurensis	18.2	2	2015-02-20	0.0	0	-
46	833	Firefinch	African	Lagonosticta	rubricata	27.3	3	2012-09-28	0.0	0	-
47	707	Fiscal	Southern	Lanius	collaris	81.8	9	2017-01-30	25.0	1	2018-12-05

	Ref	Common group	Common species	Genus	Species	FP (RR %)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
48	682	Flycatcher	African Paradise	Terpsiphone	viridis	72.7	8	2017-01-30	25.0	1	2022-09-19
49	654	Flycatcher	Spotted	Muscicapa	striata	18.2	2	2010-11-30	0.0	0	-
50	173	Francolin	Coqui	Peliperdix	coqui	45.5	5	2012-09-28	0.0	0	-
51	178	Francolin	Red-winged	Scleroptila	levaillantii	36.4	4	2015-02-20	0.0	0	-
52	89	Goose	Egyptian	Alopochen	aegyptiaca	45.5	5	2012-11-17	0.0	0	-
53	88	Goose	Spur-winged	Plectropterus	gambensis	45.5	5	2012-11-17	0.0	0	-
54	618	Grassbird	Cape	Sphenoeacus	afer	63.6	7	2017-01-30	0.0	0	-
55	6	Grebe	Little	Tachybaptus	ruficollis	9.1	1	2010-11-30	0.0	0	-
56	192	Guineafowl	Helmeted	Numida	meleagris	27.3	3	2015-02-20	0.0	0	-
57	171	Harrier-Hawk	African	Polyboroides	typus	9.1	1	2010-11-30	0.0	0	-
58	55	Heron	Black-headed	Ardea	melanocephala	72.7	8	2015-02-20	0.0	0	-
59	57	Heron	Purple	Ardea	purpurea	18.2	2	2011-09-24	0.0	0	-
60	418	Hoopoe	African	Upupa	africana	45.5	5	2012-09-28	0.0	0	-
61	81	Ibis	African Sacred	Threskiornis	aethiopicus	9.1	1	2010-11-09	0.0	0	-
62	84	Ibis	Hadada	Bostrychia	hagedash	100.0	11	2017-01-30	0.0	0	-
63	82	Ibis	Southern Bald	Geronticus	calvus	18.2	2	2012-09-28	0.0	0	-

	Ref	Common group	Common species	Genus	Species	FP (RR%)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
64	395	Kingfisher	Giant	Megaceryle	maxima	9.1	1	2010-11-30	0.0	0	-
65	397	Kingfisher	Malachite	Corythornis	cristatus	9.1	1	2017-01-30	0.0	0	-
66	394	Kingfisher	Pied	Ceryle	rudis	9.1	1	2010-11-30	0.0	0	-
67	130	Kite	Black-winged	Elanus	caeruleus	45.5	5	2012-09-28	25.0	1	2019-04-16
68	129	Kite	Yellow-billed	Milvus	aegyptius	9.1	1	2015-02-20	0.0	0	-
69	247	Lapwing	African Wattled	Vanellus	senegallus	36.4	4	2015-02-20	0.0	0	-
70	245	Lapwing	Blacksmith	Vanellus	armatus	36.4	4	2012-11-17	0.0	0	-
71	242	Lapwing	Crowned	Vanellus	coronatus	18.2	2	2017-01-30	0.0	0	-
72	488	Lark	Red-capped	Calandrella	cinerea	27.3	3	2011-09-24	0.0	0	-
73	458	Lark	Rufous-naped	Mirafra	africana	90.9	10	2017-01-30	0.0	0	-
74	703	Longclaw	Cape	Macronyx	capensis	36.4	4	2015-02-20	0.0	0	-
75	823	Mannikin	Bronze	Spermestes	cucullata	18.2	2	2017-01-30	0.0	0	-
76	510	Martin	Banded	Riparia	cincta	18.2	2	2015-02-20	0.0	0	-
77	509	Martin	Brown-throated	Riparia	paludicola	18.2	2	2012-11-17	0.0	0	-
78	210	Moorhen	Common	Gallinula	chloropus	9.1	1	2011-09-24	0.0	0	-
79	390	Mousebird	Speckled	Colius	striatus	72.7	8	2017-01-30	0.0	0	-

	Ref	Common group	Common species	Genus	Species	FP (RR %)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
80	373	Nightjar	Fiery-necked	Caprimulgus	pectoralis	45.5	5	2017-01-30	0.0	0	-
81	521	Oriole	Black-headed	Oriolus	larvatus	81.8	9	2017-01-30	0.0	0	-
82	311	Pigeon	Speckled	Columba	guinea	63.6	7	2017-01-30	0.0	0	-
83	692	Pipit	African	Anthus	cinnamomeus	63.6	7	2015-02-20	0.0	0	-
84	10877	Pipit	Nicholson's	Anthus	nicholsoni	9.1	1	2009-12-06	0.0	0	-
85	238	Plover	Three-banded	Charadrius	tricollaris	9.1	1	2010-11-09	0.0	0	-
86	1049	Prinia	Drakensberg	Prinia	hypoxantha	9.1	1	2009-12-06	0.0	0	-
87	649	Prinia	Tawny-flanked	Prinia	subflava	54.5	6	2017-01-30	0.0	0	-
88	712	Puffback	Black-backed	Dryoscopus	cubla	45.5	5	2012-11-17	0.0	0	-
89	189	Quail	Common	Coturnix	coturnix	18.2	2	2015-02-20	0.0	0	-
90	581	Robin-Chat	Cape	Cossypha	caffra	90.9	10	2017-01-30	0.0	0	-
91	511	Saw-wing	Black (Southern Africa)	Psalidoprocne	pristoptera holomelas	9.1	1	2010-11-30	0.0	0	-
92	867	Seedeater	Streaky-headed	Crithagra	gularis	45.5	5	2012-11-17	0.0	0	-
93	786	Sparrow	Cape	Passer	melanurus	18.2	2	2015-02-20	0.0	0	-
94	784	Sparrow	House	Passer	domesticus	45.5	5	2017-01-30	0.0	0	-
95	4142	Sparrow	Southern Grey-headed	Passer	diffusus	81.8	9	2017-01-30	0.0	0	-

	Ref	Common group	Common species	Genus	Species	FP (RR%)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
96	788	Sparrow	Yellow-throated Bush	Gymnoris	superciliaris	18.2	2	2015-02-20	0.0	0	-
97	159	Sparrowhawk	Black	Accipiter	melanoleucus	9.1	1	2011-09-24	0.0	0	-
98	85	Spoonbill	African	Platalea	alba	9.1	1	2010-11-09	0.0	0	-
99	185	Spurfowl	Swainson's	Pternistis	swainsonii	63.6	7	2017-01-30	0.0	0	-
100	737	Starling	Cape	Lamprotornis	nitens	18.2	2	2010-11-30	0.0	0	-
101	746	Starling	Pied	Lamprotornis	bicolor	9.1	1	2009-12-06	0.0	0	-
102	745	Starling	Red-winged	Onychognathus	morio	63.6	7	2012-11-17	0.0	0	-
103	736	Starling	Violet-backed	Cinnyricinclus	leucogaster	18.2	2	2017-01-30	0.0	0	-
104	576	Stonechat	African	Saxicola	torquatus	36.4	4	2012-11-17	0.0	0	-
105	80	Stork	White	Ciconia	ciconia	18.2	2	2015-02-20	0.0	0	-
106	772	Sunbird	Amethyst	Chalcomitra	amethystina	90.9	10	2017-01-30	0.0	0	-
107	758	Sunbird	Greater Double-collared	Cinnyris	afer	9.1	1	2012-09-28	0.0	0	-
108	493	Swallow	Barn	Hirundo	rustica	63.6	7	2017-01-30	0.0	0	-
109	502	Swallow	Greater Striped	Cecropis	cucullata	81.8	9	2017-01-30	0.0	0	-
110	503	Swallow	Lesser Striped	Cecropis	abyssinica	18.2	2	2010-11-30	0.0	0	-
111	495	Swallow	White-throated	Hirundo	albigularis	100.0	11	2017-01-30	0.0	0	-

	Ref	Common group	Common species	Genus	Species	FP (RR %)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
112	384	Swift	Horus	Apus	horus	9.1	1	2010-11-30	0.0	0	-
113	385	Swift	Little	Apus	affinis	27.3	3	2017-01-30	0.0	0	-
114	383	Swift	White-rumped	Apus	caffer	18.2	2	2010-11-30	0.0	0	-
115	715	Tchagra	Black-crowned	Tchagra	senegalus	9.1	1	2010-11-30	0.0	0	-
116	305	Tern	Whiskered	Chlidonias	hybrida	9.1	1	2010-11-30	0.0	0	-
117	552	Thrush	Kurrichane	Turdus	libonyana	9.1	1	2017-01-30	0.0	0	-
118	1105	Thrush	Olive	Turdus	olivaceus	27.3	3	2012-11-17	0.0	0	-
119	686	Wagtail	Cape	Motacilla	capensis	81.8	9	2015-02-20	0.0	0	-
120	666	Warbler	African Yellow	Iduna	natalensis	27.3	3	2012-09-28	0.0	0	-
121	604	Warbler	Lesser Swamp	Acrocephalus	gracilirostris	36.4	4	2012-11-17	0.0	0	-
122	607	Warbler	Marsh	Acrocephalus	palustris	9.1	1	2015-02-20	0.0	0	-
123	599	Warbler	Willow	Phylloscopus	trochilus	45.5	5	2017-01-30	0.0	0	-
124	839	Waxbill	Blue	Uraeginthus	angolensis	9.1	1	2017-01-30	0.0	0	-
125	843	Waxbill	Common	Estrilda	astrild	45.5	5	2017-01-30	0.0	0	-
126	799	Weaver	Cape	Ploceus	capensis	72.7	8	2017-01-30	0.0	0	-
127	803	Weaver	Southern Masked	Ploceus	velatus	81.8	9	2017-01-30	25.0	1	2018-12-05

	Ref	Common group	Common species	Genus	Species	FP (RR %)	FP (n)	Latest FP	Adhoc (RR%)	Adhoc (n)	Latest Adhoc
128	791	Weaver	Spectacled	Ploceus	ocularis	72.7	8	2017-01-30	0.0	0	-
129	797	Weaver	Village	Ploceus	cucullatus	27.3	3	2015-02-20	0.0	0	-
130	1172	White-eye	Cape	Zosterops	virens	90.9	10	2017-01-30	0.0	0	-
131	846	Whydah	Pin-tailed	Vidua	macroura	54.5	6	2015-02-20	0.0	0	-
132	816	Widowbird	Fan-tailed	Euplectes	axillaris	72.7	8	2017-01-30	0.0	0	-
133	818	Widowbird	Long-tailed	Euplectes	progne	36.4	4	2017-01-30	0.0	0	-
134	813	Widowbird	Red-collared	Euplectes	ardens	45.5	5	2017-01-30	0.0	0	-
135	450	Woodpecker	Cardinal	Dendropicos	fuscescens	27.3	3	2015-02-20	0.0	0	-
136	453	Wryneck	Red-throated	Jynx	ruficollis	54.5	6	2012-09-28	0.0	0	-

Appendix 4: Historical reptile species records from the broader study area (VMUS).

#	Species code	Family	Scientific name	Common name	Red list category	Number of QDSs	Number of records	Last recorded
1	1460	Agamidae	Agama aculeata distanti	Distant's Ground Agama	Least Concern (SARCA 2014)	1	4	1979-02-26
2	4750	Colubridae	Dasypeltis scabra	Rhombic Egg-eater	Least Concern (SARCA 2014)	1	4	1979-02-26
3	3120	Cordylidae	Cordylus vittifer	Common Girdled Lizard	Least Concern (SARCA 2014)	1	3	1979-02-24
4	5260	Elapidae	Hemachatus haemachatus	Rinkhals	Least Concern (SARCA 2014)	1	2	1900-06-15
5	400	Gekkonidae	Lygodactylus ocellatus	Spotted Dwarf Gecko	Least Concern (SARCA 2014)	1	1	1900-06-15
6	510	Gekkonidae	Pachydactylus vansoni	Van Son's Gecko	Least Concern (SARCA 2014)	1	1	1900-06-15
7	3490	Gerrhosauridae	Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)	1	2	1900-06-15
8	1750	Lacertidae	Nucras lalandii	Delalande's Sandveld Lizard	Least Concern (SARCA 2014)	1	3	1984-02-13
9	4130	Lamprophiidae	Aparallactus capensis	Black-headed Centipede-eater	Least Concern (IUCN 2021)	1	4	1979-02-26
10	2080	Scincidae	Acontias plumbeus	Giant Legless Skink	Least Concern (SARCA 2014)	1	1	1900-06-15
11	2520	Scincidae	Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	Least Concern (IUCN 2021)	1	2	1900-06-15
12	2310	Scincidae	Trachylepis capensis	Cape Skink	Least Concern (SARCA 2014)	1	3	1979-02-24
13	2450	Scincidae	Trachylepis punctatissima	Speckled Rock Skink	Least Concern (SARCA 2014)	1	4	1979-02-24
14	2480	Scincidae	Trachylepis varia sensu lato	Common Variable Skink Complex	Least Concern (SARCA 2014)	1	4	1979-02-24
15	3910	Typhlopidae	Afrotyphlops bibronii	Bibron's Blind Snake	Least Concern (IUCN 2022)	1	4	1979-03-05
16	5410	Viperidae	Bitis arietans arietans	Puff Adder	Least Concern (SARCA 2014)	1	3	1900-06-15
17	5390	Viperidae	Causus rhombeatus	Rhombic Night Adder	Least Concern (SARCA 2014)	1	1	1900-06-15
	Total					**17**	**46**	**1979-02-24*** **1900-06-15****

MINING RIGHT APPLICATION

WASTE CLASSIFICATION REPORT

Waste Classification Report for Coal Mining Right operation on portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, under the Magisterial District of Mkhondo (Piet Retief), Mpumalanga Province.

NOTRE Coal

REPORT PREPARED BY:

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DMRE REF NO: MP 305/1/2/2/10384 MR

Report Credentials.

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Project details

Report type	**Waste Classification report for a mining right application**
Project title	Waste Classification report for coal mining right operation on portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, in Magisterial district of Mkhondo (Piet Retief), Mpumalanga province.
Mineral (s)	Coal Resources
Client	Notre Coal (Pty) Ltd
Site location	Portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, in Magisterial district of Mkhondo (Piet Retief), Mpumalanga Province, South Africa.
Version	1
Date	27 February 2023

Electronic signatures

Compiled by	Valentine Mhlanga (EAP Intern) Singo consulting (Pty) Ltd
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Final review and approval	Dr. Kenneth Singo (Principal Consultant of Singo Consulting (Pty) Ltd)

Table 1: Critical Report Information

Critical Information incorporated within the Hydrological Study:	Relevant section in report
Details of the specialist who prepared the report	Appendix A, P: 38
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A, P: 38
Project Background Information, including the proposed activities description	Introduction, P: 8
An indication of the scope of, and the purpose for which, the report was prepared	Introduction, P: 8
An indication of the quality and age of base data used for the specialist report	Legal Framework, P: 19
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Waste Classification, P: 21
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Refer to the BAR
A description of the methodology implemented in preparing the report or carrying out the specialised process comprehensive of equipment and modelling used;	Methodology, P: 21
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;	Refer to the BAR
An identification of any areas to be avoided, including buffers	Refer to the BAR
A map overlaying the proposed activity including the associated infrastructures on the environmental sensitivities of the site including containing buffer zones	Background, P: 8
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	ARD Assessment, P: 33
Any mitigation and conditions measures for inclusion in the EMPr	Disposal of material, P: 25
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Recommendations, P: 36
An analytic opinion as to whether the proposed activity or portions thereof should be Authorised-i.e. specific recommendations	Recommendations, P: 36
Regarding the acceptability of the proposed activity or activities; and	Refer to the 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	Refer to the BAR
A description of any consultation process that was undertaken during carrying out the study	Refer to the BAR
Any triggered Water Uses according to section 21 of the National Water Act 36, 1998.	
Any other information requested by the competent authority.	None

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2. INTRODUCTION

1.1 Background Information

Singo consulting (Pty) Ltd was appointed by Notre Coal (Pty) Ltd to conduct a comprehensive Waste Classification study for the mining right which entails the prediction of the potential impacts that may arise from the proposed mining operations on Portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, in Magisterial district of Mkhondo (Piet Retief), Mpumalanga Province, South Africa. The purpose of this study is to evaluate and classify waste within the proposed study area to make it easier to determine and recommend how the waste should be disposed and stored during and after the life of the mine.

1.2 Project Background Information

Singo Consulting (Pty) Ltd was appointed by Mamokebe investments (Pty) Ltd (Herein referred to as Mamokebe investments) to compile a specialist waste classification report, providing the waste information that may be generated by the mining activities required for the mine to fully comply with environmental authorization stipulated conditions.

The locality map created by the QGIS illustrates the location of the proposed area, it is situated on Portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, in Magisterial district of (Mkhondo) Piet Retief, Mpumalanga Province, South Africa. The project site as seen in is identified with red boundary. The project area is situated approximately 18,9 km Southwest of Piet Retief, approximately 19.5 km northeast of Driefontein, approximately 22 km northeast from Dirkiesdorp, approximately 2.1km east of Etshondo Primary School, approximately 4.87 km southeast of Matafuleni Community, approximately 9 km east of KwaNgema Clinic, approximately 14.1 km southeast of Estheni Primary School and approximately 9.2 km southeast of Ngema Tribal Trust.

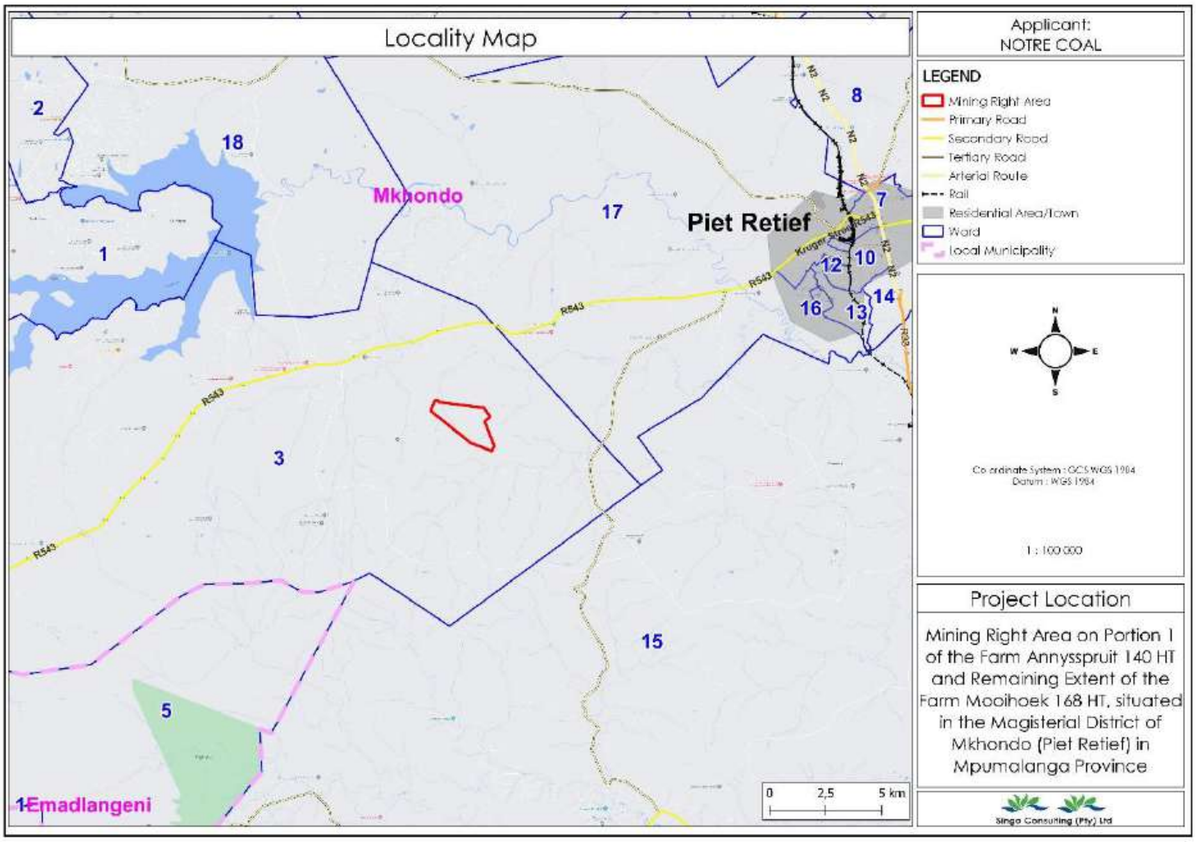


Figure 1: Locality Map of the project area (Singo Consulting (Pty) Ltd 2023)

1.3 Scope of Work

Residue stockpiles have to be characterised to identify any potential risk to health or safety hazard and environmental impact that may be associated with the residue when stockpiled or deposited at the site on a mining operation. The classification will be used to confirm the classification type (Type 0 to type 4) of the waste produced at the facility and to determine the type of containment barrier to be used for the waste management or waste treatment facility in accordance with the waste legislation.

The objectives of the waste assessment and classification study are as follows:

- To classify waste stockpiles according to SANS 10234 as per Waste Classification and Management Regulations (GN R634 of 23 August 2013)
- To assess waste stockpiles as per National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R635 of 23 August 2013).

The scope of work for a Waste Classification will entail the following:

Step 1: Review available information

Step 2: Site Visits

Step 3: Conduct sampling of geological materials and mine wastes from the core.

Step 4: Conduct laboratory analysis of samples; and

Step 5: Waste classification and assessment according to GN R.634 and GN R. 635 and reporting.

1.4 Problem statement

Mining activity is most common among different activities taking place in many developing countries. Small scale as well as large scale operations is indwelling troublesome to the environment, which results in the production of waste in large quantities that can have adverse effects for decades. Some common activities as well as stages of mining have probably inauspicious effects on the natural environment along with the society and cultural heritage and other issues like health as well as safety of the mine workers (Kitula, 2005).

Mining areas are considered as an environmental threat all around the world. As the mining activities has been ceased, the main cause of acid mine runoffs are disintegration of sulphide ore metals when comes in contact with oxygen (Gerhardt et al., 2005). Mining minerals such as gold, copper as well as nickel are related with the problems of acid mine drainage which results in the long- term deterioration to water inlet and biodiversity.

3. Sample description and analytical plan

2.1 Sampling plan

The site familiarization visits and waste sampling at Notre Coal (Pty) Ltd was conducted by Environmental Specialists from Singo Consulting (Pty) Ltd and taken to Water Lab Laboratory in Pretoria. Four (4) samples were collected from the proposed mining right area.

The sampling for each waste consisted of:

- Identifying and selecting areas to collect discrete samples.
- Use of a small hand spade to sample the waste material core from the exploration boreholes within the project area.
- Geo-referencing sampling locations and taking photographs of the discrete samples and source area; and
- Compositing the discrete samples to create a composite sample for each waste. Plastic bags were filled with 2kg composite samples and labelled appropriately.

The potential contamination source areas that were sampled and number of samples collected during the sampling event are indicated in Table 2

Table 2: Waste Material Sampled

Source Area	Material
Portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, Borehole Log	Rf-CN-SM-1.44m
Portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, Borehole Log	Sample 3
Portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, Borehole Log	Coal Sample
Portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, Borehole Log	Sample 4

The samples were transported to Water Lab (Pty) Ltd in Pretoria, a SANAS accredited laboratory for analysis. Waste sampling took place at the project area from Portion 1 of the

farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT, Borehole Log, Borehole Log on site.

Figure 2: Waste Sampling pictures at the project area

2.2 Analytical plan

The following laboratory analyses were carried out on the composite samples:

- Determination of total elemental composition of all waste samples. This included analysis of major elements by XRF and multi-acid digestion followed by analysis of trace elements by ICP; and
- ASLP (deionised 1:20 solid to liquid ratio) extraction, specified for non-putrescible mono disposed waste material, with the leachates analysed for pH, TDS, EC, major cations, major anions and trace elements.

4. Geographical Setting

4.1 Topography

The topology of the area is illustrated below by Figure 3 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 of an area influences the location of the waste, the steeper the area is, the more likely the waste material will move towards the gentle slope, in essence topography in the case of the study influences erosion, which will lead to the waste being deposited in water resources.

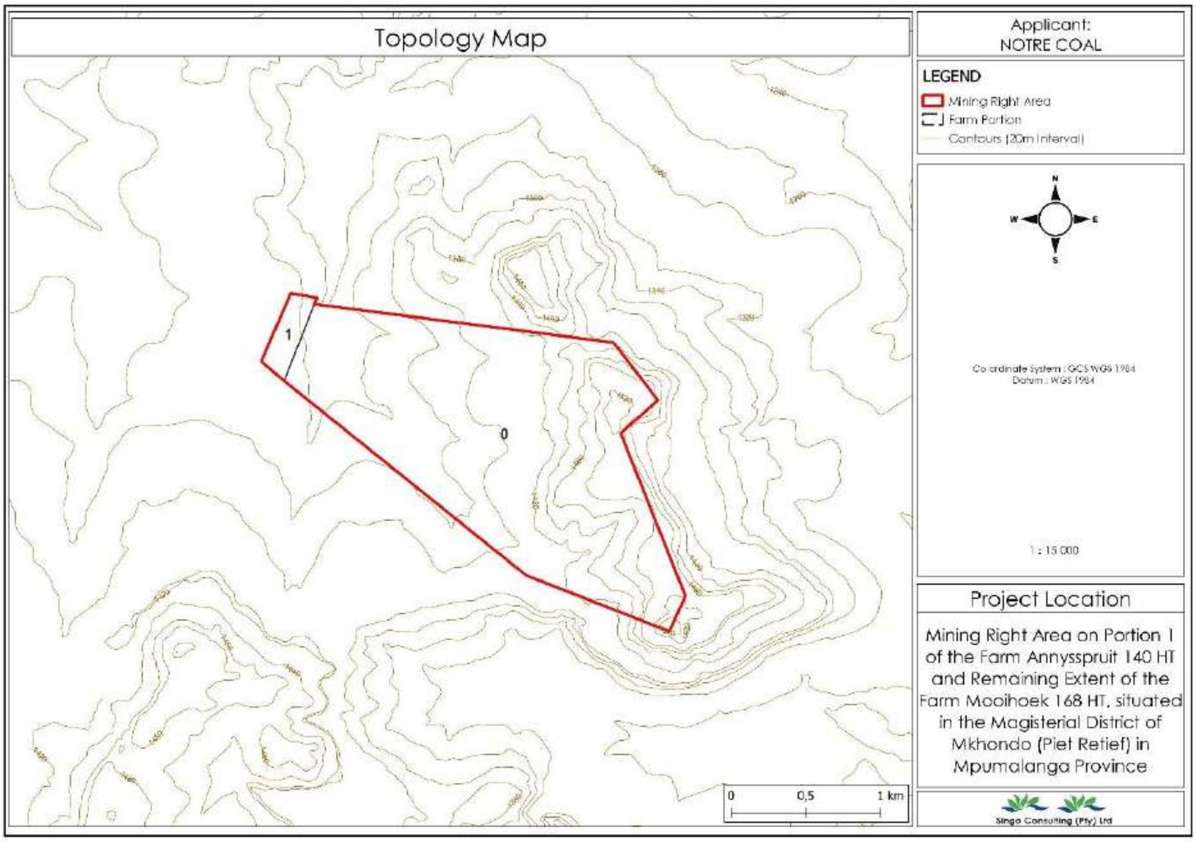


Figure 3: Topographical Map of the Study area (Singo Consulting (Pty) Ltd 2023)

3.2 Hydrology

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 within and nearby the project area:

- **Channeled Valley Bottom wetlands**
- **Seep wetlands**
- **Non-perennial**
- **Perennial**

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). Seep wetlands are defined as wetlands that occur in area where the groundwater reaches the surface, Non-Perennial rivers are rivers that flow only in certain occasions, perennial rivers are rivers that flow all year round.

The hydrology of the study area shows the presence of water bodies, this enables the team to understand where to locate the waste in such a manner that does not harm the water bodies on site. The waste material which will be produced during the mining process not only affect the water, but aquatic lives as well, soil and people, directly and indirectly.

There will be procedures and guidelines put in place for this project to avoid the risk of waste from negatively affecting water, soil, and people within the area, such as ensuring strict management of waste material and buffering of 100 m. It will be advised on more mitigation measures to ensure the waterbodies as seen on the hydrology map are not contaminated. As shown in Figure 5, a 100m buffer will be applied around the water bodies present within the mining right area.

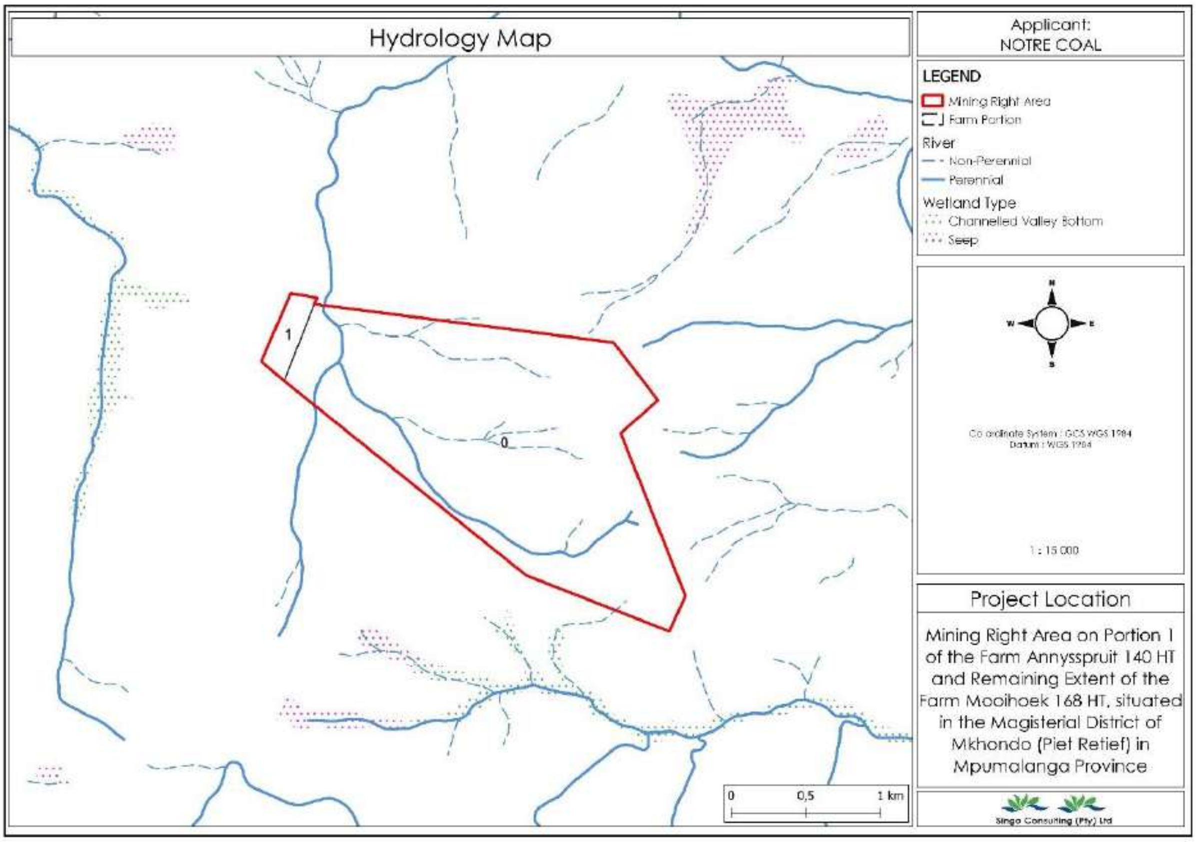


Figure 4: Hydrological Map of the Study area (Singo Consulting (Pty) Ltd 2023)

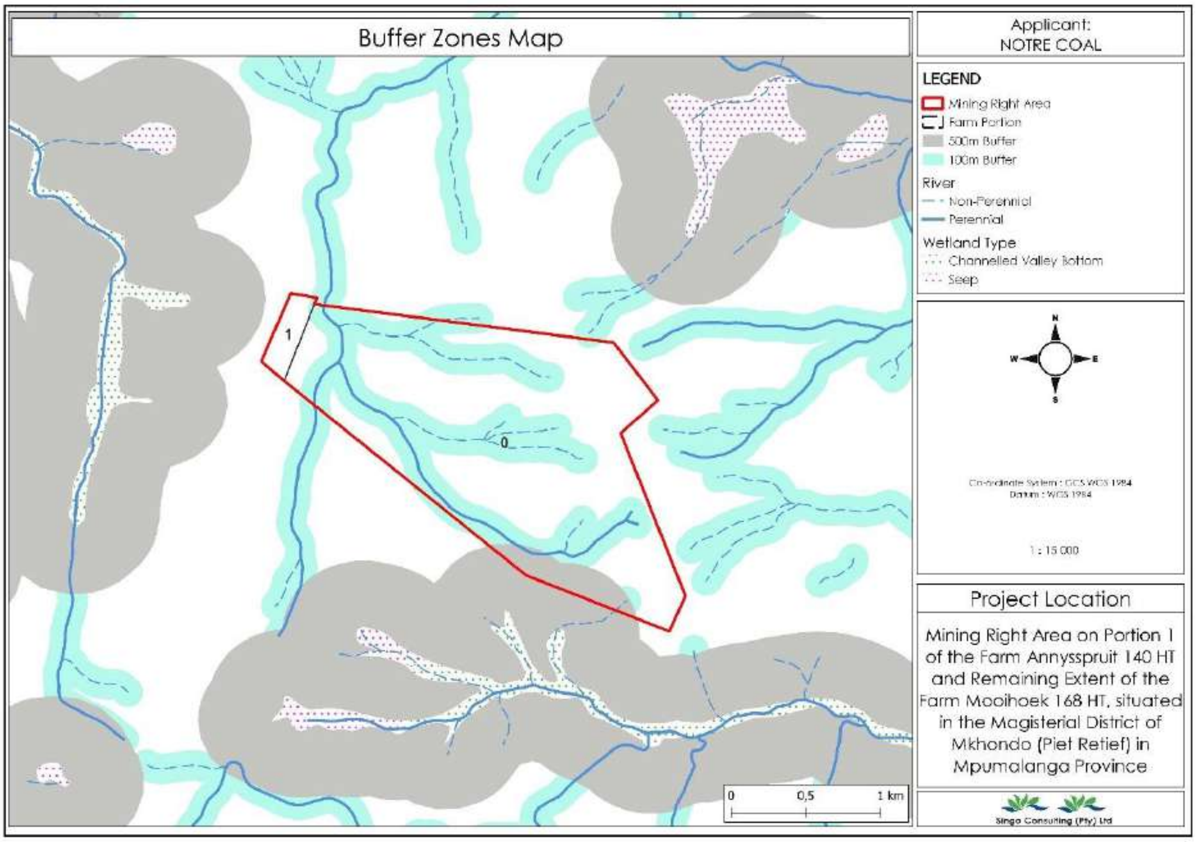


Figure 5: Buffer map of the waterbodies (Singo Consulting (Pty) Ltd 2023)

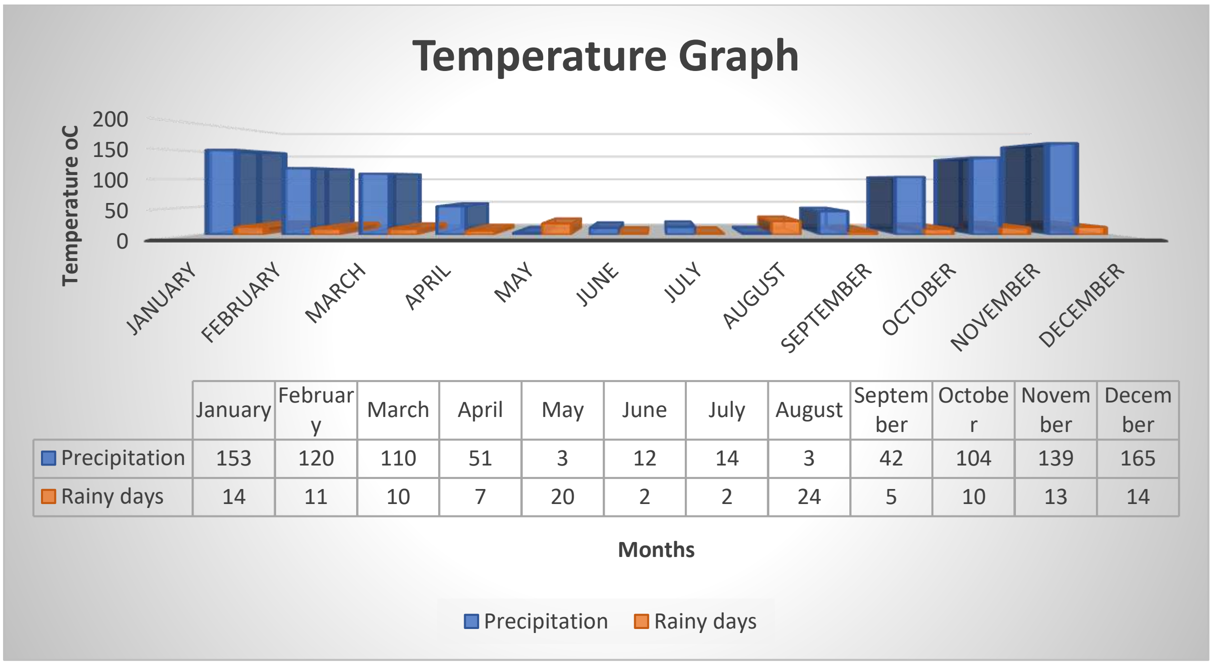
3.3 Climate

The climate here is mild, and generally warm and temperate. The summers are much rainier than the winters in Piet Retief. According to Köppen and Geiger, this climate is classified as Cwb. In Piet Retief, the average annual temperature is 16.1 °C. About 954 mm of precipitation falls annually. Precipitation is the lowest in June, with an average of 12 mm. The greatest amount of precipitation occurs in December, with an average of 165 mm. At an average temperature of 19.5 °C, February is the hottest month of the year. The lowest average temperatures in the year occur in July, when it is around 11.0 °C. Between the driest and wettest months, the difference in precipitation is 153 mm. The variation in temperatures throughout the year is 8.4 °C.

The climate of the study area which influences the wind speed and direction is equally important in waste classification report, this is based on the fact that waste movement will be affected by how often there is precipitation in the area, the average speed of the wind will influence erosion and carry it to the nearest undesirable area.

4.1.1 Temperature

The effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume may rise) and the development of the mixing and inversion layers are both determined by air temperature. During the summer, the temperature around the mine is warm to hot, while during the winter, it is chilly. Below The mean minimum annual temperature for the proposed project area ranges from -1.9 – 0 ᵒC and from 0.1 ᵒC to 2 ᵒC as seen in Figure 7 below.



	January	February	March	April	May	June	July	August	September	October	November	December
🟦 Precipitation	153	120	110	51	3	12	14	3	42	104	139	165
🟧 Rainy days	14	11	10	7	20	2	2	24	5	10	13	14

Figure 6: Temperature graph of the study area

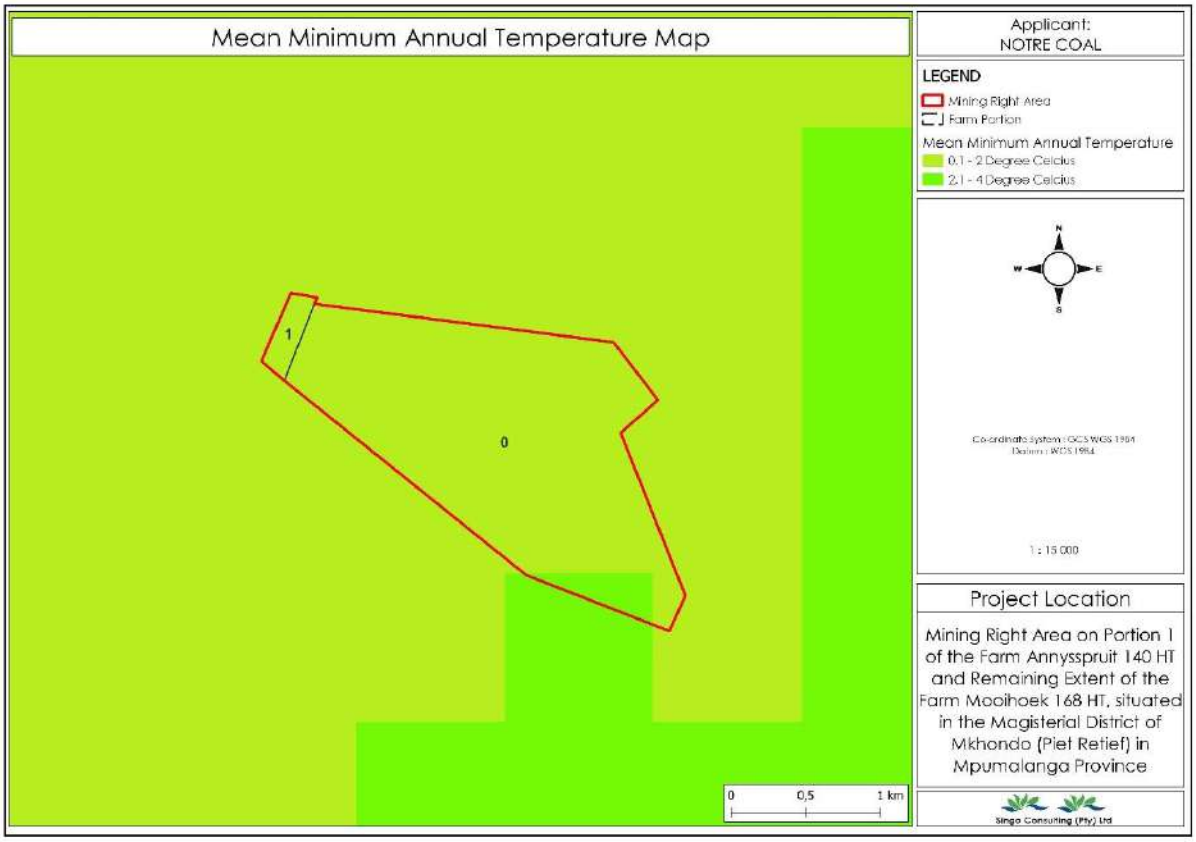
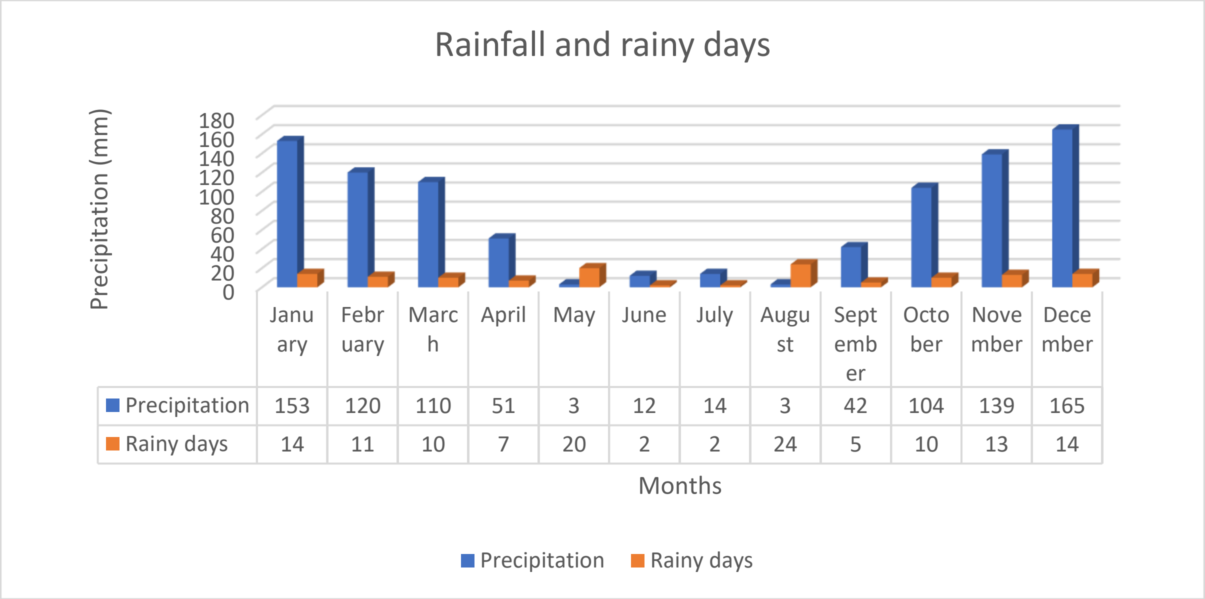


Figure 7: Annual Temperature ranges (Singo Consulting (Pty) Ltd 2023)

4.1.2 Rainfall

The proposed project area receives mean annual rainfall range from 601 mm to 800 mm as indicated in Figure 9 below.



	January	February	March	April	May	June	July	August	September	October	November	December
Precipitation	153	120	110	51	3	12	14	3	42	104	139	165
Rainy days	14	11	10	7	20	2	2	24	5	10	13	14

Figure 8: Precipitation graph

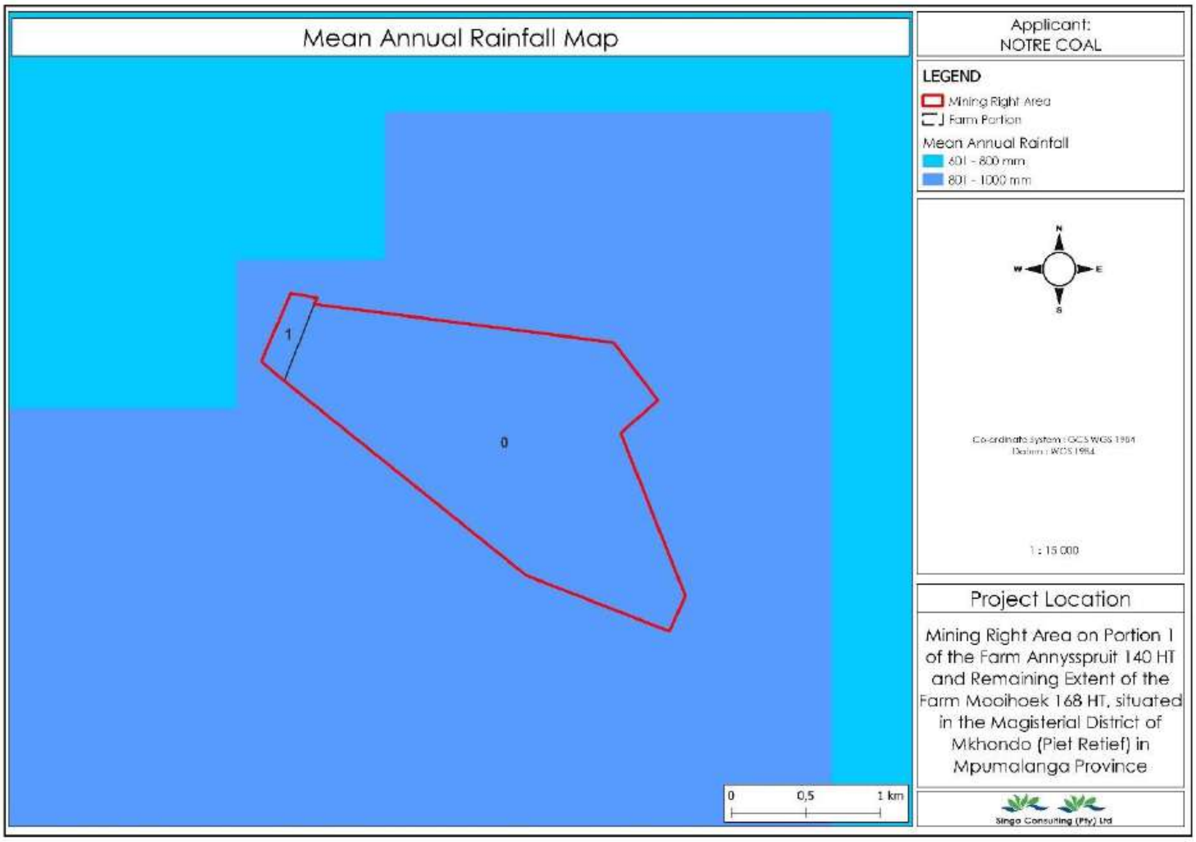


Figure 9: Mean annual rainfall of the project area (Singo Consulting (Pty) Ltd 2023)

3.4 Geology

3.4.1 Regional Geology

Barberton Greenstone Belt

The Barberton Greenstone Belt is one of the best-studied granite-greenstone terranes in the world because: 1. It is one of the three oldest (i.e., mid-Archaean) greenstone belts known; 2. It comprises a unique sequence of some of the best-preserved, first-formed lithologies on the planet; and 3. It has served as a general working model of Archaean greenstone geology world-wide. It has also, directly and indirectly, assisted with advances in understanding primaeval life forms and the crustal and geochemical development of the early Earth (e.g., Schopf, 1974; Anhaeusser, 1978a).

Windley, 1984; De Wit et al., 1982, 1992c; Taira et al., 1992). The BGB was first studied by Hall (1918) and later by Visser (1956) owing to its emergence as an important gold-producing district. The BGB, occupying an area of 120 x 50 km, is situated south and southeast of Nelspruit and is a strongly folded, ENE-trending, mid-Archaean (3600–3100 Ma), volcano sedimentary remnant, entirely surrounded by a variety of granitoids of the Kaapvaal Craton (Anhaeusser et al., 1981; Ward, 2000). Rocks of the BGB have been grouped stratigraphically into the Swaziland Supergroup (Anhaeusser, 1975), the Barberton Sequence (SACS, 1980), the Jamestown Ophiolite Complex (JOC) (De Wit et al., 1987a, 1992c) and, more recently, the Barberton Supergroup.

The Barberton Supergroup comprises three major lithostratigraphic units . In ascending order, these are: 1. The Onverwacht Group, consisting largely of ultramafic to mafic volcanic rocks; 2. The Fig Tree Group, comprising mainly greywacke, shale, chert and dacitic volcanic rocks; and 3. The Moodies Group, consisting of conglomerate, sandstone, siltstone and shale (Visser, 1956; Lowe and Byerly, 1999).

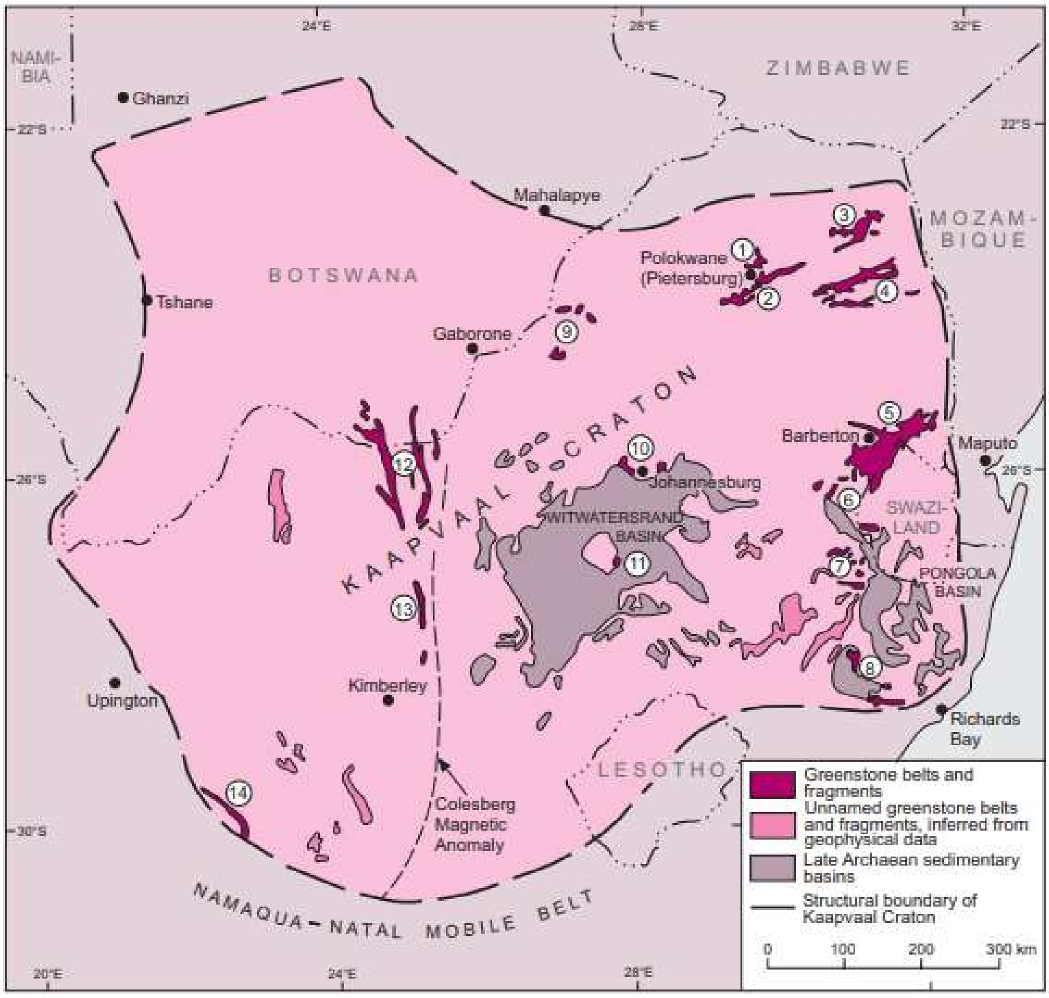


Figure 10: Geology of the Barberton Greenstone Belt (Source: Catuneanu et al., 1998; Hancox and Götz, 2014) indicating the suggested boundaries of the Kaapvaal Craton (Source: Bordy et al., 2004).

Karoo Supergroup

Within the regional geological framework of South Africa, the study area is situated within the Main Karoo Basin of the Karoo Supergroup Rocks of the Karoo Supergroup were deposited from the Late Carboniferous to Middle Jurassic eras, with coal seams deposited during the Permian period (Cairncross, 2001). Although there is still some debate the Main Karoo Basin is widely considered to be a retro-arc foreland system (Catuneanu et al., 1998; Johnson et al., 2006; Hancox and Götz, 2014). The Karoo aged sediments in South Africa were deposited mainly into two distinct tectonic environments. The first being sediments deposited into the Main Karoo Basin (where compressional tectonic stresses were dominant) and the second being sediments deposited into fault-bound basins to the north of the Main Karoo Basin (where rifting and extensional tectonic stresses were dominant)(Hancox and Götz, 2014).

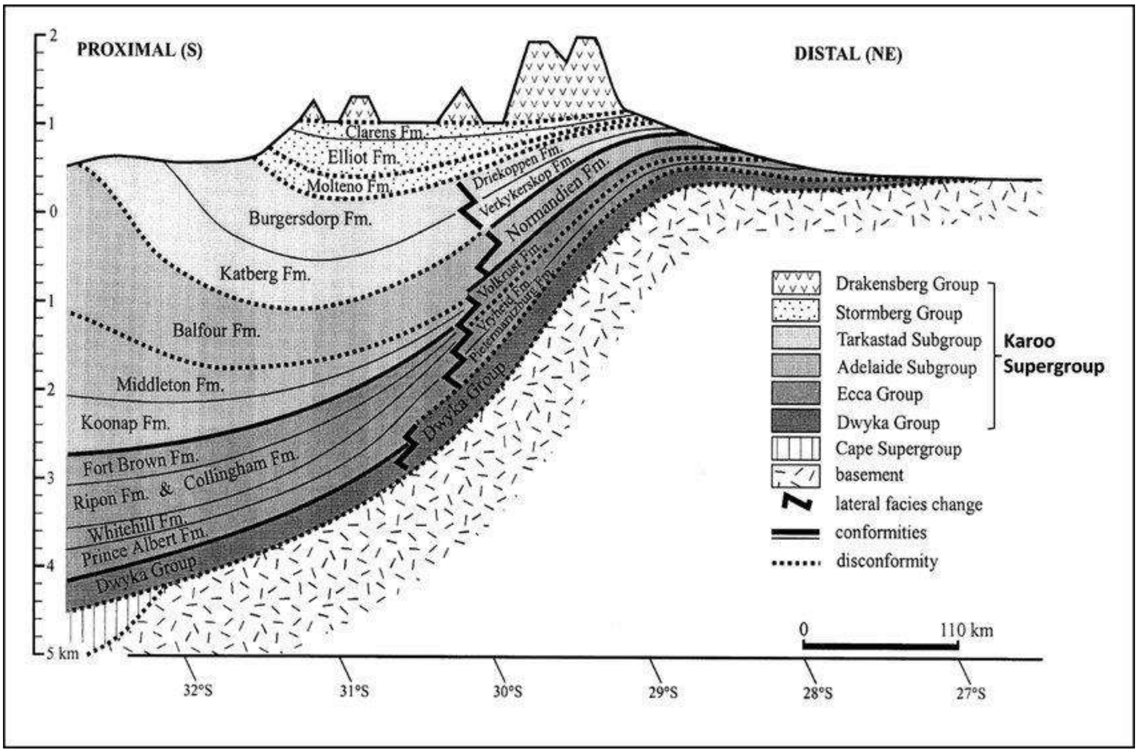


Figure 11: Karoo supergroup succession

3.4.2 Local

Vryheid Formation.

The majority of the economically extracted coal in South Africa occurs in rocks of the Vryheid Formation, which ranges in thickness in the MKB from less than 70.0 m to over 500.0 m. It is thickest to the south of the towns of Newcastle and Vryheid, where maximum subsidence took place (Du Toit, 1918; Cadle, 1975; Whateley, 1980a; Stavrakis, 1989; Cadle et al., 1982) and where the basin was the deepest. The thickness of the Dwyka Group also varies considerably depending on the nature of the underlying topography. It ranges from being thin or absent over the most prominent pre-Karoo topographic highs, to over 25 m thick in the central part of the Witbank Coalfield (Le Blanc Smith and Eriksson, 1979) to 30 m thick (Glasspool, 2003) in the deeper palaeo valleys. Le Blanc Smith and Eriksson (1979) note that the fill consists of poorly sorted matrix rich diamictites, laminated sandstones and siltstones, stratified pebbly mudstones.

Diabase

East to west striking post-Transvaal Sequence age diabase dykes traverses across the extreme southern portion of the site. The Diabase formation is exposed just along the Heyshope dam in the north-western direction, slightly intruding into the overwatch Group of the Barberton greenstone belt. The diabase formation occurs in small patches over the project area.

Karoo dolerite Suite

on Figure 12 of the geological map of the lithologies in the study area, the karoo dolerite suite, which is mostly dolomite rocks, these are rocks that compose calcium Carbonate ($CaCo_3$) and more prone to dissolution. The area covered by these rocks is shown by white and black patches on the geological map. It is exposed on the northern most part of the study area, which on the surface is mostly plantation as observed on site. The boundary of the formation is along the alluvium, onverwatch group and the Pietermaritzburg formation.

Onverwatch Group

Onverwatch Group is part of the Barberton Greenstone Belt (BGB). On the study area, this group is exposed mostly at the base of the Heyshope dam, in the northern part of the study area. The boundaries of the group are made by the contact of its rocks and Alluvium, intruded by the diabase formation and the karoo dolerite suite.

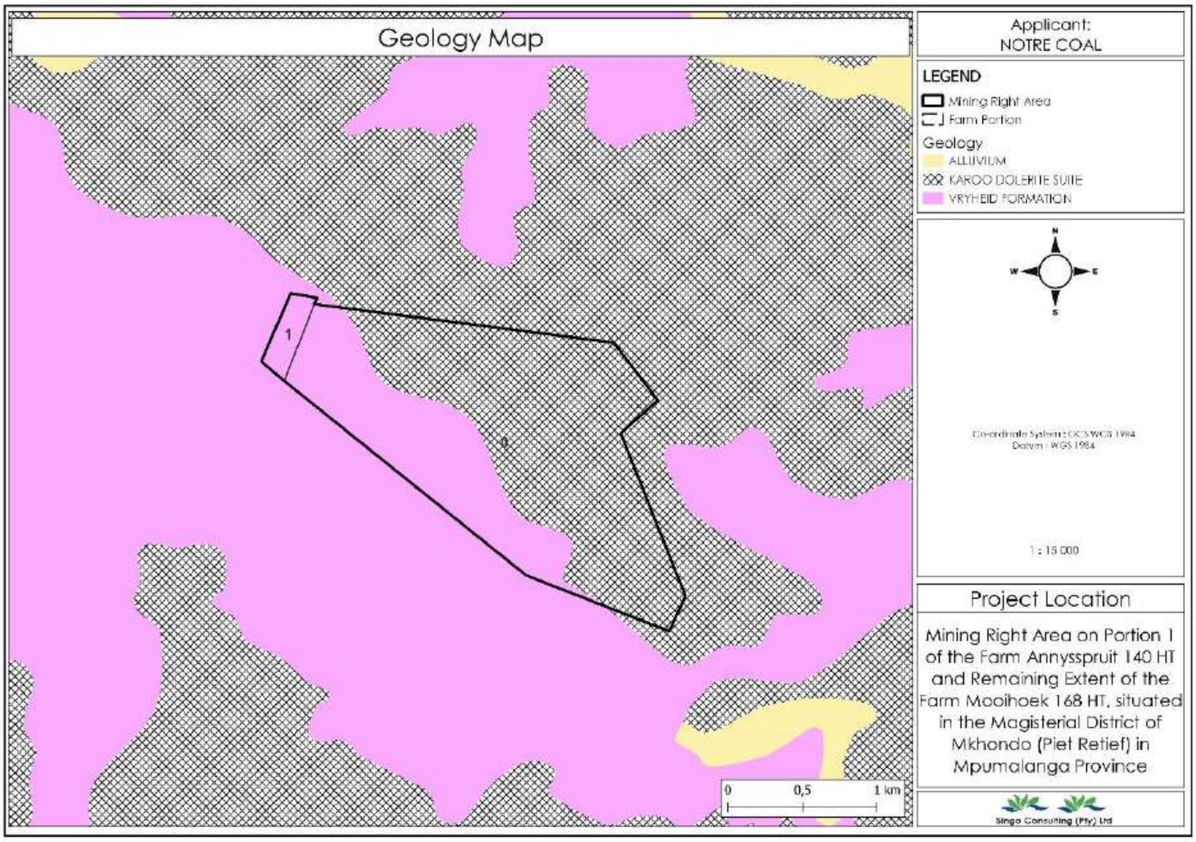


Figure 12: Geological map of the proposed project area (Singo Consulting (Pty) Ltd 2023)

5. Waste Classification

4.1 Legal framework

The classification and definitions herein considered the National Environmental Management: Waste Act 59 of 2008 (hereafter called NEMWA 59 of 2008). The waste classification was performed according to Government Notice 635 of the aforementioned act, titled: National Norms and Standards for the Assessment of Waste for Landfill Disposal (hereafter called GNR 635). The disposal of the waste is contained in Government Notice 636 of the waste act, titled: National Norms and Standards for Disposal of Waste to Landfill (hereafter called GNR 636).

4.2 Schedule 3 defined waste

4.2.1 Category A: Hazardous waste

Any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical, or toxicological characteristics of that waste, have a detrimental impact on health and the environment. Hazardous wastes are those that may contain toxic substances generated from industrial, hospital, some types of household wastes. These wastes could be corrosive, inflammable, explosive, or react when exposed to other materials. Some hazardous wastes are highly toxic to environment including humans, animals, and plants. Wastes are classified as hazardous if they exhibit one or more of ignitability, corrosively, reactivity, or toxicity. According to Resource Conservation and Recovery Act (RCRA), hazardous wastes are defined as any waste or combination of wastes which pose a substantial present or potential hazard to human health or living organisms because such wastes are non-degradable or persistent in nature or because they can be biologically magnified, or because they can be lethal, or because they may otherwise cause or tend to cause detrimental cumulative effects.

In terms of mine residue waste, this is included under Schedule 3, Category A:

- “**Residue deposits**” means any residue stockpile remaining at the termination, cancellation, or expiry of a prospecting right, mining right, mining permit, exploration right or production right.
- “**Residue stockpile**” means any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated within the

mining area for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or, production right or an old order right, including historic mines and dumps created before the implementation of this Act.

Hazardous wastes must be deposited in so-called secure landfills, which provide at least 3 metres of separation between the bottom of the landfill and the underlying bedrock or groundwater table. A secure hazardous-waste landfill must have two impermeable liners and leachate collection systems. The double leachate collection system consists of a network of perforated pipes placed above each liner. The upper system prevents the accumulation of leachate trapped in the fill, and the lower serves as a backup. Collected leachate is pumped to a treatment plant. In order to reduce the amount of leachate in the fill and minimize the potential for environmental damage, an impermeable cap or cover is placed over a finished landfill.

Hazardous wastes that are not destroyed by incineration or other chemical processes need to be disposed of properly. For most such wastes, land disposal is the ultimate destination, although it is not an attractive practice, because of the inherent environmental risks involved. Two basic methods of land disposal include landfilling and underground injection. Prior to land disposal, surface storage or containment systems are often employed as a temporary method.

4.2.2 Category B: General waste

General waste means waste that does not pose an immediate hazard or threat to health or to the environment, and includes-

a) domestic waste;

b) building and demolition waste;

c) business waste;

d) inert waste;

e) any waste classified as non-hazardous waste in terms of the regulations made under section 69, and includes non-hazardous substances, materials or objects within business, domestic, inert, building and demolition wastes.

“inert waste” means waste that:

a) Does not undergo any significant physical, chemical or biological transformation after disposal;

b) Does not burn, react physically or chemically biodegrade or otherwise adversely affect any other matter or environment with which it may come into contact;

c) Does not impact negatively on the environment, because of its pollutant content and because the toxicity of its leachate is insignificant.

4.3 Waste Classification

4.3.1 Methodology

SANS 10234 Classification

According to section 4(2) of GN R.634 of 2013, all waste generators must ensure that their waste is classified in accordance with SANS 10234 within 180 days of generation, except if it is listed in Annexure 1 of the GN R.634. Furthermore, waste must be re-classified every 5 years. Waste classification according to SANS 10234 (based on the Global Harmonized System) indicates physical, health and environmental hazards. The SANS 10234 covers the harmonized criteria for classification of potentially hazardous substances and mixtures, including wastes, in terms of its intrinsic properties/hazards.

The chemical test results and based here on the intrinsic properties of the waste streams were used for the SANS 10234 classification. Constituents present in concentrations exceeding 1% are used for classification in terms of health hazards, except when the constituent is known to be toxic at lower concentrations (carcinogens etc.). Environmental hazard is based on toxicity to the aquatic ecosystem and distinguish between acute and chronic toxicity, bioaccumulation and biodegradation.

The method used for the classification of waste, as given under the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GNR 635), comprises the determination of a Risk Profile for the waste, by following the prescribed testing and leach testing procedures. The results must be assessed against the threshold levels for Leachable (LCT) and Total Concentrations (TCT) which, in combination, determine the Risk Profile of the waste as set out below.

The threshold values and waste types are documented in GNR 635:

- Type 4 Waste: wastes with all determinant concentrations below the LCT0 and TCT0 values.
- Type 3 Waste: wastes with any determinant concentration above the LCT0 but below the LCT1 value and all determinant concentrations below the TCT1 values.
- Type 2 Waste: wastes with any determinant concentration above the LCT1 but below the LCT2 values, and all determinant concentrations below the TCT1 values.

- Type 1 Waste: wastes with any determinant concentration above the LCT2 but below the LCT3 values, or above the TCT1 but below the TCT2 values; and
- Type 0 Waste: wastes with any determinant concentration above the LCT3 or TCT2 values.

Table 3: Waste type classification and landfill design

Total concentration threshold	Link between TCT and LCT	Leachable concentration threshold	Waste Type	Landfill design
< TCT0	and	< LCT0	Type 4	Class D
< TCT1	and	< LCT1	Type 3	Class C
< TCT1	and	< LCT2	Type 2	Class B
< TCT2	or	< LCT3	Type 1	Class A
> TCT2	or	> LCT3	Type 0	Not allowed

4.3.2 Classification results

4.3.2.1 Leachable Concentrations

The laboratory results of the four samples analysed through distilled water method at a ratio of 1:20.

The waste samples are classified as follows according to the LCT threshold:

- As per the chosen elements, no sample leached element with a value greater than LCTO threshold.

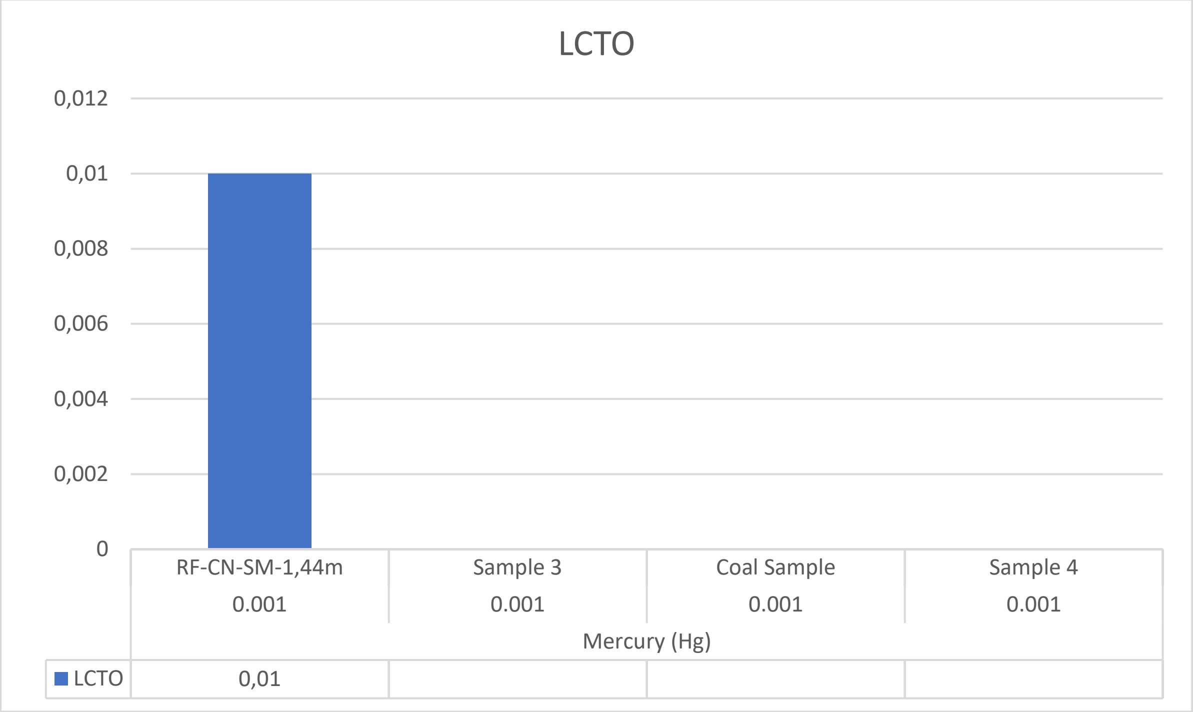


Figure 13: Mercury leachable concentration

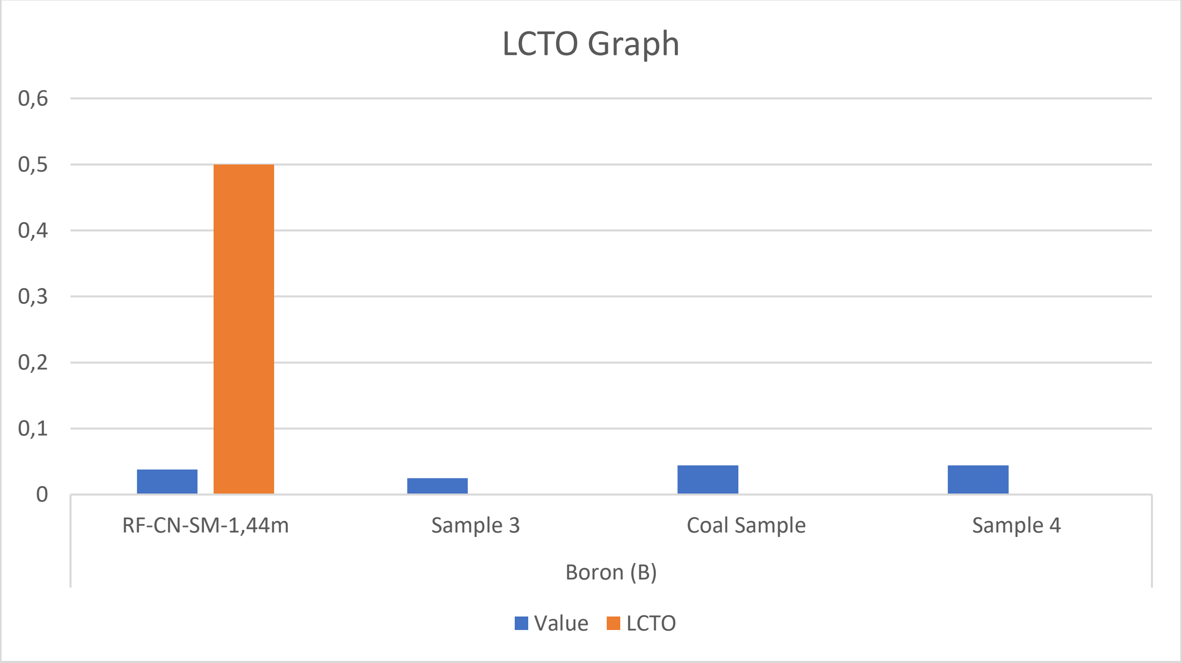


Figure 14: Leachable concentration of Boron

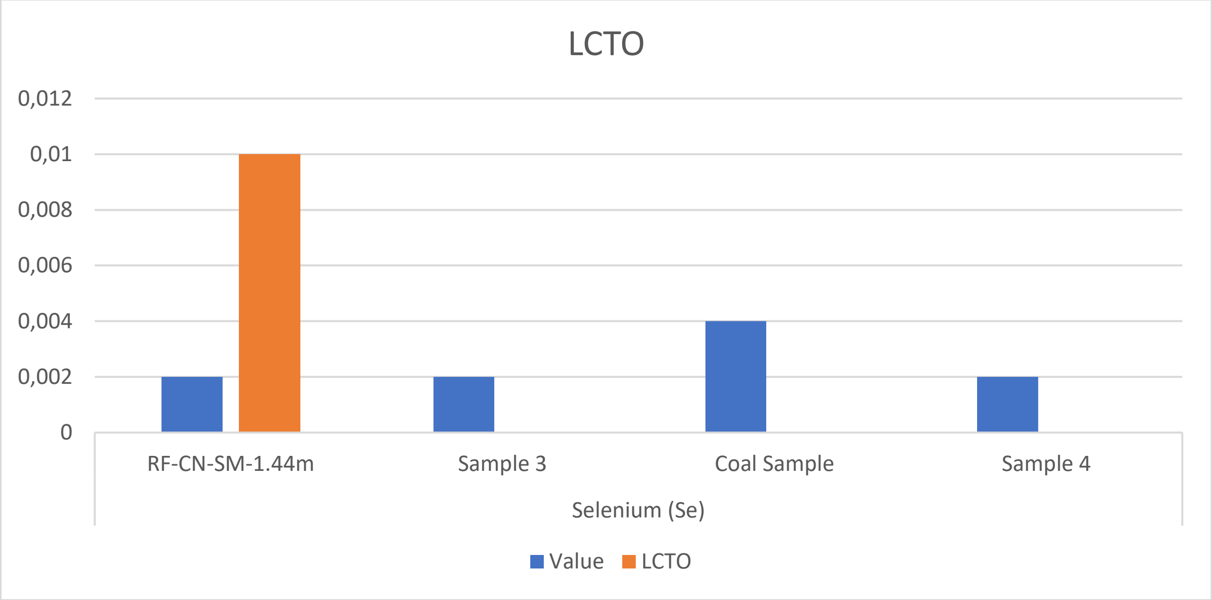


Figure 15: Leachable concentration of selenium

4.3.2.2 Total Concentration

The laboratory results of the four samples analysed shows the TCT thresholds of the four samples (RF-CN-SM-1.44m, Sample 3, Coal Sample, Sample 4).

The TC above TCT0 in the following samples:

➢ As per the chosen total concentrations of the elements analysed within the sample, Total concentration of Boron is higher than TCTO (mg/kg).

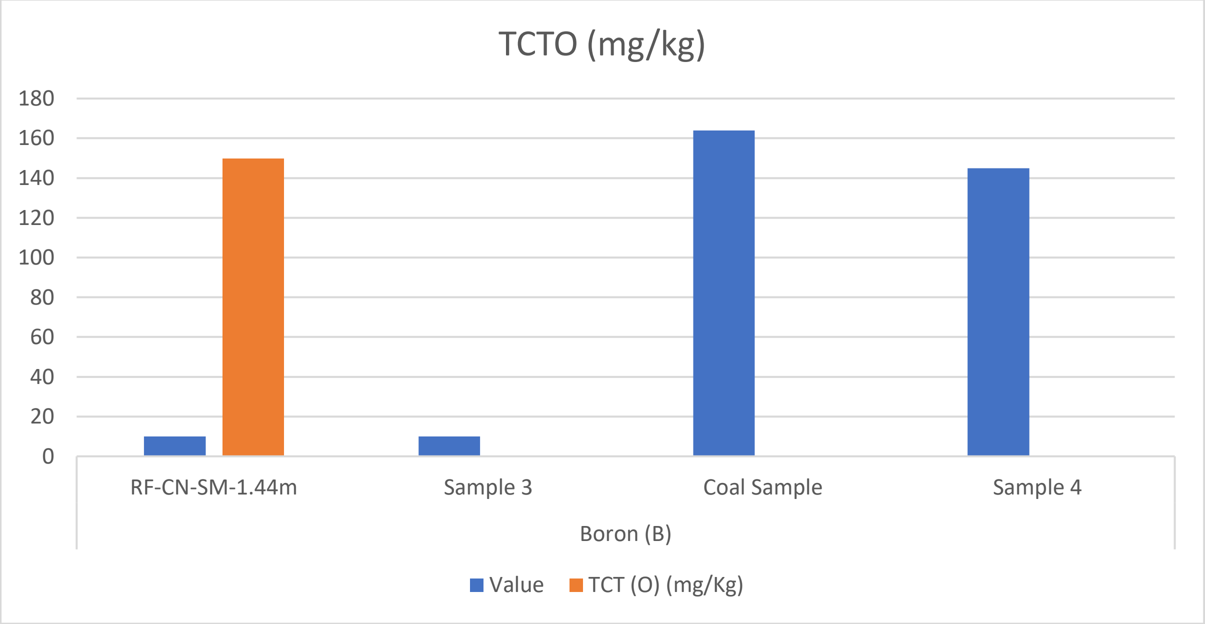


Figure 16: Total concentration of Boron in the samples

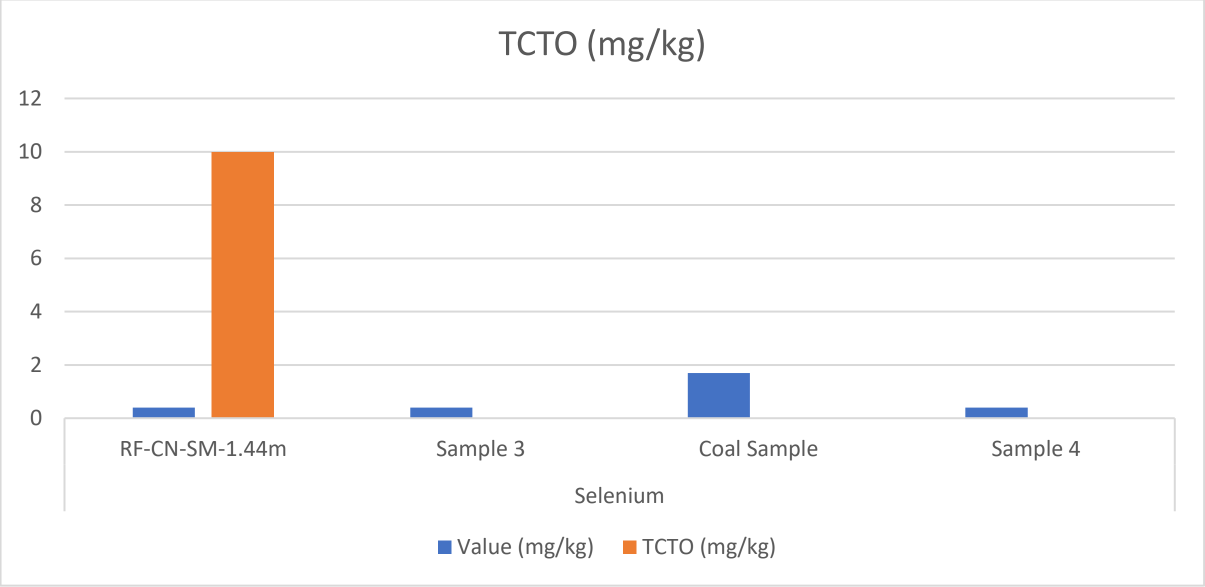


Figure 17: TCTO concentration of Selenium in the samples

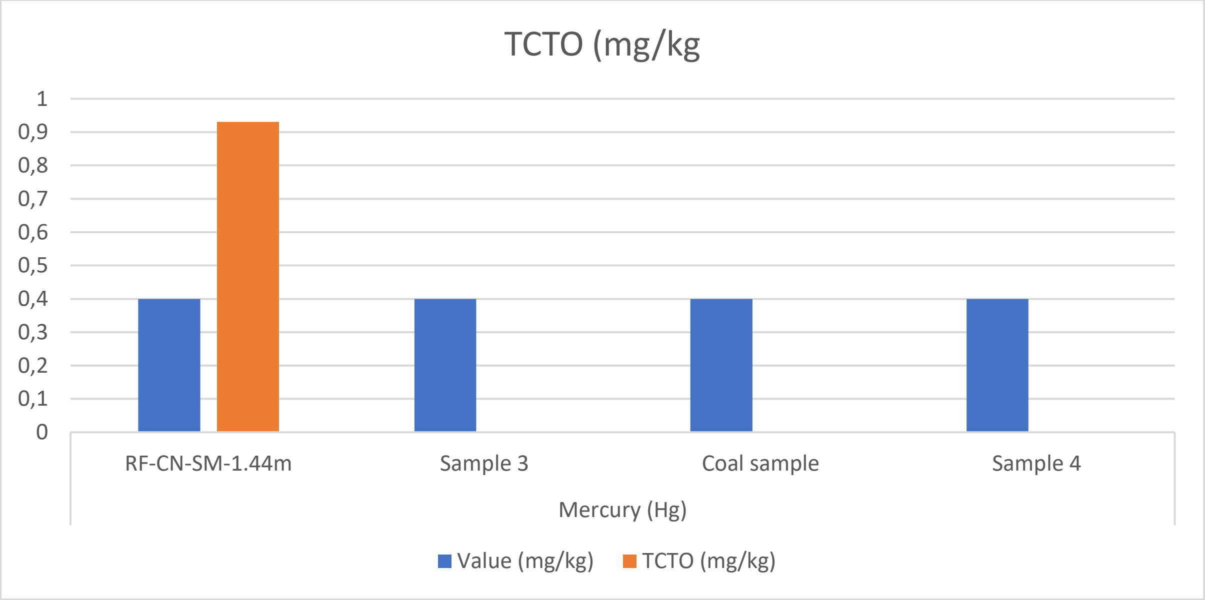


Figure 18: TCTO concentration of mercury in the sample

4.3.3 Waste types and Landfill designs

Table 4: Waste types and landfill design

Sample ID	Total concentration threshold	Link between TCT and LCT	Leachable concentration threshold	Waste Type	Landfill design
RF-CN-SM-1.44m	< TCT0	and	< LCT0	Type 4	Class D
Sample 3	< TCT 0	and	< LCT0	Type 4	Class D
Coal Sample	< TCT1	and	< LCT0	Type 3	Class C
Sample 4	< TCT0	and	< LCT0	Type 4	Class D

4.3.4. Disposal of material

The following relates to the disposal of the material according to GNR 635:

The Class C liner setup is depicted in

Figure 19 below. According to GNR 636: "Type 3 Waste may only be disposed of at a Class C landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a G: L: B+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (DWAF MR, 1998)" and Type 4 waste may be disposed at Class C landfill.

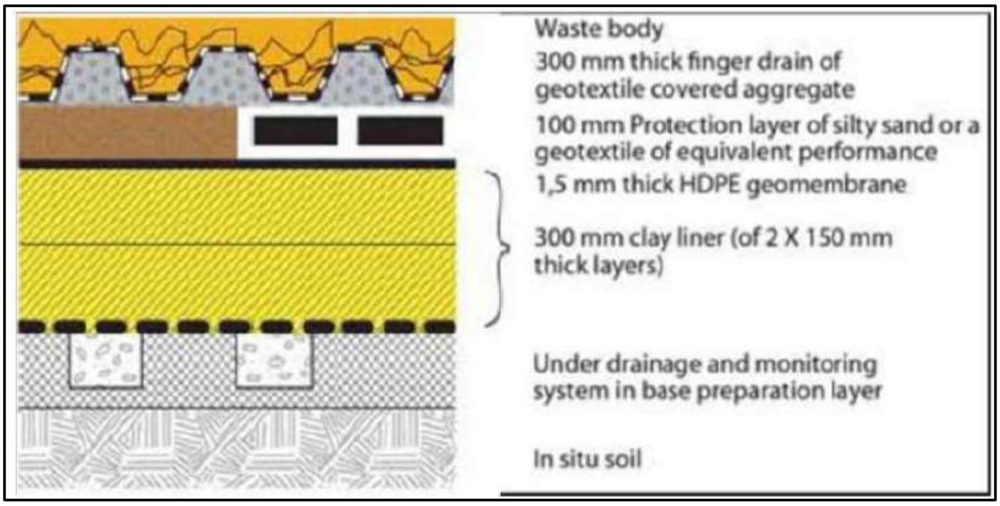


Figure 19: Class C landfill (GNR 636)

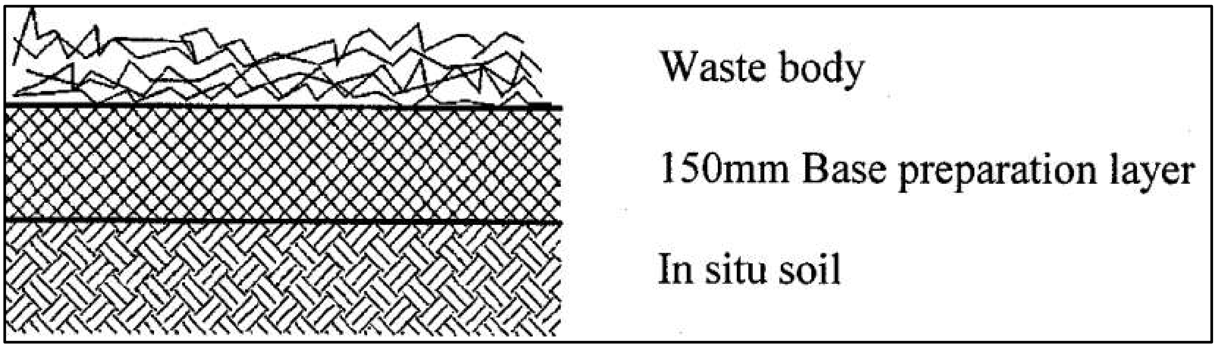


Figure 20: Class D landfill (GNR 636)

Table 5: Analyses of the samples with distilled water (mg/l)

Analyses	RF-CN-SM-1,44m	Sample 3	Coal sample	Sample 4				
Sample Number	**162964**	**162965**	**162966**	**162967**				
TCLP / Borax / Distilled Water	**Distilled Water**	**Distilled Water**	**Distilled Water**	**Distilled Water**				
Ratio*	**1:20**	**1:20**	**1:20**	**1:20**				
Units	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**	**LCT0 mg/l**	**LCT1 mg/l**	**LCT2 mg/l**	**LCT3 mg/l**
As, Arsenic	<0.001	<0.001	<0.001	<0.001	0.01	0.5	1	4
B, Boron	0.038	<0.025	0.044	0.044	0.5	25	50	200
Ba, Barium	0.036	0.045	<0.025	<0.025	0.7	35	70	280
Cd, Cadmium	<0.001	<0.001	<0.001	<0.001	0.003	0.15	0.3	1.2
Co, Cobalt	<0.025	<0.025	<0.025	<0.025	0.5	25	50	200
Cr$_{\text{Total}}$, Chromium Total	<0.025	0.039	<0.025	<0.025	0.1	5	10	40
Cr(VI), Chromium (VI)	<0.010	<0.010	<0.010	<0.010	0.05	2.5	5	20
Cu, Copper	<0.010	<0.010	<0.010	<0.010	2.0	100	200	800
Hg, Mercury	<0.001	<0.001	<0.001	<0.001	0.006	0.3	0.6	2.4
Mn, Manganese	<0.025	<0.025	<0.025	<0.025	0.5	25	50	200
Mo, Molybdenum	<0.025	<0.025	<0.025	<0.025	0.07	3.5	7	28
Ni, Nickel	<0.025	<0.025	<0.025	<0.025	0.07	3.5	7	28
Pb, Lead	<0.001	<0.001	<0.001	<0.001	0.01	0.5	1	4
Sb, Antimony	<0.001	<0.001	<0.001	<0.001	0.02	1.0	2	8
Se, Selenium	0.002	0.002	0.004	0.002	0.01	0.5	1	4

V, Vanadium	<0.025	<0.025	<0.025	<0.025	0.2	10	20	80
Zn, Zinc	<0.025	1.51	<0.025	<0.025	5.0	250	500	2000
Inorganic Anions	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**				
Total Dissolved Solids*	44	38	12	<10	1000	12,500	25,000	100,000
Chloride as Cl	2	<2	<2	<2	300	15,000	30,000	120,000
Sulphate as SO4	4	<2	<2	<2	250	12,500	25,000	100,000
Nitrate as N	0.1	<0.1	0.1	0.1	11	550	1100	4400
Nitrite as N	<0.05	<0.05	<0.05	<0.05				
Fluoride as F	<0.2	<0.2	<0.2	0.2	1.5	75	150	600
Total Cyanide as CN [o]	<0.07	<0.07	<0.07	<0.07	0.07	3.5	7	28
pH	8.0	8.8	7.5	7.1				
Paste pH	8.0	7.8	7.4	6.0				

Table 6: Analysis of Total Concentration (mg/kg)

Analyses	**RF-CN-SM-1,44m**		**Sample 3**		**Coal sample**		**Sample 4**				
Sample Number	**162964**		**162965**		**162966**		**162967**		**TCT0 mg/kg**	**TCT1 mg/kg**	**TCT2 mg/kg**
Digestion	**HNO3 : HF**		**HNO3 : HF**		**HNO3 : HF**		**HNO3 : HF**				
Dry Mass Used (g)	**0.25**		**0.25**		**0.25**		**0.25**				
Volume Used (mℓ)	**100**		**100**		**100**		**100**				
Units	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**			
As, Arsenic	0.012	4.81	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	5.8	500	2000
B, Boron	<0.025	<10	<0.025	<10	0.409	164	0.362	145	150	15000	6000

Ba, Barium	2.39	956	0.966	386	0.122	49	0.106	42	62.5	6250	25000
Cd, Cadmium	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	7.5	260	1040
Co, Cobalt	0.051	20	0.142	57	<0.025	<10	0.047	19	50	5000	20000
Cr$_{\text{Total,}}$ Chromium Total	0.049	20	0.296	118	0.052	21	0.192	77	46000	800000	N/A
Cu, Copper	0.012	4.80	0.346	138	0.036	14	0.044	18	16	19500	78000
Hg, Mercury	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	0.93	160	640
Mn, Manganese	0.575	230	3.99	1596	<0.025	<10	0.375	150	1000	25000	100000
Mo, Molybdenum	<0.025	<10	<0.025	<10	<0.025	<10	<0.025	<10	40	1000	4000
Ni, Nickel	0.108	43	0.191	76	0.040	16	0.113	45	91	10600	42400
Pb, Lead	0.086	34	0.011	4.45	0.046	18	0.057	23	20	1900	7600
Sb, Antimony	<0.001	<0.400	<0.001	<0.400	0.002	0.757	<0.001	<0.400	10	75	300
Se, Selenium	<0.001	<0.400	<0.001	<0.400	0.004	1.69	<0.001	<0.400	10	50	200
V, Vanadium	<0.025	<10	0.725	290	<0.025	<10	0.080	32	150	2680	10720
Zn, Zinc	0.069	28	0.291	116	0.053	21	0.255	102	240	160000	640000
Inorganic Anions	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**			
Cr(VI), Chromium (VI) Total [o]	---	<2	---	<2	---	<2	---	<2	6.5	500	2000
Total Fluoride [o]	---	14.18	---	9.73	---	10.15	---	19.84	100	10000	40000
Total Cyanide as CN [o]	---	<1.55	---	<1.55	---	<1.55	---	<1.55	14	10500	42000

4.4 Acid Rock Drainage Assessment

4.4.1 Acid mine drainage

Acid mine drainage (AMD) poses a serious threat in mines especially gold mines where there is an abundance of sulphide minerals. AMD is expected to occur due to the extraction of sulphide ores such as chalcopyrite, pyrite or arsenopyrite ores. Hence, acid mine drainage studies should be included as one of the impacts to be mitigated in the mining area. The presence of acid mine drainage in a mining area will be demonstrated by a drop in pH. The equations below show the process of acid mine drainage formation detailed in four steps. This process is self-propagating until the ferric iron or pyrite is depleted. Generally, when pyrite combines with oxygen and water, acid mine drainage forms. If AMD gets into surface waterways, both the acidity and metal content can produce significant environmental problems over large distances. Once AMD reaches surface waters, the acidity may cause significant environmental problems over long distances and destroy the aquatic life.

1. Oxidation of Polysulfide to sulphate by O_2

$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2Fe^{2+} + 4SO_4^{2-} + H^+$

2. Oxidation of Fe^{2+} (ferrousiron) to Fe^{3+} (ferriciron) by O_2

$4Fe^{2+} + O_2 + 4H^+ \rightarrow 4Fe^{3+} + 2H_2O$

3. Hydrolysis of iron (ferriciron→ferrichyfroxide, “yellowboy”)

$4Fe^{3+} + 12H_2O \rightarrow 4Fe(OH)_3 + 12H^+$

4. Oxidation of polysulfide to sulphate by Fe^{3+} at low pH

$FeS_2 + 14Fe^{3+} + 8H_2O \rightarrow 15Fe^{2+} + 16H^+$

Total: $FeS_2 + 15/4\ O_2 + 7/2H_2O \rightarrow 2Fe(OH)_3 + 2SO_4^{2-} + 4H^+$

Acid mine drainage can be treated in various ways including:

- An increase in pH or raising alkalinity. This can be achieved by adding lime or other alkaline materials to neutralise the acidity (like $NaCO_3$ or NaCl).
- Removing metals like iron, zinc and aluminium from water.
- Conducting passive treatments of acid mine drainage (limestone leach beds) as well as conducting active treatment of acid mine drainage (treatment plants)

4.4.2 Acid base accounting

Acid base accounting is applied to predict mine drainage potential of a sample. Old discard dumps in particular are considered to be one of the greatest polluters of the environment in

certain regions of South Africa, particularly the Witbank region, polluting the atmosphere, rivers, ground water and the aesthetics of the countryside.

Prediction Method Classes

- Static Methods
- Kinetic Methods
- Field Methodologies
- Geochemical Modelling (Phreeqc /Geochemist workbench etc.

Acid Base Accounting (ABA)

This method, also referred to as the EPA-600 method, has been the most widely used of all static test methods. It first involves the determination of NP by digesting a small (2.0 g) sample minus 60 mesh) in excess hydrochloric acid at near-boiling temperatures. A fizz test is used to determine the volume and normality of acid added. The unreacted acid remaining at the end of the digestion is then titrated with NaOH to an end point of 7.0 SO that the acid consumed can be calculated.

<u>The NP value can then be calculated as follows:</u>

$$\mathrm{NP} = \frac{50\ a\ [x-(b/a)\ y]}{C}$$

Where: NP = neutralization potential kg CaCO3, equivalent per tonne.

a = normality of HCl added in digestion

b = normality of NaOH used in titration

c = mass of sample in grams

x = volume of HCl added in mL

y = volume of NaOH added in titration

<u>The acid potential, AP is calculated from a total Sulphur analysis as follows</u>:

AP = S% x 3 1.25 kg CaCO3, equivalent per tonne

One of the advantages of this test is that it is widely used and is accepted by many regulatory authorities. It is a quick and easy, low-cost test and is ideal for the screening of a large number of samples. Like all static tests, however, the test provides no information on the rate and extent of both sulphide oxidation and neutralization that will occur in the field. In addition, the Sobek

procedure has been shown in many studies to have a tendency to overestimate NP. This is due to the rigorous digestion conditions in which some minerals, which will not be effective neutralizers in the field, react and is accounted for in the NP value.

Overestimation is exacerbated by application of the fizz test which is a subjective procedure and can lead to differences in the results obtained by different technicians for the same samples. Some laboratories do not use a fizz test either in an attempt to remove the subjectivity or else to simplify procedures. This practice leads to further problems in test interpretation.

ABA (static)

ABA is a screening procedure whereby the acid neutralizing potential (asset) and acid generating potential (liabilities) are determined and the difference (acid neutralizing potential (equity) is calculated.

Acid-Base Accounting Cumulative Screening tool ABACUS

ABACUS is Excel-based, Menu Driven software which uses prescribed classification criteria and allows interpretation of each sample and for entire spoil area.

Conclusions Static Methods

- ABA provides first level of screening for long term prediction.
- Provides indication of likelihood and severity of acid generation.

Table 7 below illustrates the extracted results from the ABACUS software using pH analysis to predict the acid generation potential. It can be deduced that the 3 samples used in this project shows that there is a lower acid risk in Shale, Sandstone and Sandstone samples, however it is recommended to do other tests that can include determination of Acid potential as well as Base potential to confirm the risk of acid mine drainage in this project area.

Table 7: Acid Generation Potential Assessment Criteria (extracted from ABACUS software).

Site Name	Initial pH	Final pH	Interpretation
RF-CN-SM-1.44m	8.0	8.0	Lower Acid Risk
Sample 3	8.8	7.8	Lower Acid Risk
Coal Sample	7.5	7.1	Lower Acid Risk
Sample 4	7.1	6.0	Moderate Acid Risk

6. Conclusion and Recommendations

Conclusion

Singo consulting (Pty)Ltd was appointed by Nore Coal (Pty) Ltd (Herein referred to as Notre Coal). Notre Coal lodged a mining right application on portion 1 of the farm Annysspruit 140 HT and remaining extent of the farm Mooihoek 168 HT in Magisterial district of Mkhondo (Piet Retief), Mpumalanga province. The project area is situated approximately 18,9 km Southwest of Piet Retief, approximately 19.5 km northeast of Driefontein, approximately 22 km northeast from Dirkiesdorp, approximately 2.1km east of Etshondo Primary School, approximately 4.87 km southeast of Matafuleni Community, approximately 9 km east of KwaNgema Clinic, approximately 14.1 km southeast of Estheni Primary School and approximately 9.2 km southeast of Ngema Tribal Trust.

The report is prepared as part of the application process, to clearly identify the waste which is anticipated and how such waste will be dealt with to preserve the environment and the livelihoods of those around the project area. The samples of material which will be at the proposed site were taken from the site and delivered to water lab in Pretoria, SANAS accredited laboratory, to clearly analyse the geochemistry of the sample. Upon analysis, type of waste was identified based on the leachable concentration and total concentration. RF-CN-SM-1.44m, Sample 3 and Sample 4 were found to be of Type 4 waste and coal sample was found to be of Type 3. The waste type aids in identifying the most ideal lining for that particular waste. For the contect of the study and consideration of the waste types, Class C lining and Class D will be used which can accommodate Type 3 and Type 4 respectively.

Through the use of the ABACUS, it was found that the samples RF-CN-SM-1.44m, Sample 3 and Sample 4have low Acid Generating potential, and Coal sample classified as Type 3 has moderate acid generating potential.

Recommendations

➢ One other option for remediation is to completely remove all the waste material from the site and transport it to another location for treatment and proper disposal. This so-called off-site solution is usually the most expensive option. An alternative is on-site remediation, which reduces the production of leachate and lessens the chance of groundwater contamination. On-site remediation may include temporary removal of the hazardous waste, construction of a secure landfill on the same site, and proper replacement of the waste. It may also include

treatment of any contaminated soil or groundwater. Treated soil may be replaced on-site and treated groundwater returned to the aquifer by deep-well injection.

- A less costly alternative is full containment of the waste. This is done by placing an impermeable cover over the hazardous-waste site and by blocking the lateral flow of groundwater with subsurface cut-offs walls. It is possible to use cut-off walls for this purpose when there is a natural layer of impervious soil or rock below the site. The walls are constructed around the perimeter of the site, deep enough to penetrate to the impervious layer. They can be excavated as trenches around the site without moving or disturbing the waste material. The trenches are filled with bentonite clay slurry to prevent their collapse during construction, and they are backfilled with a mixture of soil and cement that solidifies to form an impermeable barrier. Cut-off walls thus serve as vertical barriers to the flow of water, and the impervious layer serves as a barrier at the bottom.

Before waste is disposed of, the composition, concentration, and toxicity indicators must be determined such that the waste can be classified and rated in accordance with the Minimum Requirements. The Minimum Requirements sets out a systematic framework for identifying whether a waste stream is hazardous and classifying it in accordance with the degree of risk that it poses. From the classification, requirements are set to ensure Hazardous Waste is treated and safely disposed of. These requirements represent the lowest acceptable standard and are therefore termed the Minimum Requirements.

The initial classification of waste is to determine whether it is a general or hazardous waste. Where there is uncertainty, the precautionary principle requires the waste be classified as hazardous until proven otherwise.

- Coal sample was classified as type 3 waste, these stockpiles need to be lined with a class C lining. According to GNR 636: "Type 3 Waste may only be disposed of at a Class C landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the requirements for a G: L: B+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (DWAF MR, 1998)".
- RF-CN-SM-1.44m, Sample 3 and Sample 4 were classified as Type 4 waste, these material need to be lined with Class D lining. According to GNR 636: "Type 3 Waste may only be disposed of at a Class C landfill designed in accordance with section 3(1) and (2) of these Norms and Standards, or, subject to section 3(4) of these Norms and Standards, may be disposed of at a landfill site designed in accordance with the

requirements for a G: L: B+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (DWAF MR, 1998)".

- Type 3 and Type 4 waste will not be mixed during disposal, this is to preserve the environment during rehabilitation, and no loss or change in chemistry of the material.

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8. APPENDICES

Appendix A: Specialist's qualifications

Available upon request

Appendix B : Laboratory results

Analyses	RF-CN-SM-1,44m	Sample 3	Coal sample	Sample 4				
Sample Number	**162964**	**162965**	**162966**	**162967**				
TCLP / Borax / Distilled Water	**Distilled Water**	**Distilled Water**	**Distilled Water**	**Distilled Water**				
Ratio*	**1:20**	**1:20**	**1:20**	**1:20**				
Units	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**	LCT0 mg/l	LCT1 mg/l	LCT2 mg/l	LCT3 mg/l
As, Arsenic	<0.001	<0.001	<0.001	<0.001	0.01	0.5	1	4
B, Boron	0.038	<0.025	0.044	0.044	0.5	25	50	200
Ba, Barium	0.036	0.045	<0.025	<0.025	0.7	35	70	280
Cd, Cadmium	<0.001	<0.001	<0.001	<0.001	0.003	0.15	0.3	1.2
Co, Cobalt	<0.025	<0.025	<0.025	<0.025	0.5	25	50	200
Cr_{Total}, Chromium Total	<0.025	0.039	<0.025	<0.025	0.1	5	10	40
Cr(VI), Chromium (VI)	<0.010	<0.010	<0.010	<0.010	0.05	2.5	5	20
Cu, Copper	<0.010	<0.010	<0.010	<0.010	2.0	100	200	800
Hg, Mercury	<0.001	<0.001	<0.001	<0.001	0.006	0.3	0.6	2.4
Mn, Manganese	<0.025	<0.025	<0.025	<0.025	0.5	25	50	200
Mo, Molybdenum	<0.025	<0.025	<0.025	<0.025	0.07	3.5	7	28
Ni, Nickel	<0.025	<0.025	<0.025	<0.025	0.07	3.5	7	28

Pb, Lead	<0.001	<0.001	<0.001	<0.001	0.01	0.5	1	4
Sb, Antimony	<0.001	<0.001	<0.001	<0.001	0.02	1.0	2	8
Se, Selenium	0.002	0.002	0.004	0.002	0.01	0.5	1	4
V, Vanadium	<0.025	<0.025	<0.025	<0.025	0.2	10	20	80
Zn, Zinc	<0.025	1.51	<0.025	<0.025	5.0	250	500	2000
Inorganic Anions	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**	**mg/ℓ**				
Total Dissolved Solids*	44	38	12	<10	1000	12,500	25,000	100,000
Chloride as Cl	2	<2	<2	<2	300	15,000	30,000	120,000
Sulphate as SO4	4	<2	<2	<2	250	12,500	25,000	100,000
Nitrate as N	0.1	<0.1	0.1	0.1	11	550	1100	4400
Nitrite as N	<0.05	<0.05	<0.05	<0.05				
Fluoride as F	<0.2	<0.2	<0.2	0.2	1.5	75	150	600
Total Cyanide as CN [o]	<0.07	<0.07	<0.07	<0.07	0.07	3.5	7	28
pH	8.0	8.8	7.5	7.1				
Paste pH	8.0	7.8	7.4	6.0				

[o] = Outsourced

E. Botha

Geochemistry Project Manager

Analyses	RF-CN-SM-1,44m		Sample 3		Coal sample		Sample 4				
Sample Number	162964		162965		162966		162967		TCT0 mg/kg	TCT1 mg/kg	TCT2 mg/kg
Digestion	HNO3 : HF		HNO3 : HF		HNO3 : HF		HNO3 : HF				
Dry Mass Used (g)	0.25		0.25		0.25		0.25				
Volume Used (mℓ)	100		100		100		100				
Units	mg/ℓ	mg/kg	mg/ℓ	mg/kg	mg/ℓ	mg/kg	mg/ℓ	mg/kg			
As, Arsenic	0.012	4.81	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	5.8	500	2000
B, Boron	<0.025	<10	<0.025	<10	0.409	164	0.362	145	150	15000	6000
Ba, Barium	2.39	956	0.966	386	0.122	49	0.106	42	62.5	6250	25000
Cd, Cadmium	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	7.5	260	1040
Co, Cobalt	0.051	20	0.142	57	<0.025	<10	0.047	19	50	5000	20000
Cr_{Total}, Chromium Total	0.049	20	0.296	118	0.052	21	0.192	77	46000	800000	N/A
Cu, Copper	0.012	4.80	0.346	138	0.036	14	0.044	18	16	19500	78000
Hg, Mercury	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	<0.001	<0.400	0.93	160	640
Mn, Manganese	0.575	230	3.99	1596	<0.025	<10	0.375	150	1000	25000	100000
Mo, Molybdenum	<0.025	<10	<0.025	<10	<0.025	<10	<0.025	<10	40	1000	4000
Ni, Nickel	0.108	43	0.191	76	0.040	16	0.113	45	91	10600	42400
Pb, Lead	0.086	34	0.011	4.45	0.046	18	0.057	23	20	1900	7600

Sb, Antimony	<0.001	<0.400	<0.001	<0.400	0.002	0.757	<0.001	<0.400	10	75	300
Se, Selenium	<0.001	<0.400	<0.001	<0.400	0.004	1.69	<0.001	<0.400	10	50	200
V, Vanadium	<0.025	<10	0.725	290	<0.025	<10	0.080	32	150	2680	10720
Zn, Zinc	0.069	28	0.291	116	0.053	21	0.255	102	240	160000	640000
Inorganic Anions	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**	**mg/ℓ**	**mg/kg**			
Cr(VI), Chromium (VI) Total [o]	---	<2	---	<2	---	<2	---	<2	6.5	500	2000
Total Fluoride [o]	---	14.18	---	9.73	---	10.15	---	19.84	100	10000	40000
Total Cyanide as CN [o]	---	<1.55	---	<1.55	---	<1.55	---	<1.55	14	10500	42000

[o] = Outsourced

UTD = Unable to determine

E. Botha

Geochemistry Project Manager

Appendix C: Examples of the lining systems that can be used to line the Rock dumps.

Rock dump liners that can be used (Source: https://www.senecalandfill.com/landfill-liner-installation)


DEERE

Integrated Specialist Services (Pty) Ltd

HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED COAL MINING RIGHT APPLICATION AND ENVIRONMENTAL AUTHORISATION, ON PORTION 1 OF THE FARM ANNYSSPRUIT 140 HT AND THE REMAINING EXTENT OF THE FARM MOOIHOEK 168 HT LOCATED IN THE MAGISTERIAL DISTRICT OF PIET RETIEF, MPUMALANGA PROVINCE.

Singo Consulting (Pty) Ltd

Author: T. Mlilo

Prepared for

NOTRE Coal

DOCUMENT SYNOPSIS (EXECUTIVE SUMMARY)

Item	Description
Proposed development and location/affected farms	Proposed Coal Mining Right Application on Portion 1 of the Farm Annysspruit 140 HT and the Remaining Extent of the Farm Mooihoek 168 HT, Piet Retief Magisterial District, Mpumalanga Province
Purpose of the study	The Phase 1 Archaeological Impact Assessment for the Coal Mining Right Application in Mpumalanga Province
Coordinates	See Figure 1
Municipalities	Mkhondo Local Municipality, Gert Sibande District Municipality
Predominant land use of surrounding area	Agriculture, timber plantations, dams,
Applicant	Notre Coal (Pty) Ltd Plot 106, Road 4, Delmas, Gauteng, 2210 Tel: +27 66 211 8714 Email: eddi@notrecom.co.za
DMRE Reference	MP 30/5/1/2/2/10384 MR
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Authors	Trust Mlilo, Joshua & Thabani
Date of Report	30 May 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 within the proposed Mining Right Application site. This report is submitted in terms of Section 38 (8) of the National Heritage Resources Act 25 of 1999 as part of the Mining Right 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 Right Application on Portion 1 of the Farm Annyssoruit 140HT and the Remaining Extent of the Farm Mooihoek 168HT, Piet Retief Magisterial District, Mpumalanga Province. Desktop studies, drive-throughs and fieldwalking were conducted in order to identity heritage landmarks within the Mining Right Application site. The study site is not on pristine ground, having seen significant transformations owing to previous and current land use activities such as agriculture. The general mining area is known for occurrence of archaeological and historical sites. The study noted a cluster of historical stone walled cattle kraals that exist within the proposed mining site. In terms of graves, the study did not identify any graves however noted farm dwellings exist in the area and labour tenants in the farms buried their deceased relatives within the farms. Most of these graves occur near farm dwellings and there is potential for graves associated with farmworker dwellings to occur within the vicinity of the dwellings. 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.
- The immediate project area is agriculture and mining.
- Some sections of the proposed Mining Right site are severely degraded from previous and current land use activities.

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. It is recommended that SAHRA make a decision in terms of Section 38 (4) of the NHRA to approve the proposed Mining Right Application on condition that the site survey did not identify any significant archaeological and heritage sites.
3. The public participation process must request landowners and residents to declare graves located within their properties and residences since it was not practical to visit households during the survey.
4. From a heritage perspective supported by the findings of this study, the Mining Right Application is supported. However, the Mining Right 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. 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 Right Application. The Heritage authority may approve the Mining Right Application as planned with special commendations to implement the recommendations here in made.

This report concludes that the impacts of the proposed 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 Right 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 Right Application being submitted by Notre Coal (Pty) Ltd

Signed by

30/ 05/ 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 Notre Coal (Pty) Ltd to carry out a Phase 1 AIA/ HIA for the Mining Right application on Portion 1 of the Farm Annysspruit 140HT and the remaining extent of the Farm Mooihoek 168HT earmarked for mining. 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, road and boundary fence lines have either obliterated these materials or reduced them to isolated finds that can only be identifiable as chance finds during mining. The Mining Right Application may be approved subject to adopting recommendations and mitigation measures proposed in this report. Based on the findings there is no archaeological reasons why the Mining Right 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 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 Right 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 right area falls in the Gert Sibande District Municipality and Mkhondo Local Municipality, Mpumalanga Province. The Mining Right Application is located on Portion 1 of the Farm Annysspruit 140 HT and the Remaining Extent of the Farm Mooihoek 168 HT in the Mkondo Local Municipality in Mpumalanga Province.

Table 1: Description of Properties affected by the proposed mining project.

Farm Name:	Portion 1 of the Farm Annysspruit and remaining extent of the Farm Mooihoek168 HT,
Coordinates	See Figure 1
Application area (Ha)	
Magisterial District:	Piet Retief
Distance and direction from nearest town	Approximately 24km South-Western side of Piet Retief.
21-digit Surveyor General Code for each farm portion	

1.3 Project Description

Mineral Applied For: Coal resources.

Mining Methods: Open Cast Mining and Underground Mining

Life of Mine: 30 years lifespan

Potential Market: Eskom, other domestic (i.e. coal stove & power generation) and international markets (i.e. for steel production, liquid fuel and for cement manufacturing).

The proposed mining method and sequence comprised of the following main mining activities for both waste and coal:

- Initial topsoil and soft overburden removal which will be stockpiled to ensure it can be replaced back in the initial box cut;
- The physical mining of the coal seam which includes drilling of hard overburden material, charging and blasting;
- The coal is loaded into trucks and hauled to the crushing and screening facility;
- Discard coal will be extracted and replaced in the bottom of the opencast pit, while the product will be taken to the weighbridge via trucks and then removed off site;
- The overburden is replaced back into the pit as mining progresses leaving a minimum area open at a single time;

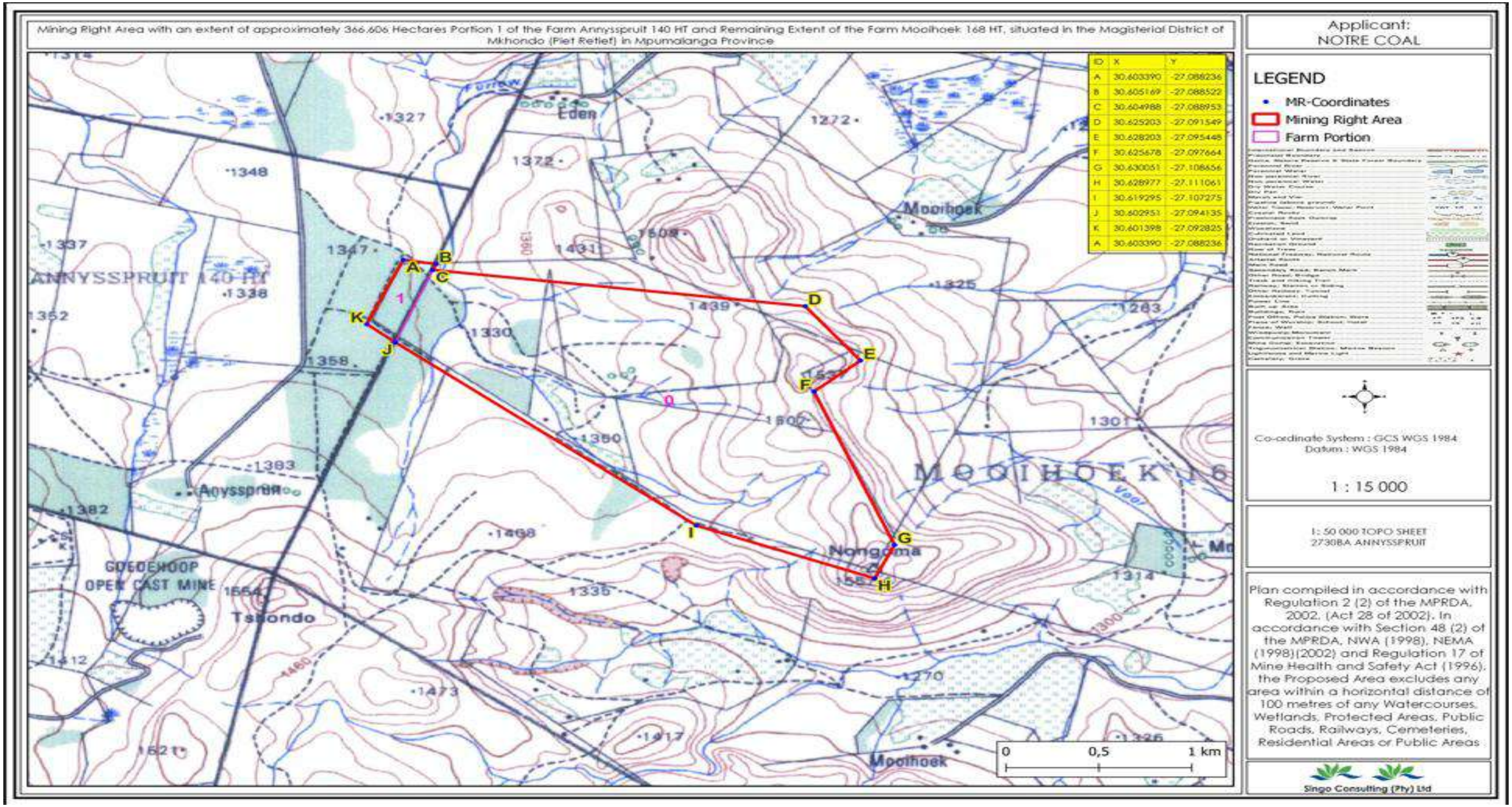
- The topsoil which was stripped and stockpiled separately before mining commenced is then replaced. The findings of the land capability study will determine the optimal composition to ensure pre-mining conditions for utilisation.

Service Requirements:

- Electricity for the operation will be sourced from Eskom (8MVA required).
- Process water will be sourced from the river and tributaries around through a WUL.
- It is envisaged that potable/ domestic water will be sourced from boreholes on site, other alternatives are also being considered.
- General waste will be collected for disposal at the Municipal dump. Industrial waste will be collected for disposal at a suitably licensed facility.
- Sewage will be collected within conservancy tanks to be emptied by honey sucker for treatment at a suitably licensed facility. Alternatively, a small, package sewage plant will be installed on site.

Employment:

- ❖ The project will create employment for approximately 48 people.



Mining Right Area with an extent of approximately 366.606 Hectares Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province

ID	X	Y
A	30.603390	-27.088236
B	30.605169	-27.088522
C	30.604988	-27.088953
D	30.625203	-27.091549
E	30.628203	-27.095448
F	30.625678	-27.097664
G	30.630051	-27.108656
H	30.628977	-27.111061
I	30.619295	-27.107275
J	30.602951	-27.094135
K	30.601398	-27.092825
A	30.603390	-27.088236

Applicant:
NOTRE COAL

Co-ordinate System : GCS WGS 1984
Datum : WGS 1984

1 : 15 000

1: 50 000 TOPO SHEET
2730BA ANNYSSPRUIT

Plan compiled in accordance with Regulation 2 (2) of the MPRDA, 2002. (Act 28 of 2002). In accordance with Section 48 (2) of the MPRDA, NWA (1998), NEMA (1998)(2002) and Regulation 17 of Mine Health and Safety Act (1996), the Proposed Area excludes any area within a horizontal distance of 100 metres of any Watercourses, Wetlands, Protected Areas, Public Roads, Railways, Cemeteries, Residential Areas or Public Areas

Singo Consulting (Pty) Ltd

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

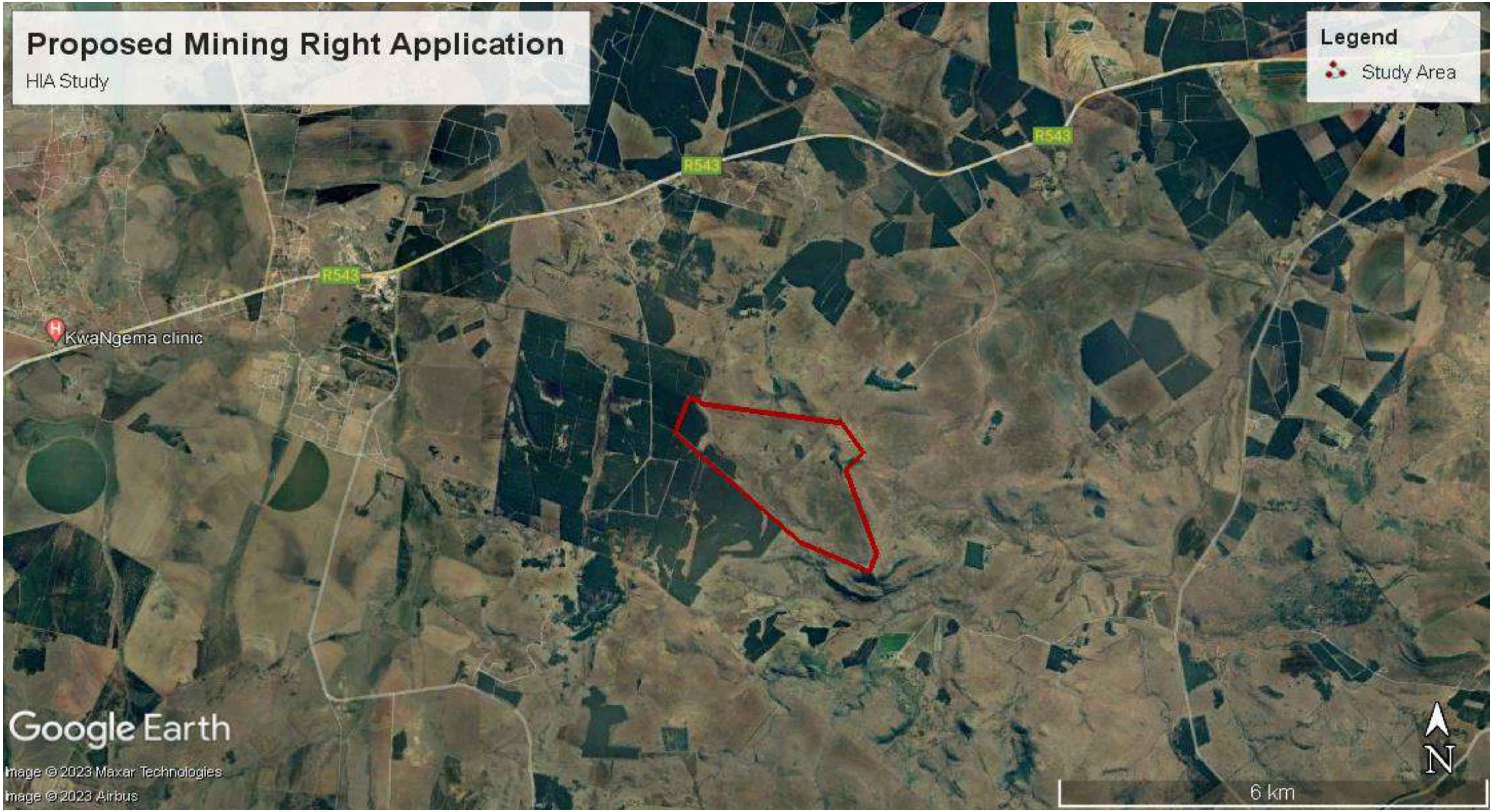


Figure 2: Location of proposed mining sites (ISS (Pty) Ltd,2023)

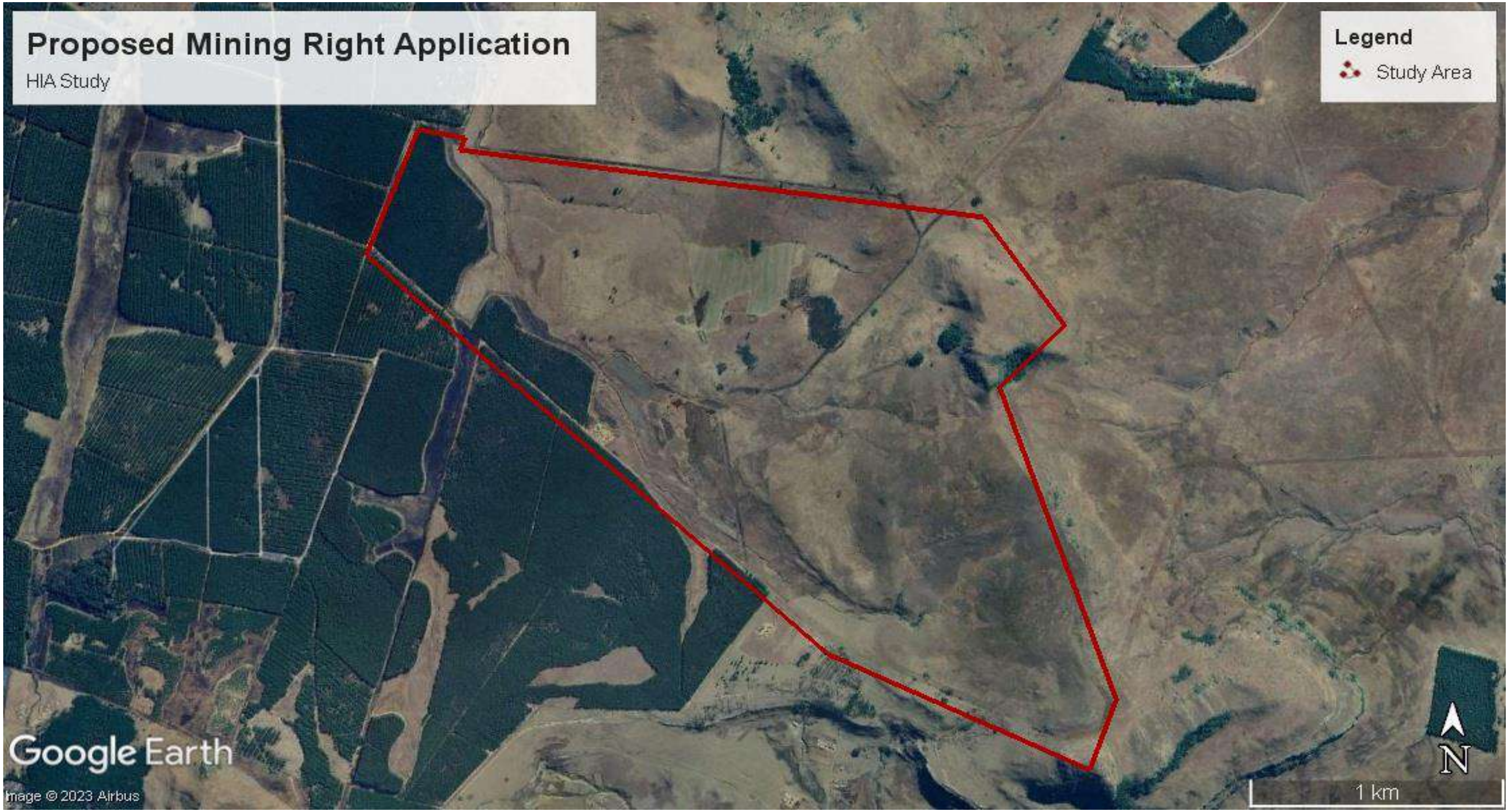


Figure 3:Showing the proposed mining development site (ISS (Pty) Ltd 2023)

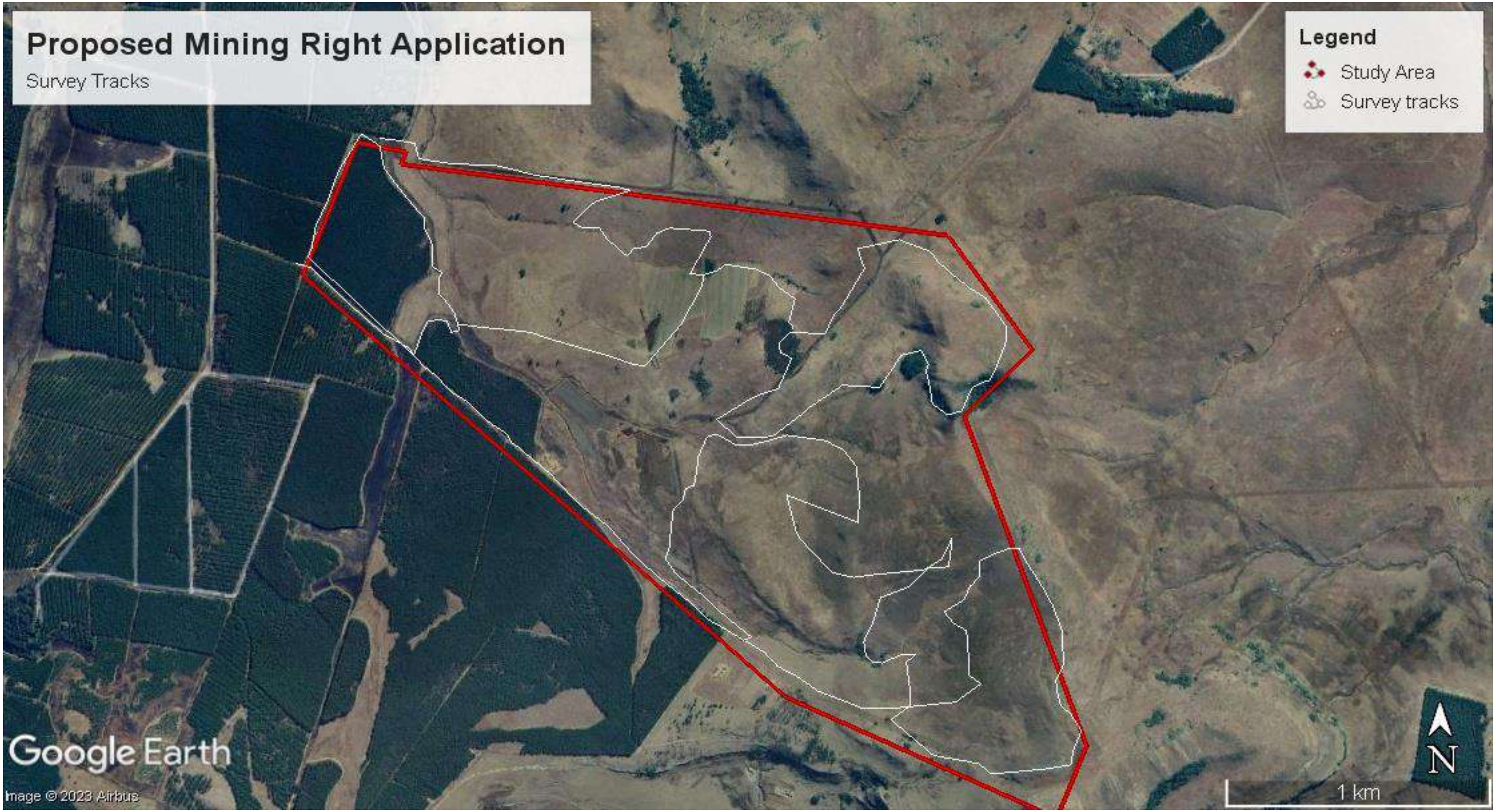


Figure 4: Tracklogs for the surveyed area (ISS, 2023)

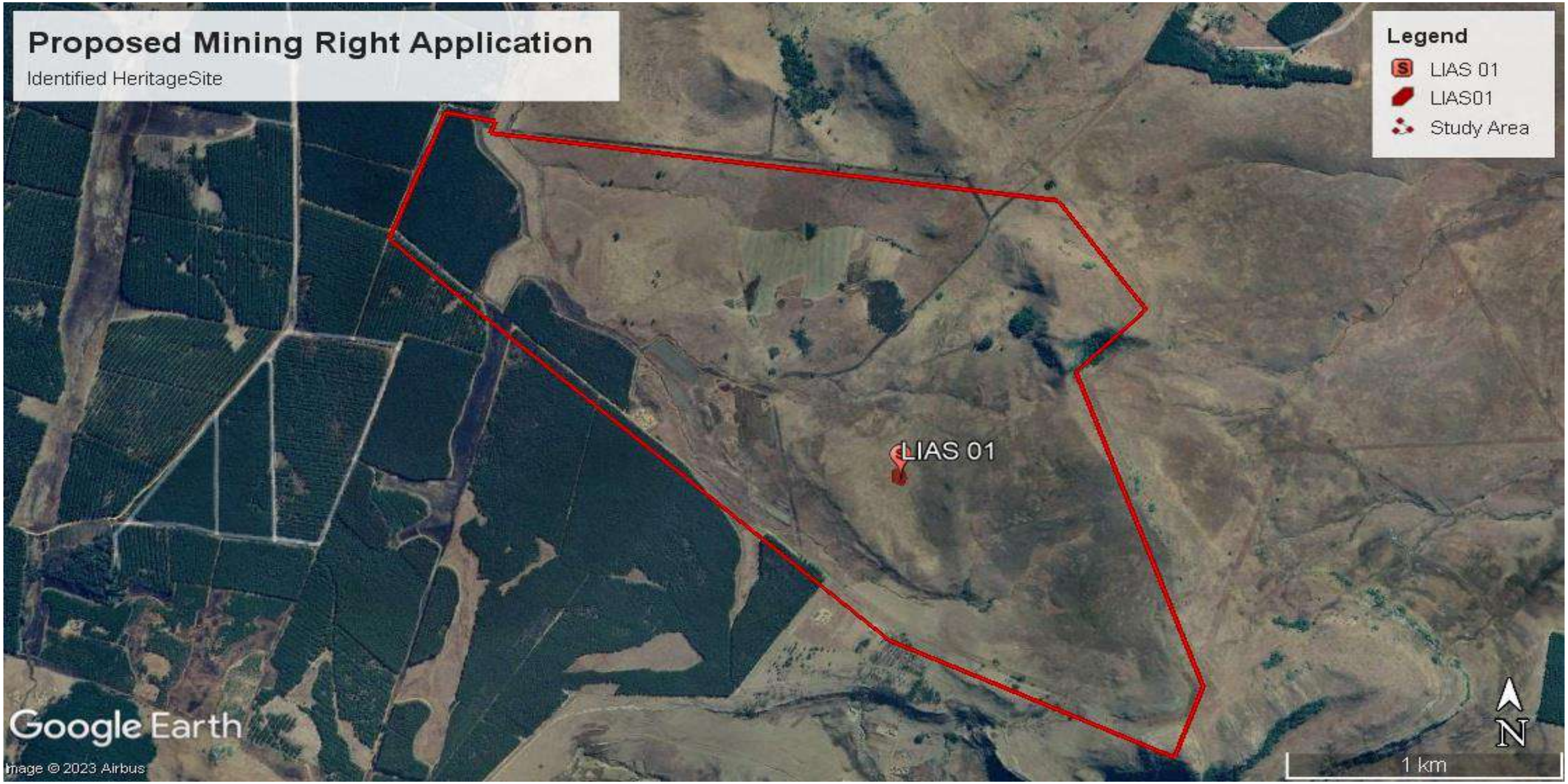


Figure 5: Identified Heritage sites within the proposed Mining Right Area (ISS, 2023)

2 LEGISLATIVE CONTEXT

Three main pieces of legislations are relevant to the present study. The Mining Right 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 authority**. 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, which is unlikely. 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 (Notre Coal Pty Ltd), 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 2: 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, because it is a mining project

3 METHODOLOGY

This document aims at providing an informed heritage-related opinion about the Mining Right 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 Right 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 Right Application.

3.1 The Fieldwork survey

The fieldwork survey was undertaken on the 29th of May 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 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 agricultural activities and timber plantations.

3.2 Visibility and Constraints

The mining right sit is huge and mountainous. Some fenced sections of the mining right site were not easily accessible. It should be noted that some sections of the proposed mining sites are built up and occupied by residents, as such it was not practical to conduct house to house survey especial for graves. It is thus recommended that the public participation process request residents and landowners to declare their family graves so that they can be properly documented and mapped prior to mining. Visibility was compromised in some sections due to 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 Process will also invite and address comments from the public and any registered heritage bodies on any matter related to the Mining Right 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 Right Application to be submitted to DMRE. The study recommends that landowners and local residents must be requested to declare their family graves occurring in the proposed mining site.

The following photographs illuminate the nature and character of the Project Area.

Plate 1: showing the proposed Mining Right Application Site

Plate 2: showing access roads that exist within the proposed coal mining site.

Plate 3: showing timber plantations that exist within the proposed coal mining site.

Plate 4: showing 22kv powerlines running across the proposed coal mining site

Plate 5: showing the proposed coal mining site.

Plate 6: showing the proposed coal mining site. Note the dense grass cover

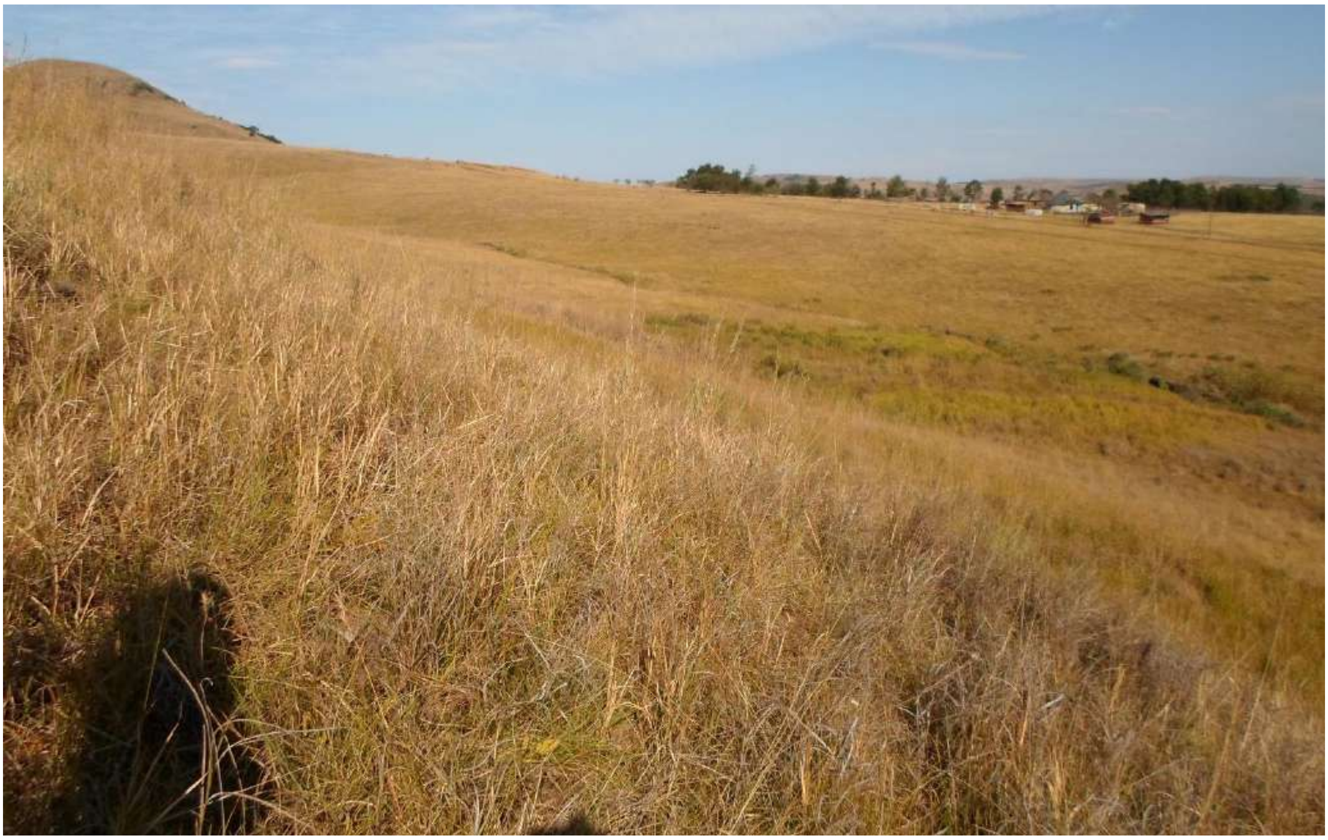


Plate 7: showing homesteads that exist within the proposed coal mining site

Plate 8: showing the proposed coal mining site

Plate 9: showing the proposed coal mining site

Plate 10: showing the proposed coal mining site

Plate 11: showing the proposed coal mining site. Note the dense grass cover

Plate 12: showing the proposed coal mining site

Plate 13: showing proposed mining site.

Plate 14: showing proposed mining site. Note the area is heavily disturbed by current and previous agricultural acitivities

Plate 15: showing homesteads that exist within 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.

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.

Historical Background

According to Bergh (1999) Piet Retief was founded in 1882 on land bough from a local Swazi chief, although physical layout of erven only started in 1884 (1999: 21; www.satowns.co.za). Another source indicates that the town was established in 1885, and the Urban Board founded in 1903 (Praagh 1906: 453).

The town of Piet Retief was laid out by the surveyor Anton von Wielligh in 1883 on the Farm Osloop and Geluk and was named such after the Voortrekker leader by the same name. In 1932 Piet Retief became a municipality. The town, conveniently located in the mist belt of South Africa, originated as a centre for timber, paper and wattle bark production, but mica, kaolin and iron played a role as well. During the early years an area of 100 square kilometres was known as the ‘Little Free State’, had its own president between 1886 and 1891 and a population of 72 residents. The republic, however, was incorporated into the Piet Retief district as Ward 1 on 2 May 1891. The Assegaai River that flows to the south of Piet Retief was erroneously translated by Europeans from ‘Mkhondo’, actually meaning zigzag (Bulpin 1986: 639-640).

Missionaries also came to this part of the country during the 19th century. The Dutch Reformed Church and the Hermannsburg Missionaries established mission stations at Volksrust and Wakkerstroom during this time (Bergh

1999). The first missionaries from Sweden erected a missionary in Piet Retief in 1905, today known as the Mission House. Piet Retief used to be known as a kind of "wild east" during the 1800's, being a buffer area between different land grabbing people. There were constant infringements and hostilities between Zulu and Swazi Impies. Then to the north were the Boers looking to extend their farming interests and to the south the British were looking to extend their Empire. Not many people today know that there used to be a little independent Republic called the "Klein Vrystaat Republic". Seen as a little chunk cut out of the rounded border of Swaziland, this land was bought from Swazi king Mbandini in 1876 for the price of blankets, picks, beads etc. to the value of 180 Pounds Sterling as well as 14 horses. The land was ruled by a three-man committee acting as executive and judicial officers. It became part of the Transvaal Republic due to popular demand by its citizens in 1892.

During the Anglo-Zulu War of 1879 a number of historic events also took place in the area. The area known as the 'disputed territory' was the site of several skirmishes during the war. The most important incident was the Battle of Entombe Drift which took place at dawn on 12 March 1879. A convoy of 18 wagons, carrying ammunition and supplies from Derby, camped along the swolen Entombe River, was attacked by a large number of Zulu irregulars. One British officer and 60 men, a civil surgeon, 2 white wagon conductors and 15 black drivers were killed. Colour-sergeant Booth was awarded the Victoria Cross for his heroic action. The battle site, a monument and war graves can be visited near the Entombe Mission Station. The men took part in action further south. (The above information was taken from www.satowns.co.za). Another source indicates that the town of Piet Retief was nearly completely destroyed by British forces during the war (www.mpumalangahappenings.co.za).

The south-eastern part of Mpumalanga was the focus point of battles between the British and the Boers. Boers trekked into this area in the 1880s. 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). The British on the other hand had a camp in Wakkerstroom and were beleaguered by the Boers. Three important battles were fought during this time. These were at Laingsnek on 25 January 1881, Schuinshoogte on 8 February 1881 and Amajuba on 27 February 1881. The Boers were victorious in all of these which led to peace being declared (Bergh 1999). Although these sites are all situated close to the town of Volksrust, it does indicate that commandos may have moved through the entire area. In the Wakkerstroom cemetery there is a commemorative stone for 18 British soldiers who died during this War (Smit n.d.: 1).

None of the early trade routes in the interior of South Africa went through the area of study (Bergh 1999). However, it is possible that due to the little research in the area, this still has to be discovered. It also is possible that secondary routes did pass through the south-east of Mpumalanga were the present day Dirkiesdorp is located. At the beginning of the 19th century a Sotho group called the Phuthing, inhabited the western section of southern Mpumalanga. To the south-east the Swazi were present (Delius 2006; Bergh 1999). It was therefore mainly the Swazi who inhabited the south-eastern parts of Mpumalanga during this time (Makhura 2006; Mitchell 2006).

In 1800 Dingiswayo fled to Hlubi close to Wakkerstroom. He died in 1818 and his empire was taken over and strengthened by Shaka (Hofmeyr & Smith 2009: ix). During the Difaqune (1820-1837) the Ndebele of Mzilikazi moved through this landscape and some even settled here. As a result, the Phuthing fled to the south. The Swazi now moved to the north and west, therefore inhabiting the area (Bergh 1999; Bergh & Bergh 1984

It was during this period when, 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 (Bergh 1999: 10-11; 109).

Early white travellers did not travel to this area (Bergh 1999). White farmers only moved into the south-eastern Mpumalanga after 1853 when the government of the South African Republic (ZAR or Transvaal) traded the land from the Swazi. Wakkerstroom 17 became a town and district in 1859 (Bergh 1999). The town was originally known as Marthinus Wesselstroom. Dirk Cornelius Uys was the founder of the town. He and his wife are buried in the municipal cemetery in the town (Smit n.d: 1). The town mainly served as market for local farmers (Hofmeyr & Smith 2009).

The broader geographical area also experienced some action during the Anglo-Boer War (1899-1902). During the British offensive, Lt-general R Buller moved through the area and occupied Volksrust on 12 June 1900. He then moved further to the north and reached Amersfoort on 7 August 1900. At this time Boer commandos were placed at Laingsnek and Amajuba, but Buller had them on the retreat. They moved through Volksrust and Amersfoort. The only battle in this area was on 22 July 1900 when a skirmish broke out to the north of Volksrust, between the Boer commando of General D Joubert and the British troops under command of Genl Coke (Bergh 1999). There was however also a skirmish, namely at Kastrolsnek, close to Wakkerstroom (Hofmeyr & Smith 2009: 96). The British later established a concentration camp for the Boer woman and children in Volksrust (Bergh 1999: 54). A memorial for British soldiers who died during the War is found in the Wakkerstroom municipal cemetery (Smit n.d.: 1).

The British also occupied Wakkerstroom and established a large camp here. This included blockhouses at Kastrolsnek (Hofmeyr & Smith 2009: 99). They also erected some blockhouses (small fortifications) in the broader geographical area during this War. Between Volksrust and Wakkerstroom they build 19 of these and the line of blockhouses was completed on 6 February 1902. Unfortunately, it is not known how many of these survived even partially. Between Wakkerstroom and Piet Retief the remains of 11 blockhouses were identified. Some of these are no more than a few stones left on some farms (Van Vollenhoven & Van den Bos, 1997). Again, this indicates that both Boer and British commandos moved through the area and remains of their fortifications may be found along these routes. A further indication of the lack of research and heritage work in the south-east of Mpumalanga comes from the SAHRA list of declared heritage sites. The only declared provincial sites in the area are buildings and streetscapes in some of the towns. Although not formally declared, many historical buildings are found in south-eastern Mpumalanga. This would be mostly sandstone buildings typical of the years approximately 1870-1920 as well as Victorian architecture from the 1890's to early in the twentieth century. Many of the latter were probably built during the Anglo- Boer War and are usually made of corrugated iron. However, these are mostly to be found in the towns with only a few located-on farms.

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.

Mining History

Historically coal is known to have been used from around 300 to 1880 in South Africa during Iron Age when charcoal was used to melt iron and copper (https://www.miningforschools.co.za/lets-explore/coal/brief-history-of-coal-mining-in-south-africa). Officially, coal was discovered in KwaZulu-Natal, Mpumalanga and the Eastern Province, and first documented between 1838 and 1859 (McGill *et al* 2015). The recorded old coal mining site may fall within this period since it was confirmed to probably more than 100 years old. The first commercial mining took place near Molteno, in the Eastern Cape Province in 1871(McGill *et al* 2015). The demand for coal was increased by the discovery of diamonds at Kimberley in 1870 and gold on the Witwatersrand in 1886, with new mines opening in Vereeniging in 1879 and Witbank in 1895. Further developments occurred in KwaZulu-Natal, Gauteng and Mpumalanga (currently home to about 84% of local coal production), followed by the Free State and Limpopo (McGill *et al* 2015). Coal mining has undergone major development over the years. In the early days of coal mining men used to physically create tunnels to get to the coal deposits by digging as is the case with the identified old coal mining site (https://miningafrica.net/natural-resources-africa/coal-mining-in-africa). They then extracted the coal and transported the coal on mine carts. These days coal mines are technologically advanced and use sophisticated equipment including; trucks, jacks, conveyors, draglines and shearers to extract the coal.

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.

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 scanned for archaeological remains, but given the previous and current land use activities, no archaeological remains were identified during the survey (see Figure 4 &Plates 1-8). The study identified a historical stone walled kraal (**LIAS01**) on the GPS coordinates **27° 6'5.28"S, 30°37'10.79"E**. The kraal is 30 meters in diameter and the walls are approximately 1m in height. It also has two smaller kraals which may have been used to house the calves. 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.

Plate 16: showing the identifed Krall (**LIAS01**)within the proposed mining right area.

Plate 17: showing smaller kraals close to the identifed Krall (**LIAS01**)within the proposed mining right area

Plate 18: showing the identifed Krall (**LIAS01**)within the proposed mining right area

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 did not identify any burial sites within the proposed Mining Right Site. The study noted that there are several farm dwellings within the proposed mining site. These farm dwellings are for the previous labour tenants and current farm workers. On the other sections there are recently established homesteads doted within the mining right application site. Based on the field findings, this means that there is potential of informal graves occurring near these isolated farmworker dwellings. The practical solution is to request landowners and residents to declare their family graves located in the mining right site during public participation. It is conceded that some of the farmworker dwellings and farmhouses will be directly affected by the proposed mining and residents may have to be relocated. In the same vein graves associated with these farm dwellings will be affected and therefore need to be documented by a professional archaeologist before mining commences. 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 or not, 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 medium to high 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.

5.3 Public Monuments and Memorials

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

5.4 Buildings and Structures

The study did not record any buildings or structures that are older than 60 years within the proposed mining site. However, contemporary homesteads and buildings exist in the mining right area. In terms of Section 34 of the NHRA the proposed Mining Right 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).

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 3: Summary of Findings

Heritage resource	**Status/Findings**
Buildings, structures, places and equipment of cultural significance	There are several buildings and structures within the proposed mining site, but none was confirmed to be older than 60 years
Areas to which oral traditions are attached or which are associated with intangible heritage	None exists
Historical settlements and townscapes	None survives in the proposed area
Landscapes and natural features of cultural significance	None
Archaeological and palaeontological sites	A LIA kraal was identified on the site
Graves and burial grounds	Two burial sites recorded and there is potential for more occurring within homesteads
Battlefields	None recorded within the site. Entombe River Battlefield site is located approximately 16km from the southern boundary of the site
Movable objects	None
Overall comment	The mining right application may be approved subject to the recommendations provided in this report

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 4: 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 5: 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 6: 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	2	2	2	16	• Request residents to declare family graves located in the area during public participation meetings. • 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 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 current Mining Right Application 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 (see Kathu and eMalahleni area as an example). The once isolated landscape will see volumes of people establishing new settlement or enlarging the existing ones 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 Right site is required to protect all the identified sites, additionally residents must be requested to declare their family graves located within the mining right site before mining commences. This should be done during public participation meetings. This will ensure that all heritage resources occurring within the proposed mine footprint are identified, documented and mitigated before mining commences. All mitigation measures for grave should not be done without consent from the affected families.

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 specialist studies were conducted in the project area since 2006 including recent studies conducted for prospecting right application within the site. These studies provided an insight about the heritage character of the affected landscape. The survey noted that some sections of the proposed site are mountainous while some sections are ploughed. On the other hand, there are timber plantations, farm dwellings and newly established residential areas within the proposed site. Although the survey did not record burial sites within the site, the study noted that there is potential for burial sites occurring near farm dwellings especially those of previous labour tenants. The practical solution is therefore to request residents to declare their family graves during public participation meetings. In addition, the graves must be documented and mapped by a professional archaeologist with the help of local residents.

In terms of archaeology, the lack of confirmable archaeological sites recorded on the mining right 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. In addition, due to the massive timber production and other agriculture activities, significant archaeological remains may have been destroyed during clearance of the land parcels and subsequent agriculture activities. However, it should be borne in mind 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 although it is surrounded by significant sites. 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 Mining Right application on portion 1 of the farm Annysspruit 140HT and the remaining extent of the farm Mooihoek 168HT, Piet Retief Magisterial District, 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 archaeological sites within the Mining Right Site. In terms of the archaeology, there are no obvious 'Fatal Flaws' or 'No-Go' areas. In terms of Section 36 of the NHRA, the site has potential to yield more burial sites, as such it is imperative to request residence to declare their family graves located in the study area. All burial sites must be treated as NO GO areas and any mitigation measures provided by the mine must involve the affected families. A copy of the chance find procedure must be kept at the site camp, 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 Right 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 Right Application on condition that the site survey did not identify any significant archaeological and heritage sites
3. The public participation process must request landowners and residents to declare graves located within their properties and residences since it was not practical to visit households during the survey.
4. From a heritage perspective supported by the findings of this study, the Mining Right Application is supported. However, the Mining Right 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. 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 Right Application. The Heritage authority may approve the Mining Right Application as planned with special commendations to implement the recommendations here in made.

This report concludes that the impacts of the proposed 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.

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11 APPENDIX 1: CHANCE FIND PROCEDURE FOR PROPOSED MINING RIGHT ON THE REMAINING EXTENT OF THE FARM MOOIHOEK 168 HT AND PORTION 1 OF THE FARM ANNYSSPRUIT 140 HT, UNDER THE MAGISTERIAL DISTRICT OF PIET RETIEF, MPUMALANGA PROVINCE

29 MAY 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 mining 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 Right Application is located on the Remaining Extent of the Farm Mooihoek168 HT and Portion 1 of the Farm Annysspruit 140HT, Piet Retief Magisterial District, Mpumalanga Province. The proposed mining development is subject to heritage survey and assessment at planning stage and Mining Right 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 construction 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 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 Right 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 Right 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, 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 COAL MINING RIGHT 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 construction.

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 Construction 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.

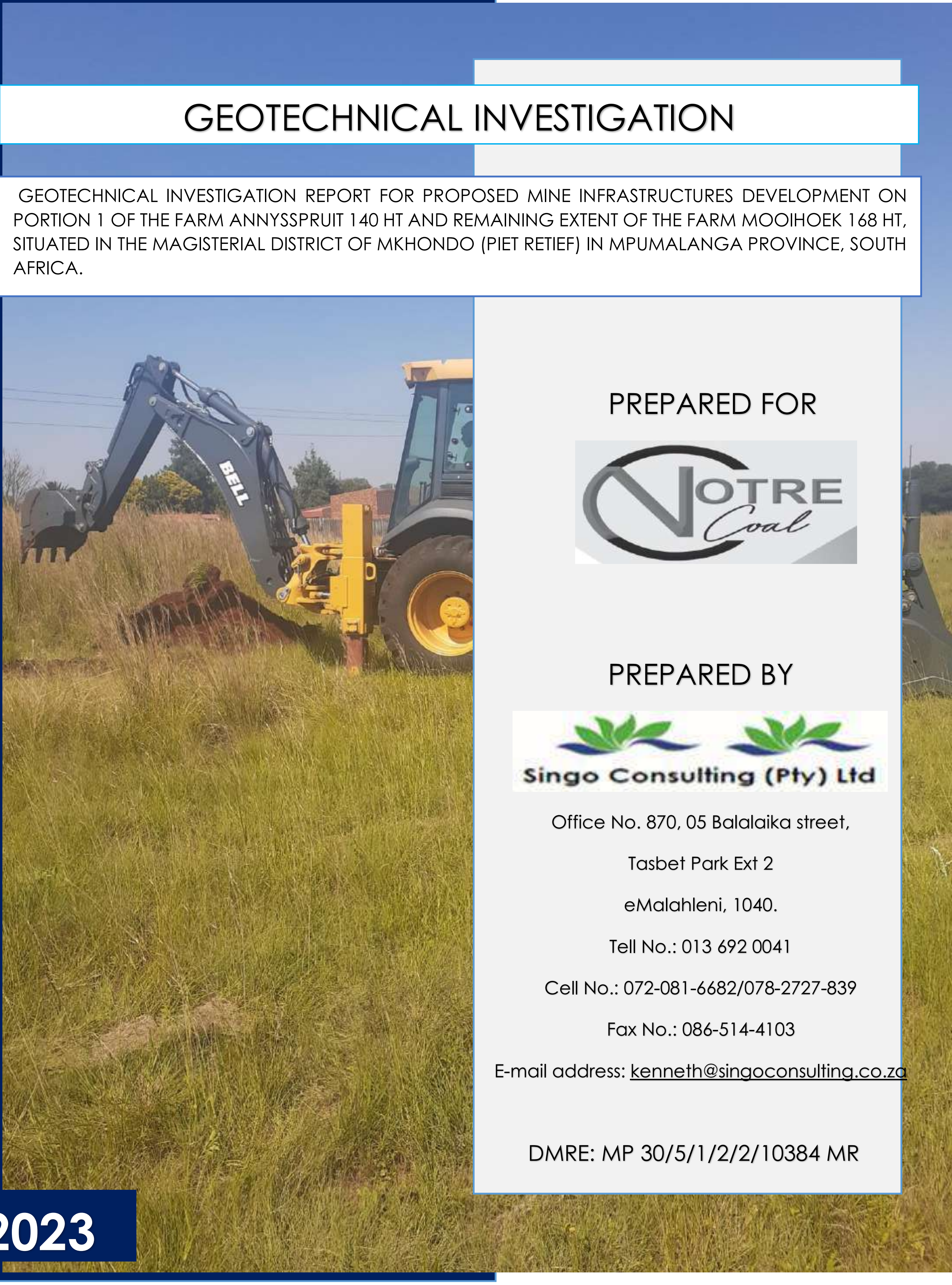
(4) Regulations by the heritage resources authority concerned must provide for a process whereby, prior to the adoption or amendment of any statement of general policy or any conservation management plan, the public and interested organisations are notified of the availability of a draft statement or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

GEOTECHNICAL INVESTIGATION

GEOTECHNICAL INVESTIGATION REPORT FOR PROPOSED MINE INFRASTRUCTURES DEVELOPMENT ON PORTION 1 OF THE FARM ANNYSSPRUIT 140 HT AND REMAINING EXTENT OF THE FARM MOOIHOEK 168 HT, SITUATED IN THE MAGISTERIAL DISTRICT OF MKHONDO (PIET RETIEF) IN MPUMALANGA PROVINCE, SOUTH AFRICA.



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Project Information

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Report Credentials

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1. EXECUTIVE SUMMARY

- This report presents the surficial geotechnical findings of a geotechnical investigation conducted for the proposed Mine infrastructures development on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa..

- The study indicates that the proposed area is located on sandstone, shale and coal beds of the Vryheid Formation of the Ecca Group, Karoo Sequence, and the Karoo dolerite, which is a well-known feature, which occurred after the deposition of the Karoo Supergroup. Site investigations and laboratory test results indicated that the site is underlain mainly by colluvial, alluvial and residual soils characterised by a low active condition.

- The geotechnical investigations conducted involved field inspections, a review of available data, a comprehensive test pit excavation programme, soil profiling, in-situ testing, and sampling of disturbed samples, testing of soil materials and reporting findings from the geotechnical investigation.

- Based on the fieldwork, soil profiles and laboratory tests, geological and hydrogeological data gathered during site investigation, the investigation indicates that the site is underlain by ‘poor’ bedding material. Suitable bedding material is not available on site and its immediate surrounds; therefore, pipe bedding material will need to be sourced commercially or by identifying a suitable borrow pit.

- Medium to hard excavations should be expected beyond depths of refusal reached during the investigation.

- It is recommended that a Geotechnical Engineer inspect all foundation trenches prior to construction to identify and evaluate any soil characteristics in variance with those found during this investigation.

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2. INTRODUCTION

Singo Consulting (Pty) Ltd was appointed by Notre Coal to carry out a geotechnical investigation for the proposed mining infrastructure to be erected at the coal mining right being applied for on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa. The geotechnical investigations were conducted through desktop study and fieldwork which included test pit excavations, soil profiling and sampling, and laboratory testing. The geological and hydrogeological data were also gathered during the site investigation process. The geotechnical investigations were carried out to assess the geotechnical conditions of the site for the proposed Mine infrastructures development.

The purpose of the report is also to identify anticipated geotechnical constraints that may impact on recommendations for foundation and structural designs for the planned mine infrastructures development and to subdivide the site into geotechnical (soil) Site Class. A wide range of geotechnical conditions were evaluated in order to characterise the site into prevailing geotechnical zones.

The report therefore documents an overview of the geotechnical properties and characteristics of the surficial soils underlying the area that is earmarked for the proposed development. It also describes the process that was undertaken during the geotechnical investigations.

3. Terms of Reference

Singo Consulting (Pty) Ltd was appointed by Notre Coal to conduct geotechnical investigations for the proposed Mine infrastructures development.

3.1 Scope of work

The investigation was carried out to assess the geotechnical conditions of the site for the proposed development. As per the Client's instructions, the scope of work included:

1. Excavation of test pits at regular intervals across the site.
2. Laboratory testing and analysis.

3.2 Objective

The purpose of this report is to detail findings from the geotechnical investigation conducted and identify anticipated geotechnical constraints that may have an adverse impact on the

proposed development. The report also provides recommendations for earthworks, drainage, and suitability of the *in-situ* soils for construction of the proposed infrastructure. The geotechnical information gathered in this investigation can be used for planning, design, and preliminary construction costing.

3.3 Methodology

The investigation was implemented in three phases, namely:

1. Desktop Study
2. Reconnaissance
3. Fieldwork

As presented in the methodology above, a phased approach was adopted which involved:

I. Desktop study

The investigation process commenced with a desktop study where available data, including existing geotechnical reports, geology maps, geomorphology, topographic maps, and aerial photography of the site, was collated, assessed, and assimilated.

II. Field Reconnaissance

The desktop study was followed by a walk over survey which was undertaken to obtain a better understanding of the existing/in-situ site conditions. The layout of the area and accessibility was assessed. Other pertinent data that was collected during this stage included identification of areas of outcrop, site drainage and storm water runoff, etc. Siting of test pit location was also conducted during the reconnaissance phase of the investigation.

III. Site Investigations

Following the reconnaissance, field investigation was conducted through test pitting and profiling, in situ testing and testing of disturbed and undisturbed samples. Test pits were excavated employing a tractor loader backhoe (TLB) to a depth of at least 3,0 m or until refusal was encountered. The guidelines in the TRH, SAICE, SAIEG and SANS documents were utilised to guide the relevant information such as number of test pits required per site. The South African standard and recommended method of profiling is used to profile the test pits as well as soil sampling for laboratory testing. The laboratory tests were conducted to assist with the purpose of classification, description, and delineation of homogenous soil zones.

4. AVAILABLE INFORMATION

The following sources of information were utilized:

1. Geological maps 1:250 000
2. Topographical Maps 1:50 000
3. Site Layout
    - Site layout plans
    - Basecamp (Software used for extracting site coordinates from GPS device);
    - Google Maps; and
    - Google Earth.

Geotechnical investigations for the proposed development comply with industry standards and code of practice, namely:

- SANS 634: Geotechnical investigations for township development.
- The NHBRC Home Building Manual, Parts 1,2 and 3. Revision 1, February 1999.
- Generic Specification GFSH – 2 of the National Department of Housing, dated September 2002, entitled: Geotechnical site investigations for housing developments.
- The requirements of Section 12 of Act 95 of 1998 (Home Consumer Protection Measures Act).
- TRH 14 – Technical Recommendation for Highways.

5. Site Description

The site covers Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa – see Figure 1 below.

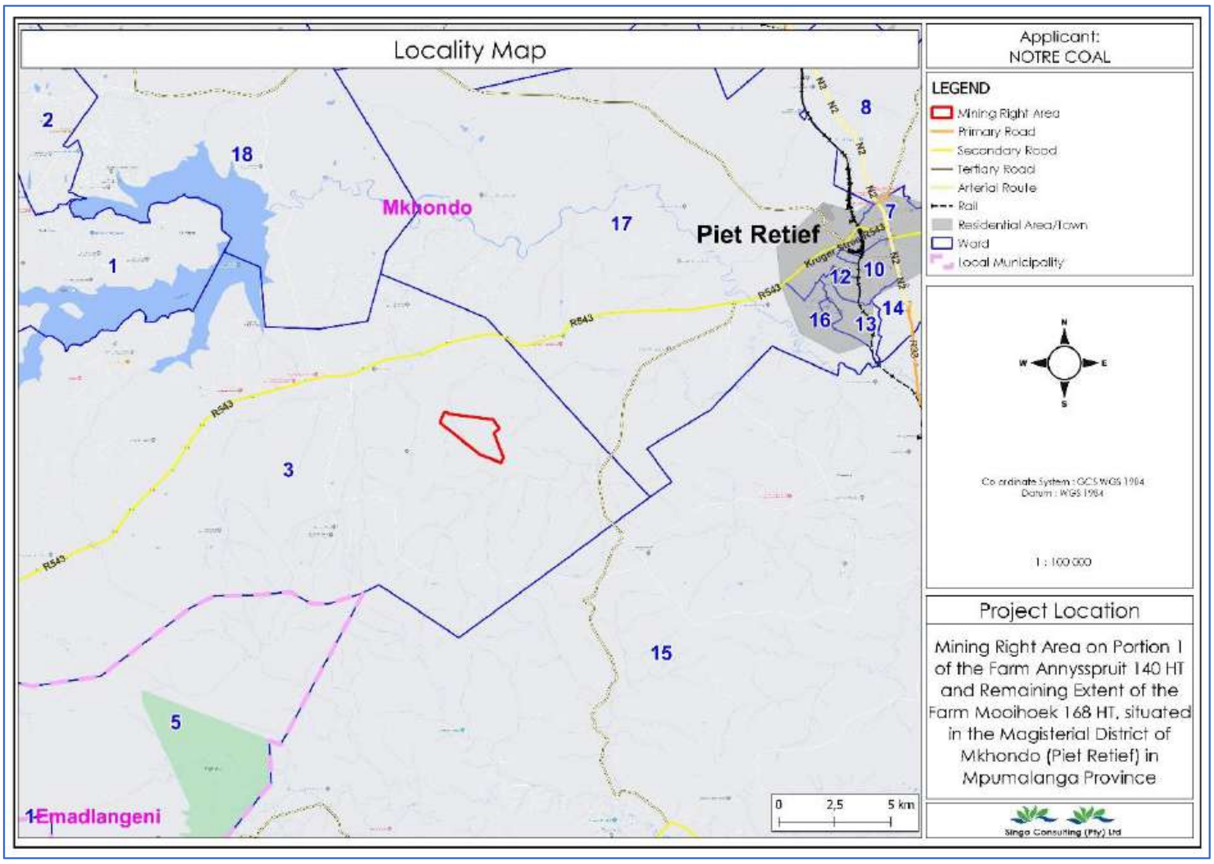

Figure 1: Locality map of the Project area

6. TOPOGRAPHY AND DRAINAGE

Topography is a field of geoscience and planetary science and is concerned with local detail in general, including not only relief but also natural and artificial features, and even local history and culture. The flow of water during rainy seasons flows from the area of high elevation to the area of low elevation.

The Figure 2: Hydrology and Topology map indicates the following waterbodies exists within and nearby the project area:

- Perennial river.
- Non-perennial river.
- Channelled valley bottom wetland.
- Seep wetland.
- Dam

Within the remaining extent of portion 12 of the farm Mooihoek 168 HT, the flow of water is from the north moving towards the southern direction. A small dam is situated on the southern side of the farm and has a dam wall on the northern side, to control the flow of water.

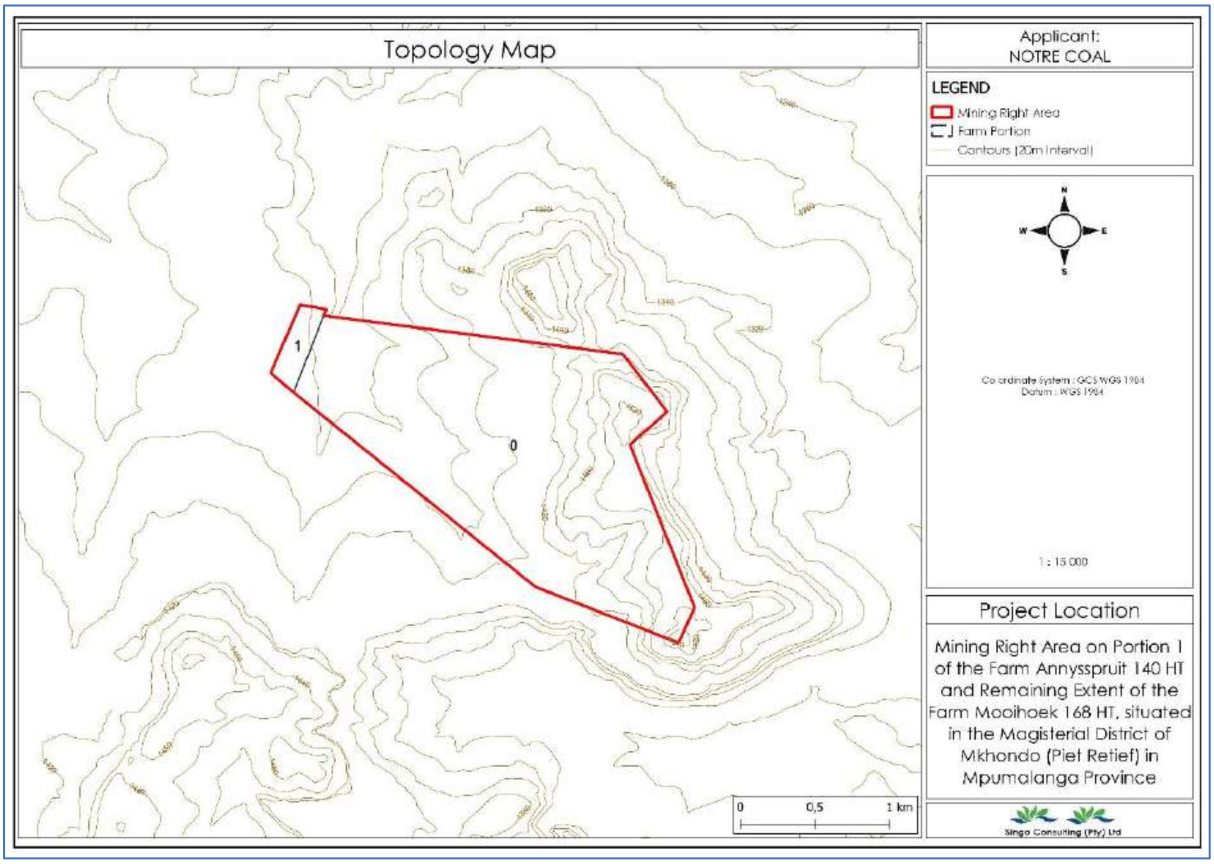

Figure 2: Hydrology and Topology map

7. Climate

In Mkhondo, temperature varies over the course of the year typically from 4°celsius to 26°celsius (refer to Figure 3). The warm seasons, from November 11 to March 13 the area has an average daily temperature above 24°celsius, with January being the hottest months of the year with an average high temperature of 26°celsius and low temperature of 15°celsius. The coldest months of the year are June and July with an average High temperature of 19°celsius and a low temperature of 4°celsius.

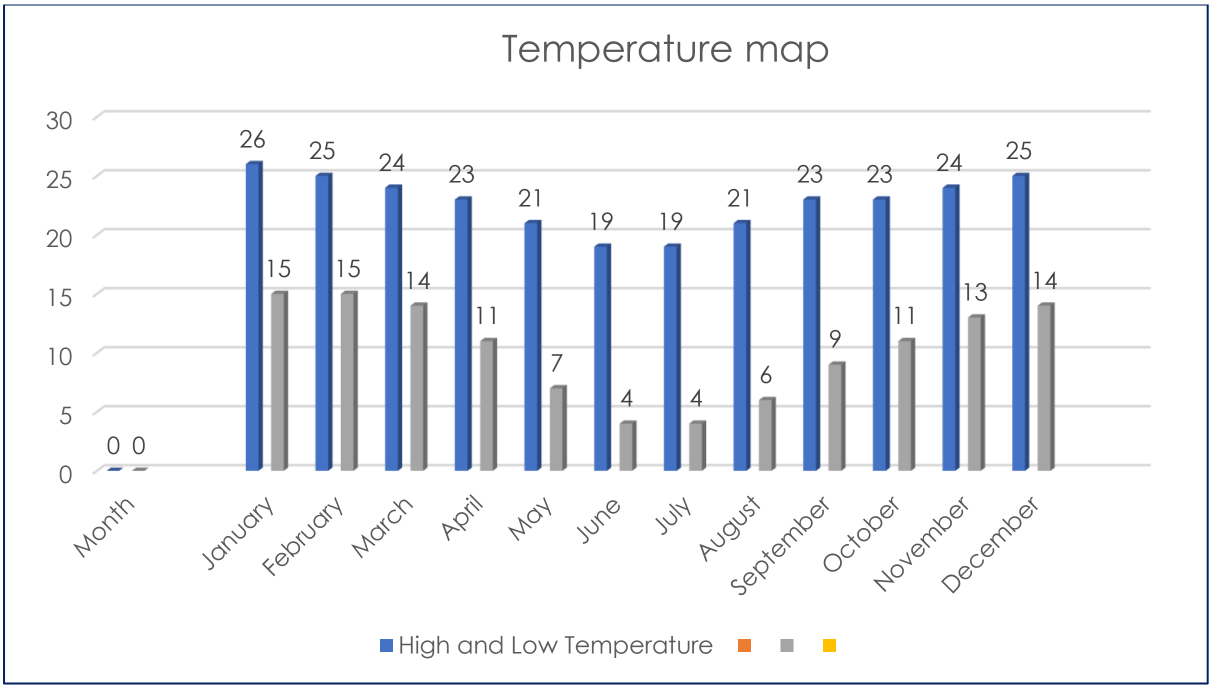

Figure 3: Temperature map of Piet Retief. Source https://en.climate-data.org/africa/south-africa/mpumalanga/piet-retief-12657/

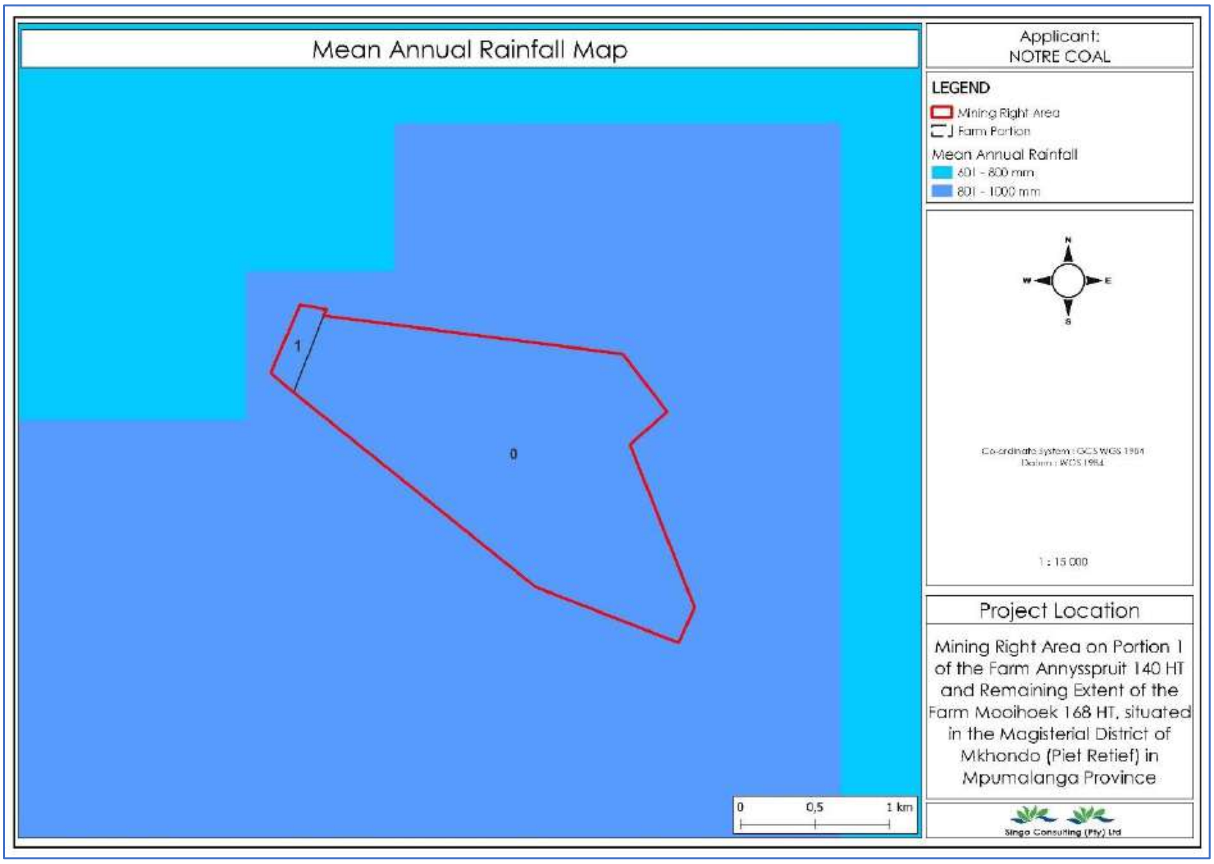

Figure 4: Mean annual rainfall map

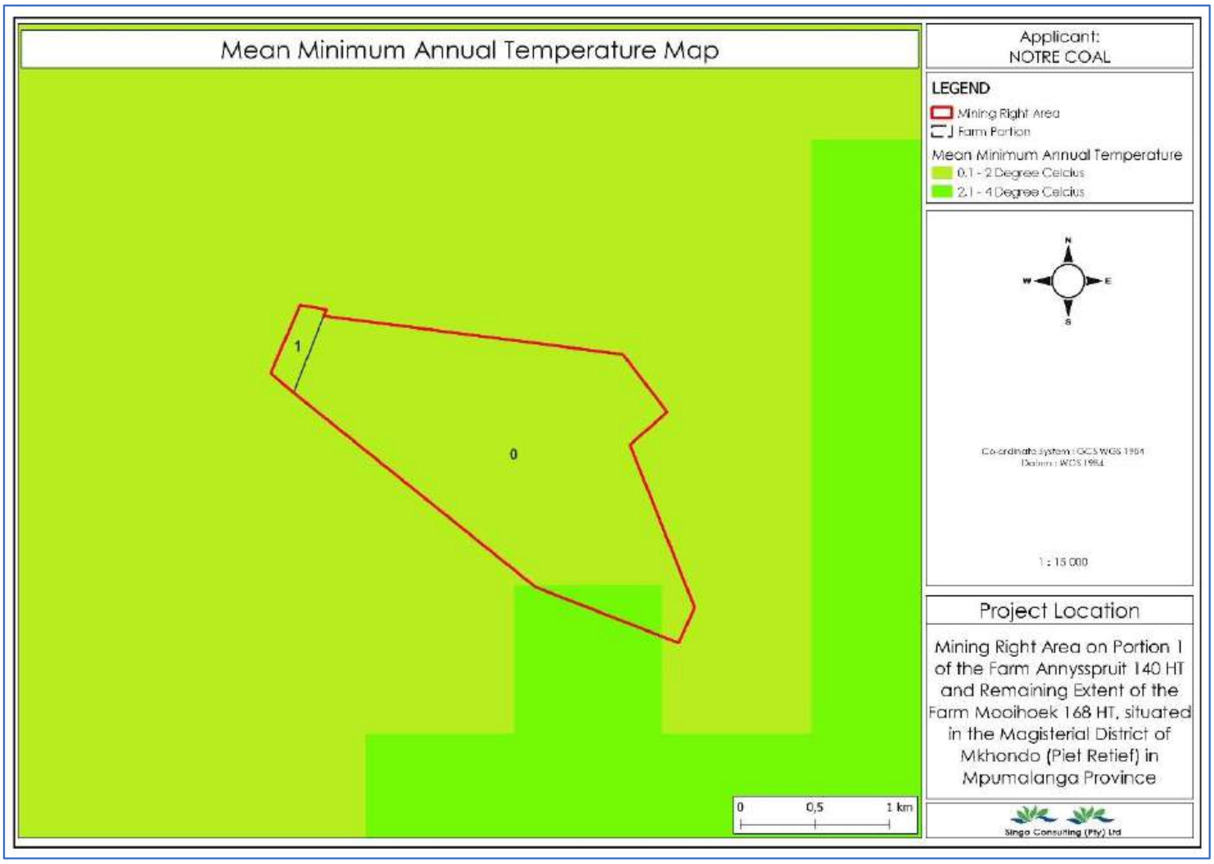

Figure 5: Mean minimum annual temperature map

8. Weathering

The type and rate of rock weathering are determined by the climate of an area. Weinert (1980) developed an N-value system, which is used to derive the type of weathering likely to occur in an area based on macro-climatic conditions (evaporation and rainfall). Mechanical weathering is likely to occur in locations where N>5, while chemical weathering occurs in regions where N<5.

An N-value ranging from 2-5 was determined for this site, using the diagram provided in below (TRH4, 1996). This indicates that moderate climatic conditions occur on the site and that rock and soil are therefore expected to be subject to predominantly chemical weathering. The green dot on the map indicates the site location.

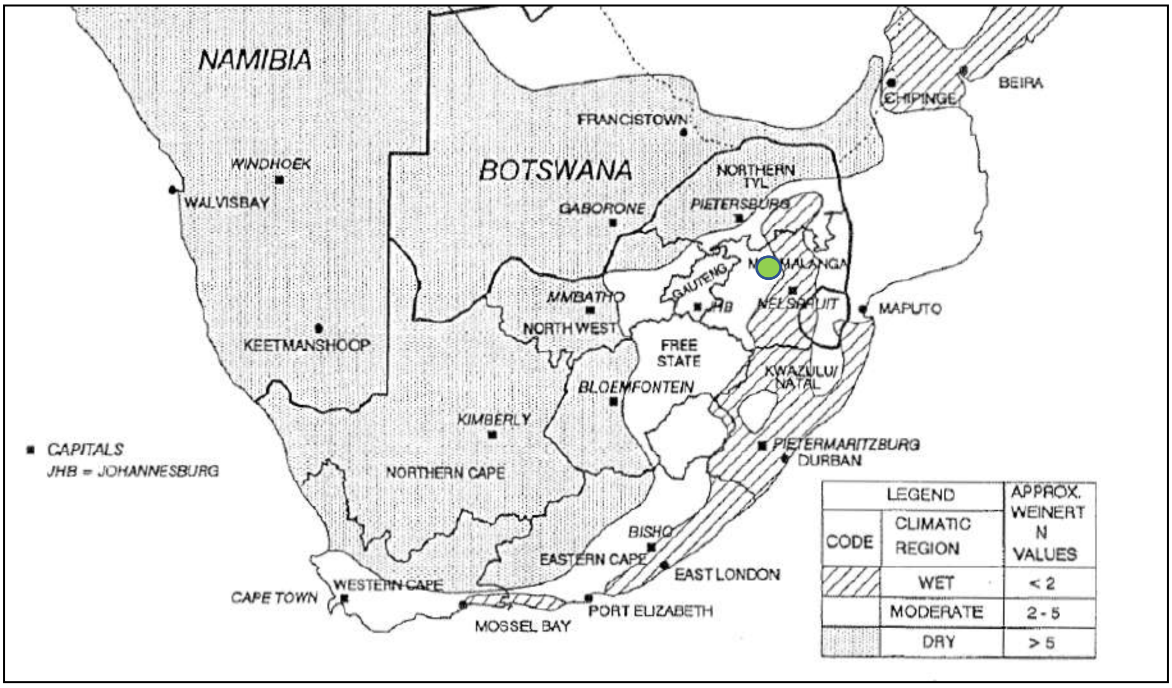

Figure 6: Macro climatic regions of Southern Africa (TRH4, 1996 adapted from Weinert, 1980).

9. GEOLOGY AND ANTCIPATED SOIL CONDITIONS

The geology of the site sourced from the 1: 250 000 scale Geological, indicates that the investigate area is located on sandstone, shale and coal beds of the Vryheid Formation of the Ecca Group, Karoo Sequence. These lithologies are overlain by their weathered soil derivatives, which are in turn mantled by variable thicknesses of Hillwash, alluvial and colluvial materials The various lithological units encountered on the sites as shown in Table 1.

Table 1: Lithological units Table of project area

LITHOLOGY	**LITHOSTRATIGRAPHIC UNIT**
Silts, sands, gravels, clayey deposits, pedocretes, aeolian	Recent deposits of mixed origin (hillwash, aeolian, pedocretes and colluvium)
Sandstone, shale and coal beds.	Vryheid Formation, Ecca Group, Karoo Sequence

9. 1 Anticipated Soil Conditions

Residual soils derived from sandstone, typically form silty sands that may exhibit a collapsible grain structure. These soils may competently bear imposed loads when dry, however, when inundation occurs and the soil is under load the colloidal 'bridges' in these voided soils fail and the soil typically collapses into a denser state, leading to differential settlement. The differential settlement may result in structural damage. 'Corners down' cracking of buildings is often observed in areas of collapsing soils.

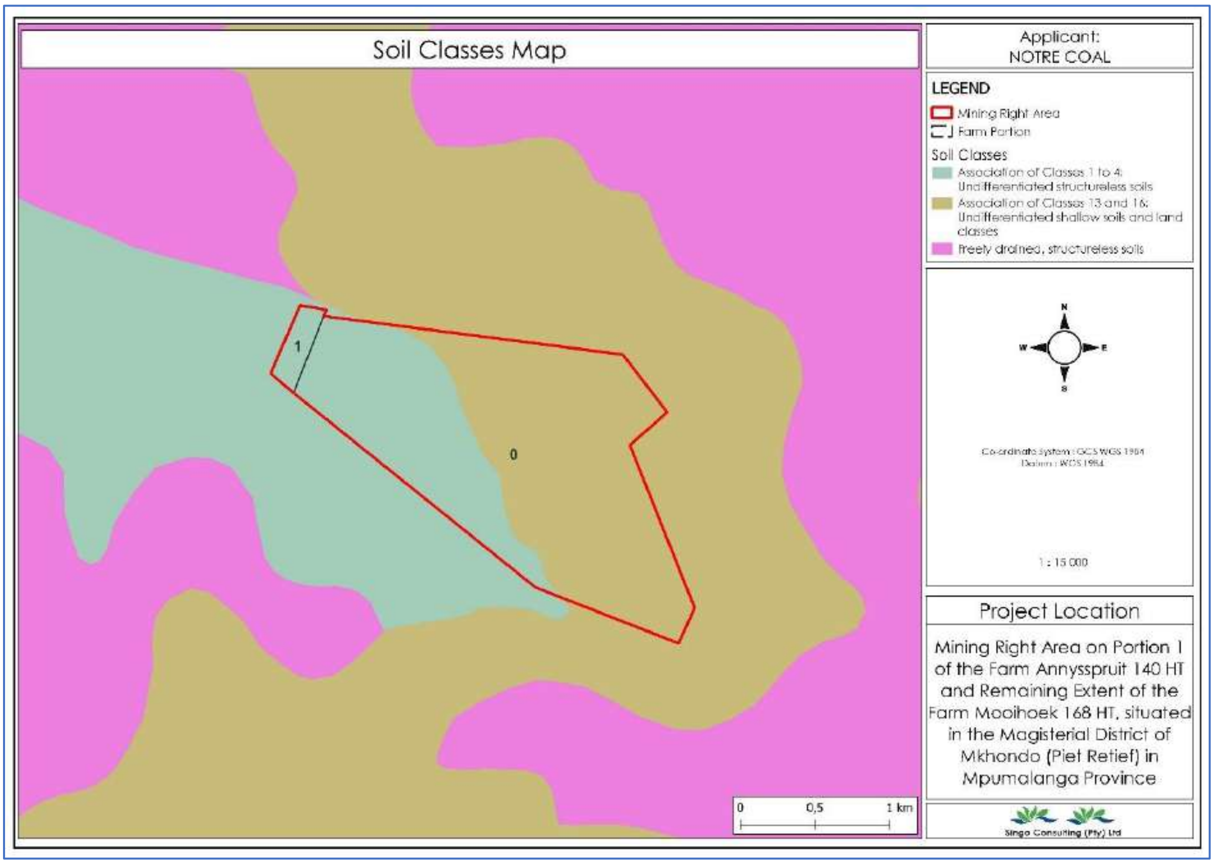

Figure 7: Soil classes map of the Project area

9.2 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 (Jermy 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 basinward facies migration down the southernly dipping paleoslope.

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).

Karoo dolerite

Karoo dolerite, which is a well-known feature, which occurred after the deposition of the Karoo Supergroup and the sandstone, shale and coal beds of the Vryheid Formation of the Ecca Group, Karoo Sequence. These lithologies are overlain by their weathered soil derivatives,

which are in turn mantled by variable thicknesses of Hillwash, alluvial and colluvial materials The various lithological units encountered on the sites. Basic dyke formation of the late Karoo magmatic period is found throughout the area. Due to their relatively high resistance to weathering and erosion, the dolerite dykes appear more dominant in areas. The dolerite dykes are generally fine-grained, and dark grey to black in colour with massive structure. These dykes consist of plagioclase (labradorite to bytownite) with augite and other minerals. Intrusions of dolerite dykes are due to weaknesses in the older rock formations and have a north-south orientation.

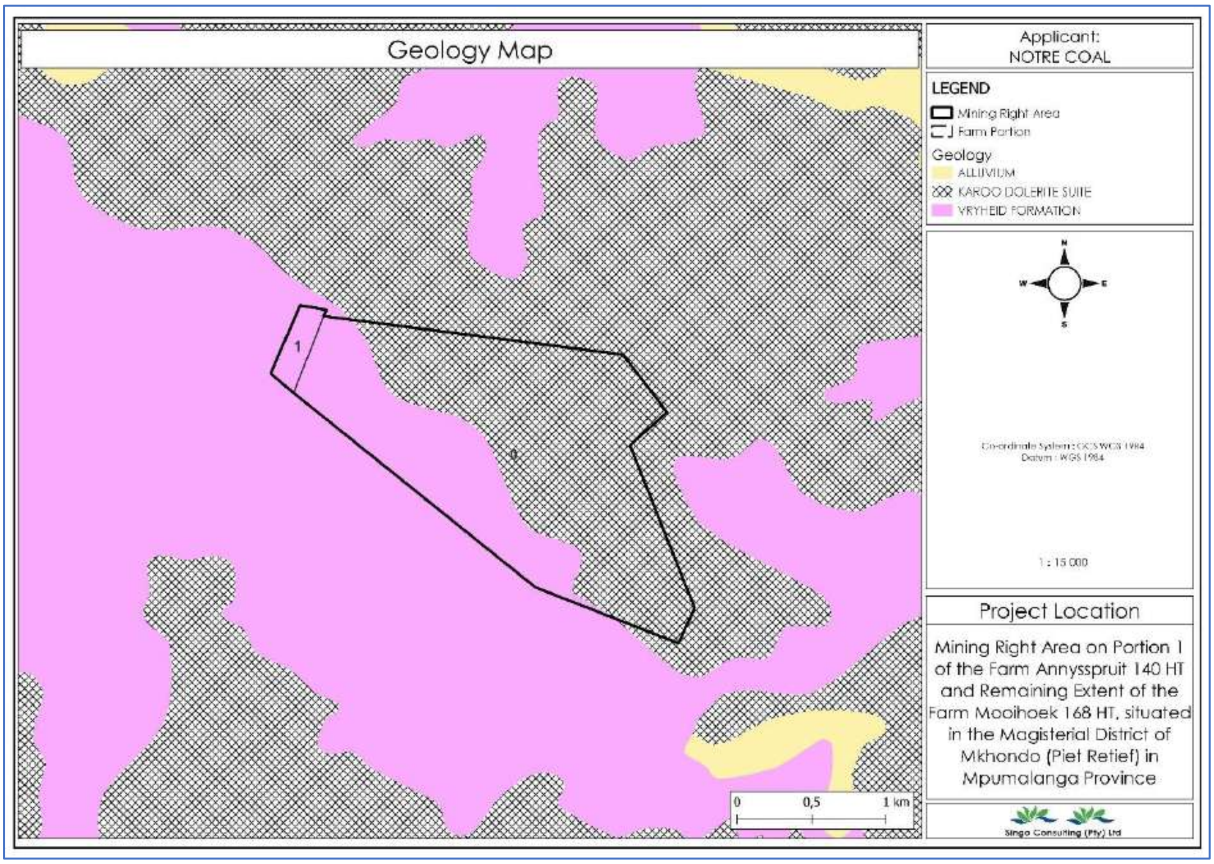

Figure 8: Geology map of the Project area

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10. GEOTECHNICAL INVESTIGATION

10.1 Model for selecting test positions

The approach for test pit siting involved:

1. Determining the extent of the site.
2. Obtaining site data and plotting site boundaries on Google Earth image; and

3. Calculating the minimum number of test pits required according to GFSH-2[1].

The spacing of the sampling points was selected taking into consideration the expected geological strata within the study area.

10.2 Desktop study

The investigation process generally begins with desktop study where evaluation of available information is conducted. The existing information may include:

- Existing geotechnical reports of the area and/or its surrounds, geology maps, topographic maps, and aerial photography of the site.
- Geology maps, topographic maps, and aerial and satellite photography of the site.
- Site layout plans of the area

10.3 Field Reconnaissance

The desktop study process was followed by field reconnaissance investigation which mainly involved a walk over survey. The walk over survey was undertaken to develop a clearer perspective of the actual site conditions including the layout of the area, accessibility, geomorphology, geology, etc. Some of the pertinent information evaluated such as outcrop/scattered outcrop, storm water runoff, etc., were mapped during this reconnaissance stage.

10.4 Field Investigation

The site investigation was conducted with test pits, excavated on-site using a hired Tractor Loader Backhoe (TLB). The test pits were positioned to determine a diagonal cross section across the site area.

The test pits were excavated at approximately regular intervals across the site of the proposed development. These test pits were strategically located to give representative soil conditions of the area.

After excavation of the test pits a registered Engineering Geologist inspected and logged the soil profiles as recommended by SAIEG (1996) and according to the MCCSSO method of

profiling by Jennings et al. The trial pits were loosely backfilled after profiling. Test pit profiling is a visual and tactile method of assessing the soil characteristics of a site in order to classify it according to its material strength, geotechnical zones and soil conditions so as to give guidance on issues such as appropriate pipe bedding material and structural designs.

disturbed soil samples were collected for foundation indicator testing including grading analysis and Atterberg Limits. disturbed bulk samples were collected for CBR testing including road indicators and MOD. These samples were submitted to Soillab Laboratories for testing. Due to the friable nature of material on site no undisturbed samples could be retrieved. The laboratory tests were conducted to assist with the purpose of classification, description, and delineation of homogenous zones. The site classification system is discussed in the Code of Practice for Foundations and Superstructures for single storey Residential Buildings of Masonry Construction compiled by the Geotechnical Division of the SAICE and the IstructE (COP) and SAICE's Guidelines for Urban Engineering Geological Investigations.

11. RESULTS

11.1Terrain observations

The topography of the proposed mine infrastructures development area is generally flat with a very gentle slope. There were no outcrops and/or sub-outcrops that were encountered across the site. Flat areas which may present retarded stormwater dispersion do occur across the site and erosion is generally via sheetwash.

11.2 Field work

test pits were spread evenly and excavated over the entire site to cover the extent of the proposed development as shown Figure 9 . These test pits were strategically located to give representative soil conditions of the area. A registered engineering geologist inspected and logged the ground profiles as recommended by SAIEG (1996) and according to the MCCSSO method of profiling by Jennings et al. The trial pits were loosely backfilled after profiling.

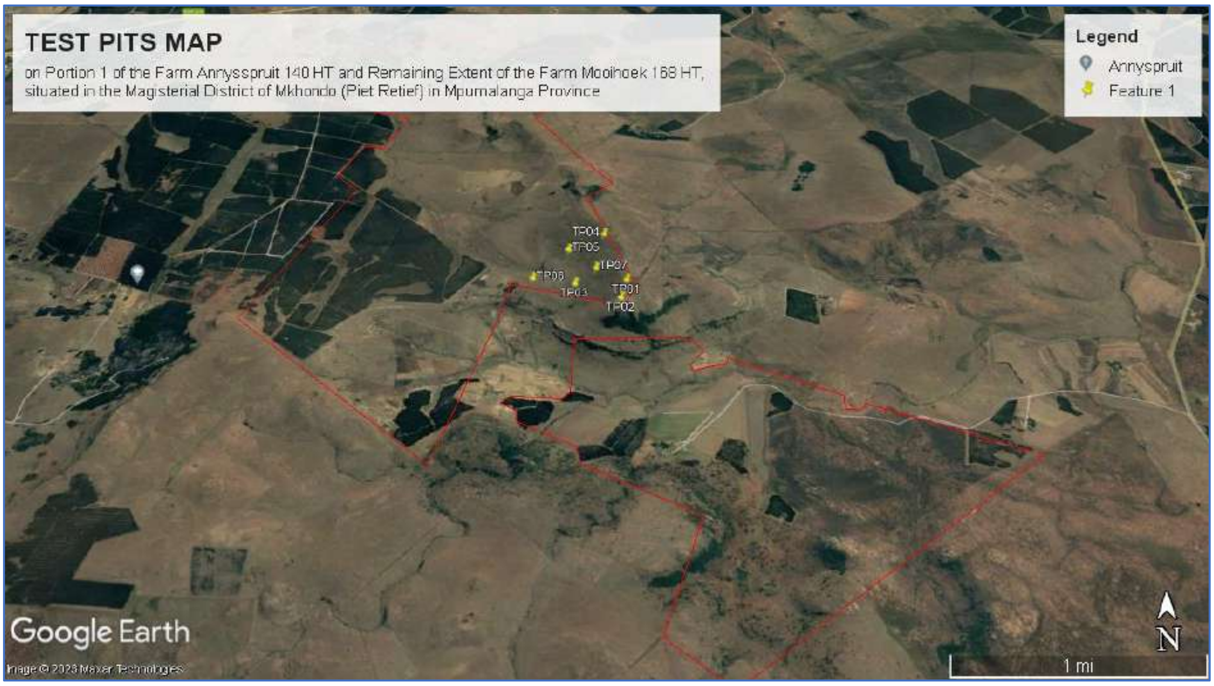


Figure 9: Test Pits map of the Project area

11.3 Sampling and laboratory test results

representative disturbed samples were taken from the selected soil horizons for laboratory testing. Foundation indicator testing including Atterberg limits as well as grading analysis was conducted on the soil samples. The samples will be submitted to Road lab laboratories for the testing. Undisturbed soil samples could not be retrieved for collapse potential testing due to the crumbly nature of the sandy soils on site. The samples were taken from the test pit position denoted in the same manner.

12. EVALUATION OF GEOTECHNICAL PROPERTIES

The report focuses on the geotechnical site investigation aimed at determining various geotechnical properties of the near surface soil horizons in accordance with SAICE, GFSH-2 and NHBRC guidelines, with emphasis on foundation recommendations for single storey masonry structures, as well as other related engineering geological characteristics.

Geotechnical properties relevant to the development that were evaluated include:

- **Active soil** – Fine grained soils (generally with high clay content) that changes in volume in response to the change in moisture content. These soils may increase in volume (heave/swell) upon wetting and decrease in volume (shrink) upon drying out.
- **Collapsing settlement** – soils that exhibit sudden settlement under load when the soil is wetted.
- **Inundation** – areas that may be prone to flooding. These areas may occur near drainage channels such as rivers, streams, marshy areas, etc.
- **Consolidation settlement** – the vertical settlement or decrease in soil volume that occurs in a soil under applied static load owing to the slow time-related reduction in volume of the voids.
- **Compressible soils** – A soil whose bulk volume may gradually decrease with time when subjected to an applied load.
- **Excavatability** – areas where difficulty in excavation for either foundations or civil servicing may be experienced.
- **Groundwater table** – areas where a shallow groundwater table may be encountered.
- **Slope instability** – areas that may be susceptible to slope failures.
- **Problem soils** – areas that may occur in marshy zones, deep unconsolidated fills, and/or areas that may be underlain by dolomite related instabilities, etc.

Table 2 below gives the basis of the soil site classification that was applied during the investigation. The table was adapted according to the site classification system detailed in the NHBRC Home Building Manual, GFSH-2 document, SAIEG guidelines and the Code of Practice (COP) by the Joint Structural Division SAICE and IStructE. The designation for the excavatability class was further subdivided in this document to allow for various levels of difficulty in excavation.

Table 2: Residential site class designation (adopted from the NHBRC Home Building Manual and the COP)

GEOTECHNICAL CATEGORY AND SITE CLASS DESIGNATION	**GEOTECHNICAL CHARACTERISTICS**
Active soils (heave/shrink) - (H) H H1 H2 H3	Expected range of total movement at surface: < 5 mm 5 – 15 mm 15 – 30 mm > 30mm
Collapsible Soils – (C) C C1 C2	Expected range of total movement at surface: < 5 mm 5 – 10 mm > 10 mm
Compressible soils (S) S S1 S2	Expected range of total movement at surface: < 5 mm 5 – 15 mm > 15 mm
Excavation – (R) r1 r2 r3	 sub outcrop scattered outcrop and sub-outcrop outcrop, scattered outcrop, and sub-outcrop
P – Problem soils	Dolomitic Areas, marshy areas, contaminated areas, abandoned borrow areas, land fill, mining subsidence and mine waste fill, shallow undermined areas, exploration pits or adits.
Inundation and seepage – (W)	Wet area, drainage line, seepage zone

Based on terrain types the GFSH-2 documents and the SAIEG guidelines subdivide areas that are earmarked for development according to Geotechnical Sub-Areas. These Geotechnical Sub-Areas give an indication of the development potential of the site with regards to various geotechnical, geological, and geomorphological constraints. The GFSH-2 and SAIEG documents have identified three main Geotechnical Sub-Areas that are simplified in Table 3 below. These classifications appear with the site soil classifications as prefixes.

Table 3: Geotechnical Classification for Urban Development (adopted from the GFSH-2 and SAIEG)

Geotechnical Sub-Area	Definition
1	Areas recommended or favourable for development
2	Areas where development can be considered with certain precautionary measures.
3	Areas that are not recommended for development

12.1. Active soils

Active/expansive soils – soils that change in volume by expanding or shrinking as a result of change in moisture content and are denoted as expansive soils **(H)** according to the SAICE/SAIGE site classes. The expansive soils can be classified as H, H1, H2 or H3 according to the severity of the predicted/anticipated volume change. The prediction of volume change was conducted using Van der Merwe's. This method gives swell differences between dry state and full saturation.

The site is underlain by uncontrolled fill, transported soils (colluvial soils), residual soils and pedogenic soils derived mainly from transported and residual dolerite soils. The soil profiling conducted during the investigations indicates that the site is underlain by cohesive soil, however a slickensided structures were observed in all five test pits i.e. The colluvial soils horizons are anticipated to exhibiting low to medium potential expansive conditions across the site. Residual soils that were encountered exhibit a slickensided structure indicates that these soils are anticipated to exhibit medium to high heaving conditions.

Reworked and pedogenic soils are anticipated to exhibit low to medium expansive conditions.

The interpretation of the fieldwork observations indicates that the soils that underlie the site will exhibit a low to medium expansive potential. Based on the interpretation of the fieldwork results, the prominent soil site class of the area will therefore be H-H2 according to the SAICE and NHBRC site classification system.

12.2. Collapsing soils

Collapse and/or consolidation settlement soils denoted as C are soils that have a potential for collapse and are commonly open textured with a high void ratio (Brink, 1985). These soils may include 'loose' to 'medium dense' colluvium material, aeolian sands as well as residual soils that are derived from dolerite.

The site investigations indicated that the site is underlain mainly by colluvial soils and residual soils derived from dolerite. Aeolian soils and soils that exhibit an open-textured/voided structure, and therefore possessing a potentially collapsible soil fabric, were not encountered on site. Due to the crumbly nature of the soils on site undisturbed soil samples could not be retrieved for collapse potential testing. From the site observations it is therefore anticipated that the site will exhibit a low potential collapsible fabric; C according to SAICE soil site classification system.

12.3. Compressible soils

Compressible soils – Typically fine-grained soils such as clay, clayey sand and clayey silt with low plasticity. Gravelly and sandy soil are commonly compressible soils, which classify as site class **S** soil. According to the severity of subsurface conditions the NHBRC site class may be designated as S, S1 or S2.

The site is generally underlain by fine-grained soils that are anticipated to exhibit low to medium plasticity conditions. Uncontrolled fill was not encountered across the site. It is anticipated that soil conditions that may exhibit potentially medium compressible characteristics may occur across the site due to the occurrence of clayey and silty soils with low plasticity conditions. From the site observations it is anticipated that the site will exhibit a medium potential compressible fabric with some areas exhibiting medium settlement conditions; S1-S2 according to the SAICE and NHBRC soil site classification system.

12.4. Excavatability

Excavatability of the ground relates to the degree of difficulty at which the ground can be excavated, to a depth of 1.5 m, for foundations as well as for services. Areas of poor/hard excavatability are characterised by outcrop, near-surface bedrock, hardpan pedocretes, etc. Although these areas present favourable founding conditions they also present a high-cost factor with regard to services installation.

The average depth of the test pits in the investigated area ranges from approximately 0.7 m to greater than 2.0 m. The test pits encountered difficult excavation, near refusal and refusal on residual dolerite. Scattered outcrops, sub-outcrops and shallow bedrock were encountered across the site. It is anticipated that excavatability problems may be encountered across the site during civil servicing and foundation excavations.

Allowance of local “difficult excavation” and “intermediate class” excavation in term of the SANS excavation specifications should however be made.

12.5. Groundwater table

A shallow/perched groundwater table normally presents a problem of rising damp on engineering structures therefore appropriate remedial measures such as damp proofing need to be implemented in areas where a shallow/ perched water table is anticipated. The presence of various forms of pedogenic soils (friable, scattered, uncemented nodular ferricrete/calcrete and signs of ferruginisation/calcarisation) is an indication of a fluctuating or seasonally perched water table conditions caused by retarded vertical infiltration and percolation rates.

Groundwater seepage was not encountered in all the excavated test pits. Various forms of ferruginisation as well as signs of seepage were observed in the excavated test pits. The site is underlain mainly by colluvial soils overlying pedogenic soils, residual. The investigated site is generally characterised by a gentle slope toward the northeast. Marshy areas/wetlands do not occur across the site. It is anticipated that a major part of the site will be characterized by a low flow of storm water however vertical flow may be retarded due to the occurrence of the fine-grained soil horizons and presence of shallow dolerite bedrock. It is therefore imperative that mitigating measures such as damp proofing, extensive storm water management and subsurface drainage should be considered.

12.6. Slope instability

The site is currently an extensively developed residential area development with extensive civil infrastructure such as water pipes, electricity, and sewage system. The services are located adjacent and to the west and east of the investigated site. The site lies in an area with a relatively minor slope toward the north-south with a gradient generally at less than 6%. There are no major man-made slopes on the site, and it surrounds therefore related slope stability problems are not anticipated.

12.7. Inundation

Seepage may be anticipated to daylight or occur at shallow depth near the drainage lines. Floodlines must be determined by the relevant Competent Person. All drainage boundaries near wet areas or drainage lines must also be confirmed by the relevant Competent Person.

The site is generally flat lying with shallow cohesive soils and ferricrete horizons therefore surface ponding is anticipated to occur during heavy rains.

12.8. Subsidence

There is no current undermining activity beneath the site, therefore, the potential for mining subsidence is not foreseen. Areas of fill such as dumping of ash or refuse and peat deposits per se, normally give rise to loosely compacted materials and the potential for uneven settlement. Such areas of dump/fill material were not encountered on this site. Uncontrolled surface dumping was encountered in some portions across the area of the proposed upgrades. The site may have borrow areas that were backfilled and covered with vegetation and therefore not identified during these investigations. If such areas are encountered during services installation or foundation/roads excavation, the Competent Person must be consulted in order that appropriate remedial measures may be recommended and implemented at that stage. All rubble and dump material must be removed prior to construction of roads, pavements, or any new structures.

12.9 Problem Soils

Problem soils such as dolomite and/or marshy areas were not encountered across the site.

13. RECOMMENDATIONS

13.1. Provisional site classification

The geotechnical investigations indicate that the site is underlain by relatively variable material comprising mainly silty and sandy gavel, gravelly sands and sandy and clayey silts. These soils are generally characterised by medium bearing capacities with a low expansive potential. Slickensiding was not encountered across the site. The foundation indicator test results indicate that the transported material, residual soils and the pedogenic soils that underlie the site are characterised by low plasticity values and therefore will exhibit low potential expansiveness. Shallow excavatible areas characterised by outcrops, sub-outcrops and shallow bedrock were not encountered across the site, however shallow hardpan ferricrete is prevalent across

the site. It is therefore anticipated that major shallow excavatible conditions may be experienced during the excavation for services in some portions of the site.

From the above discussion the site is classification is as follows: **2/H/C/S-S1**

13.2. Foundation's recommendations

The site is underlain by relatively variable material comprising mainly sandy/gravelly/clayey silty soil. Outcrops and/or sub-outcrops were not encountered across the site. The site may be underlain by soils that are anticipated to have low to medium bearing pressures with the site underlain by soils with low plasticity. These soils may be prone to settlement under structural load. The foundation indicator results indicate that the transported material, residual soils and the pedogenic soils that underlie the site are characterised by low plasticity values and therefore will exhibit low potential expansiveness. It is also anticipated that the site is underlain by soils that may exhibit a potentially compressible fabric.

Foundation recommendations and precautionary measures include:

2/H/C/S-S1

Sub-Area	Construction Type	SAICE Selected foundation recommendation and Building procedures
	Reinforced strip footings	Remove in situ material below the foundation and 1.5 m beyond to a depth of 1.5 times the foundation width or to a competent horizon. Replace with G7 material compacted to 93% MOD AASHTO in 150 mm layers at 1% to +2% optimum moisture content.
	Soil raft, Stiffened or cellular raft.	Soil/Stiffened cellular raft with articulated lightly reinforced masonry top structure. Site drainage and plumbing/service precautions. Bearing capacity not to exceed 50 kPa.

13.3. Precautionary measures

Precautionary measures for the in the area must include:

Extensive site drainage and plumbing/service precautions.

Extensive stormwater management. It is recommended that efficient drainage of stormwater channels, draining into the municipal stormwater system, must be considered.

Extensive damp proofing against shallow fluctuating groundwater table.

A 1.5 m apron slab around the structures.

The site must be graded to prevent ponding of storm water,

Walkways and drive ways must be paved to allow easy access to the property during wet seasons.

Planting of grass/lawn around the area must be considered.

14. CONCLUSIONS

The purpose of this report is to provide a general overview of the prevailing geotechnical conditions on the site, to guide decision-making with regards to the proposed Mine infrastructures establishment including foundation and structural designs. The classifications were based on desk study information and fieldwork.

- A wide range of geotechnical conditions were evaluated to characterise the site into prevailing geotechnical zones.

- Site investigations and laboratory test results indicated that the site is underlain mainly by colluvial, alluvial and residual soils characterised by a low active condition.

- A poorly developed to well-developed pedogenic horizon is characteristic of the area.

- Shallow groundwater seepage was not encountered in all the excavated test pits.

- Signs seepage and shallow pedigenic soils were encountered across the site. Good site drainage and damp proofing in foundations must be implemented across the site.

- Outcrops and sub-outcrops were not encountered in the area however shallow hardpan ferricete do occur extensively across the site; therefore excavatability problems are anticipated.

- The geotechnical zonation show that the site is developable albeit with precautions and/or remedial measures.

- Backfill/dumping areas were not encountered on site. Local areas of such material may be present between the points of investigation.

- Imported engineered soil will be required for road building and construction of pavements.

- The investigated site is characterised by a minor slope however flat areas do occur across the site. Shallow well developed pedogenic soils were encountered across the site which may lead to poor stormwater drainage. The site must be shaped to improve stormwater runoff and extensive stormwater management must be considered.

- The recommended foundation designs for the prevailing conditions across the majorpart of the site include lightly reinforced strip footings.

15. REFERENCES

ASTM D2487. 2011. *Standard Practice for Classification of Soils for Engineering Purposes* (Unified Soil Classification System).

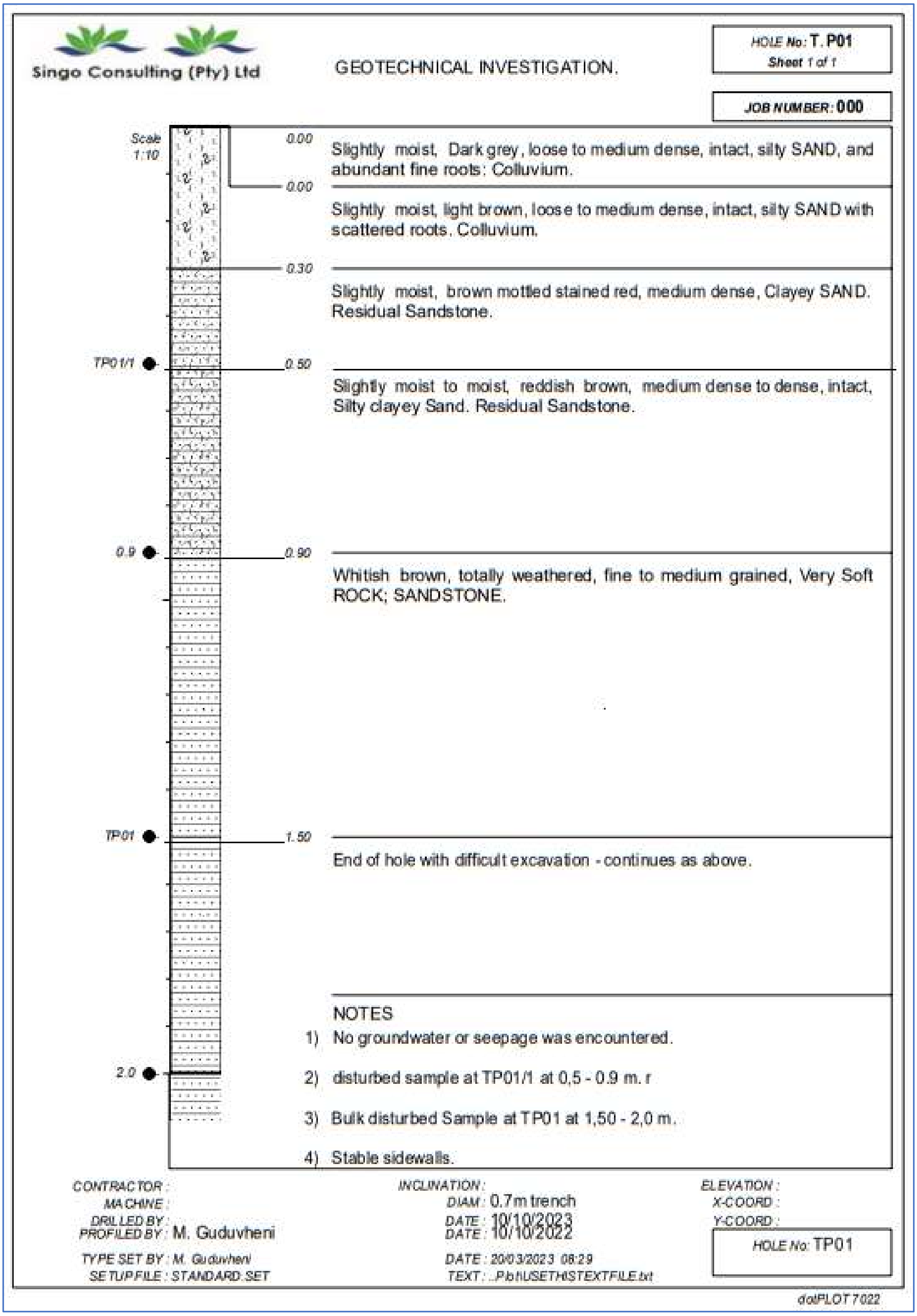
Brink, A.B.A. and Bruin, R.M.H. 2002. *Guidelines for soil and rock logging in South Africa, 2nd impression 2002*. Proceedings of geo-terminology workshop organised by AEG, SAICE and SAIEG.

SANS 634. 2012. *Geotechnical investigations for township development*

Macro climatic regions of southern Africa (TRH4, 1996 adapted from Weinert, 1980)

Appendix

Appendix A: Test Pits Map



Singo Consulting (Pty) Ltd

GEOTECHNICAL INVESTIGATION.

HOLE No: T. P01
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10

	0.00	Slightly moist, Dark grey, loose to medium dense, intact, silty SAND, and abundant fine roots: Colluvium.
	0.00	Slightly moist, light brown, loose to medium dense, intact, silty SAND with scattered roots. Colluvium.
	0.30	Slightly moist, brown mottled stained red, medium dense, Clayey SAND. Residual Sandstone.
TP01/1 ●	0.50	Slightly moist to moist, reddish brown, medium dense to dense, intact, Silty clayey Sand. Residual Sandstone.
0.9 ●	0.90	Whitish brown, totally weathered, fine to medium grained, Very Soft ROCK; SANDSTONE.
TP01 ●	1.50	End of hole with difficult excavation - continues as above.
2.0 ●		

NOTES

1) No groundwater or seepage was encountered.

2) disturbed sample at TP01/1 at 0,5 - 0.9 m. r

3) Bulk disturbed Sample at TP01 at 1,50 - 2,0 m.

4) Stable sidewalls.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : M. Guduvheni

TYPE SET BY : M. Guduvheni
SETUP FILE : STANDARD.SET

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DATE : 10/10/2022

DATE : 20/03/2023 08:29
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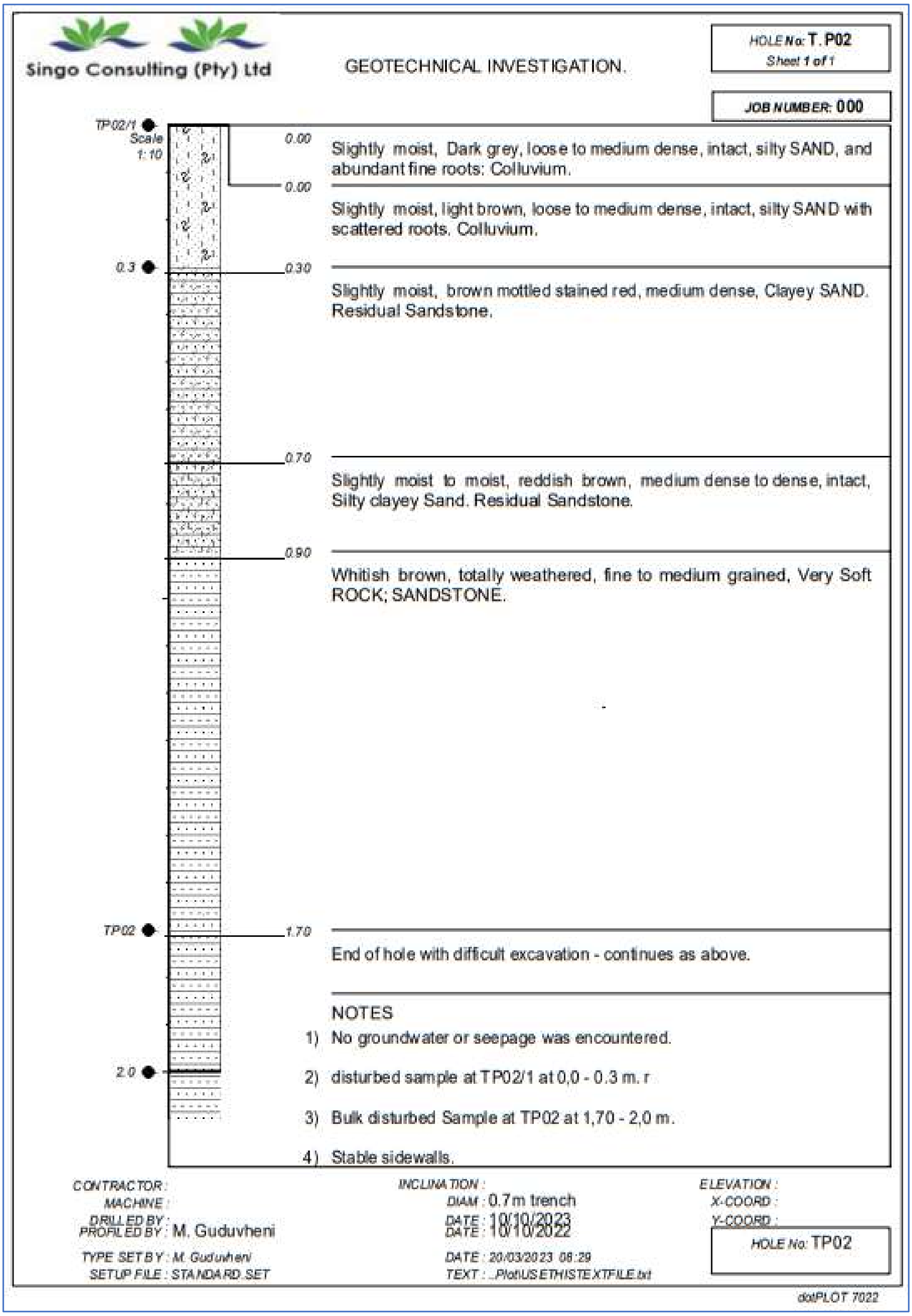
X-COORD :
Y-COORD :

HOLE No: TP01

dotPLOT 7022



Singo Consulting (Pty) Ltd

GEOTECHNICAL INVESTIGATION.

HOLE No: T.P02
Sheet 1 of 1

JOB NUMBER: 000

TP02/1
Scale
1:10

Depth	Description
0.00	Slightly moist, Dark grey, loose to medium dense, intact, silty SAND, and abundant fine roots: Colluvium.
0.00	Slightly moist, light brown, loose to medium dense, intact, silty SAND with scattered roots. Colluvium.
0.30	Slightly moist, brown mottled stained red, medium dense, Clayey SAND. Residual Sandstone.
0.70	Slightly moist to moist, reddish brown, medium dense to dense, intact, Silty clayey Sand. Residual Sandstone.
0.90	Whitish brown, totally weathered, fine to medium grained, Very Soft ROCK; SANDSTONE.
1.70	End of hole with difficult excavation - continues as above.

0.3

TP02

2.0

NOTES

1) No groundwater or seepage was encountered.

2) disturbed sample at TP02/1 at 0,0 - 0.3 m. r

3) Bulk disturbed Sample at TP02 at 1,70 - 2,0 m.

4) Stable sidewalls.

CONTRACTOR :
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TYPE SET BY : M. Guduvheni
SETUP FILE : STANDARD.SET

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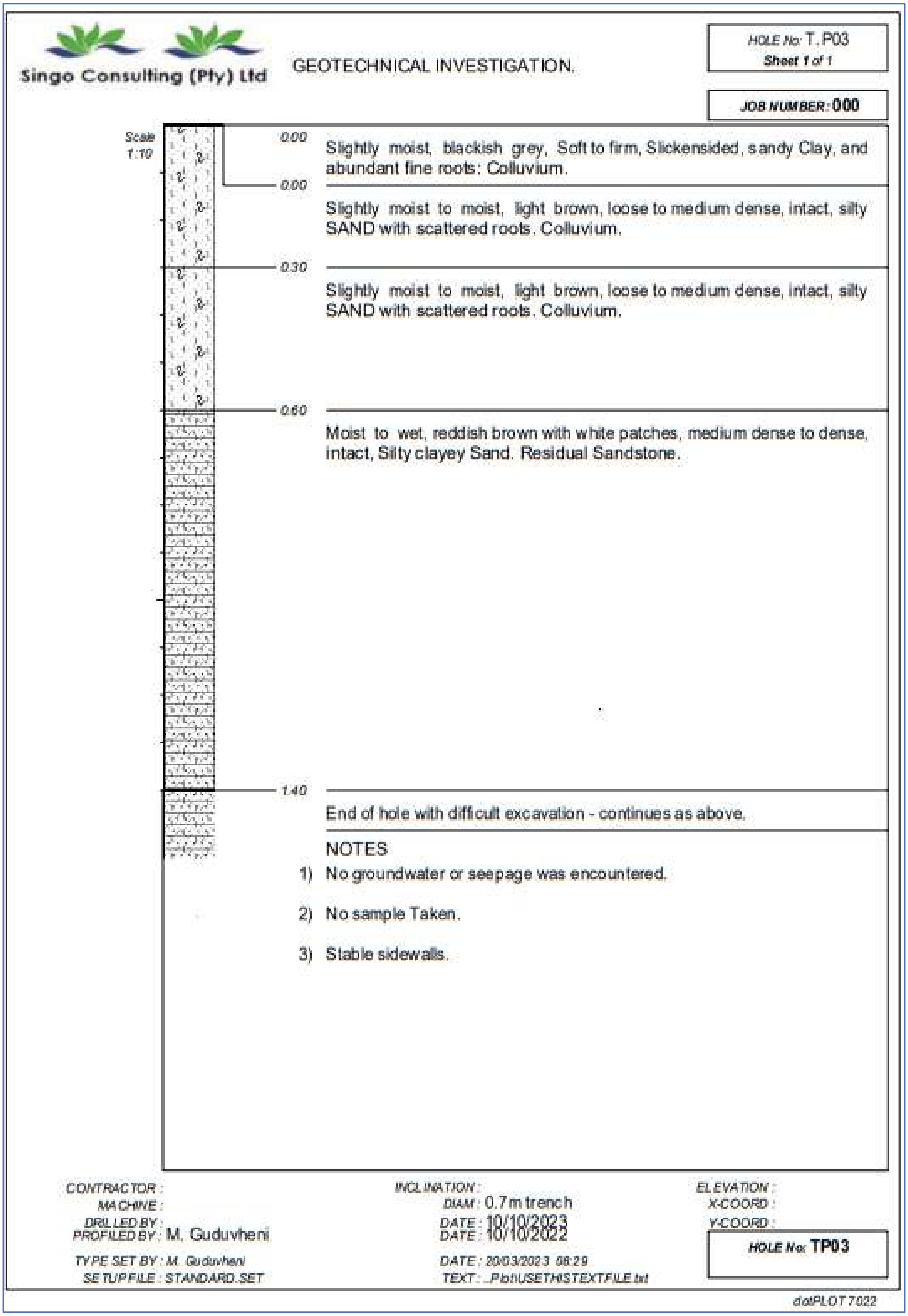
Y-COORD :

HOLE No: TP02

dotPLOT 7022



Singo Consulting (Pty) Ltd

GEOTECHNICAL INVESTIGATION.

HOLE No: T. P03
Sheet 1 of 1

JOB NUMBER: 000

Scale
1:10

0.00

Slightly moist, blackish grey, Soft to firm, Slickensided, sandy Clay, and abundant fine roots; Colluvium.

0.00

Slightly moist to moist, light brown, loose to medium dense, intact, silty SAND with scattered roots. Colluvium.

0.30

Slightly moist to moist, light brown, loose to medium dense, intact, silty SAND with scattered roots. Colluvium.

0.60

Moist to wet, reddish brown with white patches, medium dense to dense, intact, Silty clayey Sand. Residual Sandstone.

1.40

End of hole with difficult excavation - continues as above.

NOTES

1) No groundwater or seepage was encountered.

2) No sample Taken.

3) Stable sidewalls.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : M. Guduvheni

TYPE SET BY : M. Guduvheni
SETUP FILE : STANDARD.SET

INCLINATION :
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DATE : 10/10/2022

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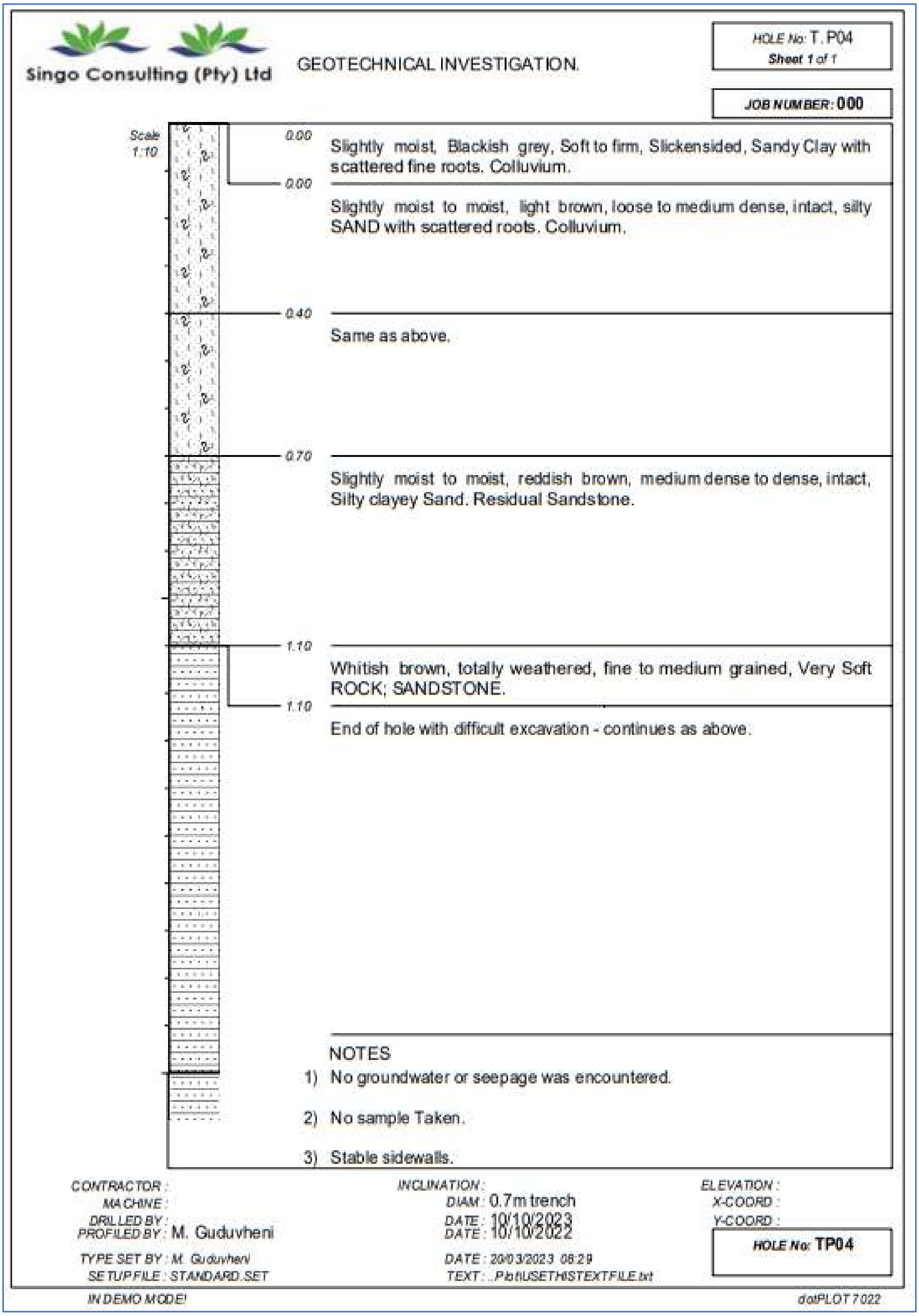
X-COORD :
Y-COORD :

HOLE No: TP03

dotPLOT 7022



Singo Consulting (Pty) Ltd

GEOTECHNICAL INVESTIGATION.

HOLE No: T. P04
Sheet 1 of 1

JOB NUMBER: 000

Scale 1:10

Depth	Description
0.00	Slightly moist, Blackish grey, Soft to firm, Slickensided, Sandy Clay with scattered fine roots. Colluvium.
0.00	Slightly moist to moist, light brown, loose to medium dense, intact, silty SAND with scattered roots. Colluvium.
0.40	Same as above.
0.70	Slightly moist to moist, reddish brown, medium dense to dense, intact, Silty clayey Sand. Residual Sandstone.
1.10	Whitish brown, totally weathered, fine to medium grained, Very Soft ROCK; SANDSTONE.
1.10	End of hole with difficult excavation - continues as above.

NOTES
1) No groundwater or seepage was encountered.
2) No sample Taken.
3) Stable sidewalls.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : M. Guduvheni

TYPE SET BY : M. Guduvheni
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 0.7m trench
DATE : 10/10/2023
DATE : 10/10/2022

DATE : 20/03/2023 08:29
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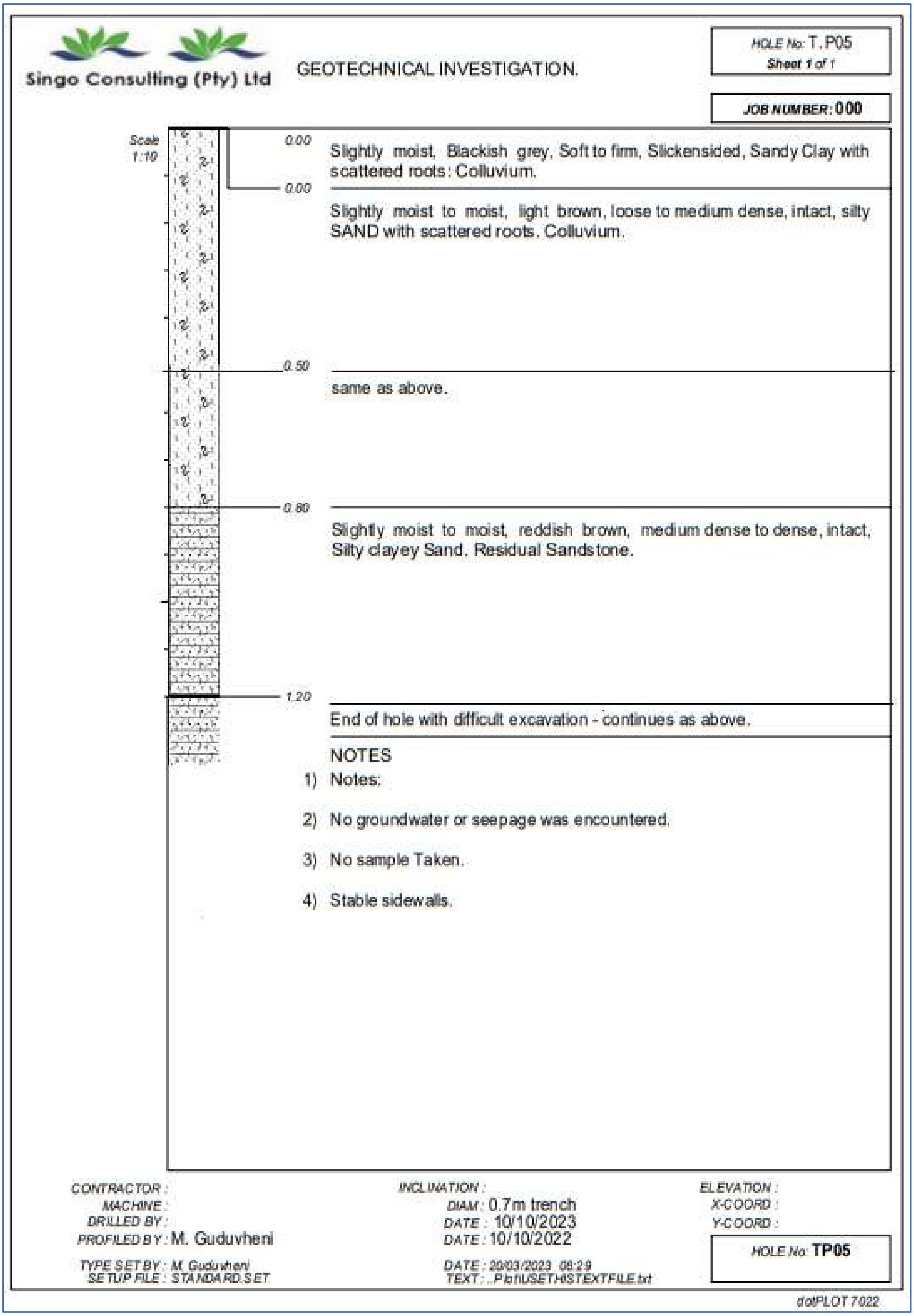
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP04

IN DEMO MODE!

dotPLOT 7022



Singo Consulting (Pty) Ltd

GEOTECHNICAL INVESTIGATION.

HOLE No: T.P05
Sheet 1 of 1

JOB NUMBER: 000

Scale
1:10

0.00	Slightly moist, Blackish grey, Soft to firm, Slickensided, Sandy Clay with scattered roots: Colluvium.
0.00	Slightly moist to moist, light brown, loose to medium dense, intact, silty SAND with scattered roots. Colluvium.
0.50	same as above.
0.80	Slightly moist to moist, reddish brown, medium dense to dense, intact, Silty clayey Sand. Residual Sandstone.
1.20	End of hole with difficult excavation - continues as above.

NOTES

1) Notes:

2) No groundwater or seepage was encountered.

3) No sample Taken.

4) Stable sidewalls.

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY : M. Guduvheni

TYPE SET BY : M. Guduvheni
SETUP FILE : STANDARD.SET

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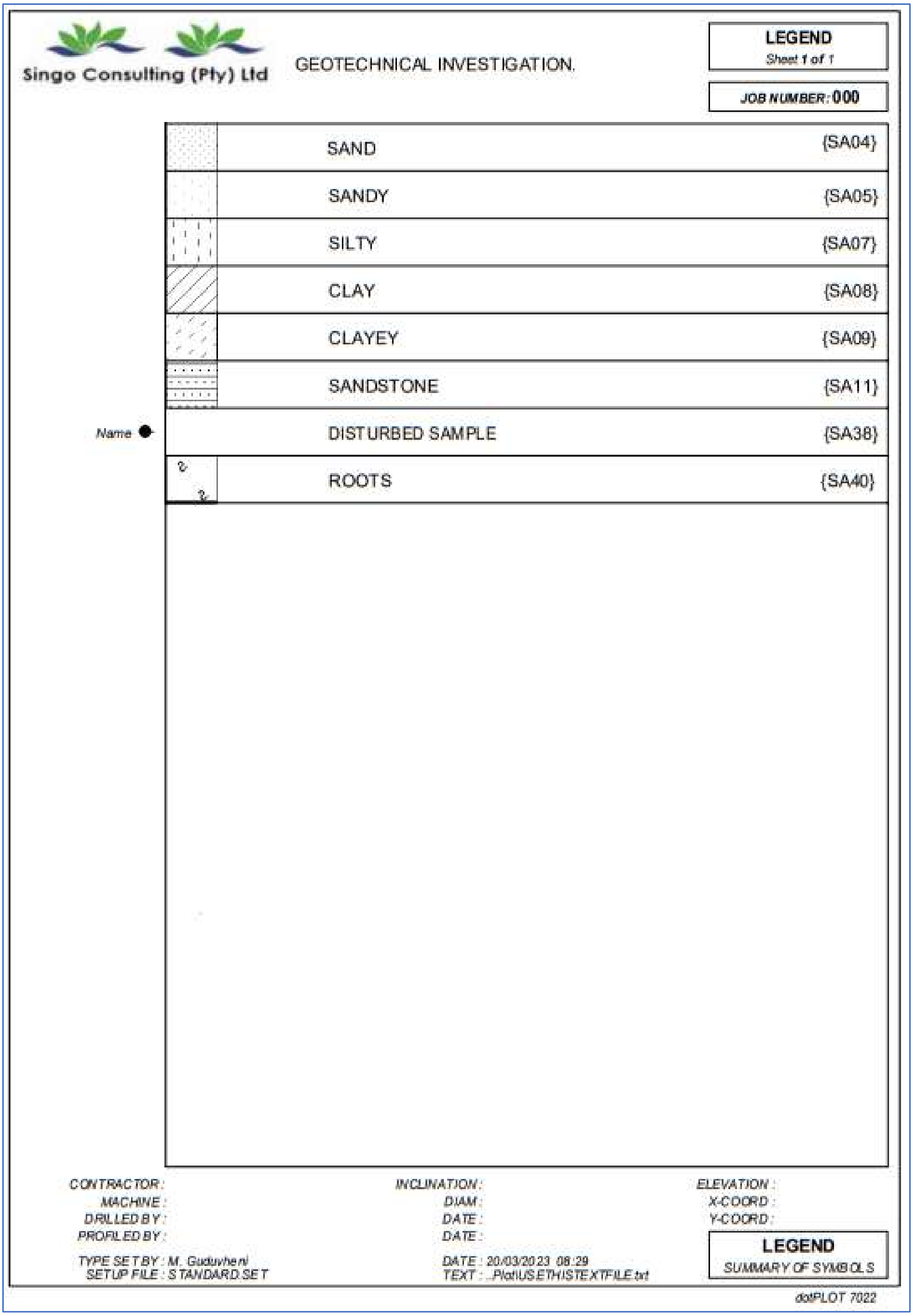
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP05

dotPLOT 7022



Singo Consulting (Pty) Ltd

GEOTECHNICAL INVESTIGATION.

LEGEND
Sheet 1 of 1

JOB NUMBER: **000**

	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	SANDSTONE	{SA11}
Name ●	DISTURBED SAMPLE	{SA38}
	ROOTS	{SA40}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

TYPE SET BY : M. Guduvheni
SETUP FILE : STANDARD.SET

INCLINATION :
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X-COORD :
Y-COORD :

LEGEND
SUMMARY OF SYMBOLS

dotPLOT 7022

Coal Mining Right Application and Environmental Authorisation Application on Portion 1 of the Farm Annysspruit 140-HT and the Remaining Extent of the Farm Mooihoek 168-HT situated under the Magisterial District of Mkhondo (Piet Retief), Mpumalanga Province

Mkhondo Local Municipality, Gert Sibande District Municipality, Mpumalanga Province.

Farm: Portion 1 Annysspruit 140-HT and Remaining Extent Mooihoek 168-HT

Fourie, H. Dr

Palaeontological Impact Assessment: Phase 1 Field Study

Facilitated by: Singo Consulting (Pty) Ltd

Office 870, 05 Balalaika Street,

Tasbet Park 2, eMalahleni,

1040, Mpumalanga

Tel: 013 692 0041

2023/04/12

Ref: MP30/5/1/2/2/10384 MR

Plant fossil – Ecca Group

B. Executive summary

Outline of the development project: Singo Consulting (Pty) Ltd has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Phase 1: Field Study of the suitability of the proposed Coal Mining Right Application and Environmental Authorisation Application on Portion 1 of the Farm Annysspruit 140-HT and the Remaining Extent of the Farm Mooihoek 168-HT situated under the Magisterial District of Mkhondo (Piet Retief), Gert Sibande District Municipality in the Mpumalanga Province.

The applicant, Notre Coal (Pty) Ltd intends to mine an area for coal with opencast/boxcut methods. Related infrastructure will be established.

The Project includes one locality Option (see Figure 2):
Option 1: A polygon area blocked in red near Anysspruit with the Heyshope dam north-west of the project area, the town of Mkhondo is 24 km to the north-east, the R543 is north. The approximate size of the site is 366.606 hectares.

Legal requirements:-

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

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

For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

A Palaeontological Impact Assessment is generally warranted where rock units of **LOW** to **VERY HIGH** palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):
(i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.

This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999). Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m² (1 ha) in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report (Appendix 6, **1c)** aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigation or conservation measures are necessary.

Outline of the geology and the palaeontology:

The geology was obtained from map 1:100 000, Geology of the Republic of South Africa (Visser 1984) and 2730 Vryheid (Wolmarans 1988), 1:250 000 geological map.

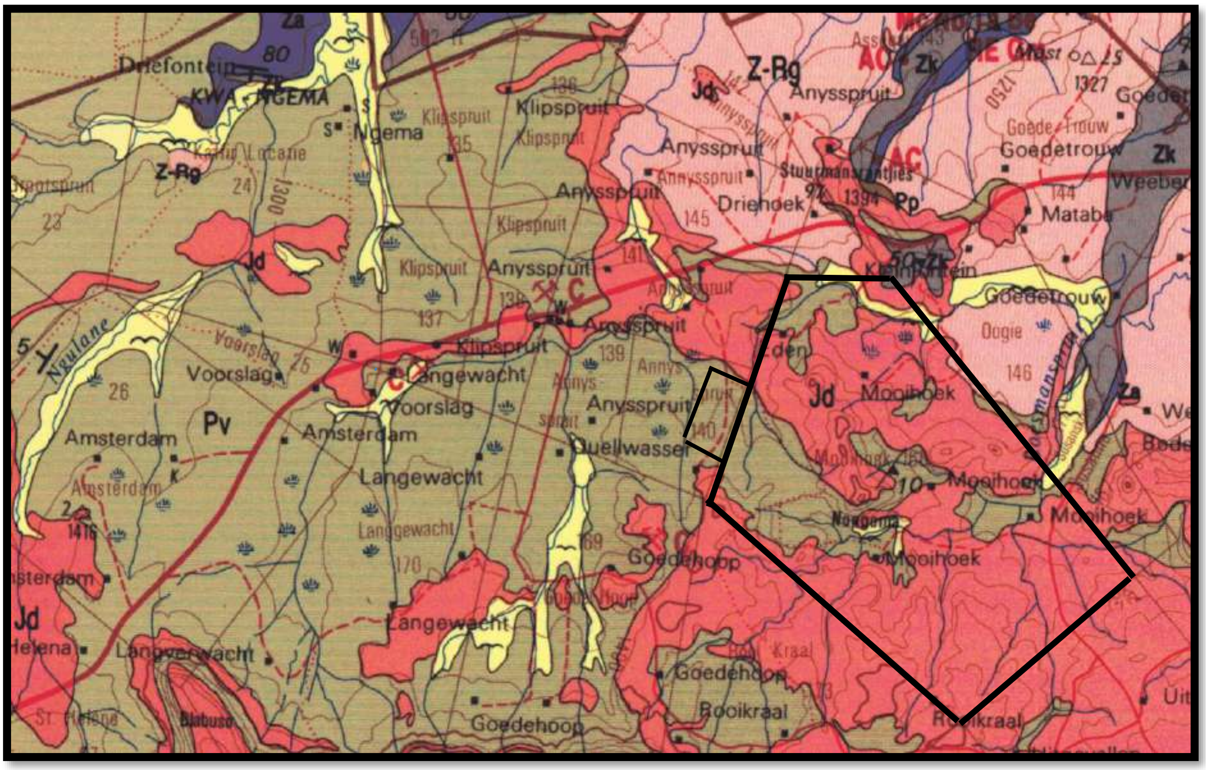

Figure: The geology of the development area.

Legend to Figure and short explanation.

m – Alluvium; Surficial deposit alluvium, scree and ferricrete. Quaternary.

Jd – Dolerite (pink). Jurassic.

Pv – Sandstone, shale and grit with coal and oil-shale beds (brown). Vryheid Formation, Ecca Group, Karoo Supergroup. Permian.

...... – (black) Lineament (Possible dyke).

--f— Fault.

⊥10˚ - Strike and dip.

□ – Approximate position of Mining Right application (blocked in black).

The Vryheid Formation is named after the type area of Vryheid-Volksrust. In the north-eastern part of the basin the Vryheid Formation thins and eventually wedges out towards the south, southwest and west with increasing distance from its source area to the east and northeast (Johnson 2009). The Vryheid Formation consists essentially of sandstone, shale, and subordinate coal beds, and has a maximum total thickness of 500 m. It forms part of the Middle Ecca (Kent 1980). This formation has the largest coal reserves in South Africa. The pro-delta sediments are characterised by trace and plants fossils (Snyman 1996).

Palaeontology – Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity can generally be **LOW** to **VERY HIGH**, and here locally in the development area **VERY HIGH** for the Vryheid Formation (SG 2.2 SAHRA APMHOB, 2012).

The Ecca Group, Vryheid Formation (Pv) may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

Summary of findings (**1d**): The Phase 1: Field Study was undertaken in April 2023 in autumn in dry and cool conditions, and the following is reported:

Field Observation: The area is large, some parts of it were not accessible due to the lack of roads. It is too large to walk the entire area. The area falls mostly on the Vryheid Formation and this will be mined. A plantation, hills, gravel roads, and open areas grassland areas are present. Fossils were not found as there are very little shale outcrops on the surface (Figures 5-11).

The Project includes one locality Option present on the Vryheid Formation:
Option 1: A polygon area blocked in red near Anysspruit with the Heyshope dam north-west of the project area, the town of Mkhondo is 24 km to the north-east, the R543 is north. The approximate size of the site is 366.606 hectares.

Recommendation:
The potential impact of the development on fossil heritage is **VERY HIGH** and therefore a field survey was necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment: Field Study was done. A Phase 2: Mitigation will be recommended if the Phase 1: Field Study finds fossils (not found) or if fossils are found during the development.

Concerns/threats **(1k,l,m)** to be added to EMPr:

1. Threats are earth moving equipment/machinery (for example haul trucks, front end loaders, excavators, graders, dozers) during construction, the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic, prospecting, mining, and human disturbance.
2. Special care must be taken during the digging, drilling, blasting and excavating of foundations, trenches, channels and footings and removal of overburden not to intrude fossiliferous layers.

The recommendations are **(1g)**:

1. Mitigation will be needed if fossils are found during the development.
2. No consultation with parties was necessary. The Environmental Control Officer must familiarise him- or herself with the formations present and its fossils and follow protocol.
3. The development may go ahead with caution.
4. The ECO together with the mine geologist must survey for fossils before and or after clearing, blasting, drilling or excavating.
5. The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during development activities. For a chance fossil find, the protocol is to immediately cease all activities, construct a 30 m no-go barrier, and contact SAHRA for further investigation.

Stakeholders: Developer – Notre Coal (Pty) Ltd.
Environmental – Singo Consulting (Pty) Ltd. Office 870, 05 Balalaika Street, Tasbet Park 2, eMalahleni, 1040. Tel: 013 692 0041.
Landowner – Several.

C. Table of Contents

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D. Background information on the project

Report

This report is part of the environmental impact assessment process under the National Environmental Management Act, as amended (Act No. 107 of 1998) (NEMA) and includes Appendix 6 (GN R326 of 7 April 2017) of the Environmental Impact Assessment Regulations (see Appendix 2). It also is in compliance with The Minimum Standards for Palaeontological Components of Heritage Impact Assessment Reports, SAHRA, APMHOB, Guidelines 2012, Pg 1-15 **(2)**.

Outline of development

This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction/pre-mining phase it may be necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency depending on the presence of fossils (SAHRA / PHRA).

The applicant, Notre Coal (Pty) Ltd intends to mine an area for coal with opencast/boxcut methods. Related infrastructure will be established.

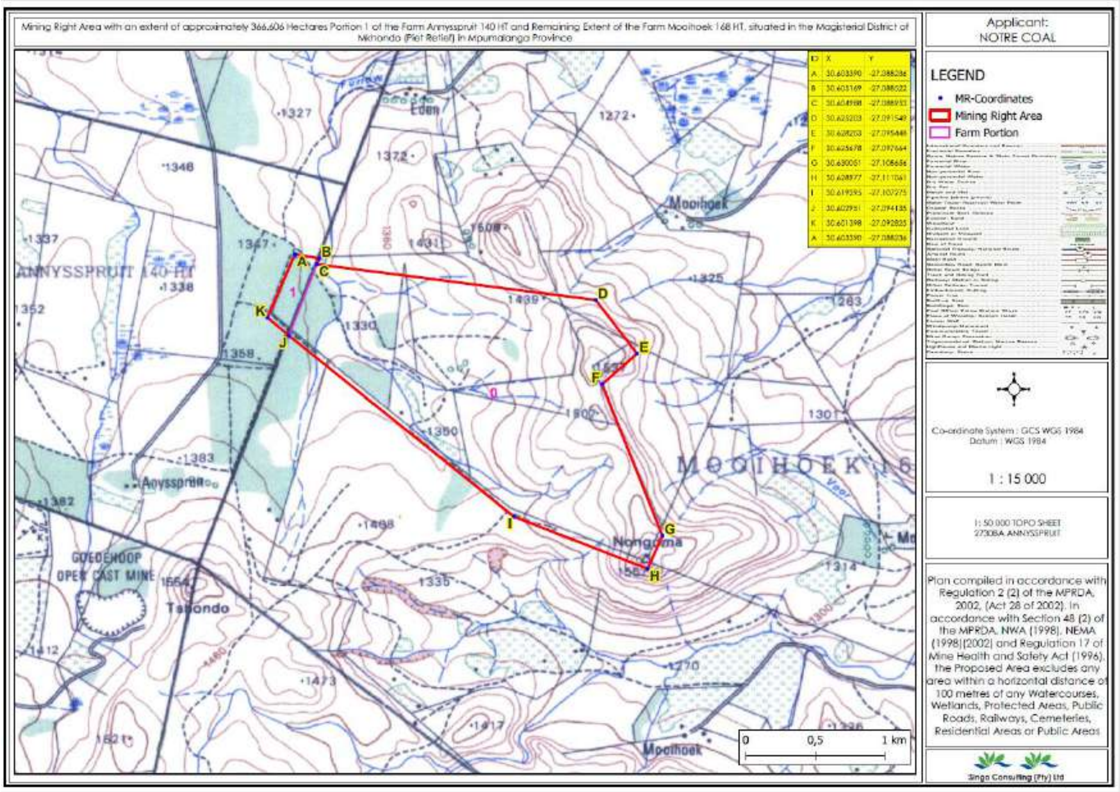

Figure 1: Lay-out topographic plan of development (Singo).

Related Infrastructure:

1. Boxcut with drilling and blasting
2. Potable water (river/boreholes) and power lines (Eskom)
3. Weigh bridge
4. Access and haul roads
5. Stockpiles of topsoil and overburden
6. Sewage management measures
7. Waste management
8. Backfill
9. Washing plant
10. Discard facility
11. Contractor’s yard and ablution
12. Diesel facilities and hardstand
13. Offices, workshop and stores

The Project includes one locality Option (see Figure 2):
Option 1: A polygon area blocked in red near Anysspruit with the Heyshope dam north-west of the project area, the town of Mkhondo is 24 km to the north-east, the R543 is north. The approximate size of the site is 366.606 hectares.

The mining will create employment for 48 people.

Rezoning/ and or subdivision of land: Yes.
Name of Developer and Consultant: Notre Coal (Pty) Ltd and Singo Consulting (Pty) Ltd.
Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a palaeontological impact assessment: field study to ascertain if any palaeontological sensitive material is present in the development area. This study will advise on the impact on fossil heritage mitigation or conservation necessary, if any.
Short *Curriculum vitae* (***1ai,aii***): Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research (now ESI), University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. At present she is curator of a large fossil invertebrate collection, Therapsids, dinosaurs, amphibia, fish, reptiles, and plants at Ditsong: National Museum of Natural History. For the past 14 years she carried out field work in the North West, Western Cape, Northern Cape, Eastern Cape, Limpopo, Mpumalanga, Gauteng and Free State Provinces. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 26 years.
Legislative requirements: South African Heritage Resources Agency (SAHRA) for issue of permits if necessary. National Heritage Resources Act (Act No. 25 of 1999). An electronic copy of this report must be supplied to SAHRA.

E. Description of property or affected environment

Location and depth:
The proposed Coal Mining Right Application and Environmental Authorisation Application will be situated on Portion 1 of the Farm Annysspruit 140-HT and the Remaining Extent of the Farm Mooihoek 168-HT situated under the Magisterial District of Mkhondo (Piet Retief), Gert Sibande District Municipality in the Mpumalanga Province.

Depth is determined by the related infrastructure to be developed and the thickness of the formation in the development area as well as depth of the foundations, footings and channels to be developed. Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to determine due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot. Geological maps do not provide depth or superficial cover, it only provides mappable surface outcrops. The depth can be verified with test pit results or drill cores.

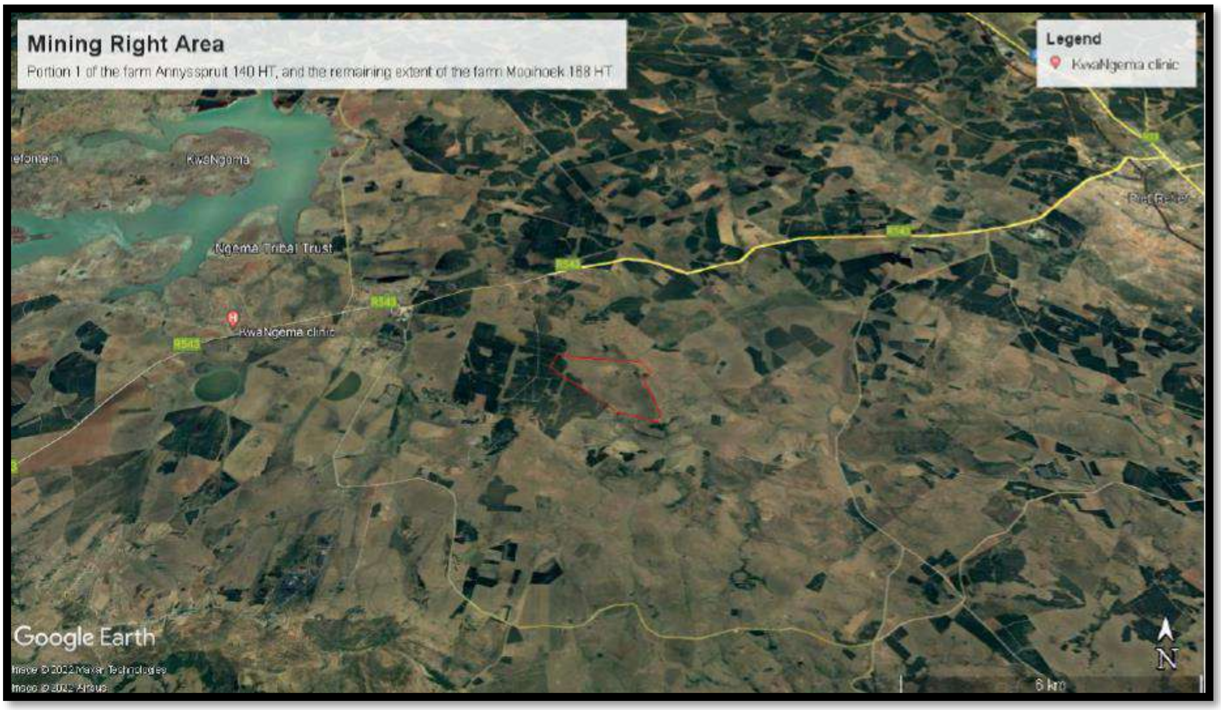

Figure 2: Google Earth image showing location (Singo).

The site is underlain by the Karoo Supergroup Formations.

F. Description of the Geological Setting

Description of the rock units:

Over areas totalling fully 40% of Southern Africa the 'hard rocks', from the oldest to the Quaternary, are concealed by normally unconformable deposits – principally sand, gravel, sandstone, and limestone. Inland deposits are much more extensive than marine deposits and are terrestrial and usually unfossiliferous. Some of these deposits date back well into the Tertiary, whereas others are still accumulating. Owing to the all-to-often lack of fossils and of rocks suitable for radiometric or palaeomagnetic dating, no clear-cut dividing line between the Tertiary and Quaternary successions could be established (Kent 1980). The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996). A thick cover of Kalahari reddish sand blankets most outcrops and is dominated by the typical Kalahari thornveld (Norman and Whitfield 2006).

Large areas of the southern African continent are covered by the Karoo Supergroup (Figure 3). It covers older geological formations with an almost horizontal blanket. Several basins are present with the main basin in the central part of south Africa and several smaller basins towards Lebombo, Springbok Flats and Soutpansberg. An estimated age is 150 – 180 Ma. And a maximum thickness of 7000 m is reached in the south. Three formations overlie the Beaufort Group, they are the Molteno, Elliot and Clarens Formations. The Elliot Formation is also known as the Red Beds and the old Cave Sandstone is known as the Clarens Formation. At the top is the Drakensberg Basalt Formation with its pillow lavas, pyroclasts, etc. (Kent 1980, Snyman 1996). The Beaufort Group is underlain by the Ecca Group which lies on the Dwyka Group.

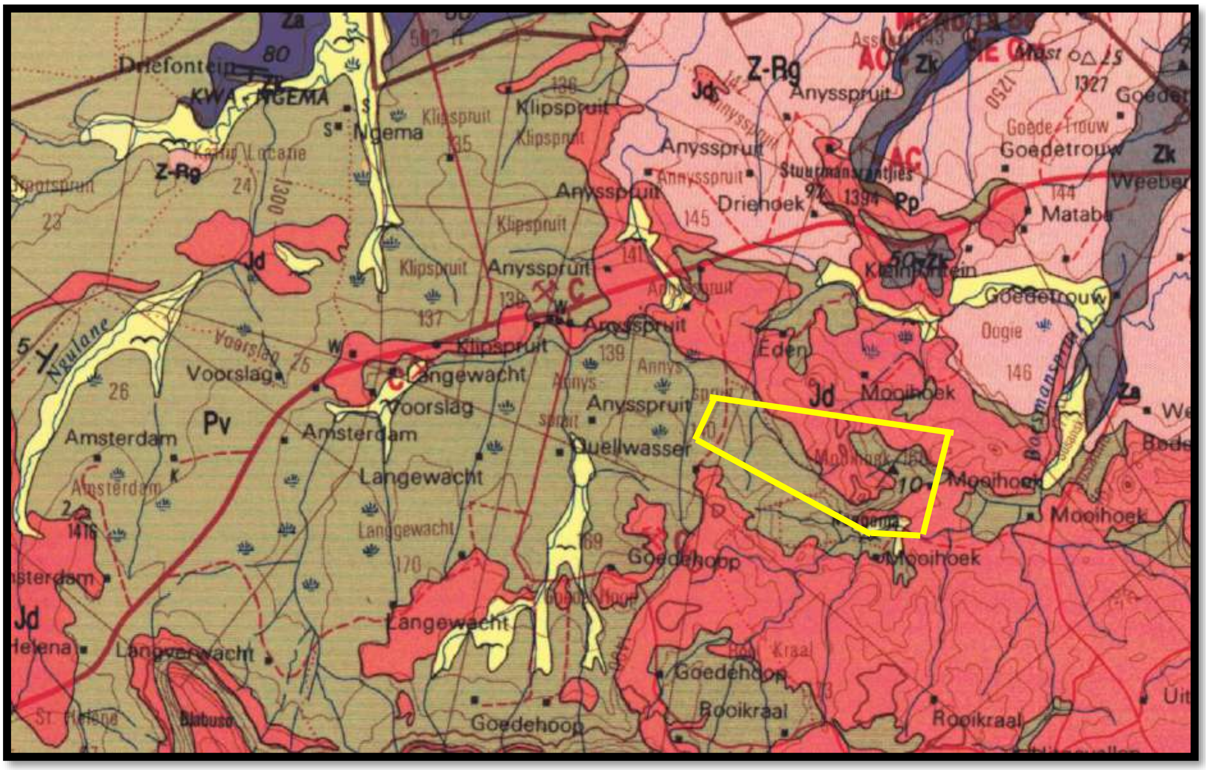

Figure 3: Geology of the development area **(1h)**.

Legend to Figure and short explanation.

m – Alluvium; Surficial deposit alluvium, scree and ferricrete. Quaternary.

Jd – Dolerite (pink). Jurassic.

Pv – Sandstone, shale and grit with coal and oil-shale beds (brown). Vryheid Formation, Ecca Group, Karoo Supergroup. Permian.

…… – (black) Lineament (Possible dyke).
--f— Fault.
⊥10˚ - Strike and dip.
□ – Approximate position of mining right (blocked in yellow).

Mining Activities in area:
C – Coal.
Mining past and present has an influence on the project.

Dolerite dykes (Jd) occur throughout the Karoo Supergroup. Structural geological features such as dykes and faults can have a measurable influence on ground water flow and mass transport. Permian sediments are extensively intruded and thermally metamorphosed (baked) by sub-horizontal sills and steeply inclined dykes of the Karoo Dolerite Suite. These early Jurassic (183 Ma) basic intrusions baked the adjacent mudrocks and sandstones to form splintery hornfels and quartzites respectively. Thermal metamorphism by dolerite intrusions tends to reduce the palaeontological heritage potential of the adjacent sediments.

The Ecca Group is early to mid-Permian (545-250 Ma) in age. Sediments of the Ecca group are lacustrine and marine to fluvio-deltaic (Snyman 1996). The Ecca group is known for its coal (mainly the Vryheid Formation) (five coal seams) and uranium. Coalfields formed due to the accumulation of plant material in shallow and large swampy deltas (see Appendix 1). The Ecca Group conformably overlies the Dwyka Group and is conformably overlain by the Beaufort Group, Karoo Supergroup. It consists essentially of mudrock (shale), but sandstone-rich units occur towards the margins of the present main Karoo basin in the south, west and north-east, with coal seams also being present in the north-east (Kent 1980, Johnson 2009).

The Vryheid Formation is named after the type area of Vryheid-Volksrust. In the north-eastern part of the basin the Vryheid Formation thins and eventually wedges out towards the south, southwest and west with increasing distance from its source area to the east and northeast (Johnson 2009). The Vryheid Formation consists essentially of sandstone, shale, and subordinate coal beds, and has a maximum total thickness of 500 m. It forms part of the Middle Ecca (Kent 1980). This formation has the largest coal reserves in South Africa. The pro-delta sediments are characterised by trace and plants fossils (Snyman 1996).

Coal has always been the main energy source in industrial South Africa. It is in Mpumalanga, south of the N4, that most of the coal-fired power stations are found. Eskom is by far the biggest electricity generator in Africa. Thick layers of coal just below the surface are suited to open-cast mining and where the overlying sediments are too thick, shallow underground mining. In 2003, coal was South Africa's third most valuable mineral commodity and is also used by Sasol for fuel- and chemicals-from-coal (Norman and Whitfield 2006). Grodner and Cairncross (2003) proposed a 3-D model of the Witbank Coalfield to allow easy evaluation of the sedimentary rocks, both through space and time. Through this, one can interpret the environmental conditions present at the time of deposition of the sediments. This can improve mine planning and mining techniques. The Vryheid Formation is underlain by the Dwyka Group and is gradually overlain by mudstones (and shale) and sandstones of the Volksrust Formation. The typical colours for the Vryheid Formation are grey and yellow for the sediments and black for the coal seam. The thickness of the grey shale can vary and this is interlayered with the also variable yellow sandstone and coal seams.

Ecca rocks are stable and lend themselves well to developments. It is only unstable in or directly above mining activities (Snyman 1996). Dolerite dykes occur throughout the Karoo Supergroup. Structural geological features such as dykes and faults can have a measurable influence on ground water flow and mass transport. The Vryheid

Formation sediments may attain a thickness of 120 – 140 m. A typical profile includes soil and clay, sandstone and siltstone, shale, 2 upper seam, shale, 2 seam, sandstone, no 1 seam, shale and dolomite at the bottom. The typical colours for the Vryheid Formation are grey and yellow for the sediments and black for the coal seam. The thickness of the grey shale can vary and this is interlayered with the also variable yellow sandstone and coal seams.

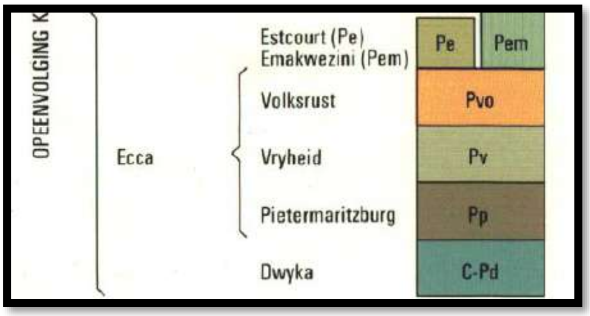

Figure 4: Lithostratigraphic column of the development area (Vryheid 2730).

Field Observation: The area is large, some parts of it were not accessible due to the lack of roads. It is too large to walk the entire area. The area falls mostly on the Vryheid Formation and this will be mined. A plantation, hills, gravel roads, and open areas grassland areas are present. Fossils were not found as there are very little shale outcrops on the surface (Figures 5-11).

Figure 5: Annysspruit. View on corner of project in in north-east.

Figure 6: Annysspruit. View of south-west corner.

Figure 7: Mooihoek view from dirt road towards middle of project.

Figure 8: Mooihoek view to the east.

Figure 9: Another view of project area towards the middle of Mooihoek.

Figure 10: Mooihoek view.

Figure 11: View towards the west.

It is recommended to wait for the response from SAHRA on the Phase 1: Field Study (this report). SAHRA protocol must be followed.

G. Background to Palaeontology of the area

Summary: When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, a desk top and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB, 2012).

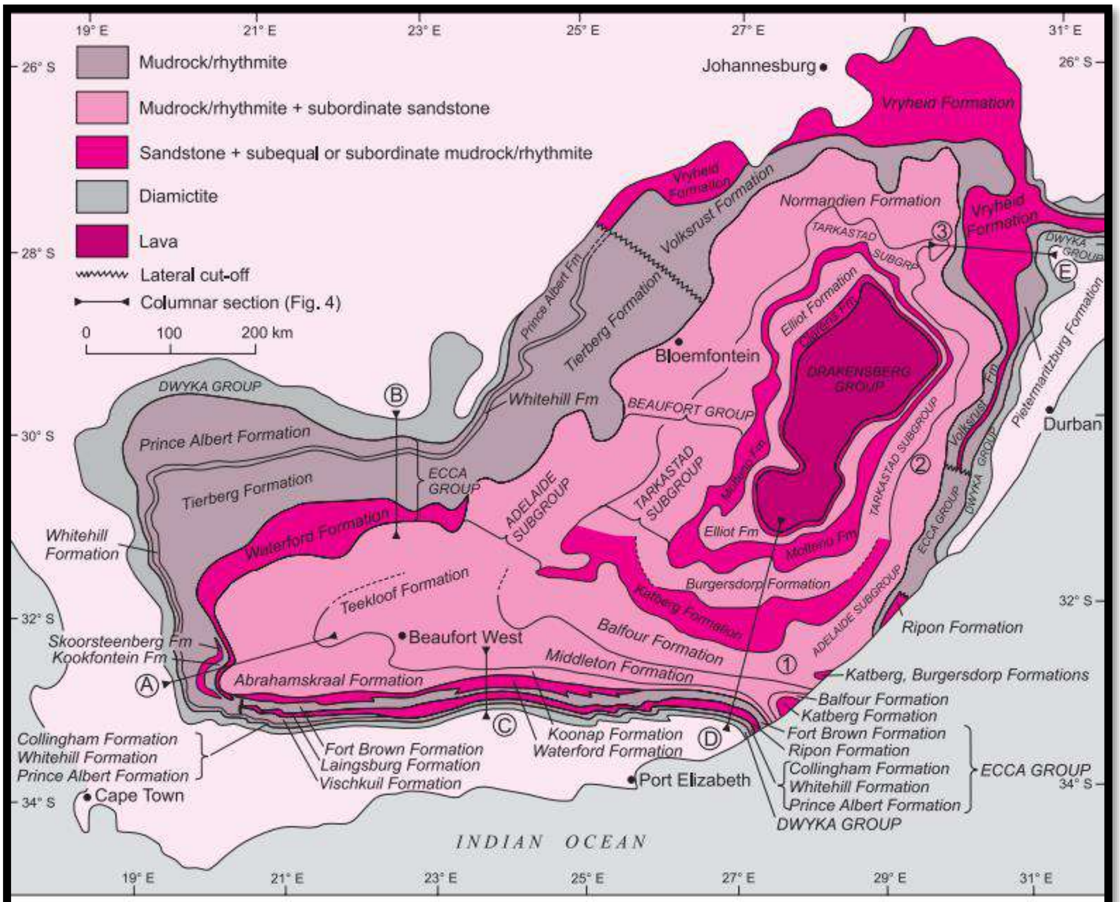

Fig. 3 Areal distribution (schematic) of lithostratigraphic units in the Main Karoo Basin and location of sections A–E (Fig. 4) and 1–3 (Fig. 14). Modified after Johnson et al. (1997, Fig. 2).

Figure 12: Extent of the Karoo Supergroup (Johnson *et al.* 2006).

The Ecca Group, Vryheid Formation (Figure 12) may contain fossils of diverse non-marine trace, *Glossopteris* flora, mesosaurid reptiles, palaeoniscid fish, marine invertebrates, insects, and crustaceans (Johnson 2009). *Glossopteris* trees rapidly colonised the large deltas along the northern margin of the Karoo Sea. Dead vegetation accumulated faster than it could decay, and thick accumulations of peat formed, which were ultimately converted to coal. It is only in the northern part of the Karoo Basin that the glossopterids and cordaitales, ferns, clubmosses and horsetails thrived (McCarthy and Rubidge 2005).

The Glossopteris flora is thought to have been the major contributor to the coal beds of the Ecca. These are found in Karoo-age rocks across Africa, South America, Antarctica, Australia and India. This was one of the early clues to the theory of a former unified Gondwana landmass (Norman and Whitfield 2006).

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally **LOW** for some layers to **VERY HIGH** for other layers.

Table 1: Taken from Palaeotechnical Report (Groenewald 2012) (**1cA**).

Vryheid (Pv)		Light grey coarse- to fine-grained sandstone and siltstone. Dark coloured siltstone due to presence of carbon enrichment and coal beds	Abundant plant fossils of *Glossopteris* and other plants. Trace fossils. The reptile *Mesosaurus* has been found in the southern part of the Karoo Basin

Table 2: Criteria used (Fossil Heritage Layer Browser/SAHRA) (**1cB**):

Rock Unit	**Significance/vulnerability**	**Recommended Action**
Vryheid Formation	**Very High**	Field assessment and protocol for finds is required

Databases and collections: Ditsong: National Museum of Natural History. Evolutionary Studies Institute, University of the Witwatersrand (ESI).

Impact: **VERY HIGH** for the Vryheid Formation, Karoo Supergroup. There are significant fossil resources that may be impacted by the development (mudstone, shale) and if destroyed are no longer available for scientific research or other public good (Almond, *et al.* 2009).

The Project includes one locality Option (see Figure 2) (**1f,j)** The palaeontological sensitivity is as stated above. Option 1: A polygon area blocked in red near Anysspruit with the Heyshope dam north-west of the project area, the town of Mkhondo is 24 km to the north-east, the R543 is north. The approximate size of the site is 366.606 hectares.

All the land involved in the development was assessed **(ni,nii)** and none of the property is unsuitable for development (see Recommendation B).

H. Description of the Methodology (1e)

The palaeontological impact assessment field study was undertaken in April 2023. A Phase 1: Field Survey of the affected portion includes photographs (in 7.1 mega pixels) taken of the site with a digital camera (Canon PowerShot A470). Additionally, Google Maps will be accessed on a cellular phone/tablet for navigation. A Global Positioning System (GPS) (Garmin eTrex 10) is used to record fossiliferous finds and outcrops (bedrock) when the area is not covered with topsoil, subsoil, overburden, vegetation, grassland, trees or waste. The survey did identify the Karoo Supergroup. A literature survey is included and the study relied heavily on geological maps.

SAHRA document 7/6/9/2/1 (SAHRA 2012) requires track records/logs from archaeologists not palaeontologists as palaeontologists concentrate on outcrops which may be recorded with a GPS. Isolated occurrences of rocks usually do not constitute an outcrop. Fossils can occur in dongas, as nodules, in fresh rock exposures, and in riverbeds. Finding fossils require the experience and technical knowledge of the professional palaeontologist, but that does not mean that an amateur can't find fossils. The geology of the region is used to predict what type of fossil and zone will be found in any particular region. Archaeozoologists concentrate on more recent fossils in the quaternary and tertiary deposits.

Assumptions and Limitations (**1i**):-

The accuracy and reliability of the report **may be** limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. Inaccessibility of site – sufficient.
7. Insufficient data from developer and exact lay-out plan for all structures - sufficient.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities.
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes.

Act No. 25 of 1999. National Heritage Resources Act, 1999.
National Estate: 3 (2) (f) archaeological and palaeontological sites,
(i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,
Heritage assessment criteria and grading: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;
(b) Grade 2: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 3: Other heritage resources worthy of conservation.
SAHRA is responsible for the identification and management of Grade 1 heritage resources.
Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 2 heritage resources.
Local authorities identify and manage Grade 3 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.
Archaeology, palaeontology and meteorites: Section 35.
(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

I. Description of significant fossil occurrences

All Karoo Supergroup geological formations are ranked as **LOW** to **VERY HIGH**, and here the impact is potentially **VERY HIGH** for the Vryheid Formation.

Fossils likely to be found are mostly plants (Appendix 1) such as '*Glossopteris* flora' of the Vryheid Formation. The aquatic reptile *Mesosaurus* and fossil fish may also occur with marine invertebrates, arthropods and insects. Trace fossils can also be present. During storms a great variety of leaves, fructifications and twigs accumulated and because they were sandwiched between thin films of mud, they were preserved to bear record of the wealth and the density of the vegetation around the pools. They make it possible to reconstruct the plant life in these areas and wherever they are found, they constitute most valuable palaeobotanical records (Plumstead 1963) and can be used in palaeoenvironmental reconstructions (Appendix 1).

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to be determined due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot.

The threats are:-

- Earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during development,
- The sealing-in or destruction of fossils by development, vehicle traffic, prospecting, mining, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation

a. There is no objection (see Recommendation B) to the development, it was necessary to request a Phase 1 Palaeontological Impact Assessment: Field Study to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity of the area is **VERY HIGH**. A Phase 2 Palaeontological Mitigation is only required if the Phase 1 Palaeontological Assessment identified a fossiliferous formation (Karoo Supergroup) and fossils or if fossils are found during mining or prospecting. Protocol is attached (Appendix 2).

b. This project may benefit the community, will create short- and long-term employment, the life expectancy of the community, the growth of the community, and social development in general.
c. Preferred choice: Locality Option 1 is preferred and possible.
d. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, drilling or prospecting SAHRA must be notified. All construction activities must be stopped, a 30 m no-go barrier constructed and a palaeontologist should be called in to determine proper mitigation measures.
e. Consultation with parties was not necessary **(1o,p,q).**
f. This report must be submitted to SAHRA/PHRA together with the Heritage Impact Assessment Report.

Sampling and collecting:
Wherefore a permit is needed from the South African Heritage Resources Agency (SAHRA / PHRA).

a. Objections: Cautious. See heritage value and recommendation.
b. Conditions of development: See Recommendation.
c. Areas that may need a permit: Yes.
d. Permits for mitigation: **Needed from SAHRA/PHRA prior to Mitigation**.

K. Conclusions

a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
b. All information needed for the Phase 1 Palaeontological Impact Assessment and Field Study was provided by the Consultant. All technical information was provided by Singo Consulting (Pty) Ltd.
c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
d. The following should be conserved: if any palaeontological material is exposed during clearing, digging, excavating, drilling or prospecting, SAHRA must be notified. All development activities must be stopped, a 30 m barrier constructed, and a palaeontologist should be called in to determine proper mitigation measures.
e. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment (fossils) and adjacent areas as well as for safety and security reasons.

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WOLMARANS, L.G. 1988. 1:250 000 Geological Map of Vryheid, 2730. South African Committee for Stratigraphy, Council for Geoscience, Pretoria.

Declaration (1b)

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological assessment. There are no circumstances that compromise the objectivity of me performing such work.

I accept no liability, and the client, by receiving this document, indemnifies me against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

It may be possible that the Phase 1: Field Study may have missed palaeontological resources in the project area as outcrops are not always present or visible while others may lie below the overburden of earth and may only be present once development commences.

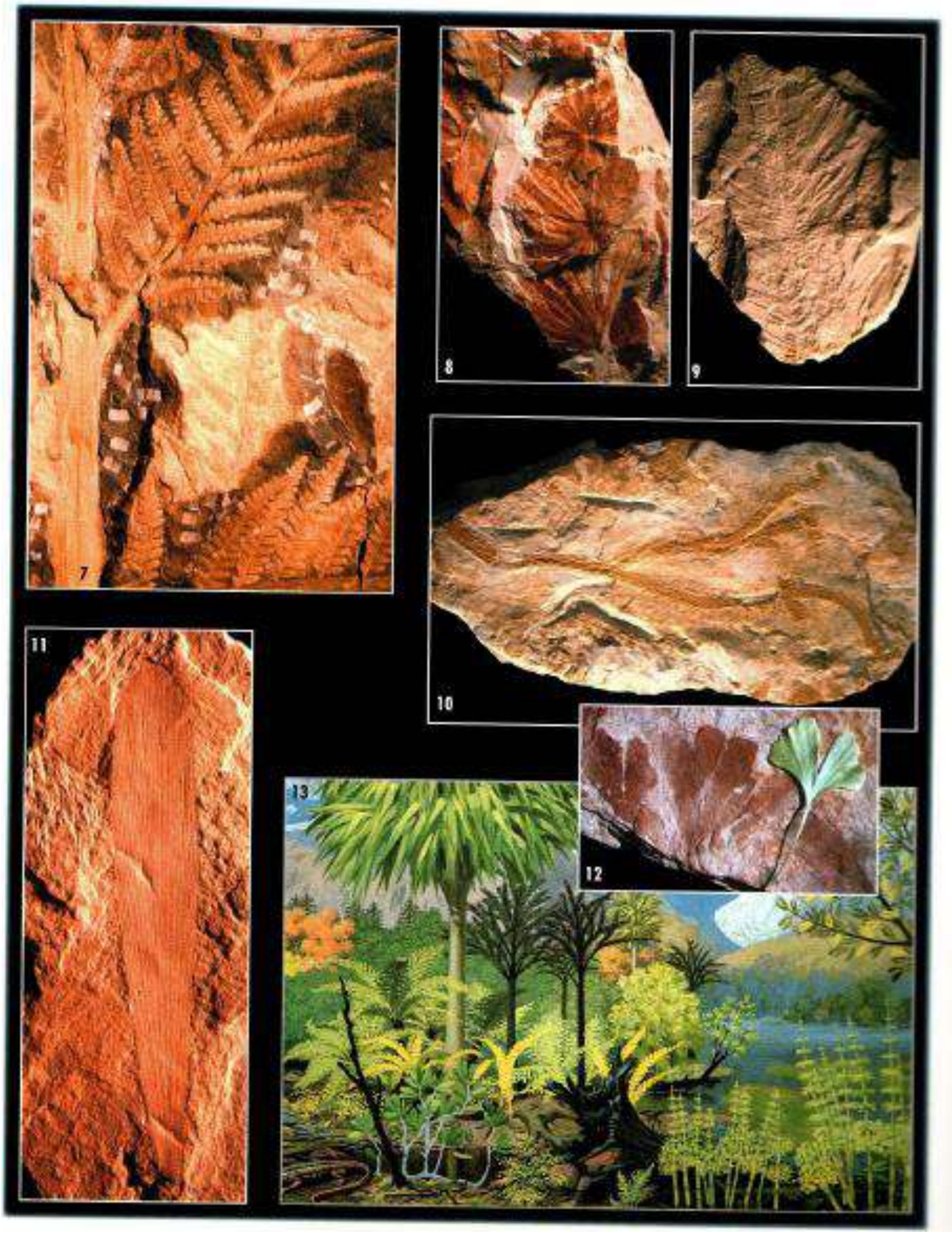
This report may not be altered in any way and any parts drawn from this report must make reference to this report.

POPI Act 2013 Statement
It provides that everyone has the right to privacy and includes a right to protection against the unlawful collection, retention dissemination and use of personal information contained in this document and pertains to the phone and contact details, signature and contents.

As per the Declaration Section none of the information may be shared without the permission of the author.

Heidi Fourie
2023/04/12

Appendix 1: Example of Vryheid Formation Fossils (MacRae 1999)



Appendix 2: **Protocol for Chance Finds and Management Plan (1k,l,m)**

This section covers the recommended protocol for a Phase 2 Mitigation process as well as for reports where the Palaeontological Sensitivity is **LOW**; this process guides the palaeontologist / palaeobotanist on site and should not be attempted by the layman / developer. As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction activities in line with the legally binding Environmental Management Programme (EMPr).

- The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities.

- For a chance find, the protocol is to immediately cease all construction activities, construct a 30 m no-go barrier, and contact SAHRA for further investigation. Construction workers must be informed that this is a no-go area.
- It is recommended that the EMPr be updated to include the involvement of a palaeontologist for pre-construction training of the ECO or during the digging and excavation phase of the development.
- The ECO must visit the site after clearing, drilling, excavations and blasting and keep a photographic record.
- The developer may be required to survey the areas affected by the development and indicate on plan where the construction / development / mining will take place. Trenches may have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give an indication of the depth of the topsoil, subsoil, and overburden, if need be trenches should be dug deeper to expose the interburden.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during mining or excavations. In order for this to happen, in case of coal mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good plant localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.
10. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining/ construction/ development operations and dig representative trenches and if possible supply geological borehole data. When the route is better defined, it is recommended that a specialist undertake a ‘walk through’ of the entire road as well as construction areas, including camps and access roads, prior to the start of any construction activities, this may be done in sections.
2. When clearing vegetation, topsoil, subsoil or overburden, hard rock (outcrop) is found, the contractor needs to stop all work.
3. A Palaeobotanist / palaeontologist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
4. If the palaeontologist / palaeobotanist is satisfied that no fossils will be destroyed or have removed the fossils, development and removing of the topsoil can continue.
5. After this process the same palaeontologist / palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.
6. When permission for the development is granted, the next layer can be removed, if this is part of a fossiliferous layer, then with the removal of each layer of sediment, the palaeontologist / palaeobotanist must do an investigation (a minimum of once every week).
7. At this stage the palaeontologist / palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the palaeontologist / palaeobotanist.

Fossil excavation if necessary, during Phase 2:

1. Photography of fossil / fossil layer and surrounding strata.
2. Once a fossil has been identified as such, the task of extraction begins.

3. It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
4. Using Paraloid (B-72) as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
5. Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.
6. Once the full extent of the fossil / fossils is visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
7. Chipping away sides to loosen underside.
8. Splitting of the rock containing palaeobotanical material should reveal any fossils sandwiched between the layers.

This document forms part of the Environmental Monitoring Programme. For practical reasons a palaeontologist/palaeobotanist may be required to be on site as predetermined. If any fossil material is discovered then a Phase 2 rescue operation may be necessary, and a permit will be required.

The South African Heritage Resources Agency has the following documents in place:
Guidelines to Palaeontological Permitting policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.
Palaeotechnical Reports (Eastern Cape, North West, Northern Cape, Mpumalanga, Gauteng, Western Cape, Free State, Kwazulu Natal, and Limpopo)

Appendix 3: **Table 3:** Listing points in Appendix 6 of the Act and position in Report (bold in text).

Section in Report	**Point in Act**	**Requirement**
B	1(c)	Scope and purpose of report
B	1(d)	Duration, date and season
B	1(g)	Areas to be avoided
D	1(ai)	Specialist who prepared report
D	1(aii)	Expertise of the specialist
F Figure 3	1(h)	Map
F, B	1(ni)(iA)	Authorisation
F, B	1(nii)	Avoidance, management, mitigation and closure plan
G Table 1	1(cA)	Quality and age of base data
G Table 2	1(cB)	Existing and cumulative impacts
G, D	1(f)	Details or activities of assessment
G	1(j)	Description of findings
H	1(e)	Description of methodology
H	1(i)	Assumptions
J	1(o)	Consultation
J	1(p)	Copies of comments during consultation
J	1(q)	Information requested by authority
Declaration	1(b)	Independent declaration
Appendix 2	1(k)	Mitigation included in EMPr
Appendix 2	1(l)	Conditions included in EMPr
Appendix 2	1(m)	Monitoring included in EMPr
D	2	Protocol or minimum standard

Appendix 4: Impact Statement

The development footprint is situated on the Vryheid Formation (Pv) of the Ecca Group, Karoo Supergroup with a **Very High** palaeontological sensitivity. The nature of the impact is the destruction of Fossil Heritage. Loss of fossil heritage will have a negative impact. The extent of the impact only extends in the region of the development activity footprint and may include transport routes. The expected duration of the impact is assessed as potentially permanent. The intensity/magnitude of the impact is high as it is destructive. The probability of the impact occurring will be definite and will occur regardless of preventative measures.

In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be irreversible. With Mitigation the impact will be moderate and the cumulative impact is low. Impacts on palaeontological heritage during the mining/construction and pre-mining/preconstruction phase could potentially occur and is regarded as having a high possibility. The significance of the impact occurring will be as below:

S= (2+5+8)5
S = 75 High (>60).

HYDROGEOLOGICAL STUDY

Hydrogeological Study for the proposed Mining Right Application within portion 1 of farm Annysspruit 140 HT, and remaining extent of farm Mooihoek 168 HT, situated in the magisterial District Mkhondo in Mpumalanga Province, South Africa

REPORT PREPARED BY:

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DMRE NO: MP 30/5/1/2/2/10384 MR

NOTRE Coal

Report Credentials.

Disclaimer

The opinion expressed in this and associated reports are based on the information provided by Notre Coal (Pty) Ltd 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 Notre Coal (Pty) Ltd 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 Notre Coal (Pty) Ltd 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.

Project Information		
Project Title	Hydrogeological Study for the proposed Mining Right Application within portion 1 of farm Annysspruit 140 HT, and remaining extent of farm Mooihoek 168 HT, situated in the magisterial District Mkhondo in Mpumalanga Province, South Africa	
Applicant	Notre Coal	
Project Location	portion 1 of farm Annysspruit 140 HT, and remaining extent of farm Mooihoek 168 HT, situated in the magisterial District Mkhondo in Mpumalanga Province, South Africa	
Mineral (s)	Coal Resources	
Project Date	20 October 2022	
Authors Detail (s)		
		Electronic signatures
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Final Review and Approval	Dr. Kenneth Singo (Principal Consultant of Singo Consulting (Pty) Ltd)	

Table 1: Critical Report Information

Critical Information incorporated within the Basic Hydrogeological Study:	Relevant section in report
Details of the specialist who prepared the report	Project details: 3
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A: 95
Project Background Information, including the proposed activities description	Project background information P: 12
An indication of the scope of, and the purpose for which, the report was prepared	Scope of work P: 21
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	Geographical impacts P: 63
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Project details P: 3
A description of the methodology implemented in preparing the report or carrying out the specialised process comprehensive of equipment and modelling used;	Methodology P: 23
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;	
An identification of any areas to be avoided, including buffers	
A map overlaying the proposed activity including the associated infrastructures on the environmental sensitivities of the site including containing buffer zones	
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Geographical Impacts P: 63
Any mitigation and conditions measures for inclusion in the EMPr	Groundwater management plan P: 76
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Groundwater monitoring plan P: 86
An analytic opinion as to whether the proposed activity or portions thereof should be Authorised-i.e. specific recommendations	Recommendations P: 92
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	Groundwater management plan P: 76
A description of any consultation process that was undertaken during carrying out the study	Refer to bar
Any triggered Water Uses according to section 21 of the National Water Act 36, 1998.	
Any other information requested by the competent authority.	N/A

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1 INTRODUCTION

The hydrogeological study over Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa.

Within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa. The application has been accepted by the Department of Mineral Resources (DMRE), Mpumalanga region with reference number MP 30/5/1/2/2/10384 MR. The Geohydrological Assessment is intended to ensure that there are no adverse environmental impacts on the groundwater because of the proposed mining activities.

Below is a table that summarizes the total resources on within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa, where the Mining Right Application has been lodged. It should be noted that the extent of this Geohydrological Assessment is such that it covers Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province to ensure maximum mitigation of the environmental impacts to groundwater that may arise as a result of mining activity on the Notre Coal Project.

Table 2: Total resources on within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT.

Seam	TTIS	CV(Mj/kg)	Ash9(%)	FC(%)	Vol(%)	IM(%)	TS(%)	Resources class
No.4	2064678	20.45	31.80	39.20	25.90	3.10	1.70	Measured
No.2	1963798	15.31	45.39	32.76	19.11	2.74	0.92	Measured
Total	4028475	17.88	38.60	38.60	22.51	2.92	1.31	Measured

1.1 Project Background Information

Singo Consulting (Pty) Ltd was appointed by Notre Coal (Pty) Ltd as an independent consulting company to conduct a hydrogeological study. The hydrogeological study is being conducted in support to a mining right application of coal within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa.

The proposed activity has a potential to contaminate the groundwater through possible accident of leakage and infiltration to the sub-surface.

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 right 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 stockpile area

The goal of this study:

- To assess the quality condition of surface and groundwater within and around the mining right 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 includes but not limited to crushing.

2 GEOGRAPHICAL SETTING

2.1 Project Location

The locality map created by the QGIS illustrates the location of the proposed area is situated within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa. The project site covers an area of about 877,148 hectares (ha) in extent. The area of interest is situated approximately 14 km South-West of Piet Retief and about 8.06 km East of Heyshore Dam. Access to the site is via an unnamed road that is connected to the R543 from Piet Retief.

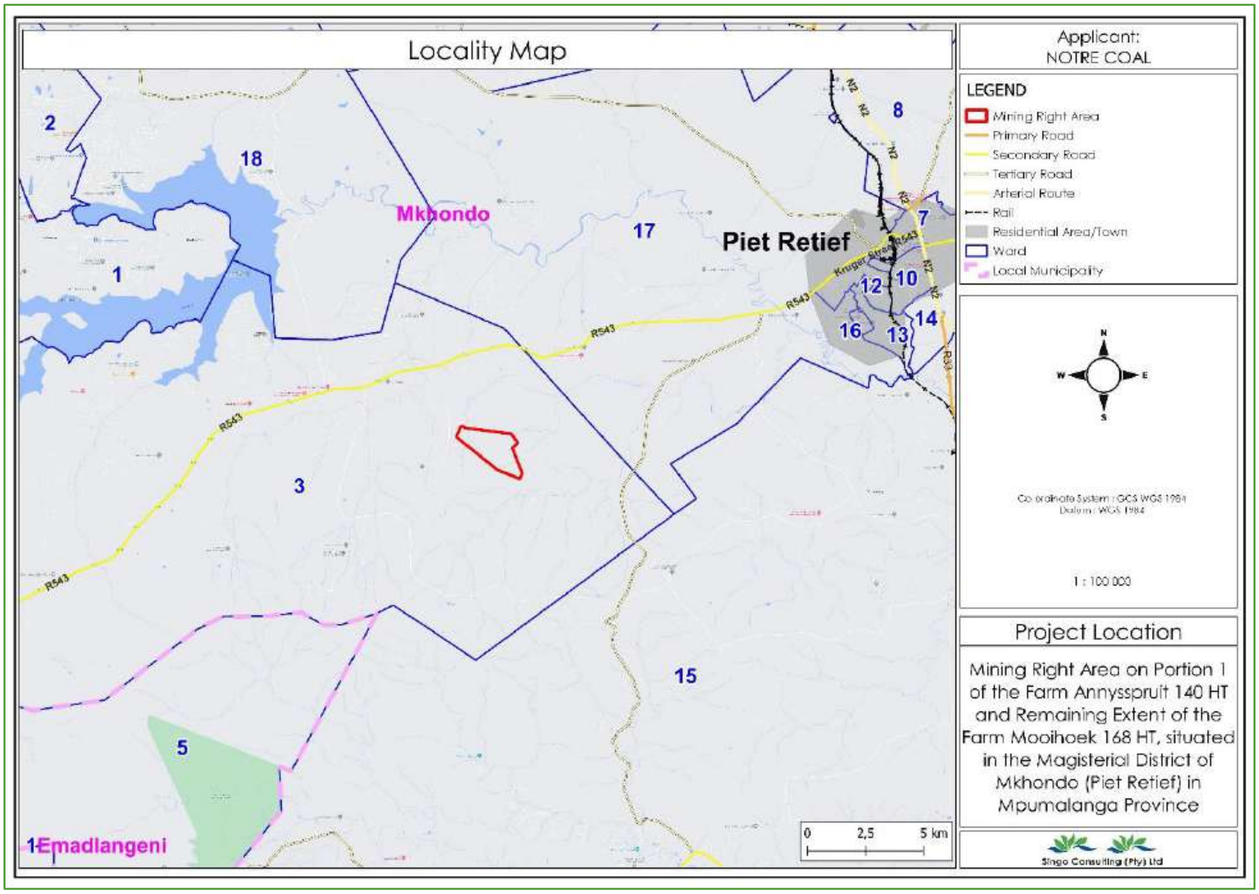


Figure 1: Locality map of the project area

Figure 2: Google earth view of the study area

2.2 Climate

Climate can be defined as the weather conditions in an area recorded over a long period of time. Mpumalanga Province is characterized by two major climatic regions, namely: highveld and lowveld. The two regions are separated by the Drakensberg Mountains (Cadman, 2007). The project area is located in the highveld region characterized by warm to hot summers but cold at night during winter. The project area experiences low mean minimum annual temperatures between 0 to 2 °C in the northern portion whereas the temperature ranges from 2 to 4 °C hot during summer and cold in the winter.

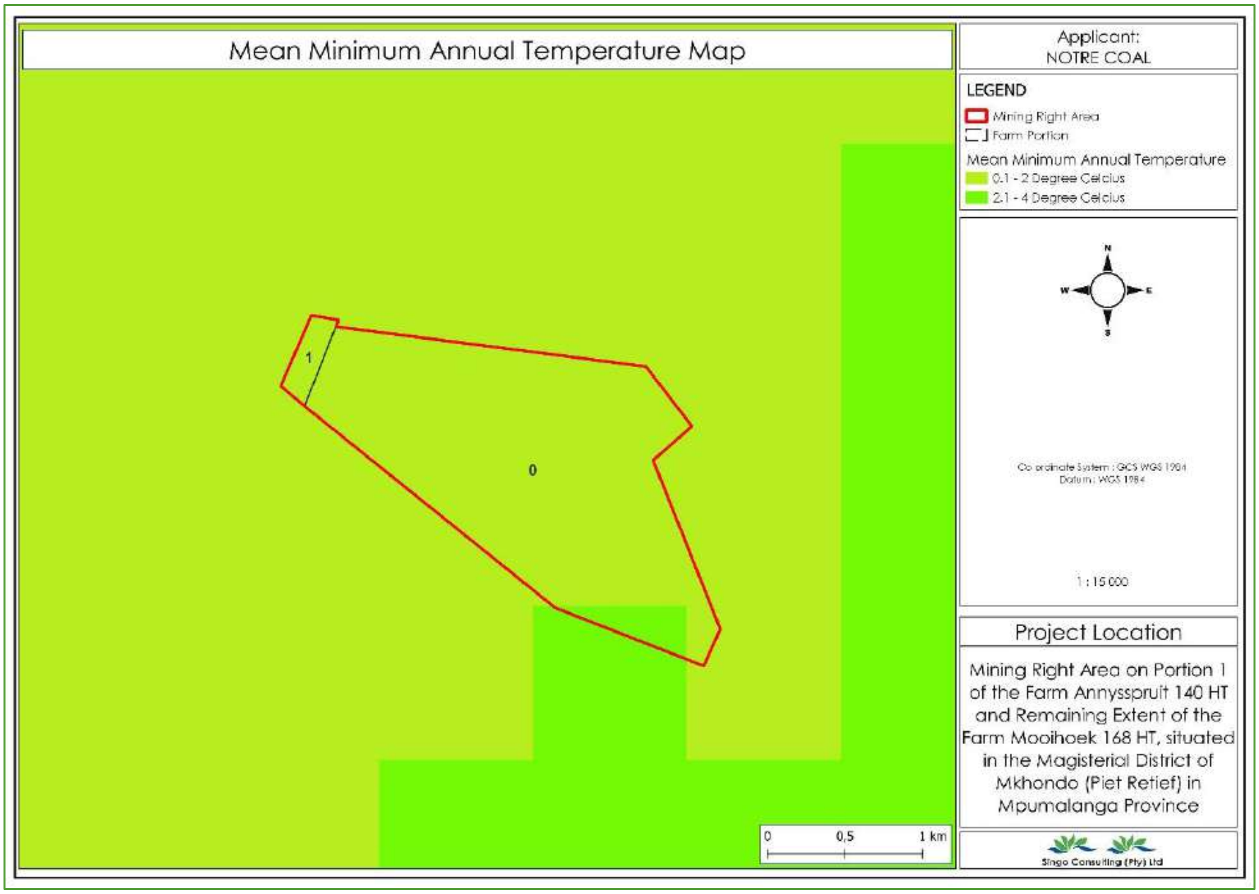


Figure 3: Mean minimum annual temperature map

A large portion of the area has a mean annual rainfall value ranging from 801 mm to 100 mm and minor portions in the southeastern and northwestern part of the study area. In general, the study area receives its most precipitation in summer with minor rain received in winter.

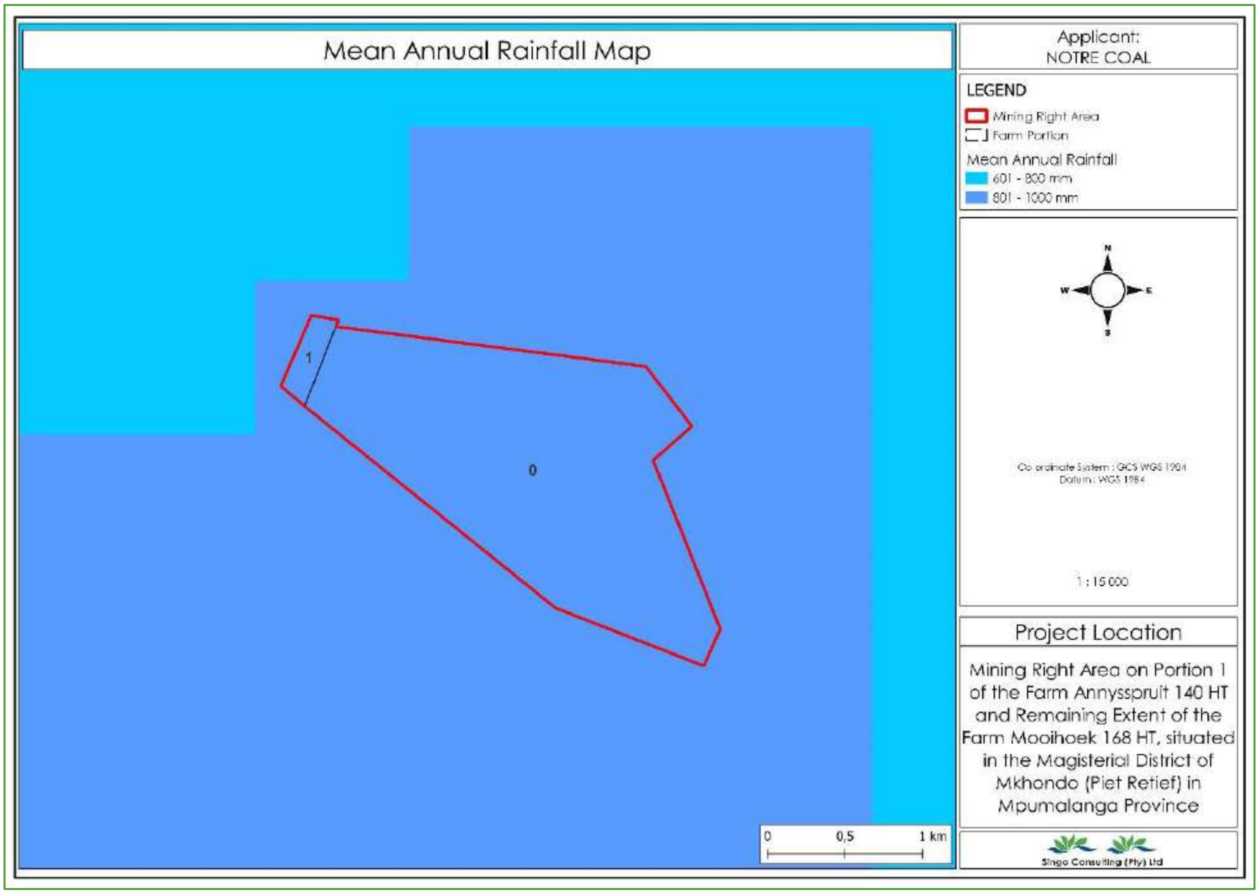


Figure 4: Mean annual rainfall

2.3 Drainage and Topography

Topography is a field of geoscience and planetary science and is concerned with local detail in general, including not only relief but also natural and artificial features, and even local history and culture. The flow of water during rainy seasons flows from the area of high elevation to the area of low elevation.

The project area is characterized by topographical elevations ranging from 1360 to about 1480 meters above mean sea level (mamsl). The area shows a high elevation to the east and south as compared to the west. Therefore, the water is anticipated to flow from east to west to mimic with the topography. The hydrology of the study area is defined by the presence of perennial and channeled valley bottom wetland as depicted by the figure below.

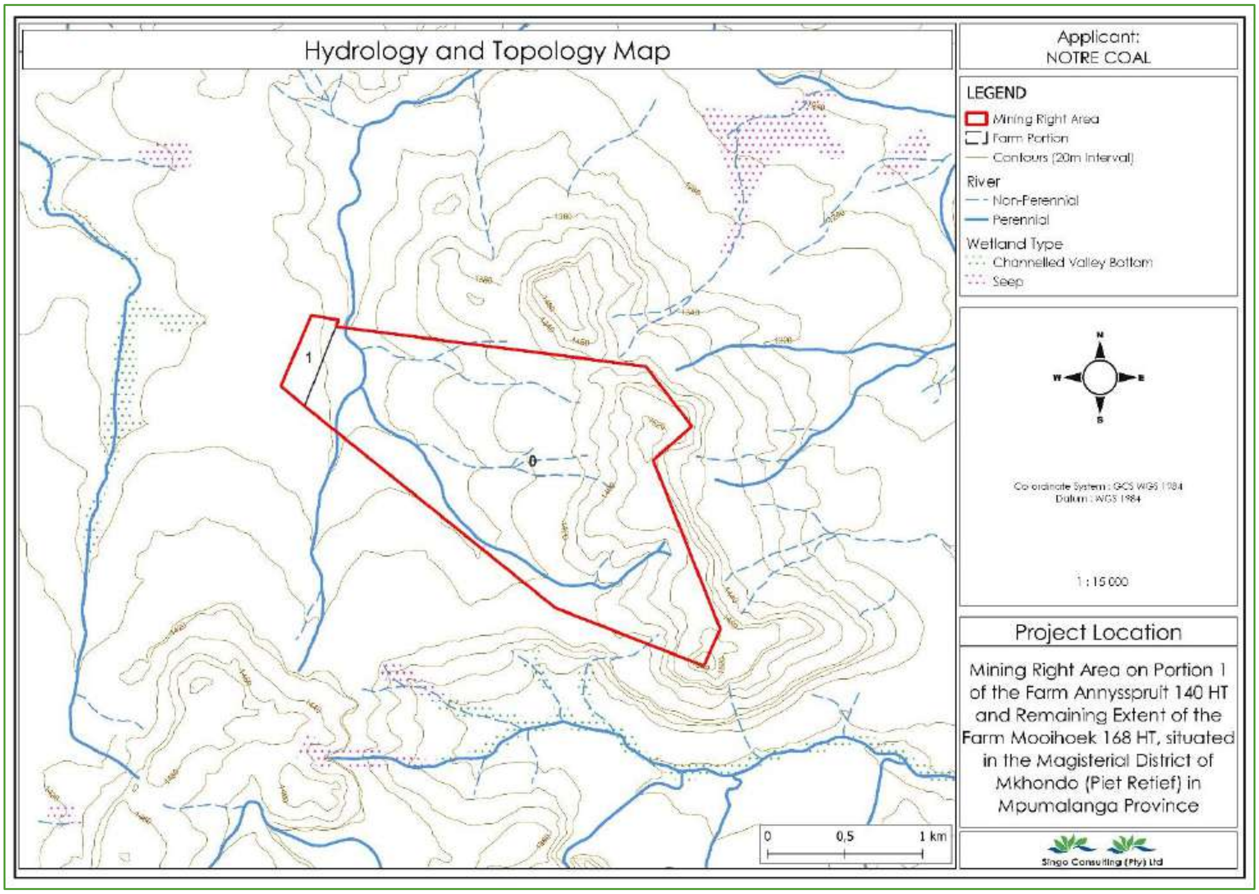


Figure 5: Hydrology and topology map

2.4 Catchment Information

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). 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 project area falls within the **Inkomati-Usuthu** Water Management Area (WMA). The quaternary catchment is **W51C**. The WRC 2012 study, presents hydrological parameters for each quaternary catchment including area, mean annual precipitation (MAP) and mean annual runoff (MAR).

Quaternary Catchment	**Water Management Area**	**Catchment Area**	**S-Pan Evaporation**		**Rainfall**	
			Evaporation Zone	**MAE (mm)**	**Rainfall Zone**	**MAP (mm)**
W51C	Inkomati-Usuthu water management area	678	13A	1400	W5A	903

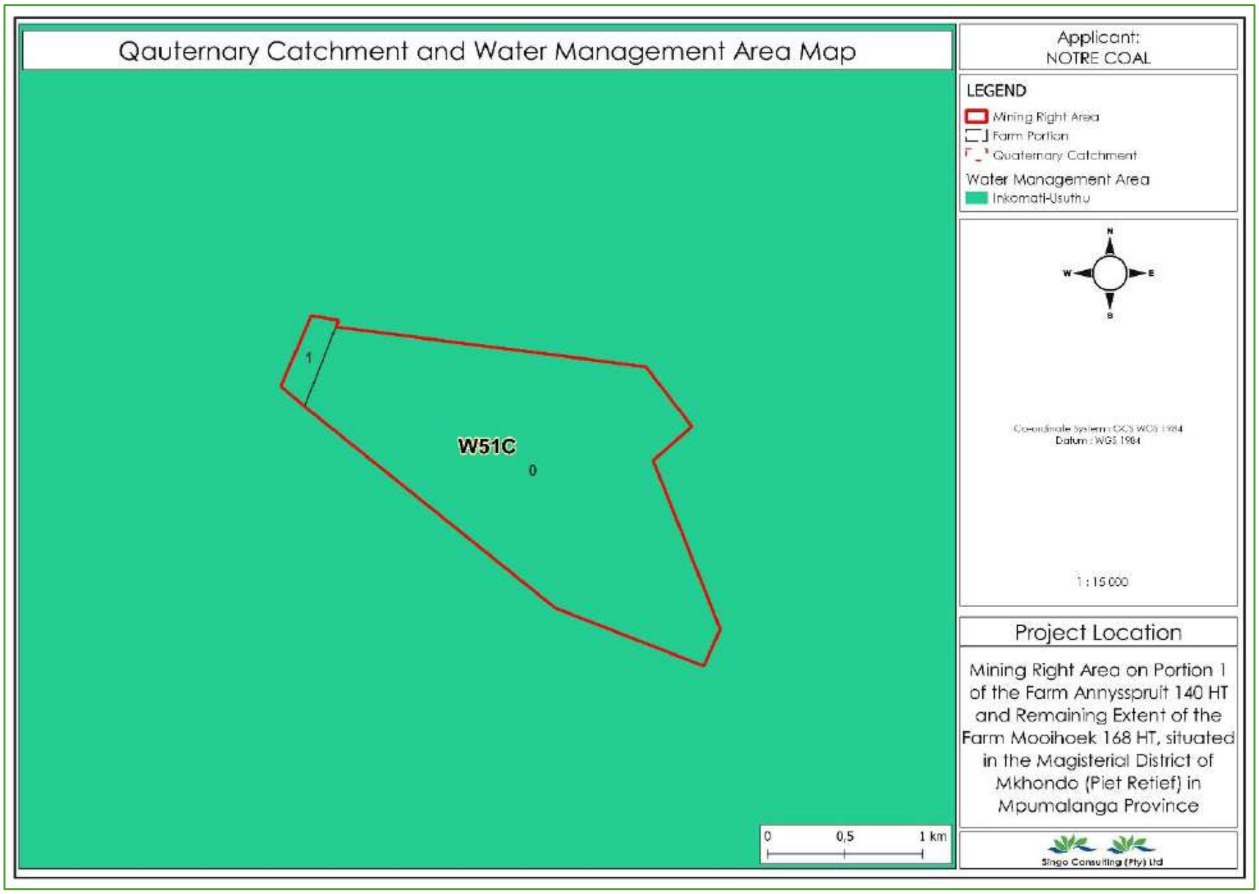


Figure 6: Quaternary catchment and water management area

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.

4 METHODOLOGY

4.1 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

4.2 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.

Table 3: Hydrocensus for the project area

Identity	Water Resource	Latitude	Longitude	Purpose
2730BA00029	Borehole	-27.16245	30.58697	Exploration
2730BA00006	Borehole	-27.1244	30.54725	Domestic
2730BA00008	Borehole	-27.10051	30.56031	Domestic
2730BA00032	Borehole	-27.08745	30.50808	Domestic
2730BA00031	Spring	-27.08579	30.51781	Domestic
2730BA00027	Borehole	-27.08495	30.63253	Agriculture
2730BA00048	Borehole	-27.06801	30.58339	Agriculture
2730BA00064	Borehole	-27.06801	30.58339	Agriculture
2730BA00002	Borehole	-27.04412	30.60419	Domestic
2730BA00024	Borehole	-27.04051	30.53558	Domestic
2730BA00003	Borehole	-27.0394	30.62281	Agriculture
2730BA00065	Borehole	-27.00634	30.63752	Agriculture
2730BA00025	Borehole	-27.00218	30.54197	Domestic

4.3 Geophysical survey and results

Geophysics is basically an application of physics to investigations of the Earth, Moon and planets. The relevant geophysical type in this sense would be Applied/ Exploration Geophysics which is the study of the Earth's crust and near surface to achieve a practical/economic aim. It can be for:

- Mineral exploration
- Engineering Geophysics

- Hydrogeophysics (Groundwater Geophysics) which is basically geophysical investigation focusing on groundwater problems.
- Environmental Geophysics

Geophysical methods

There are two types of geophysical methods that can be used, there is **passive methods** and **Active methods.**

Passive methods are those that detect variations within the natural fields associated with the Earth, such as the gravitational and magnetic fields.

Active methods are those in which artificially generated signals are transmitted into the ground.

There are various Geophysical methods, measuring different properties of earth materials with different applications, all requiring some contrast in the physical properties of the earth materials

Types of surveys that can be undertaken

- Ground geophysics Measurements are taken on the Earth's surface.
- Borehole geophysics Measurements are taken down a borehole.
- Underground geophysics Measurements are taken underground, e.g. mine shafts
- Airborne geophysics Measurements are taken from an airplane, helicopter, droid, and balloon.
- Satellite geophysics Measurements are taken from a satellite orbiting the Earth.
- Marine geophysics Measurements are taken at the surface of the oceans. In the present study basically, geophysical methods where not applied for this project as the drilled boreholes where for coal mineral exploration and not specifically drilled to find areas with underground water, where geophysics techniques could have been significant.

4.4 Drilling and sitting of boreholes

At various places throughout the proposed project area, exploration boreholes will be bored one at a time. The drill hole depths will average 100 m and will be determined onsite as the drilling program progresses. A 100- meter buffer will be maintained between specified wetlands, waterways, and public roads.

After drilling in an area, such area will immediately be rehabilitated, to preserve the environment and preventing the risk of soil and water (groundwater and surface) contamination, this will be a standard procedure before moving on to the next drilling area and until the drilling process is done.

4.5 Sampling and Chemical Analysis

The data was collected using a variety of equipment, a handheld GPS, probes (pH conductivity and Dissolved oxygen), and sampling bottles. For the dam that was being monitored, the hand GPS was utilized to determine the longitudinal, latitude, and elevation.

4.6 Groundwater recharge calculation

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 behavior, 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 any 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)

$$q = \mathrm{P\ x}\ \frac{\mathrm{CLwap}}{\mathrm{Clgw}}$$

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.

In this project: given data:

4.7 Groundwater Modelling

- Numerical Groundwater Flow and Transport Model
    - Model inputs
    - Model Calibration
    - Scenario Modelling
    - Hydrogeological Impact Assessment
    - Use the model to predict potential prospecting impacts on the shallow and deep groundwater flow systems, groundwater seepages and spring discharges.

4.8 Groundwater Availability Assessment

Diabase group forms when molten igneous rock is squeezed up into a vertical crack in other rocks, the crack is usually forced apart and the molten rock cools in the space to form a tabular igneous intrusion cutting across the surrounding rocks and is known as a dike.

All groundwater movement in this study area occurs along secondary structures such as fractures, cracks, and joints in the rock. These structures are best developed in intruded bedrocks where cracks are formed hence the better water yielding properties. Dolerite sills and dykes are generally impermeable to water movement, except in the weathered state. In terms of water quality, the fractured aquifer always contains higher salt loads than the upper weathered aquifer. The higher salt concentrations are attributed to a longer contact time between the water and rock (IGS,

5 PREVAILING GROUNDWATER CONDITION

5.1 Geology

5.1.1 Regional Geology

Karoo Supergroup

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-colored 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.

Dwyka Group

The rocks of the Dwyka Group in South Africa are amongst the most important glaciogenic deposits from Gondwana. This Group is named for exposures along the Dwyka River east of Laingsburg and forms the basal succession of the Karoo Supergroup. Dwyka Group strata are mostly contained within bedrock valleys incised into Archean to lower Palaeozoic bedrock (Visser, 1990; Visser and Kingsley, 1982; Von Brunn, 1996). The lithologies in the areas underlying

the coalfields of South Africa consist of a heterolithic arrangement of massive and stratified polymictic diamictites, conglomerates, sandstones and drop stone-bearing varved mudstones. The easily identifiable lithologies form a good marker below the coal bearing Ecca Group. In the distal sector of the MKB these sedimentary strata accumulated largely as ground moraine associated with continental ice sheets and is generally composed of basal lodgement and supraglacial tills. These deposits are generally massive, but crude horizontal bedding occurs in places towards the top (Tankard et al., 1982).

Ecca Group

In the 1970s a number of studies (Cadle, 1974; Hobday, 1973, 1978; Mathew, 1974; Van Vuuren and Cole, 1979) showed that the Ecca Group could be subdivided into several informal units based on the cyclic nature of the sedimentary fills. In 1980 the South African Committee for Stratigraphy (SACS, 1980) introduced a formal lithostratigraphic nomenclature for the Ecca Group in the northern, distal sector of the MKB, which replaced the previously used informal Lower, Middle and Upper subdivisions with the Pietermaritzburg Shale Formation, the Vryheid Formation and the Volksrust Shale Formation.

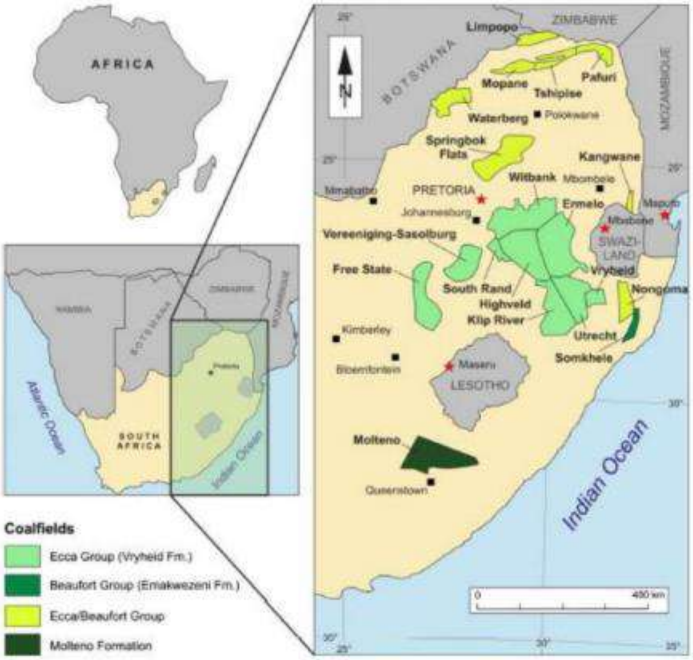


Figure 7: Coal field of South Africa (adopted from Hancox and Gotz, 2014)

5.1.2 Local Geology

Vryheid Formation

The majority of the economically extracted coal in South Africa occurs in rocks of the Vryheid Formation, which ranges in thickness in the MKB from less than 70.0 m to over 500.0 m. It is thickest to the south of the towns of Newcastle and Vryheid, where maximum subsidence took place (Du Toit, 1918; Cadle, 1975; Whateley, 1980a; Stavrakis, 1989; Cadle et al., 1982) and where the basin was the deepest. The area of interest falls under the Ermelo Coalfield, and it is dominated by exposures of the Permian Vryheid Formation rocks and the Jurassic aged dolerites. This Coalfield hosts five thinner seams labelled as letter codes A to E with varying thickness between 170 and 350 m (Greenshields, 1986) and are said to be sedimentologically and structurally complex. The coal seams in the Ermelo Coalfield are generally flat-lying to slightly undulating and are separated by fine- to coarse-grained sandstones, siltstones and mudstones. The A, D and E seams are usually too thin to be of economic interest and historically the C Seam group was the most important in and the B Seam group in the Ermelo area. The E Seam may reach a thickness of up to 3 m and its economic importance is only in isolated patches in the north of the Ermelo Coalfield.

The coal is mostly bright and banded, has a competent sandstone roof and floor and is sometimes split by a thin sandstone or carbonaceous fines parting (Greenshields, 1986). In the central and southern part of the coalfield, it is developed as a torbanite or as a carbonaceous siltstone or mudstone unit, and locally becomes too thin for mining (Greenshields, 1986). The coal of the D Seam is of good quality, but in general is too thin (0.1–0.4 m) to be of economic importance (Greenshields, 1986). The coal is not split by partings and consists of large amounts of vitrain and occasional durain bands (Greenshields, 1986; Jeffrey,2005a). The C Seam group has been one of the main seam packages of economic importance throughout the Ermelo Coalfield. It is usually split by several partings which can lead to miscorrelation of the seams (Greenshields, 1986). In general, the C Seam is subdivided into the C Upper (CU) and C Lower (CL) seams. The CU Seam is well-developed over the entire coalfield and is often split by partings of different lithologies, such as sandstone, siltstone or mudstone, reaching a composite thickness of 0.7–4 m. It has historically been mined in several collieries of the Ermelo Coalfield, including the Golfview, Usutu, Goedehoop, Union, and Kobar collieries (Greenshields, 1986).

The CL Seam is not developed throughout the entire coalfield, but where developed is between 0.5 and 2 m thick. It locally grades into carbonaceous siltstone and mudstone, which often form the roof of the seam, whereas the floor mostly consists of sandstone. Locally seam floor rolls may negatively influence the thickness of the CL Seam in the Ermelo Coalfield. The B Seam group varies in thickness from 1 to 2.7 m and may be split into three units. Greenshields 1986) terms these the B1, B and BX seams, but they are more commonly referred to as the B Lower.

Karoo Dolerite Suite-Intrusions in the Ermelo Coalfield

The sedimentary rocks of the Karoo Supergroup typically do not yield acceptable pavement aggregates due to the argillaceous nature of the lower (flysch) units and the relatively poor strength arenaceous (mollase) upper units. There is however an extensive network of dolerite intrusions which represent the shallow feeder system to the Drakensberg flood basalt eruptions (183 ± 1 Ma) (Duncan & Marsh, 2006) which erupted at the end of the Karoo sedimentary succession deposition. These intrusions are collectively called the Karoo Dolerite Suite and have been widely, and successfully, used as pavement aggregate sources. Large areas of the Ermelo Coalfield are affected by Jurassic aged dolerite intrusions, and these intrusives are probably the single most disruptive aspect of the coalfield (Barker, 1999).

The dolerites form thin sub-vertical dykes and thick (30–50 m) bedding parallel sills. Several have been identified and mapped based on cross-cutting relationships and petrological characteristics (Visser et al., 1958). In places thin stringers may occur within the coal seam succession creating difficult mining conditions. Both the B4 and the B6 sills are present in this area, with the B6 sill normally underlying the CL Seam. The B4 sill often breaks through the coal seams to surface and causes dislocations of the coal seams into blocks. Associated with these intrusions is faulting that causes displacement of the coal seams (Greenshields, 1986). Faulting occurs with increasing frequency towards the south of the coalfield; with displacements of up to 250 m. Faults are almost without exception intruded by dolerite.

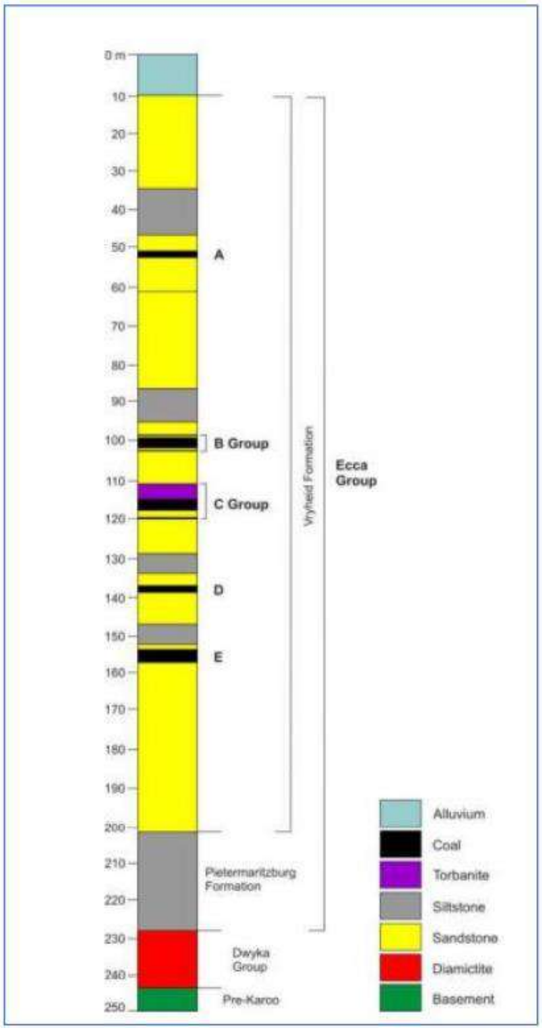


Figure 8: The stratigraphy of the Ermelo coal field including the underlying PreKaroo basement rocks (after Greenshields, 1986).

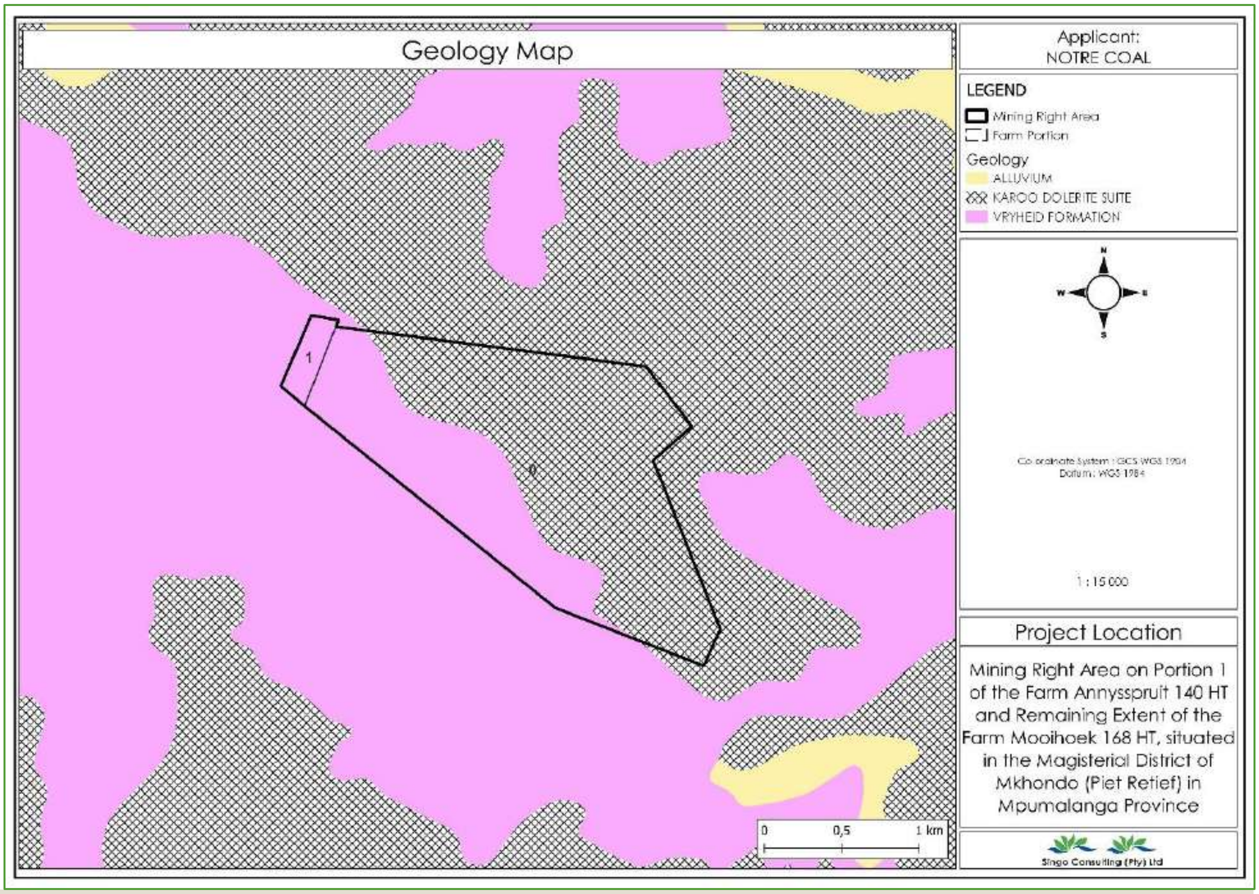


Figure 9: Geology map of the project area

5.2 Acid Generation Capacity

5.2.1 ACID MINE DRAINAGE

Acid mine drainage (AMD) is a serious problem in mines where sulphate is a by-product, like in this project where it is a coal mine, AMD is expected to occur due to the extraction of sulphide ores such as chalcopyrite, pyrite or arsenopyrite ores. Therefore, acid mine drainage studies should be included as one of the impacts to be mitigated in this area. Acid mine drainage occurrence in a mining area will be indicated by a decrease in pH level in mine waters.

The equations below illustrate the process of acid mine drainage formation described in four steps. This development is self-propagating until the ferric iron or pyrite is diminished. Basically, when pyrite blends with oxygen and water, acid mine drainage forms. Acid mine drainage is dangerous and can destroy aquatic life as well as the aesthetic conditions of a particular environment.

1. Oxidation of Polysulfide to sulphate by O_2

$2FeS_2 + 7O_2 + 2H_2O \rightarrow 2Fe^{2+} + 4SO_4^{2-} + H^+$

2. Oxidation of Fe^{2+} (ferrous iron) to Fe^{3+} (ferric iron) by O_2

$4Fe^{2+} + O_2 + 4H^+ \rightarrow 4Fe^{3+} + 2H_2O$

3. Hydrolysis of iron (ferric iron → ferrichyfroxide, “yellowboy”)

$4Fe^{3+} + 12H_2O \rightarrow 4Fe(OH)_3 + 12H^+$

4. Oxidation of polysulfide to sulphate by Fe^{3+} at low pH

$FeS_2 + 14Fe^{3+} + 8H_2O \rightarrow 15Fe^{2+} + 16H^+$

Total: $FeS_2 + 15/4\ O_2 + 7/2H_2O \rightarrow 2Fe(OH)_3 + 2SO_4^{2-} + 4H^+$

Acid mine drainage can be treated in various ways including:

- An increase in pH or raising alkalinity. This can be achieved by neutralization reactions, introducing alkalinity reagents such as $NaCO_3$ or NaCl,
- Removing metals like iron, zinc and aluminum from water.
- Conducting passive treatments of acid mine drainage (limestone leach beds) as well as conducting active treatment of acid mine drainage (treatment plants).

5.2.2 ACID BASE ACCOUNTING

Acid base accounting is applied to predict mine drainage potential of a sample. The Witbank coalfields (Witbank-Middelburg, Ermelo and Standerton-Secunda areas) in Mpumalanga, contains extensive coal reserves and is the country's most productive coalfield. There is also new coal mining in the Waterberg Coalfield.

Old discard dumps are one of the greatest polluters of the environment in certain regions of South Africa, particularly the Witbank region, polluting the atmosphere, rivers, ground water and the esthetics of the countryside.

5.2.3 PREDICTION METHOD CLASSES

- Static Methods
- Kinetic Methods
- Field Methodologies
- Geochemical Modelling (Phreeqc /Geochemist workbench etc.

5.2.4 ACID BASE ACCOUNTING (ABA)

This method, also referred to as the EPA-600 method, has been the most broadly used of all static test methods. It first involves the determination of NP by digesting a small (2.0 g) sample minus 60 mesh in excess hydrochloric acid at near-boiling temperatures. A fizz test is used to establish the volume and normality of acid added. The unreacted acid remaining at the end of the digestion is then titrated with NaOH to an end point of 7.0 so that the acid consumed can be calculated.

<u>The NP value can then be calculated as follows:</u>

$$NP = \frac{50\,\mathrm{a}(\,\mathrm{x}-\left(\frac{\mathrm{b}}{\mathrm{a}}\right)\mathrm{y})}{\mathrm{c}}$$

Where: NP = neutralization potential kg CaCO3, equivalent per tonne.

a = normality of HCl added in digestion

b = normality of NaOH used in titration

c = mass of sample in grams

x = volume of HCl added in mL

y = volume of NaOH added in titration

<u>The acid potential, AP is calculated from a total Sulphur analysis as follows:</u>

AP = S% x 3 1.25 kg CaCO3, equivalent per tonne

One of the advantages of this test is that it is broadly used and is accepted by many regulatory authorities. It is a fast and easy, low-cost test and is perfect for the screening of many samples. Like all static tests, however, the test provides no information on the rate and extent of both

sulphide oxidation and neutralization that will occur in the field. In addition, the Sobek procedure has been shown in many studies to have a tendency to overestimate NP. This is due to the difficult digestion conditions in which some minerals, which will not be effective neutralizers in the field, react and are accounted for in the NP value.

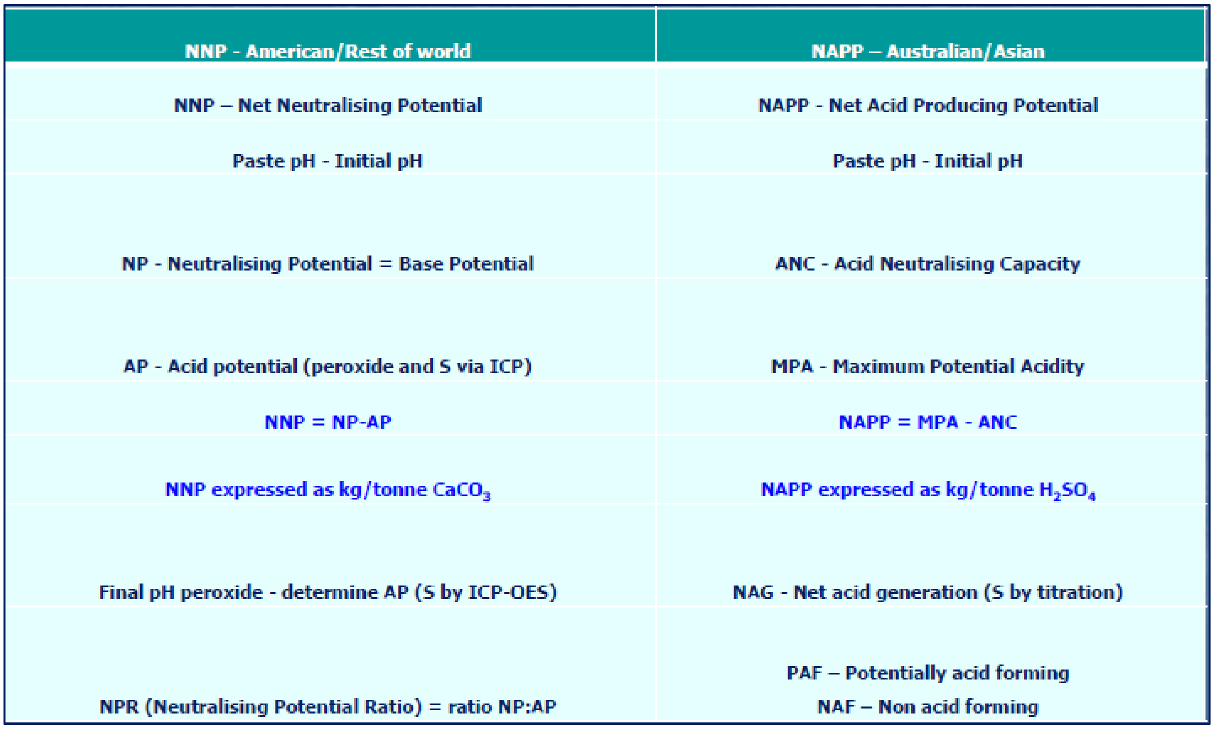
Overestimation is exacerbated by application of the fizz test which is a subjective procedure and can lead to differences in the results acquired by different technicians for the same samples. Some laboratories do not use a fizz test either to remove the subjectivity or else to simplify procedures. This practice leads to further problems in test interpretation.

ABA (static)

ABA is a screening procedure whereby the acid neutralizing potential (asset) and acid generating potential (liabilities) are determined and the difference (acid neutralizing potential (equity) is calculated.

There are two ways that ABA results are expressed:

- American/European/South African expressed as CaCO3
- Australian expressed as H2SO4



NNP - American/Rest of world	NAPP – Australian/Asian
NNP – Net Neutralising Potential	NAPP - Net Acid Producing Potential
Paste pH - Initial pH	Paste pH - Initial pH
NP - Neutralising Potential = Base Potential	ANC - Acid Neutralising Capacity
AP - Acid potential (peroxide and S via ICP)	MPA - Maximum Potential Acidity
NNP = NP-AP	NAPP = MPA - ANC
NNP expressed as kg/tonne $CaCO_3$	NAPP expressed as kg/tonne H_2SO_4
Final pH peroxide - determine AP (S by ICP-OES)	NAG - Net acid generation (S by titration)
NPR (Neutralising Potential Ratio) = ratio NP:AP	PAF – Potentially acid forming NAF – Non acid forming

Figure 10: Different terminologies used for acid base accounting calculations

Acid-Base Accounting Cumulative Screening tool ABACUS is an Excel-based, Menu Driven software which uses prescribed classification criteria and allows interpretation of each sample and for entire spoil area.

Conclusions Static Methods

- ABA provides first level of screening for long term prediction
- Provides indication of likelihood and severity of acid generation

5.3 Hydrogeology

The natural geohydrological system within the Witbank Coalfield consists of three superimposed aquifers namely an upper weathered aquifer, a fractured Karoo aquifer and a fractured pre-Karoo aquifer (Hodgson & Krantz, 1998). The upper weathered aquifer consists of material weathered in situ and transported as part of the erosion process. The depth to weathering is generally between 1m and 15m from surface and the water level varies between 5m and 10m below ground level (mbgl). The flow mechanism within the weathered aquifer is porous flow (primary aquifer type). The water quality is generally good due to years of dynamic groundwater flow resulting in the leaching of soluble salts.

The fractured Karoo aquifer consists of the various lithologies of siltstone, shale, sandstone and the coal seams. The pores of the geological units are generally well cemented, and the principle flow mechanism is fractured flow along secondary structures e.g. faults, bedding plane fractures etc. The intrusion of the fractured aquifer by dolerite dykes and sills has led to the formation of preferential flow paths along the contacts of these lithologies due to the development of cooling joints. The intrusions of dykes crush the lithologies on which they intrude through, forming cracks where water can flow through.

The fractured pre-Karoo aquifer is separated from the overlying fractured Karoo aquifer by Dwyka tillites which act as an aquiclude where present. The flow mechanism is fracture flow as can be expected from the crystalline nature of the granite rocks. The water quality is generally characterized by high fluoride levels which restricts exploitation of this aquifer in combination with the general low yields, deep drilling and the low recharge (Grobbelaar et al, 2004). Mining of the coal seams has resulted in the establishment of an artificial aquifer system which generally dominates the groundwater flow on a local and regional scale. Below is a summary of the geohydrological system.

5.3.1 KAROO AQUIFERS AND AQUICLUDE

a. Shallow weathered zone aquifers (Overburden/weathered)

b. Fractured aquifers

- Upper fractured aquifer
- Dolerite sill (aquiclude)
- Deep fractured aquifer

c. Coal mine artificial aquifer

5.3.2 SHALLOW WEATHERED KAROO AQUIFER (UNCONFINED)

Overburden/Weathered Zone Aquifer

- The weathered zone of the Karoo sediments hosts the unconfined or semi-confined shallow weathered Karoo aquifer. Water levels are often shallow, and the water quality is good due to direct rainfall recharge and dynamic groundwater flow through the unconfined aquifer in weathered sediments, which makes it also easily exposed to contamination. Water intersections in the weathered aquifer is mostly encountered above or at the interface to fresh, where the vertical infiltration of water is typically

limited by impermeable layers of weathering products and capillary forces, with subsequent lateral movement following topographical gradients.

- Localized perched aquifers may occur on clay layers or lenses at shallower depth (soil zone) but are due to their localized and detached nature of no further interest in the context of the present study.
- Alluvial deposits occur in most valley bottoms associated with surface water courses, but their regional coverage is little. These unconsolidated alluvial sediments consist of clay, sand, gravel and boulder sized grains.

Upper fractured aquifer unconfined to semi-confined

- The weathered aquifer is underlain by a deeper semi-confined to confined fractured aquifer in which fracture flow dominates. The fractured Karoo aquifer consists of the various lithologies of siltstone, shale, sandstone and the coal seams, where groundwater flow is governed by secondary porosities like faults, fractures, joints, bedding planes or other geological contacts, while the rock matrix itself is considered impermeable. Geological structures are generally better developed in competent rocks like sandstone, which subsequently show better water yields than the less competent silt or mudstones. Not all secondary structures are water bearing due to e.g. compressional forces from the neo-tectonic stress field overburden closing the apertures.
- Although the Karoo aquifer supports domestic and stock water requirements in the area, their physical and hydraulic characteristics preclude large scale groundwater exploitation for e.g. irrigation.
- The strike frequency analysis for the Karoo rocks indicates a predominant shallow groundwater occurrence, mostly in the first 50 meters below the water table (Woodford and Chevallier, 2002.

5.3.1 Unsaturated Zone

The unsaturated zone is a portion of the subsurface above the groundwater table. The unsaturated zone is common on arid areas (regions) and rocks in this zone contains air and water in its pore spaces (USGS Groundwater Information: Unsaturated Zone)

5.3.2 Saturated Zone

The saturated zone holds within the area below the ground in all interconnected openings within the geological medium are filled with water. The mining right area is situated within a saturated zone

5.4 Groundwater Quality

The groundwater quality results have been compared to the South African National Standards (SANS) 241:2015 Standards for Drinking and have been grouped into two classes in accordance with the above stated standards. According to the SANS 241:2015 standards, water quality can be classified as Acceptable and Unacceptable: Concentrations that are below the recommended limits are categorised as Acceptable and are considered of good quality and suitable for human consumption; and Concentrations that are above the standards are categorised as Unacceptable and are not desired for human consumption, either due to aesthetic, acute or chronic effects. All the water in the data set has been classified as Acceptable Quality.

Sample ID	**Latitude**	**Longitude**
Annyspruit River	27,09958˚	30,61181˚
Annyspruit River	27˚03'41"	30˚35'38"
Boesmanspruit River	27˚06'21"	30˚38'20"

Table 4: Site water sampling

Piper Diagrams illustrates cations and anions shown by separate ternary plots. The apexes of the cation plot are calcium, magnesium, and sodium plus potassium cations. The apexes of the anion plot are sulphate, chloride and carbonate plus hydrogen carbonate anions. The two ternary plots are then projected onto a diamond, where the water type is determined

Stiff diagram

Stiff diagram, or Stiff pattern, is a graphical representation of chemical analyses, first developed by H.A. Stiff in 1951. It is widely used by Hydrogeologist and geochemists to display the major ion composition of a water sample. A polygonal shape is created from four parallel horizontal axes extending on either side of a vertical zero axis. Cations are plotted in milliequivalents per liter on the left side of the zero axis, one to each horizontal axis, and anions are plotted on the right side. Stiff patterns are useful in making a rapid visual comparison between water from different sources. An alternative to the Stiff diagram is the Maucha diagram. Results from the sampled borehole represents more alkaline contents.

6 AQUIFER CHARACTERIZATION

6.1 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 main concerns in terms of possible groundwater contamination from the proposed mining activity are as follows:

- During the construction phase, Total Petroleum Hydrocarbon (TPH) contamination is possible due to the presence of heavy machinery on site. Spillages may occur which may impact both the soil and groundwater environment.
- During the operational phase, potential contamination may arise due to possible erosion which might lead to contamination of nearby water resources.

Because of the ensuing possibility of possible groundwater contamination from the sources or risks mentioned above, the aquifer's vulnerability is analysed. The following evaluation methodologies were used to establish the aquifer's vulnerability to various pollution sources:

Method 1: Aquifer Vulnerability Rating (DRASTIC Method).

Method: 1 evaluates and rates seven key parameters within the hydrogeological setting to determine a final aquifer vulnerability rating.

Aquifer Vulnerability Rating (Drastic Method)

n the DRASTIC method, aquifer vulnerability is determined within hydrogeological settings by evaluating seven parameters denoted by the acronym:

- Depth to groundwater – Determined from DWA, GRA2 data, confirmed with a hydrocensus.
- Recharge – Obtained from DWA, GRA2 data.
- Aquifer media – Determined from geological maps and test pit profiles.
- Soil media – Determined from test pit profiles.
- Topography – Determined by digital elevation data.

- Impact on vadose zone – Determined from geological maps and test pit profiles.
- Hydraulic Conductivity – Protocol to Manage the Potential of Groundwater Contamination form on-site Sanitation (DWAF, 1997).

Each of the parameters is weighted according to its relative importance. The DRASTIC Index is determined by rating each parameter according to a set of tables, multiplying the assigned rating by the parameter weighting and summing the resulting products. The higher the DRASTIC Index; the higher the vulnerability to contamination.

Table 5: Drastic model table rating for the aquifer underlying the study area

Parameter	Effect	Rating										Weight	Site rating	Score
		1	2	3	4	5	6	7	8	9	10			
Depth to Water	Increasing depth to water increases time for natural attenuation or remediation of contaminant	> 33m	25 - 33m	17 - 25m		10 - 17m		5 - 10m		2 - 5m	0 - 2m	5	5	25
Recharge	Increasing recharge leads to faster	0 - 10mm/a	10 - 25mm/a	25 - 37mm/a		37 - 50mm/a	50 - 75mm/a	75 - 110mm/a	110 - 160mm/a	160 - 200mm/a	>200mm/a	4	8	32

	movement of contaminant													
Aquifer Media	Increasing porosity increases movement of contaminants		Compact sedimentary rocks with widely spaced fractures	Igneous and/or crystalline metamorphic rocks: fractured	Igneous and/or crystalline metamorphic rocks: fractured and weathered	Compact sedimentary rocks: fractures directly below ground water level		Compact sedimentary rocks: weathered and fractured	Massive dolomite / limestone. Sand and Gravel		Fractured dolomite / limestone with solution channels	3	4	12
Soil media (Drainage)	increasing soil drainage decreases time for natural attenua		Clay loam and silty clay	Silty clay loam, sandy clay and silty loam	Sandy clay loam and loam	Sandy loam	Sandy loam	Shrinking and/or aggregate clay. Loamy sand	Sand. Shrinking and/or aggregate clay	Sand	Sand	2	4	8

	tion or remediation													
Topography (%Slope)	increasing slope promotes runoff and decreases downward contaminant movement	> 18		12 to 18		6 to 12				2 to 7	0 - 2	1	10	10
Impact of the Vadose Zone	Increasing vadose zone conductivity decreases time		Mainly compact tillite	Mainly compact tillite and shale. Lava and Intrusive	Mainly compact tillite, shale and sandstone. Assemb	Compact sedimentary strata	Compact, dominantly arenaceous strata	Consolidated porous to compact sedimentary		Porous unconsolidated to semi consolidated sedimentary	Dolomite, chert, subordinate limestone	5	5	25

	for natural attenuation or remediation of contamination				lage of compact sedimentary strata, and extrusive and intrusive rocks			strata		strata				
Hydraulic Conductivity	Increasing vadose zone conductivity decreases time for natural attenuation or remediation of	0.03 - 0.69 m	0.69 - 1.35m	1.35 - 2.02m	2.02 - 2.68m	2.68 - 3.34m	3.34 - 10m				>10m	2	10	20

	contamination													
Final Score						132								

The vulnerability index score (DRASTIC index) for the site is 132. Below is a classification table indicating the class description for the index range.

Table 6: Aquifer vulnerability table of the aquifer at Middelburg

Index Range	Class name
≤ 89	Very Low
90 – 105	Low
106 – 140	Medium
141 – 186	High
187 – 210	Very High
≥ 211	Extremely High

The aquifer vulnerability from possible pollution sources is classed as "Moderate". A moderate potential or likelihood for possible contaminated fluids originating from the site to reach the groundwater table exists. A medium aquifer protection level is therefore recommended.

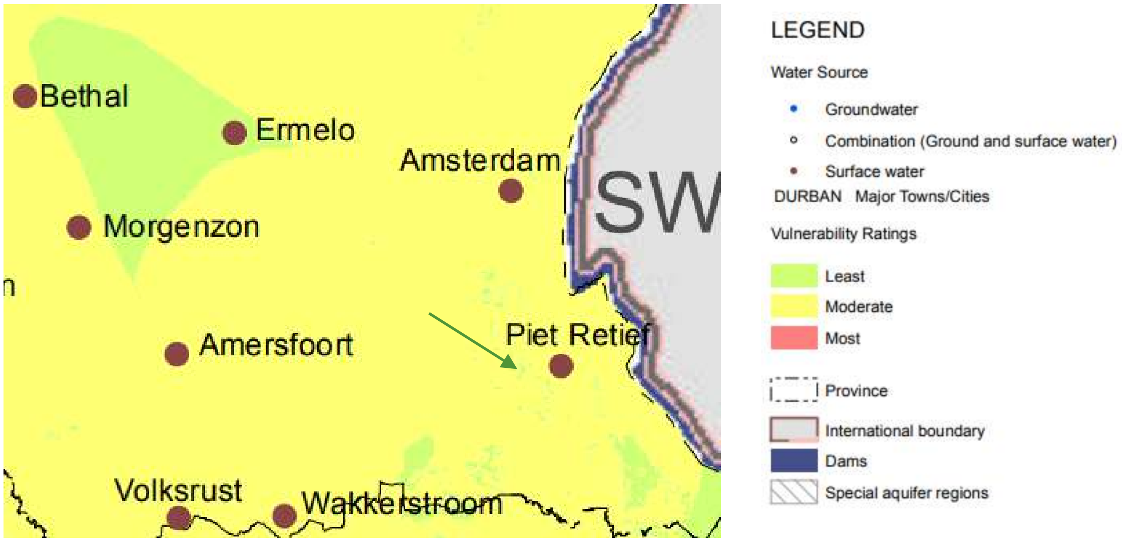


Figure 11: Aquifer Vulnerability of the study area

6.2 Aquifer classification

The classification of aquifers was done using the Aquifer classification Map of south Africa (Matoti, Conrad and Jones, 1999). The Map provides an overview of aquifer that exist within an area, this information helps the decisionmakers to fully understand how over abstraction from the aquifer could affect those in the area.

The map details the dominant source water in the area, Surface water. The aquifer classification is minor aquifers.

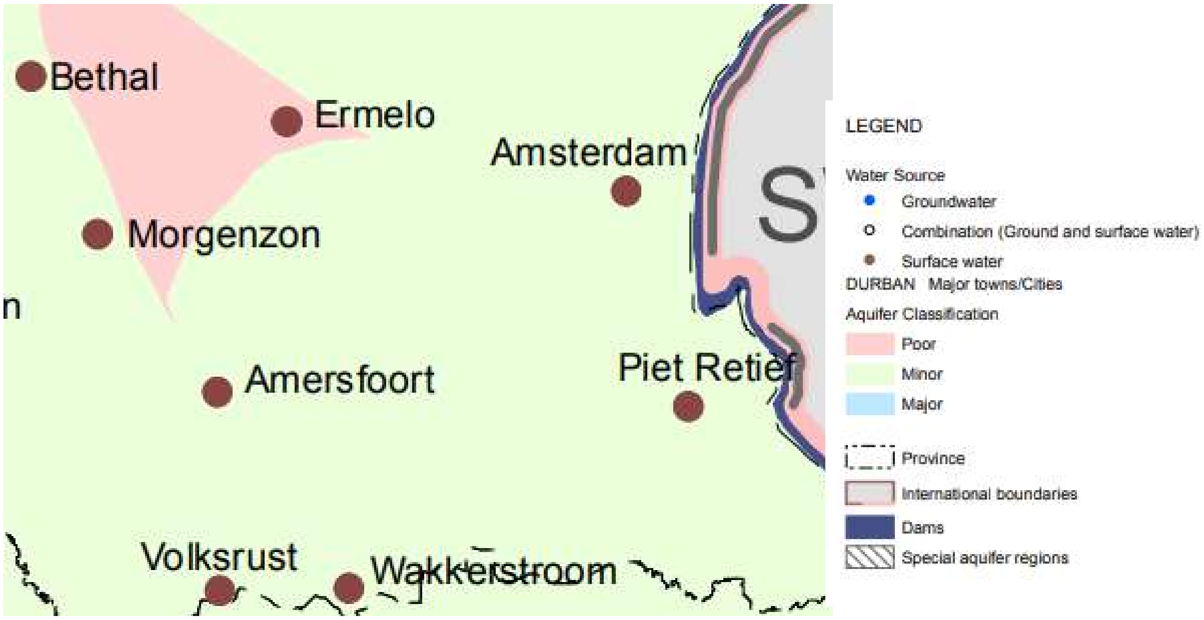


Figure 12: Aquifer Classification of the project area (Source: Vegter $ Seymour, 2012)

Table 7: 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.

8 GEOGRAPHICAL IMPACTS

The following major groundwater impacts are expected during the life of mine:

Dewatering (water users in close proximity or downstream user): Analytical solutions and readily available groundwater data of the Witbank coalfields were used to calculate the possible drawdown after one year of opencast mining. The result of this is indicative and might vary to some extent in reality. A radius of influence of approximately 500 m was derived from this method using generic existing hydraulic conductivity and storativity values. This could have associated effects on existing adjacent water users.

Acid Mine Drainage (risk ABA): Studies undertaken indicated that the No. 2 coal seam could have a high acid generating potential. Geological core from the coal seam, interburden and overburden have been tested for acid base accounting and neutralisation potential. Results indicated that a low acid generating potential can be expected from the No. 4 coal seam and host rock. The banded sandstone indicated to have a medium neutralisation potential that will help neutralize the acid generation.

Post mining water management (flooding decanting and downstream impacts): High recharge values are expected through the back-filled areas and high hydraulic conductivity values can be expected from the spoils and waste rock. Surface and coal seam elevations indicate three possible decant points on site thus appropriate mitigation measures will have to be put in place to manage the water after mine closure. AMD could impact on the water quality while potentially negatively impacting on receiving water users. More in depth studies will have to be performed during the operational phase to determine the geochemical characteristics of the groundwater during and after mining has taken place.

Table 8: 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 of 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

The Environmental Significance is derived from the below mentioned variables:

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

Spatial Scope **(S)**

Duration of Impact **(D)**

Frequency of Activity **(Fa)**

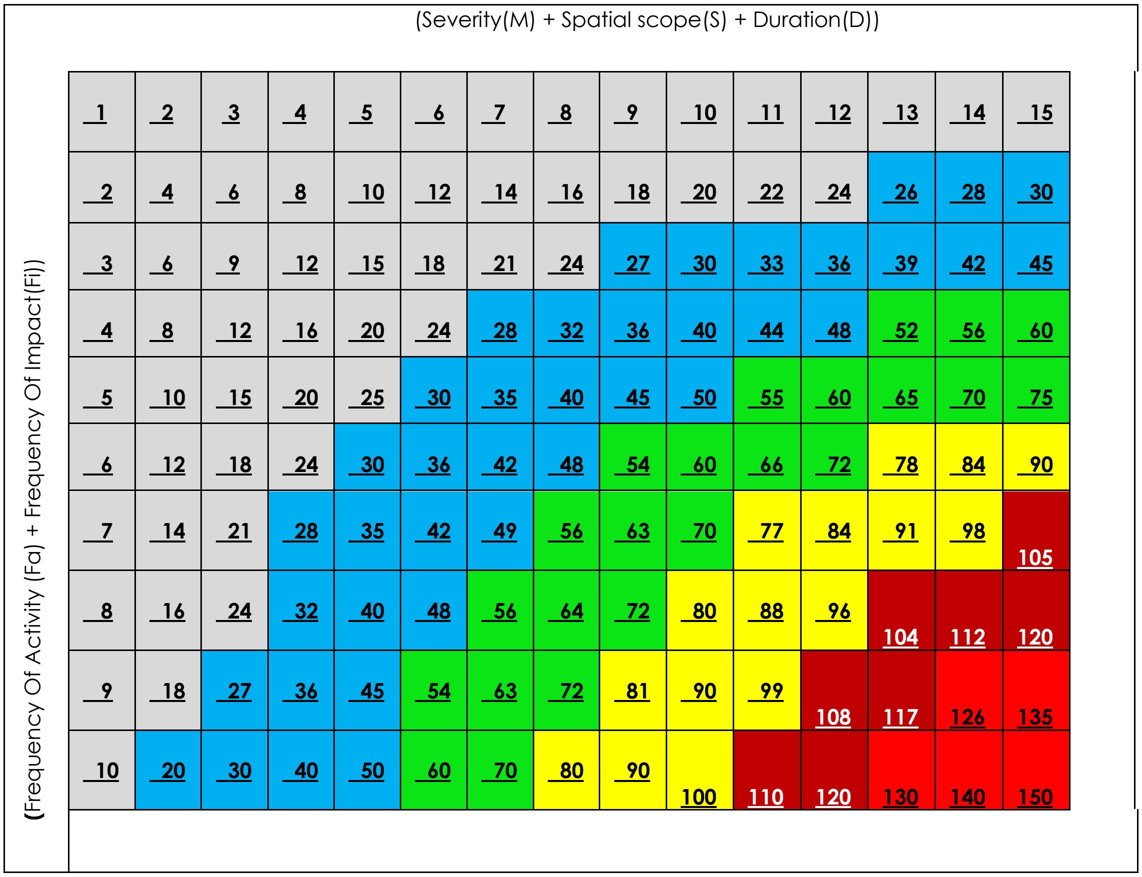
Frequency of Impact **(Fi)**

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

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

Significance Rating Matrix

Table 9: 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

Table 10: Impact assessment and mitigation measures table

	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
OPERATIONAL PHASE IMPACTS	Increased ground water 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 stock piles 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**	**3**	**2**	**2**	**24**	
	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 pollu	**2**	**1**	**3**	**2**	**1**	**18**	

							🟦	tion.							⬜
	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 baseflow contribution as before mining (hundred fold less).	**2**	**3**	**5**	**4**	**4**	**80**	🟨
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	**3**	**2**	**3**	**5**	**5**	**80**	🟨

🟩								🟨	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.							🟨
🟩	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 quality, boreholes should be mounted nearer to the decant points.	**3**	**3**	**4**	**5**	**4**	**90**	🟨

🟩	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**	🟨

The impact assessment was performed based on the available geological, geohydrological and mining information. The following sections describe the expected impacts to groundwater at the Notre Coal Project.

8.1 Construction phase

8.1.1 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 neighboring boreholes.

8.1.2 IMPACTS ON GROUNDWATER QUALITY

The operation of the fuel and lubricants storage facility has the potential for causing contamination of surface water due to infrastructure failure (emergency), leakage or spillages during normal operation. Included in normal operation is the potential for the incorrect disposal of spill absorbing material.

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.

8.1.3 GROUNDWATER MANAGEMENT

- All spillages will need to be cleaned up as soon as practically possible
- Proper management of stormwater drainage infrastructure should be ensured
- Vehicles and machinery will be maintained in good order to minimize leakages
- 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 a bunded areas which are watertight and able to contain 110% of the stored volume and
- All equipment utilizing hydrocarbons will be stored on a hard-standing surface

8.2 Operational phase

8.2.1 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 removal of vegetation during topsoil and overburden pre-stripping for haul road construction reduces the recharge of rainwater to aquifers due to increased run-off.

8.2.2 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.

8.2.3 IMPACTS ON SURFACE WATER

- Impact on water quality and erosion as a result of the pipeline breaking and spillage to non-perennial streams
- Pump failure will result in dirty water accumulation in the plant, 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 into the wetland
- High rate of ground water ingress causing flooding of the mine.
- The rainfall water within the designated dirty water area of the coal mine 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 as a result of crossings and diversions leading to siltation of the streams.

- Impacts on surface water resources quality as a result of incorrect waste management practices and pollution

8.2.4 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 minimize 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

8.3 Decommissioning phase

The quality of groundwater will be impacted upon by the coal mine. The coal mine might produce a seepage zone or decant as the recharge to opencast workings have increased by the disturbance of the strata. There are no large-scale groundwater users in the area but poor-quality groundwater emerging as seeps into the surface water environment can be seen as a negative, long-term impact.

8.4 Post-mining phase

8.4.1 GROUNDWATER QUALITY

The long-term water quality impact for coal mine is the generation of AMD water. The coal mine must be rehabilitated in such a way that recharge to the plant areas are limited to an absolute minimum. This would include shaping to allow surface water to drain away from the plant, compaction of materials, suitable soil cover and vegetation of the rehabilitated areas to intercept recharge. Water quality in the processing plants is not expected to be suitable for use and these areas will be sterilized in terms of available groundwater quantity.

8.4.2 CUMULATIVE IMPACTS

The cumulative impacts due to the mine could be of a quantitative and qualitative nature. The aquifers within the region are classified as major 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 taken into account for mining, agriculture and the remainder of the current surface and groundwater uses in the quaternary catchment.

8.5 Mine Decant

A major environmental problem relating to mining in many parts of the world is uncontrolled discharge of contaminated water (or decant) from abandoned mines (Banks et al., 1997, Pulles et al., 2005). Commonly known as acid mine drainage (AMD), there is wide acceptance that this phenomenon is responsible for costly environmental and socio-economic impacts.

Surface sources of AMD that present the greatest threat to the environment are coal discard dumps and slurry dams, gold tailings/slimes dams and waste rock dumps, and uranium slimes dams. Subsurface impacts are generally associated with water ingress (flooding) into underground mine workings, with the attendant threat of dewatering the source (and often pristine) groundwater regime and, in the post mining phase, providing a source of acid mine water for potential migration into the groundwater environment during rewatering (Banister et al., 2002).

Possible sources of Mine decant:

- Exposed diggings/ mine working which could collect water during rainy seasons.
- Non-maintained sewage systems of which leaks could mix with freshwater bodies.
- Created voids during mining which act as a preferential flow for groundwater towards the surface.

Mitigation measures of mine decant:

- Once an area has been mined out, methods such as resistivity or seismic methods should be used to clearly identify fracture, voids, or openings, of which such opening can be closed.
- Post mining, there should be monitoring of the groundwater using software to clearly understand future water volumes, direction, and possible paths.

9 GROUNDWATER MANAGEMENT PLAN

9.1 Proposed Actions

9.1.1 Operational Phase

- 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 minimize 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 equipment utilizing 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

9.1.2 Post-Closure Phase

- Post mining, there should be rehabilitation which includes but not limited to vegetation and removal of hard standing surfaces.
- There should be frequent monitoring until such time the cumulative impacts of the mining activity are no longer visible
- The stockpile or overburden post mining phase, it should be disposed of from that area or used to fill the voids used by the mining activities.
- The wastewater should be treated and then returned to the environment in the best quality as practically possible.

9.2 AMD Treatment Plan

Acid mine drainage (AMD) forms when sulphide minerals are exposed to oxidizing conditions in coal and metal mining, highway construction, and other large-scale excavations. There are many types of sulphide minerals. Iron sulphides common in coal regions are predominately pyrite and marcasite (FeS2).

9.2.1 Site Characterisation and Field Work

9.2.2 Risk-Based AMD Assessment

To ascertain which factors may impact on environmentally sensitive receptors and which may require on-going management. A risk assessment was undertaken in accordance with the Risk Management Standard. The hierarchy of risk controls considered are:

- **Elimination**: stop using the equipment or stop undertaking the procedure/activity causing the risk (e.g., comprehensive surface /ground water management plan).
- **Substitution**: use an alternative substance, equipment or process which poses less risk (e.g., implement different more technologically driven excavations to recover resources and differentiate PAF materials).
- **Isolation:** separate receivers from the source of the risk (e.g., implement compaction and ground sealing activities to prevent surface water percolation).
- **Engineering controls**: reduce exposure to the risk by making physical changes to equipment, procedures, or the work environment (e.g., installing equipment in areas with low risk of acidity and/or alkalinity).
- **Change work practices**: adopt work procedures which minimize exposure to the risk (e.g., where feasible zone and preserve areas with high PAF risk).

Table 11: Risk likelihood Classification (Hendry Alison, 2016)

Level	**Likelihood**	**Description**	**Criteria**
A	Rare	Practically impossible, will only occur in exceptional circum-stances. Has never occurred in the industry.	0-1%
B	Unlikely	Could occur at some time but highly unlikely. Has occurred in the industry previously.	1-10%
C	moderate	Might occur at some time. Has occurred in associated companies previously.	11-50%
D	Likely	Known to occur or will probably occur in most circum-stances. Has occurred several times/year in associated companies.	51-90%
E	Almost certain	Common or repeating occurrence. Is expected to occur several times/year in any associated business.	91-100%

Table 12: Risk Consequence Classification (Hendry Alison, 2016)

Level	**Consequence**	**Description**
1	Insignificant	No measurable impact on the environment. No injuries. Low financial loss.
2	Minor	Minor, temporary environmental impact. No publicity likely and no stakeholder concerns. First aid treatment required. Medium-low financial loss.

3	moderate	Substantial temporary or permanent minor localized environmental damage. Stakeholder enquires (this may include government, unions or public). Medical attention required. High-medium financial loss.
4	Major	Substantial or permanent environmental damage. Prosecution possible. Loss of company credibility and high stakeholder interest. Permanent injuries. High financial loss.
5	Catastrophic	Widespread severe and permanent environmental damage. Major stakeholder and media interest. Prosecution likely. Permanent injury or death. Extreme financial loss

Table 13: Risk assessment matrix for the AMD assessment (Hendry Alison, 2016)

		consequences				
		1	**2**	3	4	5
Likelihood		**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
E	Almost Certain	11	16	20	23	25
D	Likely	7	12	17	21	24
C	Probable	4	8	13	18	22
B	Unlikely	2	5	9	14	19
A	Rare	1	3	6	10	15
🟥	Extreme risk, intolerable					
🟧	High risk, intolerable					
🟨	Medium risk, intolerable					
🟩	Low risk, acceptable					

9.2.3 PREVENTION

- Sealing or flooding of mine workings
- Reclamation of contaminated land by adding lime or other alkaline materials to neutralize the acidity, and adding uncontaminated topsoil, planting vegetation, and modifying slopes to stabilize the soil and reduce infiltration of surface water into underlying contaminated material
- Soil removal to relocate contaminated material to new sites where it can be monitored and treated

- Direct treatment of the contaminated water, either through treatment plants (where lime or other neutralizing materials are added to reduce the acidity, which causes metals to precipitate out of the contaminated water) or artificial wetlands (which help sequester contaminated material in place, and where microbial action produces oxygen-free conditions to help prevent further sulfuric acid formation).

- Filling in abandoned mines with materials that will prevent the formation of AMD. This can include flooding the mines with water to remove the oxygen necessary to form AMD or filling in mines with alkaline materials to prevent the formation of acidic water.
- Relocation and isolation of mine waste that may produce AMD if allowed to react with water. This often involves isolating the waste from interaction with groundwater by moving the waste above the water table, treating it, and covering it with a layer of impermeable material to keep out surface water
- Bacteria control – certain common bacteria substantially speed up the formation of AMD. Some efforts to prevent AMD involve the use of bactericides to kill these bacteria, or the addition of organic waste to provide an alternative energy source for some of these bacteria and produce oxygen-free conditions that prevent the formation of sulfuric acid

- Diverting water from the mine site to prevent it from running through AMD-forming materials
- Disposing mine waste underwater to prevent exposure to oxygen.

9.2.4 TREATMENT

Treatment Methods AMD treatment are classified as “passive” or “active,” both potentially combining physical, chemical, and biological approaches. Active treatment methods are more reliable and are typically less costly than passive systems, but they require more maintenance and capital-intensive operations.

Ph Control

pH control is a commonly used AMD treatment method. It increases the pH level to prevent the leaching of most metals. This method can also reduce the solubility of most metals by precipitation.

De-Carbonation

The de-carbonation process is the first step in the flowsheet preparation of acid mine drainage systems. It involves removing CO_2 from the waste stream. Aerators are commonly used to reduce CO_2. They work by agitating the water below the tank, which results in the release of oxygen or nitrogen. A high concentration of CO_2 can cause aerators to retain hydraulics for a long time, which can help remove the CO_2.

Iron-Reaction Aeration

The flow exiting the de-carbonation tank splits through two troughs. It continues through the other side of the de-carbonation tank. The final step in the iron-reaction process is the distribution of the chemical. As iron goes from being in the reaction tank to being in the ferric hydroxide, it changes state. The blue/green water in the left tank is the de-carbonation stage. This water then travels to the reaction tanks and displays the different states of iron.

High-Density Sludge Process

The water then flows back into the iron-reaction tanks through the recirculation of the thickener. This process, known as the high-density sludge, is different from the traditional method. The underflow solids contain lime. By recirculating them, the recirculating particles can get more time to react with the lime, allowing the whole process to use all the lime. Also, by introducing the lime, the recirculating particles can coat the outside of the tank, making the iron particles larger and denser. reduce the solubility of most metals by precipitation.

9.2.5 AMD MANAGEMENT PLAN

AMD Monitoring

AMD monitoring provides feedback to confirm that the design and operational controls are effective for their stated aim. In that regard, the following will be monitored:

- Tailings and waste rock (including ore) to validate the existing geochemical classifications and to provide an historic inventory for site archives and legacy management.
- Sources and use of construction materials; and
- Water (surface water and groundwater).

Geochemical Monitoring

Visual Methods, the Site Manager or delegate will undertake weekly inspections of waste rock/ore management and water management structures to ensure their integrity. The site Manager or delegate will also inspect to ensure that no PAF material has been won from the engineered landforms for use in construction.

Records will be kept and photographic evidence of any management inconsistencies and structural integrity failing captured, with the Mine Manager notified for action. Examples include evidence of erosion and sediment transport downslope after a storm event, poorly maintained sediment traps, or a ruptured run-on bund. This is applicable to historic and future mineral waste and water management structures.

Laboratory Analysis

Following visual inspection, a subset of the development waste and tailings samples will be forwarded to a SANS accredited laboratory to be analysed for:

- Acid base accounting.
- Metals.

Further details of this laboratory based analytical program will be provided in a supplemental geochemical sampling and analysis procedure.

10 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.

10.1 Groundwater monitoring system

10.1.1. 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.

10.2 Sampling Methods and Preservation

Required apparatus:

- Plastic bottles (1L)
- Glass bottles
- Dip meter
- Steel bailer
- Cooler box

- EC and Ph meter
- Marking pens

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

10.3 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.

10.4 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.

10.5 Monitoring parameters

Table 14: Monitoring Parameters

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.
Chemical	Major chemical parameters: Ca, Mg, Na, K, NO3, SO4, Cl, Fe, Alkalinity, pH, EC TPH (Total Petroleum	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.

	Hydrocarbons)		
	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)

10.6 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 right conditions

11 CONCLUSION AND RECOMMENDATION

11.1 Conclusion and Summary

- Current land use practices are restricted to agricultural activities, which include livestock and small-scale maize production.
- Borehole yields from the aquifers are low and no major groundwater development is expected.
- Water levels are generally shallow and follow the surface topography. Therefore, groundwater will flow from highest to lowest elevation, in the direction of surface water drainage.
- Potential implications of incorrectly assigning the diffusion for a contaminant transport model, can lead to wrong interpretations of the model, you can miss the pathway of the contaminant.

11.2 Recommendations

Aspect	Recommendation
Monitoring	❖ Conduct water monitoring and implement remedial actions as required and effective rehabilitation to as close to pre-processing conditions as practically possible. ❖ It is recommended that the monitoring network be extended to all the boundaries; north, south, east and west of the proposed coal mine. The construction must be overseen by a qualified Hydrogeologist to monitor pollution in the upper weathered aquifer as well as the lower fractured aquifer. ❖ A monitoring network should be dynamic. This means that the network should be extended over time to accommodate the migration of contaminants through the aquifer as well as the expansion of infrastructure and/or addition of possible pollution sources. An audit on the monitoring network should be conducted annually
Modelling	❖ 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
Water contamination	❖ Prevention of pollution of surface water resources and impacts on other surface water users by training of workers to prevent pollution, equipment and vehicle maintenance, fast and effective clean-up of spills, effective waste management, manage clean and dirty water in accordance

Flow of water	❖ The disturbance of streams and surface drainage patterns and reduction in flow to downstream must be mitigated through careful design of ephemeral stream diversion that minimizes impacts on the downstream environment, limit activities and infrastructure within wetland and watercourses and their floodlines and implementation of storm water management plan to divert clean water ❖ Clean water trenches should be constructed surrounding the coal mine to prevent clean water from entering the coal mine area, regarded as a dirty water catchment ❖ Dirty water trenches must be constructed as well to direct water from the mine to the pollution control dam, thereby preventing any contaminant water from leaving the mine area.
Water use license	❖ For the industrial use portion though, water use must be registered and in terms of the abstraction, a water use license may be required. All water users instructed to register have the statutory obligation to do so. There are strict penalties, prescribed in the Act, for those who do not comply. In future, when water users are required to apply for licences, those who did not register will lower their chances of getting a licence to use water.

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APPENDICES

Appendix A: Specialist's qualifications

Available upon request

MINING RIGHT APPLICATION

HYDROLOGICAL STUDY

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Hydrological study for the proposed Mining Right Application for Notre Coal on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa.

NOTRE Coal

DMRE REF: MP 30/5/1/2/2/10384 MR

Report Credentials.

Disclaimer	**The opinion expressed in this and associated reports are based on the information provided by Notre Coal ("Singo Consulting") and is specific to the scope of work agreed with Notre Coal. Singo Consulting acts as an advisor to the Notre Coal 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 Notre Coal 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	**Hydrological Study for a mining right application**
Project title	Hydrological Study for the proposed mining right application for Notre Coal on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province.
Mineral (s)	Coal resources
Client	Notre Coal
Site location	Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province.
Version	1
Date	20 October 2022

Electronic signatures

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Final review and approval	Dr. Kenneth Singo (Principal Consultant of Singo Consulting (Pty) Ltd)

Table 1: Critical Report Information

Critical Information incorporated within the Hydrological 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, P: 51
Project Background Information, including the proposed activities description	Introduction, P: 9
An indication of the scope of, and the purpose for which, the report was prepared	Scope of work, P: 10-11
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	Impact assessment rating and mitigation measures, P: 40
The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Project details, P: 3
A description of the methodology implemented in preparing the report or carrying out the specialised process comprehensive of equipment and modelling used;	Methodology and data sources, P: 35
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	Buffer zone, P: 25
A map overlaying the proposed activity including the associated infrastructures on the environmental sensitivities of the site including containing buffer zones	Buffer zone, P: 25
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Surface water impact assessment, P: 43
Any mitigation and conditions measures for inclusion in the EMPr	Stormwater management plan, P: 46
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Monitoring plans, P: 51
An analytic opinion as to whether the proposed activity or portions thereof should be Authorised-i.e. specific recommendations	Recommendation, P: 53
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	
A description of any consultation process that was undertaken during carrying out the study	Refer to bar
Any triggered Water Uses according to section 21 of the National Water Act 36, 1998.	Legal framework, P: 14
Any other information requested by the competent authority.	N/A

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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 fs surface water sources are 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

Notre Coal has appointed Singo Consulting (Pty) Ltd as an independent consulting company to conduct a hydrological study. The hydrological study is being conducted in support of a mining right application for coal resources on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province.

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 groundwater and its related potential impacts

Proposed infrastructures on site within the mining right 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 stockpile area

The surface water study includes a 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 and groundwater within and around the mining right 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

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 a crusher

Operational phase:

- Movement of machinery
- Stripping of overburden

Decommission and Rehabilitation Phase:

- Movement of machinery
- Removal of infrastructures

1.3 Scope of Work

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

Phase 1:

- Information sourcing / literature review (Desktop Study):
    - 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
  - Aerial imagery of the world map (Google earth).

- Collection and revision of relevant information
- Description of the surface water regime:

  - Identification of monitoring surface water bodies during which hydrological data will be recorded.
  - Laboratory testing of samples for physical, chemical, and biological parameters

Phase 2:

- Site visit
  - Site assessment (better understanding of site) and sampling
- 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 locality map created by the QGIS illustrates the location of the proposed area The project area is situated on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province. The project area as seen on Figure 1 is indicated by a red polygon and is situated approximately 18,3 km Southwest of Piet Retief, approximately 1.1km east of Etshondo Primary School, approximately 3.4 km southwest of Röhrs Farm Guesthouse, approximately 3.8 km southeast from Inkululeko Primary School, approximately 6 km southeast of Matafuleni Community, and approximately 8.5 km southeast of Ngema Tribal Trust.

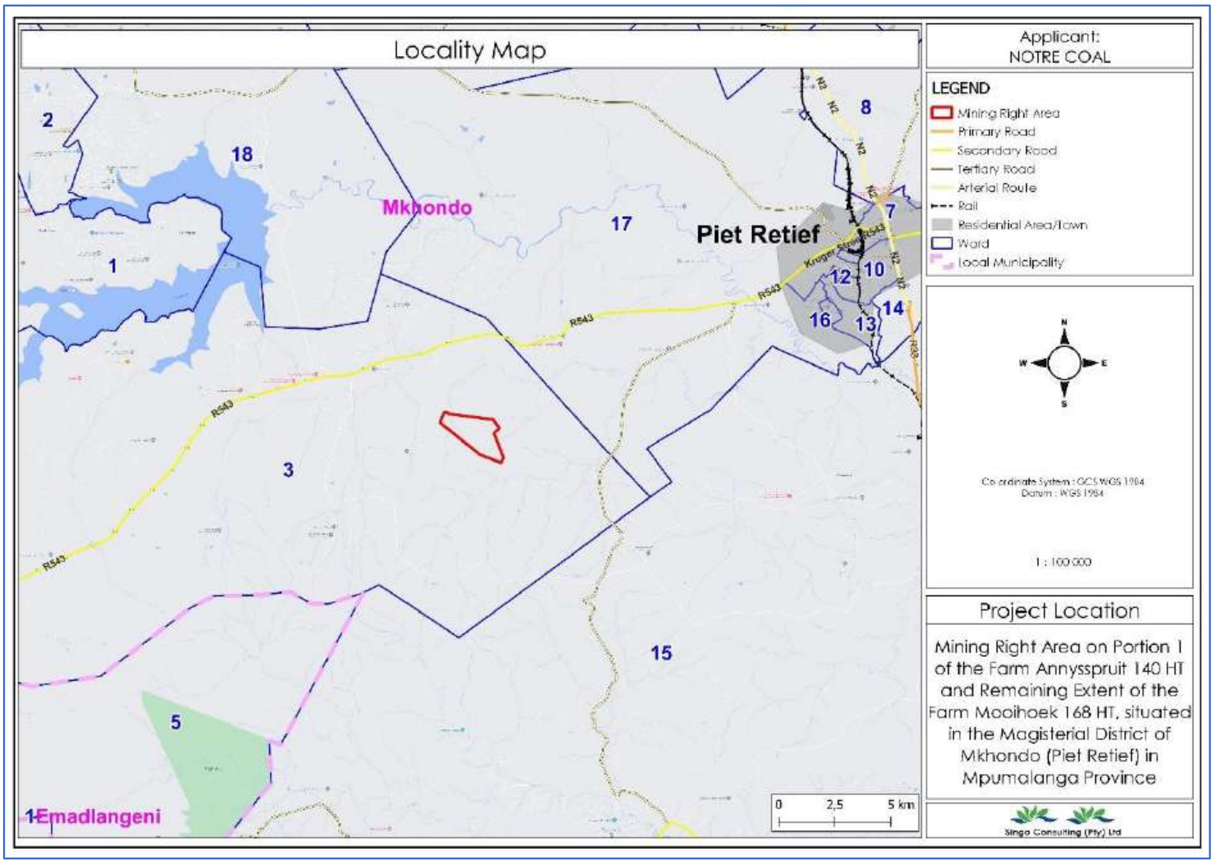


Figure 1: Locality map of the project area

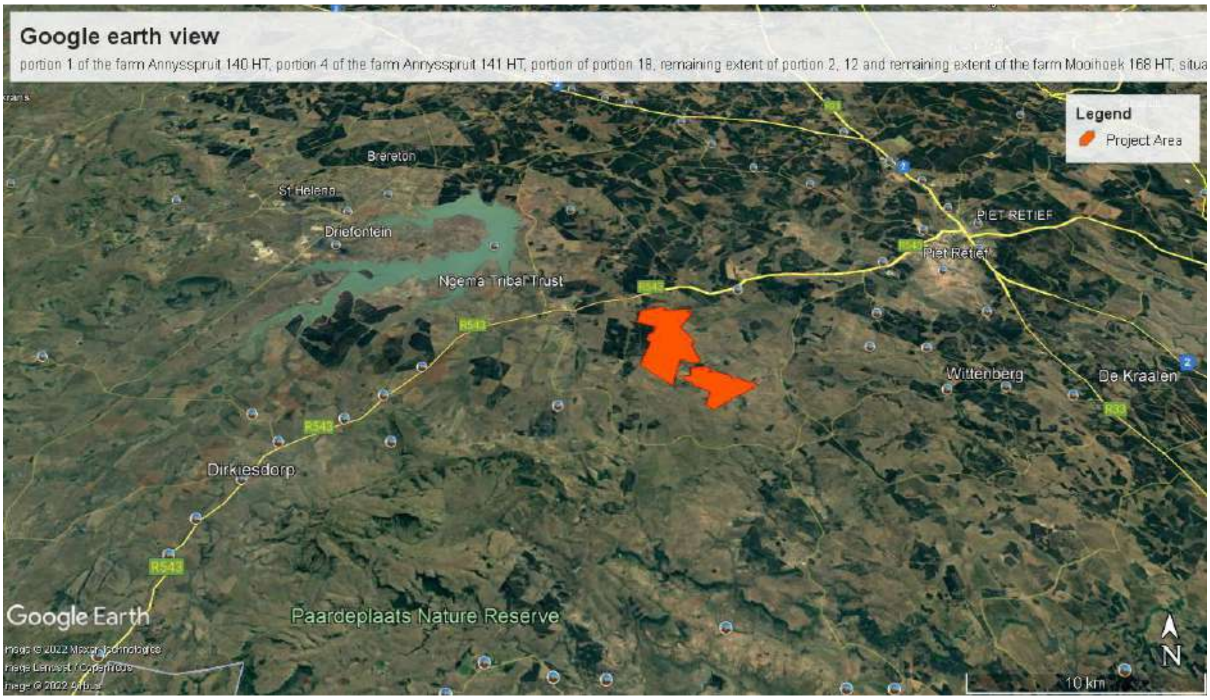


Figure 2: Google earth view of the mining right area

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.
- **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

3. HYDROLOGICAL SETTING AND BASELINE HYDROLOGY

3.1 Climate

In Mkhondo, temperature varies over the course of the year typically from 4°celsius to 26°celsius (refer to Figure 3). The warm seasons, from November 11 to March 13 the area has an average daily temperature above 24°celsius, with January being the hottest months of the year with an average high temperature of 26°celsius and low temperature of 15°celsius. The coldest months of the year are June and July with an average High temperature of 19°celsius and a low temperature of 4°celsius.

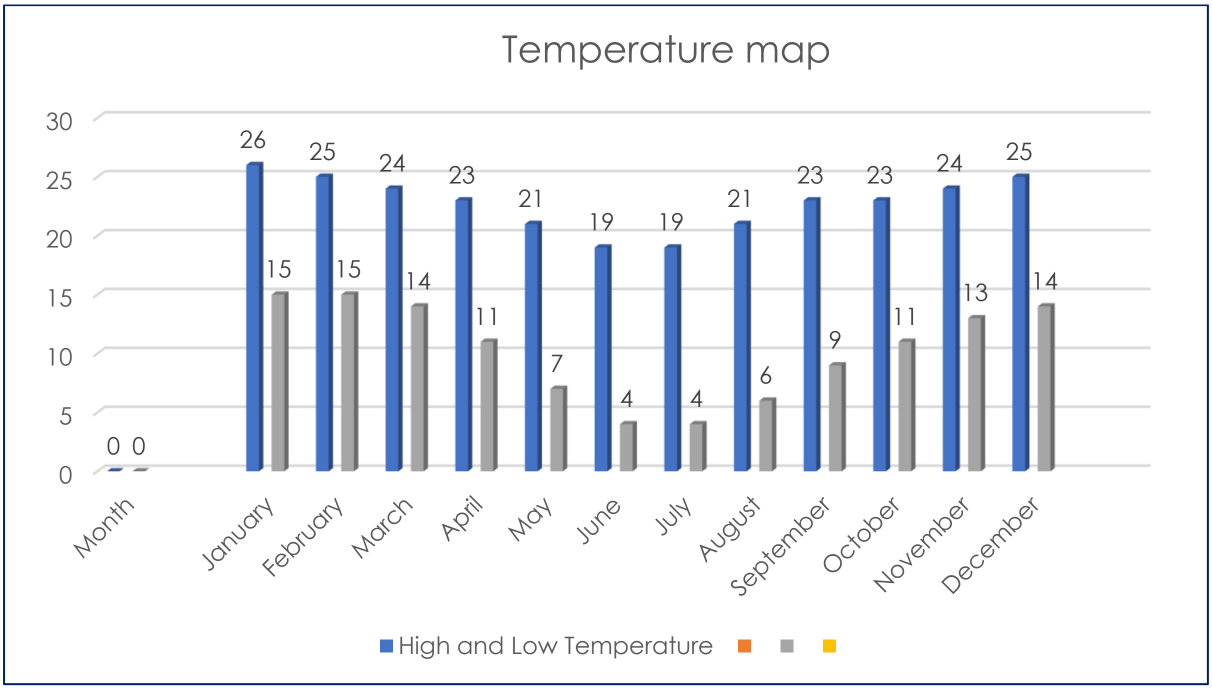


Figure 3: Temperature map of Piet Retief. Source https://en.climate-data.org/africa/south-africa/mpumalanga/piet-retief-12657/

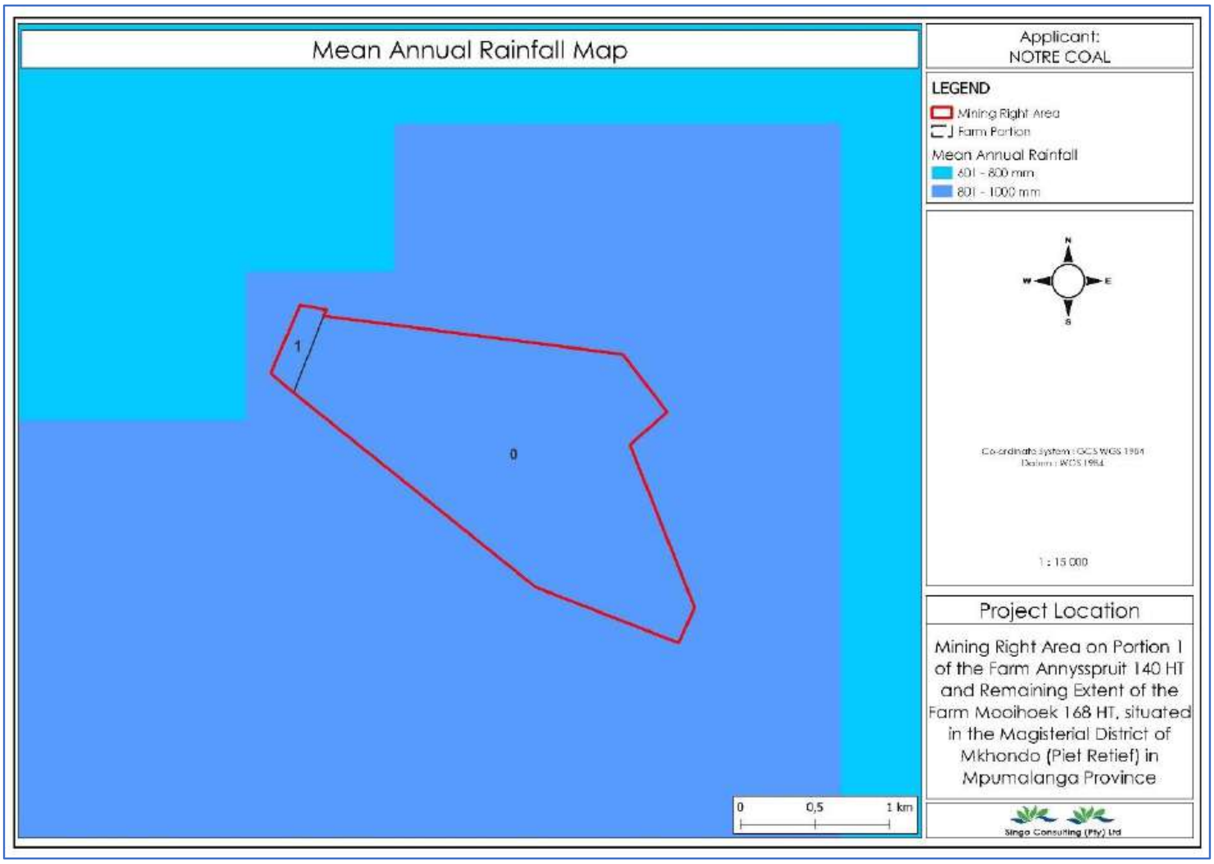


Figure 4: Mean annual rainfall map

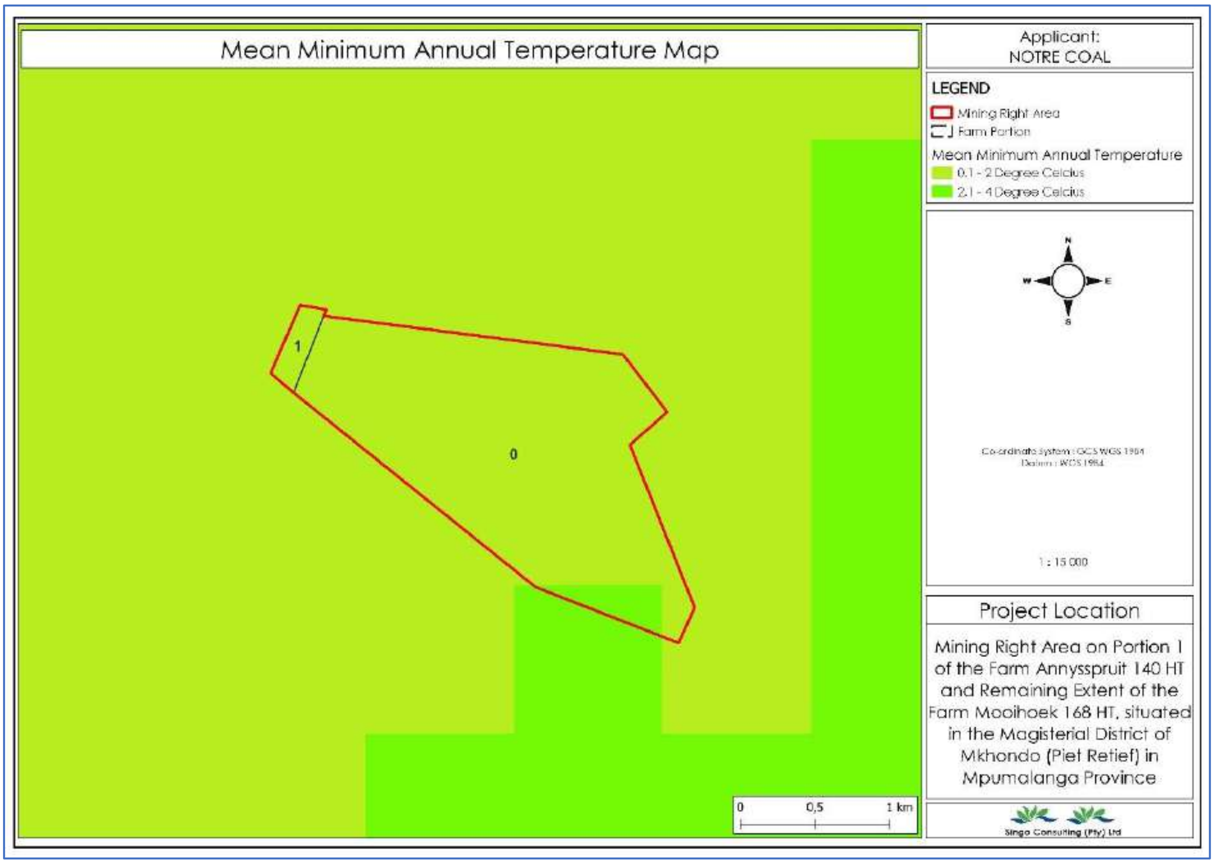


Figure 5: Mean minimum annual temperature map

3.2 Drainage and Topography

Topography is a field of geoscience and planetary science and is concerned with local detail in general, including not only relief but also natural and artificial features, and even local history and culture. The flow of water during rainy seasons flows from the area of high elevation to the area of low elevation.

The Figure 6: Hydrology and Topology map indicates the following waterbodies exists within and nearby the project area:

- Perennial river.
- Non-perennial river.
- Channelled valley bottom wetland.
- Seep wetland.
- Dam

Within the remaining extent of portion 12 of the farm Mooihoek 168 HT, the flow of water is from the north moving towards the southern direction. A small dam is situated on the southern side of the farm and has a dam wall on the northern side, to control the flow of water.

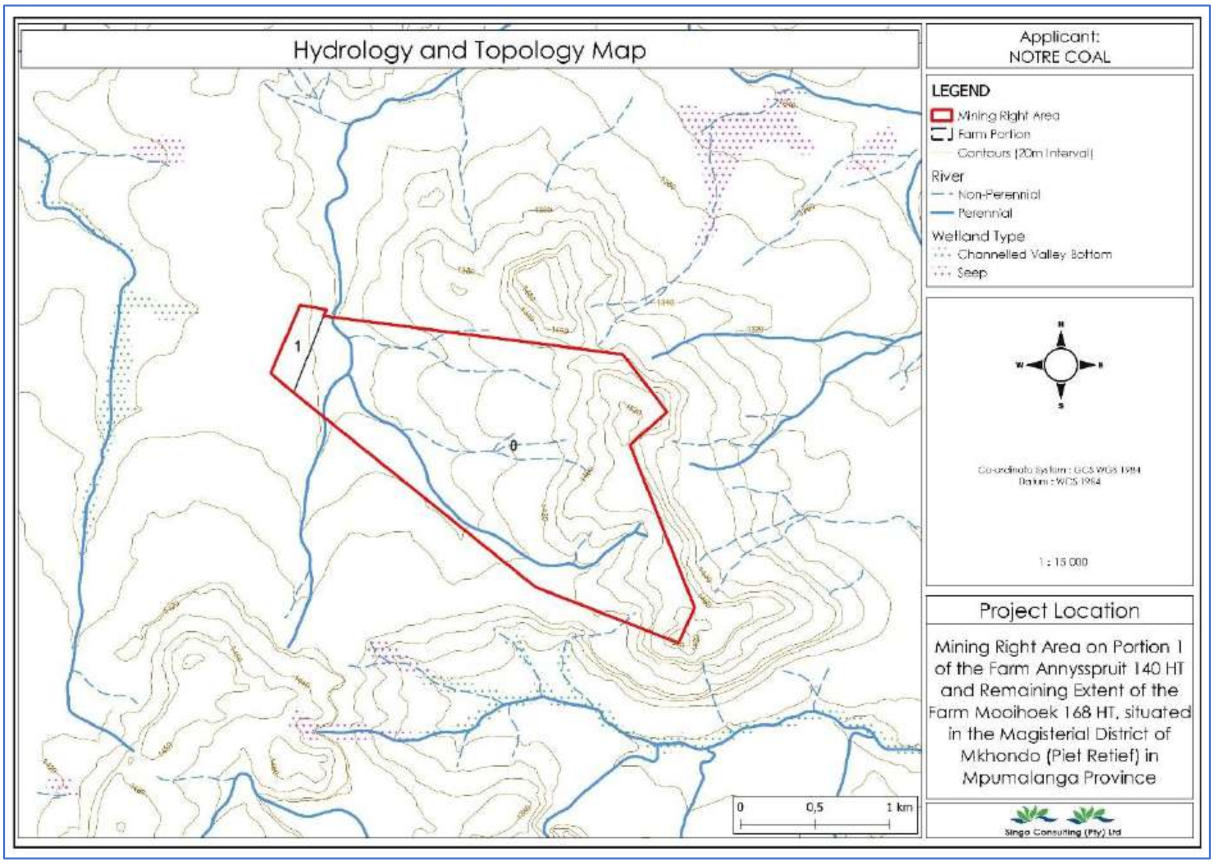


Figure 6: Hydrology and Topology map

There will be procedures and guidelines put in place for this project to avoid the risk of water contamination through nearby wetlands, and the perennial river, such as ensuring strict management of waste material and buffering of 100 m. It will be advised on more mitigation measures to ensure the waterbodies as seen on the hydrology map are not contaminated. As shown in Figure 7, a 100m buffer will be applied around the water bodies present within the mining right area.

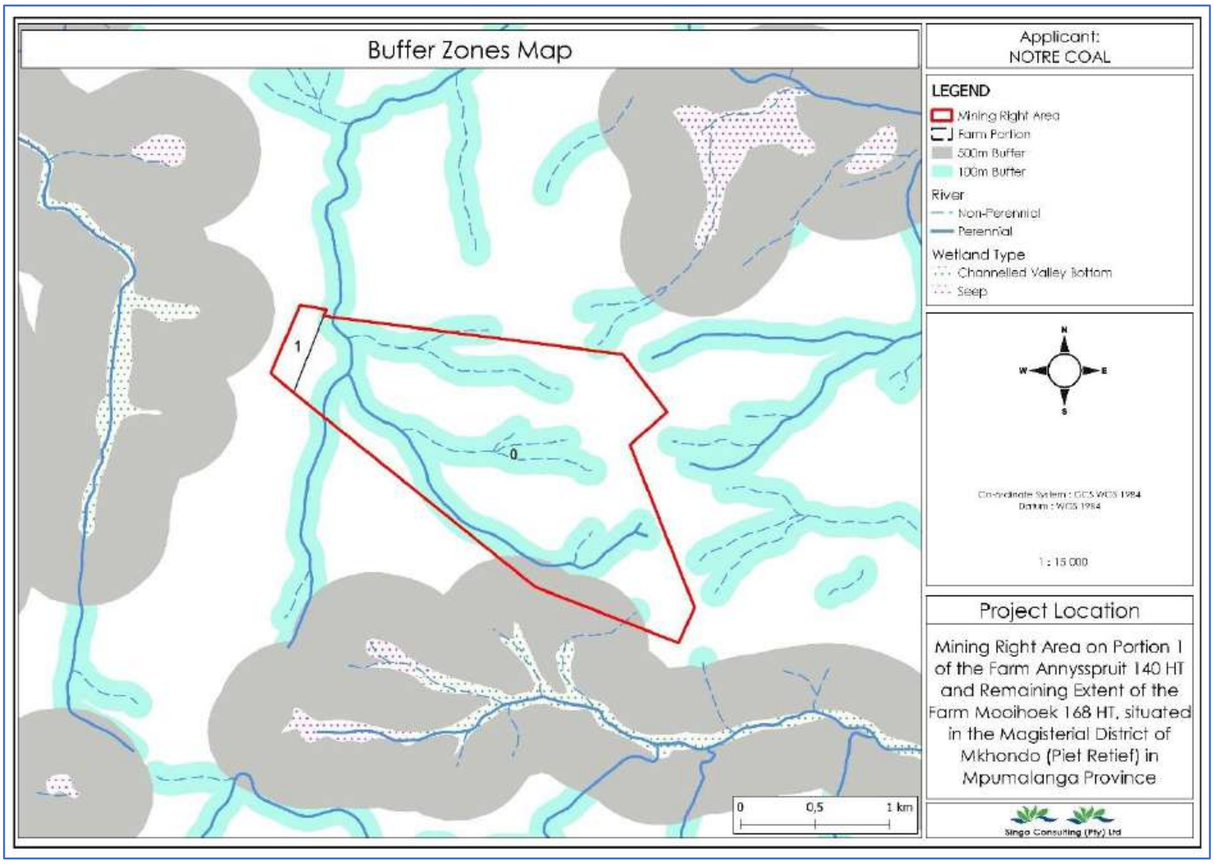


Figure 7: Buffer map

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). 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 prospecting area falls within the Inkomati-Usuthu Water Management Area (WMA). The quaternary catchment is the W51C. The WRC 2012 study, presents hydrological parameters for each quaternary catchment including area, mean annual precipitation (MAP) and mean annual runoff (MAR).

Table 2: Quaternary information data

Quaternary Catchment	Water Management Area	Catchment Area	S-Pan Evaporation		Rainfall	
			Evaporation Zone	MAE (mm)	Rainfall Zone	MAP (mm)
W51C	Inkomati-Usuthu	678	13A	1400	W5A	903

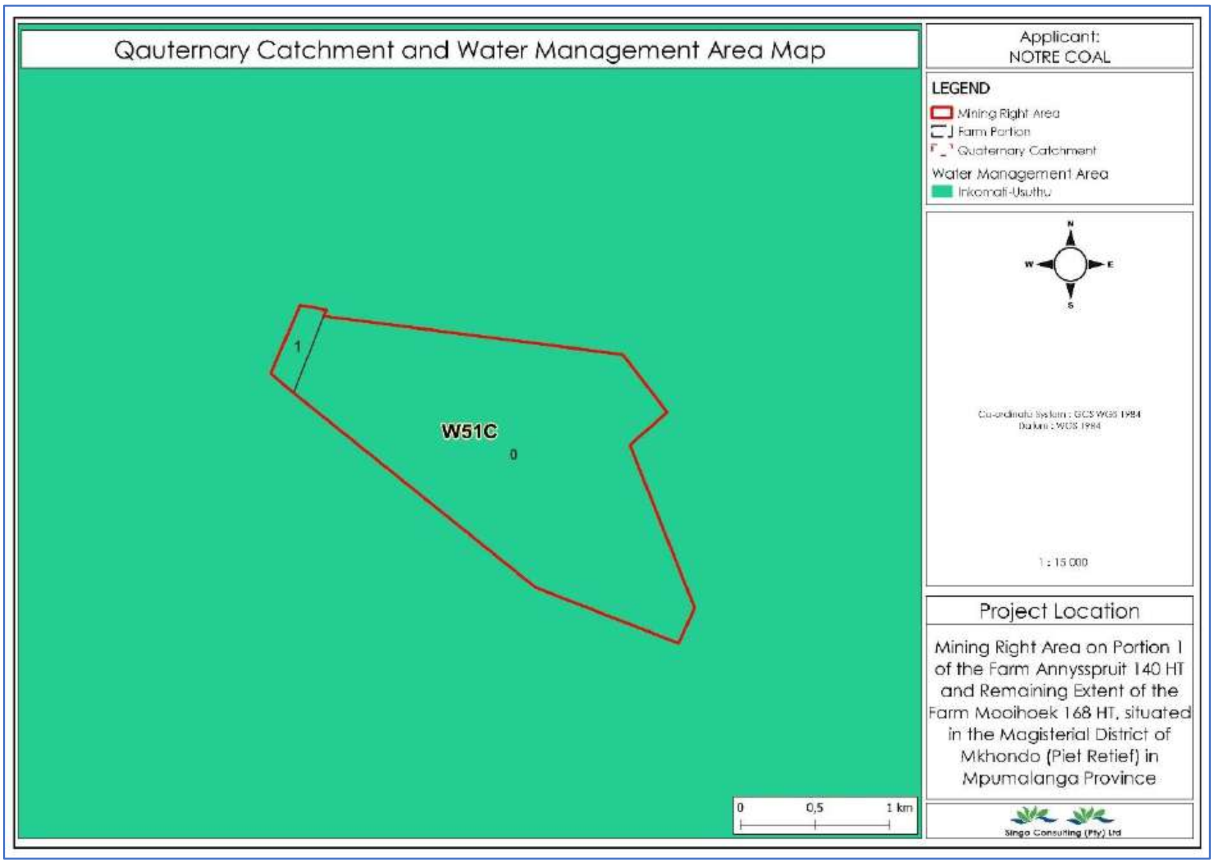


Figure 8: Quaternary catchment and water management area map

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**.
- 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).

To this study, redoxymorphic indicator will be used to delineate a wetland, this is because it is the most reliable, diagnostic indicator of wetland. These features develop due to prolonged saturation (and associated anaerobic conditions) and can be used to indicate zones of a permanently, seasonally, or temporarily high-water table, as described in the characteristics of the permanent, seasonal, and temporary wetland zones in the national water Act 36 of 1998.

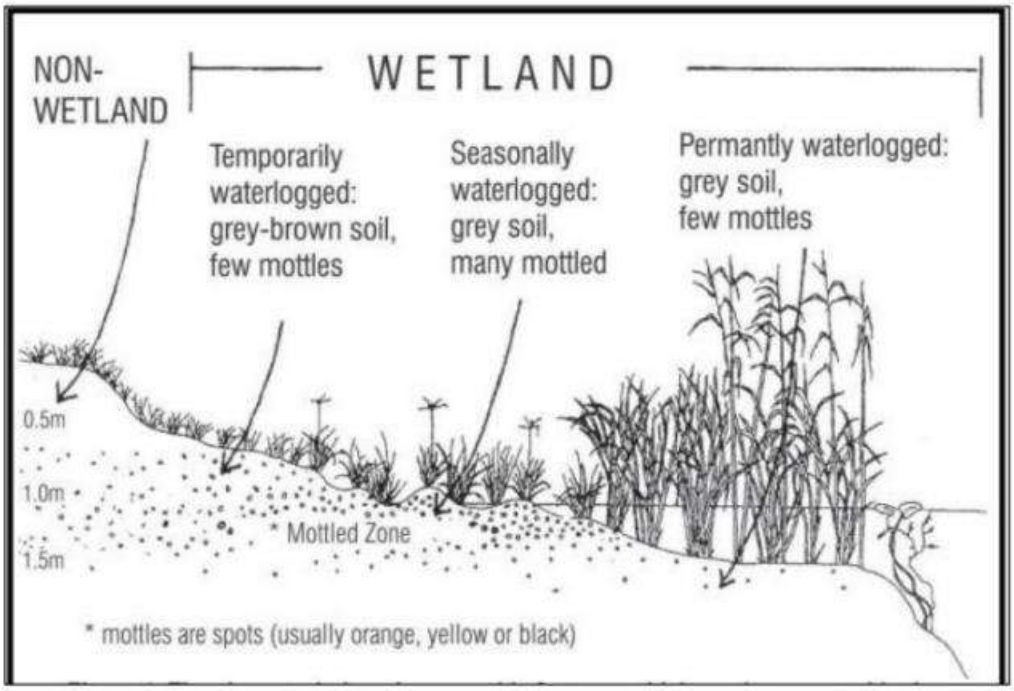


Figure 9: The characteristics of redoxymorphic indicator (DWAF, 2008)

Redoxymorphic features as an indicator of a wetland presence:

Water is the most important criterion for defining land as a wetland, with "the water table at or near the surface, or the ground is occasionally covered with shallow water" being the most important. Unfortunately, due to southern Africa's very fluctuating climate, the water table may not always remain at or near the surface in a consistent, predictable manner year after year, or even seasonally predictable. The existence of the water table (or the extent of flooding) will not always be a highly useful criteria for detecting wetlands due to intra- and inter-annual fluctuations in the extent of saturation/inundation of wetlands. As a result, the fundamental wetlands classification criterion – a high water table and/or frequent flooding – cannot be accurately measured.

Roots and microorganisms eventually deplete the oxygen contained in pore spaces in soil that has been saturated for an extended period. The oxygen consumed in this fashion would be replaced by diffusion from the air at the soil surface in an unsaturated soil. However, because oxygen diffuses 10 000 times slower via water than it does through air, restoring depleted soil oxygen in a saturated soil takes much longer. As a result, once the oxygen in a saturated soil is gone, the soil becomes practically anaerobic. Long-term anaerobic soil conditions cause changes in the chemical properties of the soil's mineral constituents, which are visible as colour changes in the soil. As a result, even a high-water table. Although the frequency of flooding cannot be directly assessed, it is possible to analyse soil parameters for signs of saturation by looking for redoxymorphic traits that come from prolonged anaerobic conditions. The two important redoxymorphic features are mottling and gleying Figure 10 and Figure 11 respectively; both features caused by prolonged saturated conditions in the soil and the subsequent development of anaerobic conditions.

Gleying is characterised by the development of grey or blueish-grey colours in the mineral soil component. Certain soil components, such as iron and manganese, are insoluble under aerobic conditions. Iron is one of the most abundant elements in soils, and the iron oxide (rust) coatings over soil particles is responsible for the red and brown colours of many soils. However, under prolonged anaerobic conditions iron becomes soluble and can thus be dissolved out of the soil profile. Once most of the iron has been dissolved out of a soil, the soil matrix is left a greyish, greenish, or bluish colour, and is said to be Gleyed.

Mottling follows the same initial process as gleying, in that the iron becomes soluble and dissolved under anaerobic conditions. A fluctuating water table, common in wetlands that are seasonally or temporarily saturated, results in alternation between aerobic and anaerobic conditions in the soil. Lowering of the water table results in a switch from anaerobic to aerobic soil conditions, causing dissolved iron to return to an insoluble state and be deposited in the form of patches, or mottles, in the soil. Recurrence of this cycle of wetting and drying over many decades concentrates these bright (orange or red) insoluble iron compounds. Thus, soil that is Gleyed but has many mottles may be interpreted as indicating a zone that is seasonally or temporarily saturated.

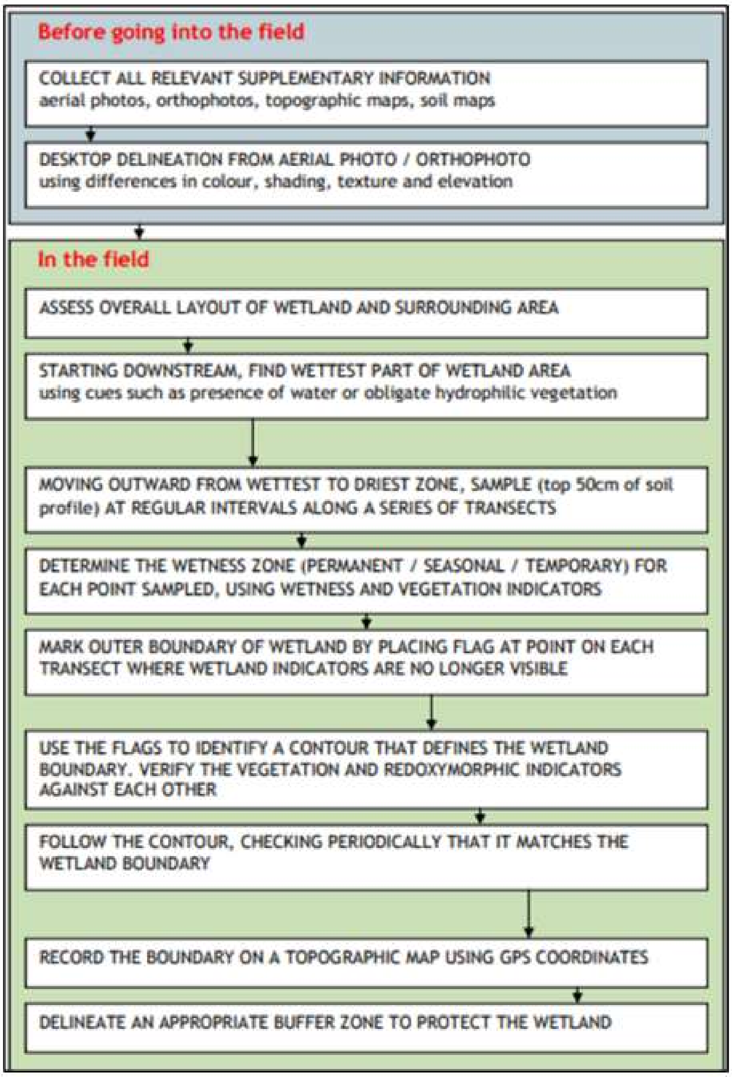
Figure 10: dentification of mottles (Source: redoxymorphic feature Mottling - Bing images)

Figure 11: Identification of greying (Source: redoxymorphic feature Mottling - Bing images)

Using redoxymorphic features to identify a wetland.

The outer edge of the temporary zone of the wetland should be determined. This should be done using a transect-based approach in the field.

Starting from the wettest (central or lowest lying) part of the wetland, move perpendicularly upslope towards the surrounding terrestrial areas, sampling (with the aid of an auger or through other excavation means) the soil to a depth of at least 50cm. Note the presence of any gleying or mottling (Rountree et al., 2008). Ensure that the indicators observed meet the requirements prescribed for the redoxymorphic indicators of wetland soils. Continue moving outwards from the wetland until the redoxymorphic indicators of wetland soils can no longer be found within the top 50cm of the soil. This will be the outer edge of the temporary wetland zone. At this stage the boundary indicated by redoxymorphic features should be verified using the vegetation indicators.



Before going into the field

COLLECT ALL RELEVANT SUPPLEMENTARY INFORMATION
aerial photos, orthophotos, topographic maps, soil maps

DESKTOP DELINEATION FROM AERIAL PHOTO / ORTHOPHOTO
using differences in colour, shading, texture and elevation

In the field

ASSESS OVERALL LAYOUT OF WETLAND AND SURROUNDING AREA

STARTING DOWNSTREAM, FIND WETTEST PART OF WETLAND AREA
using cues such as presence of water or obligate hydrophilic vegetation

MOVING OUTWARD FROM WETTEST TO DRIEST ZONE, SAMPLE (top 50cm of soil profile) AT REGULAR INTERVALS ALONG A SERIES OF TRANSECTS

DETERMINE THE WETNESS ZONE (PERMANENT / SEASONAL / TEMPORARY) FOR EACH POINT SAMPLED, USING WETNESS AND VEGETATION INDICATORS

MARK OUTER BOUNDARY OF WETLAND BY PLACING FLAG AT POINT ON EACH TRANSECT WHERE WETLAND INDICATORS ARE NO LONGER VISIBLE

USE THE FLAGS TO IDENTIFY A CONTOUR THAT DEFINES THE WETLAND BOUNDARY. VERIFY THE VEGETATION AND REDOXYMORPHIC INDICATORS AGAINST EACH OTHER

FOLLOW THE CONTOUR, CHECKING PERIODICALLY THAT IT MATCHES THE WETLAND BOUNDARY

RECORD THE BOUNDARY ON A TOPOGRAPHIC MAP USING GPS COORDINATES

DELINEATE AN APPROPRIATE BUFFER ZONE TO PROTECT THE WETLAND

Figure 12: Wetland delineation process (DWAF, 2008)

3.5 Soil

The Figure 13: Soil class map below, indicates that the project area is covered by **freely drained, structureless soils, Association of classes 1 to 4: undifferentiated structureless soils and the Association of classes 13 and 16: Undifferentiated shallow soils and land classes**

<u>Freely drained, structureless soils and Association of classes 1 to 4: Undifferentiated structureless soils</u>

These soils can be defined based on their **soil depth, soil drainage, erodibility, and natural fertility**.

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, though, 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.

Natural Fertility

Soil fertility refers to the ability of soil to sustain agricultural plant growth, i.e., to provide plant habitat and result in sustained and consistent yields of high quality. The soil, as a nature of them, contains some nutrients which is known as 'inherent fertility'. Among the plant nutrients, nitrogen, phosphorus, and potassium is essential for the normal growth and yield of crop. The proposed area has a low natural fertility soil.

Association of classes 13 and 16: Undifferentiated shallow soils and land classes:

The Favourable properties of Association of Classes 13 and 16: Undifferentiated shallow soils are that the soil may receive water runoff from associated rock; water-intake areas. The soil has Restricted land use options.

Solum depth is less than 50 cm in shallow soils. They usually have a thin A horizon over the parent material or bedrock. The total depth of the A and B horizons does not exceed 50 cm if there is a B horizon beneath the A horizon. Moderately deep soils have a solum depth of 50–100 cm, whereas deep soils have a solum depth of greater than 100 cm. High Mountain and valley soils are typically quite shallow and devoid of considerable topsoil. They are easily eroded. Earlier soil classification systems referred to such shallow soils on bedrock as Lithosols.

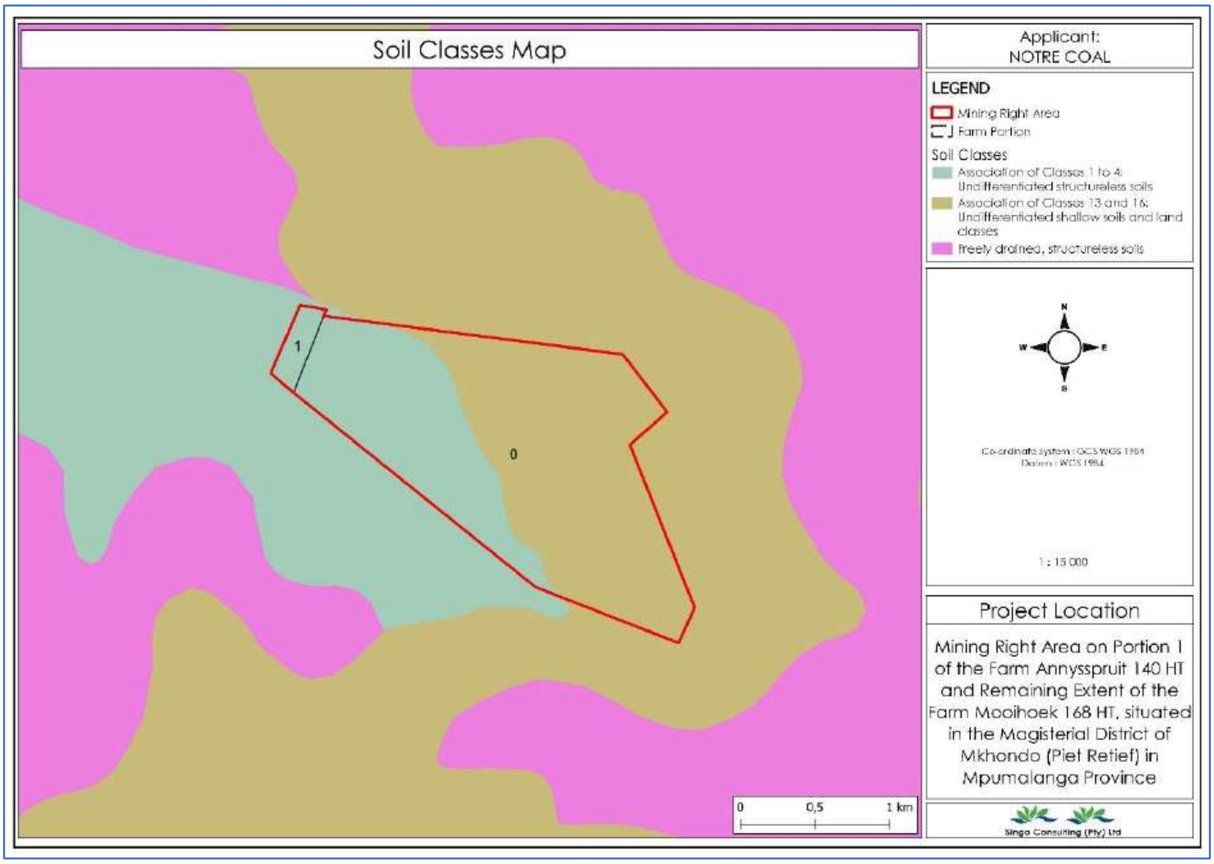


Figure 13: Soil class map

3.7 Geological Setting

Regional Geology

Karoo Supergroup

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 (Johnson et al., 2006). The proposed project area falls within the Ermelo Coalfield which hosts thinner seams that are more sedimentological and structurally complex. Sediments of Vryheid and Dwyka formations underlay the area which was deposited on a glaciated Pre-Karoo basement consisting of Rooiberg felsites. The deposit is preserved as an outlier underlying the small hill known as Vlooikop, surrounded by strata of the Dwyka Group (mainly tillites and varved mudstones/shales).

The Vryheid formation is essentially an interbedded succession of sandstone with lesser gritstone, siltstone, and mudstone, which contains five coal seams of the Ermelo coalfield.

Dwyka Group

The rocks of the Dwyka Group in South Africa are amongst the most important glaciogenic deposits from Gondwana. This Group is named for exposures along the Dwyka River east of Laingsburg and forms the basal succession of the Karoo Supergroup. Dwyka Group strata are mostly contained within bedrock valleys incised into Archean to lower Palaeozoic bedrock (Visser, 1990; Visser and Kingsley, 1982; Von Brunn, 1996). The lithologies in the areas underlying the coalfields of South Africa consist of a heterolithic arrangement of massive and stratified polymictic diamictites, conglomerates, sandstones, and dropstone-bearing varved mudstones. The easily identifiable lithologies form a good marker below the coal bearing Ecca Group. In the distal sector of the MKB these sedimentary strata accumulated largely as ground moraine associated with continental ice sheets and is generally composed of basal lodgement and supraglacial tills. These deposits are generally massive, but crude horizontal bedding occurs in places towards the top (Tankard et al., 1982).

Ecca Group

In the 1970s several studies (Cadle, 1974; Hobday, 1973, 1978; Mathew, 1974; Van Vuuren and Cole, 1979) showed that the Ecca Group could be subdivided into several informal units based on the cyclic nature of the sedimentary fills. In 1980 the South African Committee for Stratigraphy (SACS, 1980) introduced a formal lithostratigraphic nomenclature for the Ecca Group in the northern, distal sector of the MKB, which replaced the previously used informal Lower, Middle and Upper subdivisions with the Pietermaritzburg Shale Formation, the Vryheid Formation, and the Volksrust Shale Formation.

In general, the coal deposits in South Africa are hosted in 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 (~320 Ma) sequence of glacial and periglacial sediments, including diamictite, till moraine, conglomerate, sandstone, mudstone and varved shale. This is overlain by the Ecca Group, which is an Early to Late Permian (~260 Ma) sequence comprising sandstone, siltstone, mudstone and significant coal seams deposited in a terrestrial basin on a gently subsiding shelf platform.

In South Africa, based on the literature; only 19 coalfields are generally accepted which cover an area of approximately 9.7 million hectares (ha). The distinction between coalfields is based on geographic considerations and variations in the mode of sedimentation, origin, formation, distribution, and quality of the coals. (Hancox & Annette, 2014).

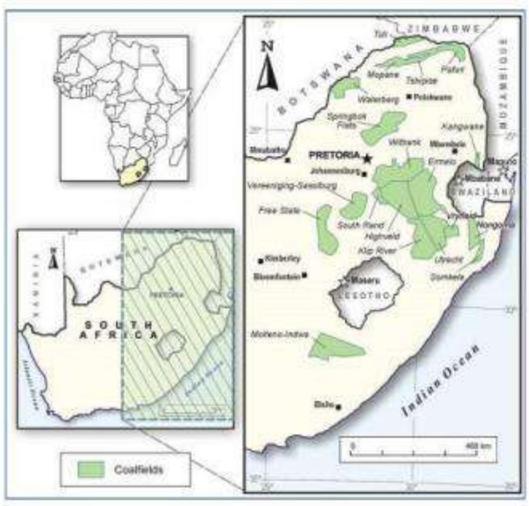


Figure 14: South Africa's Coalfields, Snyman (1998).

Ermelo Coalfield

The Ermelo Coalfield is located in the districts of Carolina, Dirkiesdorp, Hendrina, Breyten, Davel, Ermelo and Morgenzon in the southeast Mpumalanga Province. It extends approximately 75 km east-west, and 150 km north-south, covering an area of about 11,250,000 ha. The northern and eastern boundaries of the Ermelo Coalfield are defined by the sub-outcrop of the coal-bearing strata against pre-Karoo basement. In the west, the Ermelo Coalfield shares a boundary with the Witbank and Highveld coalfields, and to the south with the Klip River and Utrecht coalfields of KZN (Greenshields, 1986).

Rocks of the Permian Vryheid Formation and Jurassic aged dolerites dominate the surface exposures of the coalfield. As in the Witbank and Highveld coalfields the Vryheid Formation is the coal bearing horizon in the Ermelo Coalfield and five coal seams are also recognised within an 80-90 m thick sedimentary succession. Unlike in the Witbank and Highveld coalfields, the seams are given letters as codes and are named from the top to bottom the A to E seams (Wyburgh, 1928).

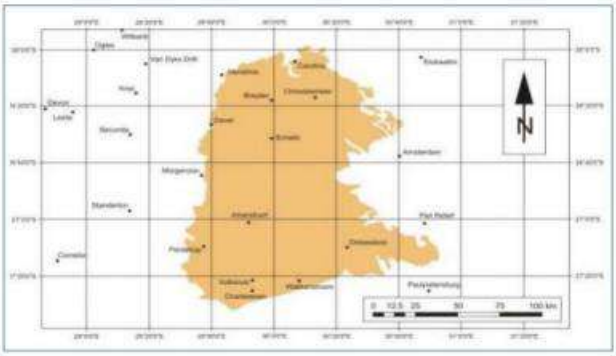


Figure 15: Geological extent of the Ermelo Coalfield

The coal seams in the Ermelo Coalfield are generally flat-lying to slightly undulating and as for the Witbank and Highveld coalfields, are separated by fine- to coarse-grained sandstones, siltstones and mudstones. The A, D and E seams are usually too important in the Carolina–Breyton area, and the B Seam group in the Ermelo area. Rapid seam thickness variations characterise the coalfield.

The E Seam may reach a thickness of up to 3m but is of economic importance only in isolated patches in the north of the Ermelo Coalfield (Greenshields, 1986). The coal is mostly bright and banded, has a competent sandstone roof and floor and is sometimes split by a thin sandstone or carbonaceous fines parting (Greenshields, 1986). In the central and southern part of the coalfield, it is developed as a torbanite or as a carbonaceous siltstone or mudstone unit, and locally becomes too thin for mining (Greenshields, 1986).

The coal of the D Seam is of good quality, but in general is too thin (0.1–0.4 m) to be of economic importance (Greenshields, 1986). The coal is not split by partings and consists of large amounts of vitrain and occasional durain bands (Greenshields, 1986; Jeffrey, 2005a). The C Seam group has been one of the main seam packages of economic importance throughout the Ermelo Coalfield. It is usually split by several partings which can lead to miscorrelation of the seams (Greenshields, 1986). In general, the C Seam is subdivided into the C Upper (CU) and C Lower (CL) seams. The CU Seam is well-developed over the entire coalfield and is often split by partings of different lithologies, such as sandstone, siltstone or mudstone, reaching a composite thickness of 0.7–4 m. It has historically been mined in several collieries of the Ermelo Coalfield, including the Golfview, Usutu, Goedehoop, Union, and Kobar collieries (Greenshields, 1986), as well as more recently at the Ferreira opencast mine.

The CL Seam is not developed throughout the entire coalfield, but where developed is between 0.5 and 2 m thick. It locally grades into carbonaceous siltstone and mudstone, which often form the roof of the seam, whereas the floor mostly consists of sandstone. It has historically been mined at the Savmore, Anthra, Ermelo, Golfview, and Wesselton mines (Greenshields, 1986; Paulson and Stone, 2002). Several other mines in and around the towns of Ermelo and Breyten have at times extracted coal from this seam including the Spitzkop, Bellevue, Grenfell, Usutu, Consolidated Marsfield, and Union collieries. The CL was also the main target seam at CCL's Ferreira opencast mine, and it is also currently being mined underground at their Penumbra mine, where it occurs at an average depth of around 100 m. It is the thickest of all the coal seams intersected here, reaching a thickness of more than 1.5 m over large parts of the project area. Locally seam floor rolls may negatively influence the thickness of the CL Seam in the Ermelo Coalfield.

The B Seam group varies in thickness from 1 to 2.7 m and may be split into three units. Greenshields (1986) terms these the B1, B and BX seams, but they are more commonly referred to as the B Lower.

Marsfield collieries, and was the seam mined at CoAL's Mooiplaats Colliery, where it is between 0.6 and 2.87 m thick. The BU was mined at the end of the mine life at the old Usutu Colliery, and the BL at the Ferreira mine. At Mooiplaats the BU Seam occurs at depths of between 90 and 140m and ranges in thickness between 0.15 m in the southeast to over 3 m in the north.

The A Seam occurs only in the northern and central parts of the coalfield, where it varies in thickness from 0 to 1.5 m (Greenshields, 1986). Wakerman (2003) provides a weighted average thickness of 0.94 m for the seam thin to be of economic interest and historically the C Seam group was the most in the Sheepmoor exploration area. Over most of the Ermelo Coalfield however this seam has been removed by erosion. Like in the Witbank and Highveld coalfields for the No. 5 Seam, the A Seam is overlain by a green glauconitic sandstone that forms a useful marker horizon and denotes the transition from a fluvio-deltaic to a marine depositional environment.

Dykes are common throughout the coalfield and the frequency of sills increases southwards. Dolerite sills displace the coal seams causing structural complications and also cause devolatilization of the coal (destruction of quality).

The coal of the Ermelo Coalfield, while variable in quality, is generally bituminous with the following airdried raw quality parameters of; calorific value 24MJ/kg, 23% ash, volatiles 26 %, inherent moisture 3 %, fixed carbon of 48% and 1.2 sulphur. Table 1 summarises the average thickness and quality of the various coal seams within certain areas of the Ermelo Coalfield.

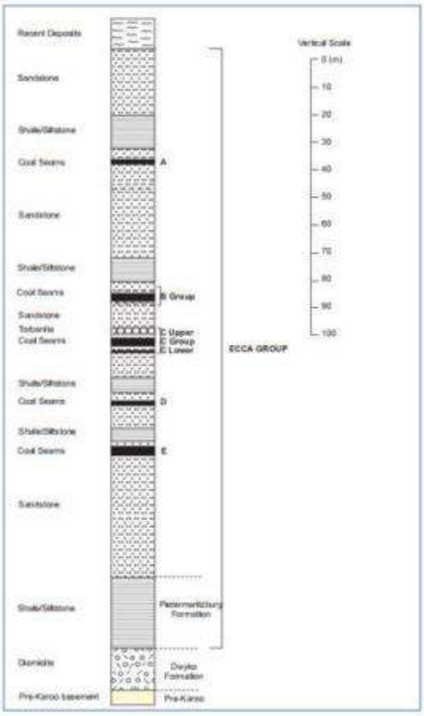


Figure 16: Atypical representation of coal seams in the Ermelo Coalfield.

Local Geology

The geological formations in the project area includes Vryheid formation, Alluvium and the Karoo Dolerite Suite.

Vryheid formation

This formation has been subdivided into three different lithofacies arrangements. They are dominated by fine-grained mudstone, carbonaceous shale with alternating layers of bituminous coal seams, and coarse-grained, bioturbated immature sandstones respectively. The rock sediments are predominantly arranged in upward-coarsening cycles, although some fining-upward cycles are found in this formation's easternmost deposits. The alternating rock types observed in the Vryheid Formation indicate seasonal variations of storms and fairer weather in a pro-delta setting. The carbonaceous shales were formed below the water surface in anoxic conditions and the coal formed from compacted plant matter deposited at the bottom of peat swamps. These swamps formed on abandoned alluvial plains where stagnant water accumulated. The Vryheid Formation reaches a maximum of 1030m in Nongoma, KwaZulu-Natal, within the Nongoma Graben.

The majority of the economically extracted coal in South Africa occurs in rocks of the Vryheid Formation, which ranges in thickness in the MKB from less than 70.0 m to over 500.0 m. It is thickest to the south of the towns of Newcastle and Vryheid, where maximum subsidence took place (Du Toit, 1918; Cadle, 1975; Whateley, 1980a; Stavrakis, 1989; Cadle et al., 1982) and where the basin was the deepest. The coal seams in the Ermelo Coalfield are generally flat-lying to slightly undulating and as for the Witbank and Highveld coalfields, are separated by fine- to coarse-grained sandstones, siltstones, and mudstones. The A, D and E seams are usually too thin to be of economic interest and historically the C Seam group was the most important in the Carolina–Breyton area, and the B Seam group in the Ermelo area. Coal qualities. The coal of the Ermelo Coalfield, whilst variable in quality, is generally of better quality than that of the Witbank and Highveld coalfields (Hancox and Gotz, 2014).

Karoo Dolerite Suite

The Karoo dolerite, which includes a wide range of petrological facies, consists of an interconnected network of dykes and sills and it is nearly impossible to single out any particular intrusive or tectonic event. It would, however, appear that a very large number of fractures were intruded simultaneously by magma and that the dolerite intrusive network acted as a shallow stockwork-like reservoir.

Dolerite dykes, like many other magmatic intrusions, develop by rapid hydraulic fracturing via the propagation of a fluid-filled open fissure, resulting in a massive magmatic intrusion with a neat and transgressive contact with the country rock. This fracturing mechanism is in contrast to the slow mode of hydraulic fracturing responsible for breccia-intrusions (i.e., kimberlite). For the intrusion to develop the magma pressure at the tip of the fissure must overcome the tensile strength of the surrounding rock. Dykes can develop vertically upwards or laterally along-strike over very long distances, as long as the magma pressure at the tip of the fissure is maintained. The intrusion of dolerite and basaltic dykes are therefore never accompanied by brecciation, deformation or shearing of the host-rock, at least during their propagation.

The average thickness of Karoo dolerite dykes ranges between 2 and 10m. The country rock is often fractured during and after dyke emplacement. These fractures form a set of master joints parallel to its strike over a distance that does not vary greatly with the thickness of the dyke (between 5 and 15m).

One of the most prominent features of the present Karoo landscape is the large number of dolerite sills and ring-complexes. These structures often display a subcircular saucer-like shape, the rims of which are commonly exposed as topographic highs and form ring-like outcrops. The Karoo dolerite sills and ring-complexes have the same geographical distribution as the dolerite dykes, and they are by far the most common type of intrusion in the Karoo basin. The dolerite sills and dykes form a complex intrusive network that probably acted as a shallow magma storage system. The lithology of the country-rock strongly controlled the emplacement of the sills.

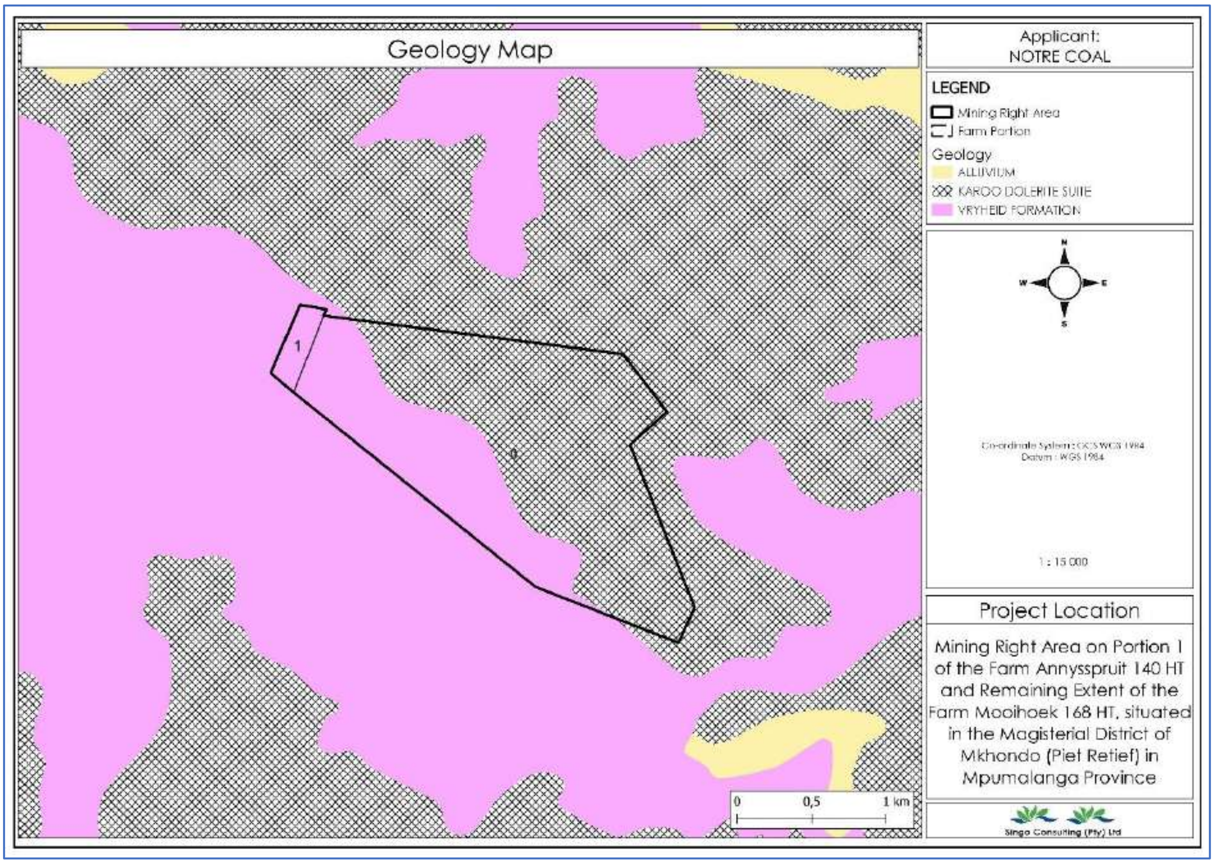


Figure 17: Geology map

4. SITE ASSESSMENT

4.1 Locality Setting

The locality map created by the QGIS illustrates the location of the proposed area The project area is situated on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province. The project area is situated approximately 22.93 km Northeast of Dirkiesdorp and approximately 18.02 km Southwest of Piet Retief. The co-ordinates for the project area are **S -27.071958** and **E 30.599123.**

4.2 Water Sampling

The process of collecting a representative portion of water, as from the natural environment or from an industrial site, for the purpose of analysing it for constituents.

Surface water sampling

Sampling using sampling vessels:

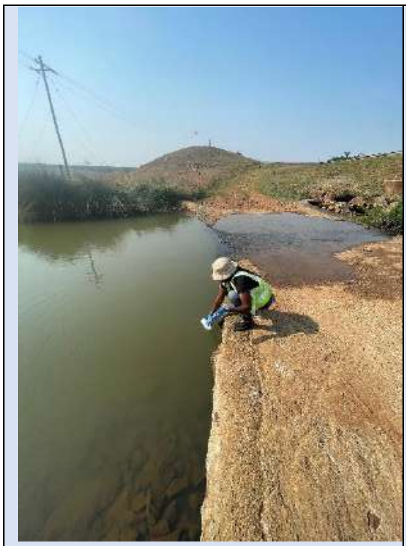
Before sampling, sample bottles must be rinsed atleast three (3) times to avoid prior sample container contamination influencing sample integrity. Each sample container's lids will also be rinsed three (3) times.

Until a meniscus was created, samples will be filled to the top of the bottleneck. This guarantees that all air is excluded from the samples, preventing sample oxidation that may cause iron to precipitate. It can also stop other dissolved gases from being removed from the solution. The samples will be put in a cooler box with ice blocks once obtained and transported to the **Regen Water Laboratory**.

Surface water sampling was conducted by a specialist from Singo Consulting (Pty) Ltd, see

Table 3 surface water sampling below.

Table 3: Surface water sampling

		
Surface water sampling was conducted on three different waterbodies		

Groundwater sampling

Sampling using a Bailer:

A bailer is a hollow tube used to collect samples of groundwater from wells for monitoring. Bailers are tied to and lowered into the water column by a piece of rope or a piece of wire. 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 18: Example of a bailer (water sampling Bailer - Bing images)

4.3 Current Activities

The project area is covered by natural vegetation, plantation, waterbodies, bare land, built-up area, and wetlands. The land is currently being used as a cultivation land.

Table 4: Site assessment conducted

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.

The following methodologies were used for the hydrological assessment of the catchment that the mine will be situated in: A holistic approach was followed, and an attempt was made to link local hydrological, water quality and environmental studies to regional and national concerns, regulations, and management strategies. A site visit was conducted in order to obtain information on normal flow rates, river health and potential factors that could influence hydrological modelling of flows. Generally accepted methods and formulae were used to determine design floods in the relevant catchments. The likely surface water impact associated with the planned mining development was identified and possible mitigation measures were recommended to reduce the impacts thereof.

5.1.1 Elevation Data

Elevation data in the form of 20 m contour intervals covering the project acquired from the topography map. The contour lines were used to generate a 20 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 steep slope, when contour lines are closer to each other, then slope is steep slope

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.

5.1.3 Peak Flows

Peak flows are the most important flood parameter which relatively reflects the highest level and potential destructive power of a flood. Understanding peak flow changes can effectively capture a flood characteristic and is essential for developing flood control strategies.

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:

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

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.
- 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

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 Methodology

6.1.1 Impact Status

The impacts are assessed as either having a:

- 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

Extent of the Impact

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

6.1.3 Impact Duration

The length that the impact will last for is described as either:

- 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

Probability of Occurrence

- 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

Magnitude of the Impact

The intensity or severity of the impacts is indicated as either:

- 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 mining project consists of various phases, which include construction phase and operational phase, which all have the potential to affect surface water regime.

CONSTRUCTION PHASE.

The construction phase consists of the following activities:

- Footprint area clearance.
- The construction of the total clean water and dirty water diversion trenches; and
- Handling of truck fuel and oil spills.

Surface water contamination.

Truck oils and fuel could leak and spill to water resources. All oils and fuels must be stored in banded areas and any spillages must be managed immediately in accordance with the Emergency Response plan. The emergency response plan must be provided by contractors. This will reduce the risks from High to Medium.

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 for stormwater management shall guide the planning, design, and implementation of stormwater management (Centre for watershed, 2010).

- The ecosystems to be protected and a target ecological state should be explicitly identified.
- The post development balance of evapotranspiration, stream flow, and infiltration should mimic the predevelopment balance, which typically requires keeping significant runoff volume from reaching the stream.
- Stormwater control measures (SCMs) should deliver flow regimes that mimic the predevelopment regime in quality and quantity.
- SCMs should have capacity to store rain events for all storms that would not have produced widespread surface runoff in a predevelopment state, thereby avoiding increased frequency of disturbance to biota.
- SCMs should be applied to all impervious surfaces in the catchment of the target stream.

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

A stormwater management plan is required to ensure adequate clean and dirty water separation, with all water emanating from the mine area (dirty water) being captured, conveyed, and safely contained, while clean water emanating from the upstream environment is diverted to the nearest watercourse or downstream environment.

Government Notice 704, which is explained in the section below, is the regulation that allows for the management of clean and filthy water in a mining setting.

7.3.1 Government Notice 704

GN 704 (Government Gazette 20118 of June 1999) was established to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. The five main principal conditions of GN 704 applicable to this project are:

- **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.
- **Condition 6** which 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 the 1:50 year peak flow. 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.

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
- 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
- Berms around the stockpile and waste material should be made.
- Trenches should be created, to effectively channel water and treat it if contaminated.
- There should be PCD to store wastewater, and catchment to drain stormwater.
- The infrastructure should be created in a way that is able to harvest stormwater, this will decrease the amount of stormwater within the area on the ground which could potentially cause water pollution.

7.5 ROM Stockpile Consolidation

- Trenches around the stockpile, which will collect dirty water which was in contact with the stockpile.
- Impermeable pavement will be constructed around the stockpile.

7.6 Water Management Infrastructure

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.

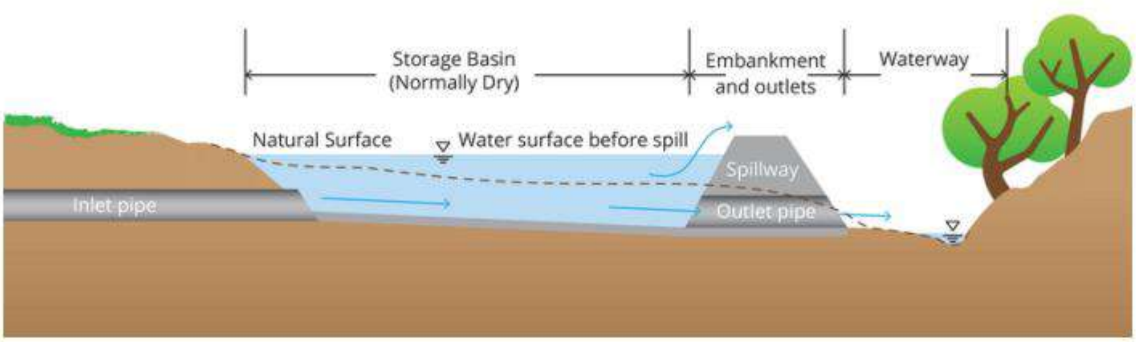


Figure 19: Detension basin

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.

8. MONITORING PLANS

The goal of the surface water management and monitoring measures to minimise the effect on surface water-based structures to be maintained from disruption within and adjacent to regulated sites; to preserve hydrological regimes of surface water so that the environmental values are preserved and, to ensure compliance with license requirements and for reporting purposes.

Water dependent systems are parts of the environment in which species composition and natural ecological processes are determined by the permanent or temporary presence of surface water or groundwater flowing or standing. The in-stream areas of rivers, riparian vegetation, springs, wetlands, floodplains, groundwater-dependent terrestrial vegetation are all examples of water dependent systems (Department of Water, January 2013). The objectives of these systems will be achieved if the in-stream and downstream fitness for use criteria is not affected.

8.1 Surface Water Quality

During the Construction and Operational Phases of the mine project water body adjacent to the mining right area should be sampled monthly.

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 monthly.

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 project area must have

water trenches, to minimize and prevent possibility of gully erosion inside the mining right 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 hydrology.

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 monthly.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusion and Summary

The application for the mining right is proposed to be developed on a steep topography with the project area situated within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province. The identified water bodies in the proximity of the project include the perennial river, non-perennial river, channelled valley-bottom wetland, seep wetland and a dam.

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.
- Operational phase, the adjacent water body will likely be affected by dust settling in the water and possibly oil 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, Alluvium and the karoo dolerite suite.
- The area is overlain by Association of classes 1 to 4: undifferentiated structureless soil, the Freely drained, structureless soils and the Association of classes 13 and 16: Undifferentiated shallow soils and land classes.

9.2 Recommendation

- 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.
- 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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APPENDICES

Appendix A: Specialist’s qualifications

Available Upon Request.

MINING RIGHT APPLICATION

REHABILITATION AND CLOSURE PLAN

REPORT PREPARED BY:

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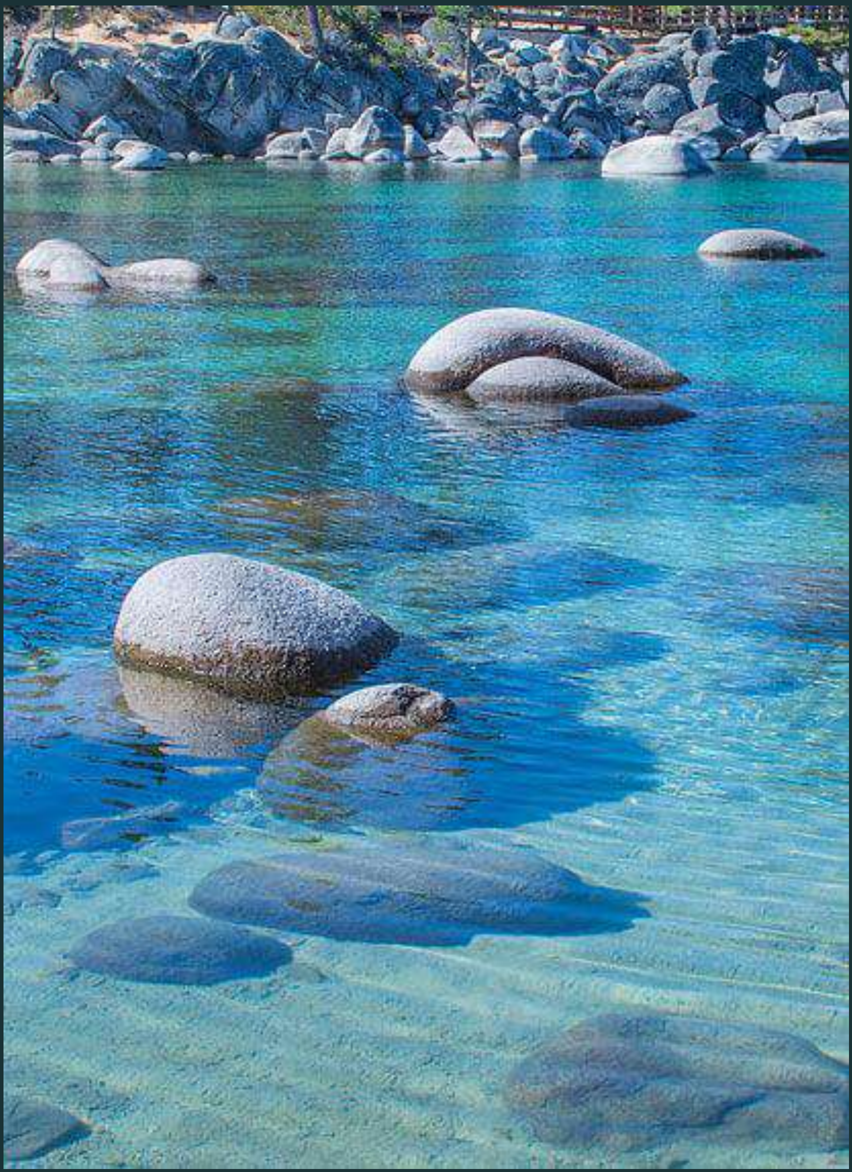
Rehabilitation and Closure Plan for the proposed Mining Permit application for Notre Coal (Pty) Ltd within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province.



NOTRE Coal

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DMRE REF: MP 30/5/1/2/2/10384 MR

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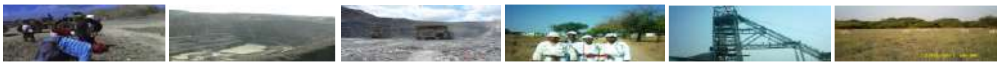

Project details

Report type	**Rehabilitation Plan for a Mining Right application**	
Project title	Rehabilitation Plan for Mining Right application for Notre Coal (Pty) Ltd of Coal on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province.	
Mineral (s)	Coal	
Client	Notre Coal (Pty) Ltd	
Site location	Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province.	
Version	02	
Date	19 October 2022	
		Electronic signatures
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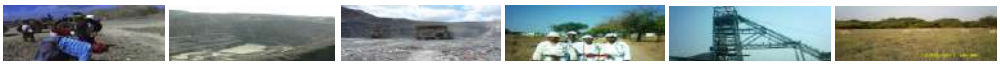
Final review and approval	Dr. Kenneth Singo (Principal Consultant of Singo Consulting (Pty) Ltd)	



EXECUTIVE SUMMARY

Singo Consulting Pty Ltd has been requested by **Notre Coal (Pty) Ltd** to compile a Rehabilitation and Closure Plan, as well as financial provision for mining operation which will involve opencast mining within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province in South Africa to support the Environmental Authorisation Process.

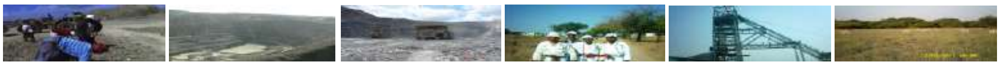
The document supplies the Department of Mineral Resources & Energy (DMRE) with information pertaining to closure planning for the mining activities as required in terms of the National Environmental Management Act 107 of 1998 (NEMA) and the Mineral and Petroleum Resources Development Act 28 of 2002. 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 Right 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.



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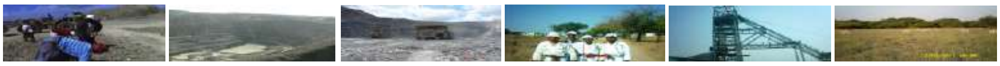

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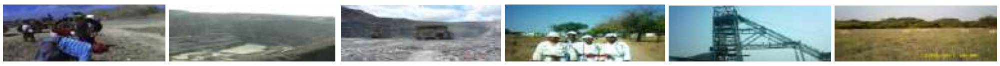

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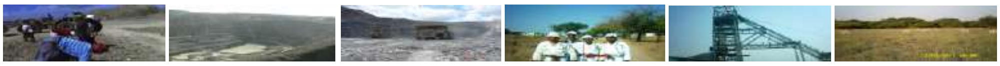


1 INTRODUCTION

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).

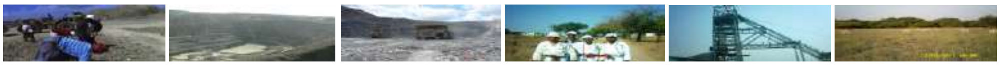
Singo Consulting Pty Ltd has been tasked by **Notre Coal (Pty) Ltd** to compile a Rehabilitation and Closure Plan, as well as financial provision for its mining activities in support of the Environmental Authorisation Process. Contained herein is the conceptual rehabilitation plan, which is one of the 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, minimise 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.



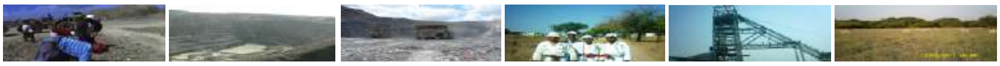
- All engineering inputs appointed contractor's responsibility and are thus not included in this report
- The rehabilitation guidelines and plan are dependent on the specialist studies done for the area and the full mine plan for the project

3 STUDY AREA AND DESCRIPTION

3.1 Project Area

Farm name	Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province
Application area (ha)	approximately 366.606 Hectares
Magisterial district	Mkhondo
Distance and direction from nearest town	The proposed project site is situated approximately 18,3 km Southwest of Piet Retief, approximately 1.1km east of Etshondo Primary School, approximately 3.4 km southwest of Röhrs Farm Guesthouse, approximately 3.8 km southeast from Inkululeko Primary School, approximately 6 km southeast of Matafuleni Community, and approximately 8.5 km southeast of Ngema Tribal Trust.

The Coal Mining Right application within Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa. The surrounding land use on the proposed project area are associated with cultivation.



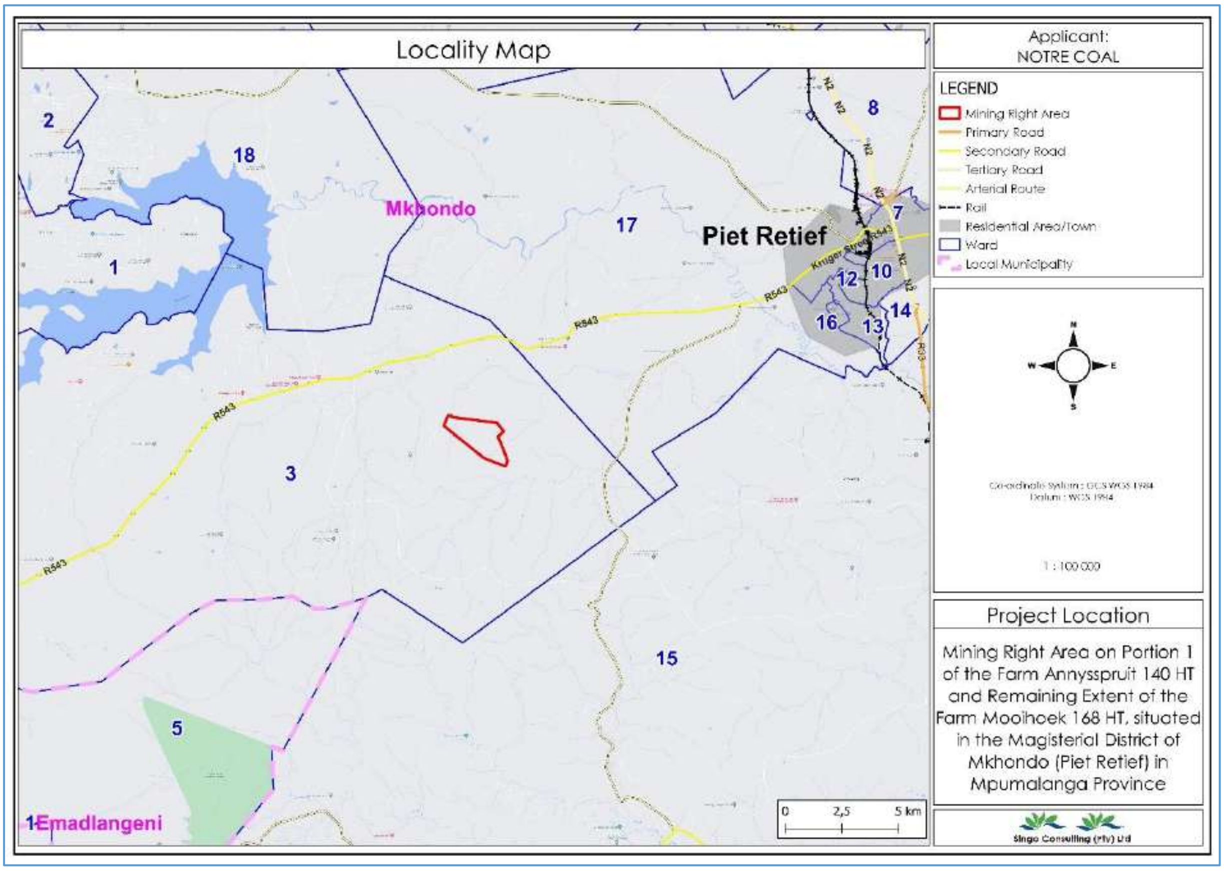


Figure 1: Locality map of the proposed mining area.

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

3.3 Description of The Scope of the Overall Activity

The method of mining preferred for this proposed Mining Right by Notre Coal (Pty) Ltd 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.

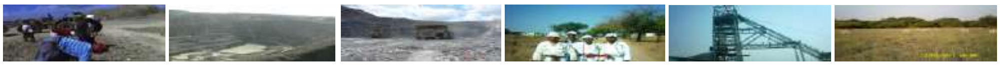
4 REHABILITATION OBJECTIVES

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 right area is largely covered with Association of Classes 13 and 16: Undifferentiated shallow soils, Association of Classes 1 to 4: Undifferentiated structureless soils, and land classes Red or yellow structureless soils with a plinthic horizon.

The Favourable properties of **Association of Classes 13 and 16: Undifferentiated shallow** soils are that the soil may receive water runoff from associated rock; water-intake areas. The soil has Restricted land use options.

Solum depth is less than 50 cm in shallow soils. They usually have a thin A horizon over the parent material or bedrock. The total depth of the A and B horizons does not exceed 50 cm if there is a B horizon beneath the A horizon. Moderately deep soils have a solum depth of 50–100 cm, whereas deep soils have a solum depth of greater than 100 cm. High mountain and valley soils are typically quite shallow and devoid of considerable topsoil. They are easily eroded. Earlier soil classification systems referred to such shallow soils on bedrock as Lithosols.

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.

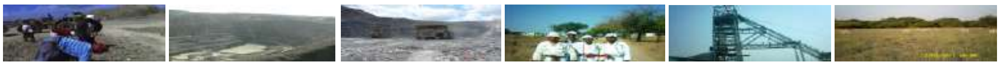
Soil Drainage

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.

Red or yellow structureless soils with a plinthic horizon

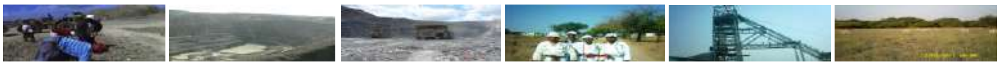


Red apedal soils

These soils have a structure that is weaker than moderate blocky or prismatic in the moist state, if structure is borderline, CEC (NH4OAc, pH7) per kg soil is less than 11cmol (+)/kg soil. These soils are non-calcareous in any part of the horizon which occurs within 1500mm of the soil surface but may contain infrequent, discrete, relict lime nodules in a non-calcareous soil matrix. It does not have alluvial or aeolian stratifications. The B horizons that have uniform colours, falling within the range defined as red and that in the moist state, lack well-formed peds other than porous micro-aggregates, qualify as red apedal. The concept of these macroscopically weakly structured or structureless materials embraces that kind of weathering that takes place in a well-drained oxidizing environment to produce coatings of iron oxides on individual soil particles (hence the diagnostic red colours) and clay minerals dominated by non-swelling 1:1 type.

Yellow apedal soil

This horizon does not have grey colours in the dry state as defined for the E horizon. Although colour must be substantially uniform, some variability is permitted, for example mottles or concretions which are insufficient to qualify the horizon as a diagnostic plinthic B, faunal reworking may also result in acceptable colour variegations. It is non-calcareous within any part of the horizon which occurs within 1500mm of the surface but may contain infrequent, discrete, relict lime nodules in a non-calcareous soil matrix. Does not have alluvial or aeolian stratifications., directly underlies a diagnostic topsoil horizon or an E horizon. Yellow- brown apedal B horizons occur over approximately the same climatic spread as their red counterparts and so are also very widely distributed throughout the country. They may be found on all types of parent material.



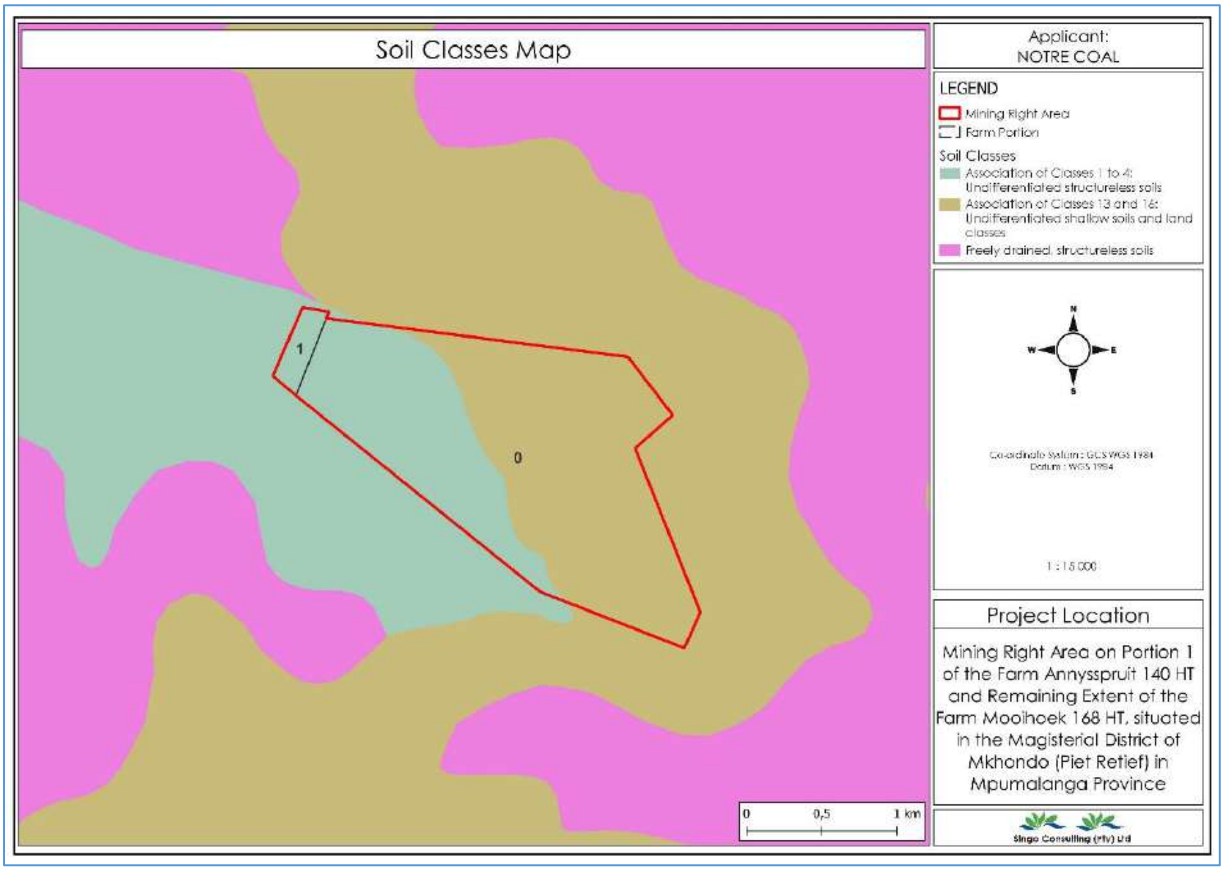
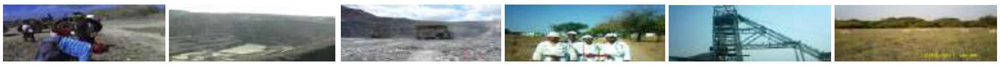


Figure 2: soil class map of the project area.

Photo 1: Soil sampling picture

5.4 Land Capability and Land Use

The proposed project area is an arable land this type of land it is the land that is ploughed or tilled regularly. From observation the area is sometimes used for livestock grazing.



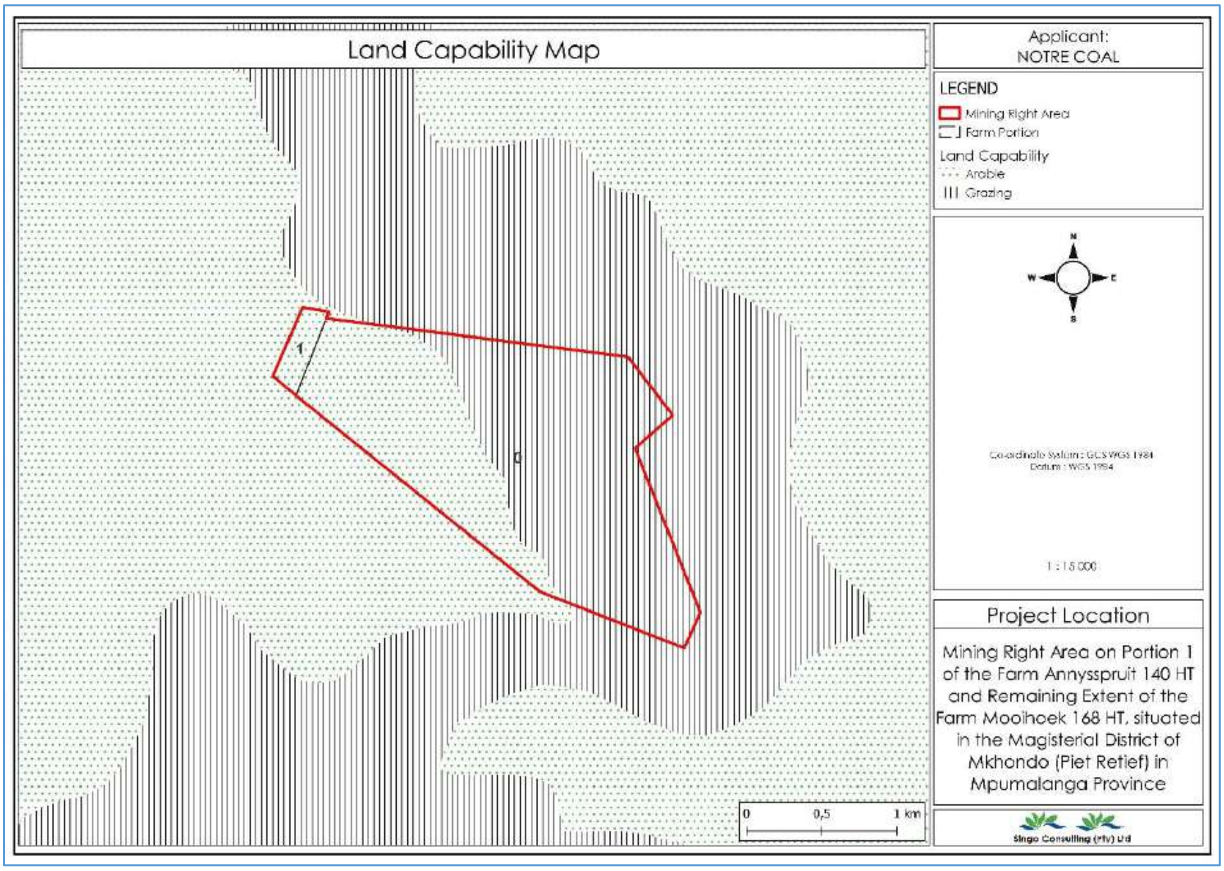
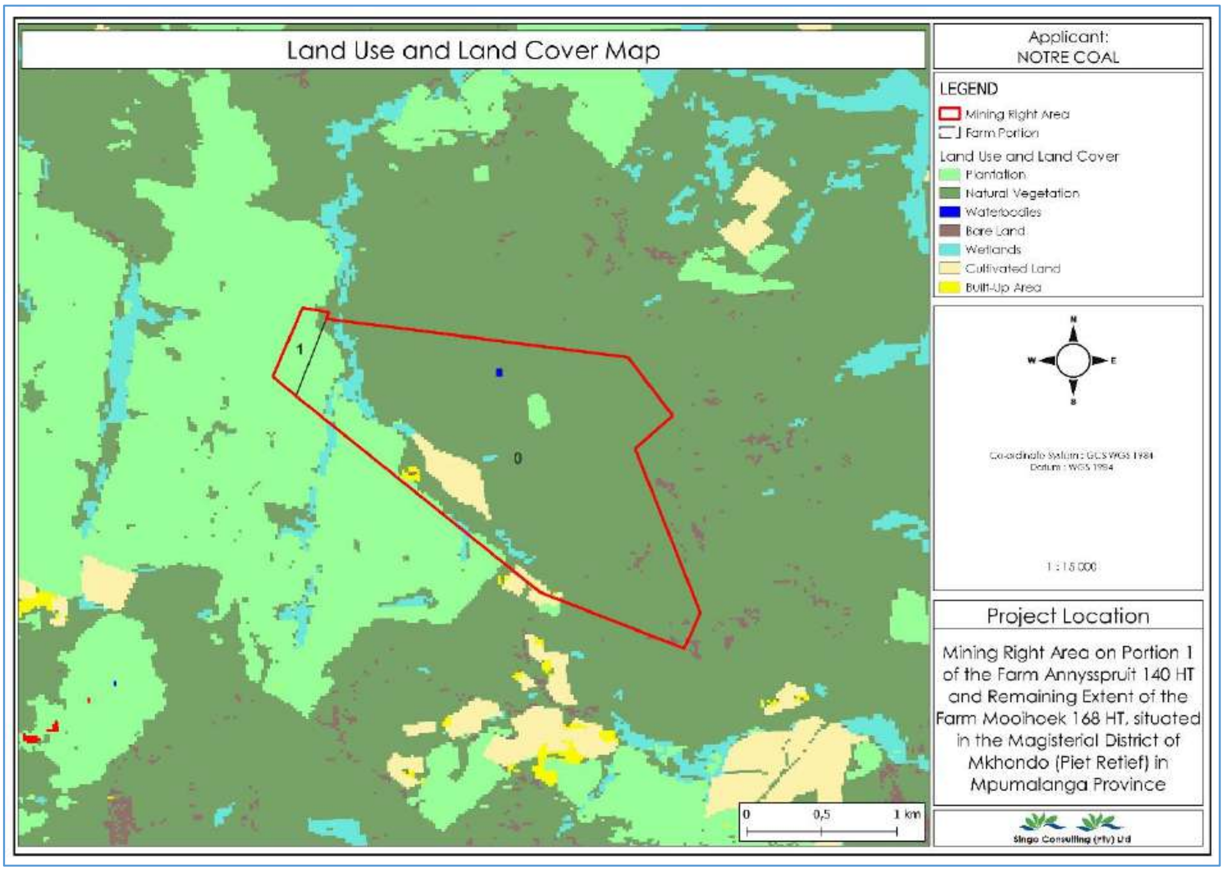


Figure 3: Land capability map of the area



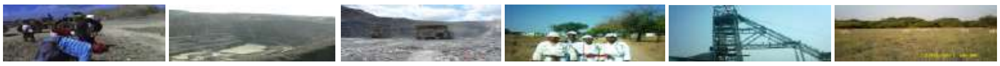


Figure 4: Land use map

5.5 Fauna and Flora

5.4.1 Flora

North-eastern mountain grassland holds 78 endemic and near-endemic plant species, mostly in the Liliaceae, Iridaceae, Asteraceae, Lamiaceae and Orchidaceae families, on Black Reef quartzites. A further 31 endemics are found on dry dolomites. Most of these endemics are present in this IBA. The rare rock barbel *Austroglanis sclateri* is reported from the region. Giant girdled lizard *Cordylus giganteus* occurs on some of the farms and rough-haired golden mole *Chrysospalax villosus*, serval *Felis serval*, African striped weasel *Poecilogale albinucha* and Warren's girdled lizard *Cordylus warreni* range throughout the region. Laminate vlei rat *Otomys laminatus* and many-spotted mountain snake *Anplorhinus multimaculatus* have been recorded in the grassland areas near wetlands.

Natal red rock rabbit *Pronolagus crassicaudatus* occurs on the rocky outcrops and in upland areas. The extremely rare striped harlequin snake *Homoroselaps dorsalis* and Zulu golden mole *Amblysomustris* may occur within this large blanket area. The streams in the forested areas of the south-eastern section of the IBA may hold Natal ghost frog *Heleophryne natalensis*.

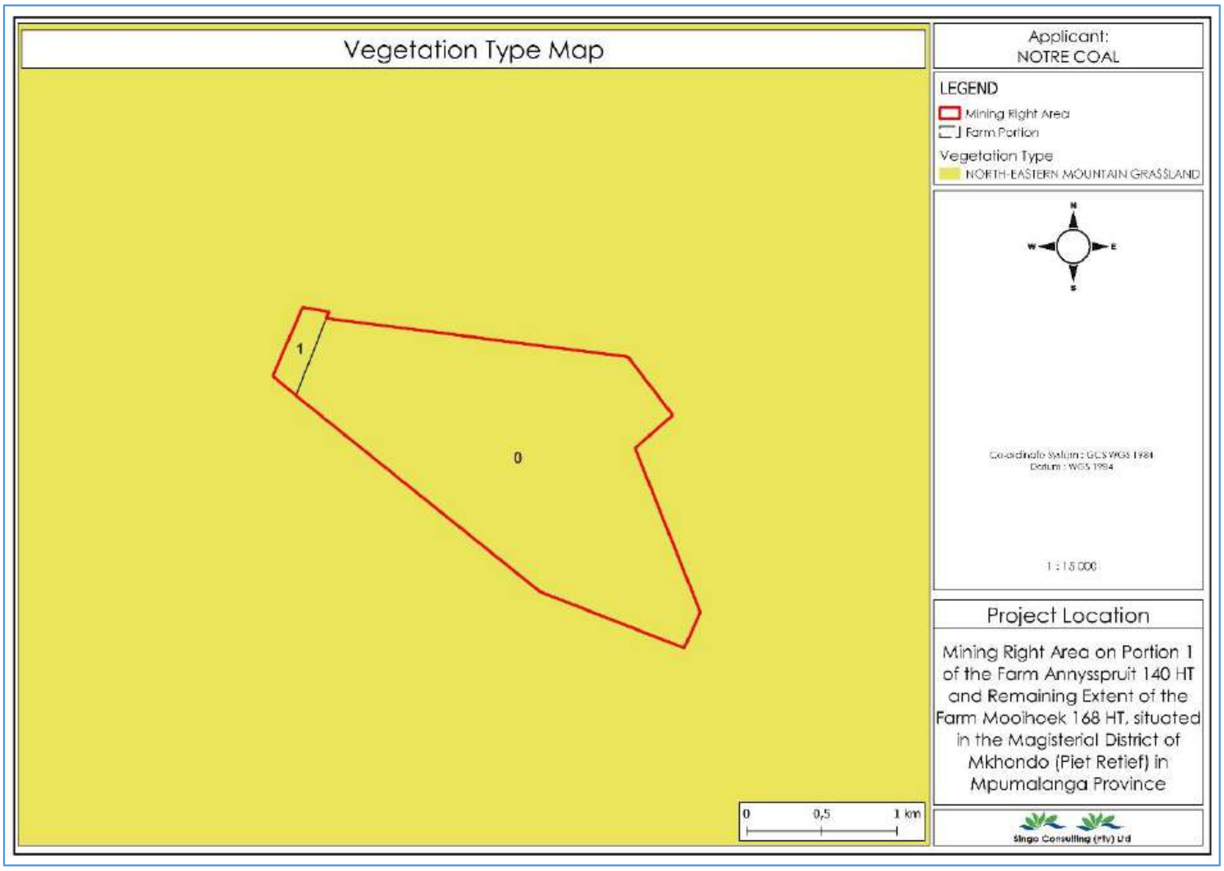


Figure 5: Vegetation map of the mine area

The Grassland Biome has an extremely high biodiversity, second only to the Fynbos Biome. At the 1000 m^2 scale, the average species richness of the Grassland Biome is even higher than that of most Fynbos communities (Cowling et al., 1997; van Wyk, 2002), being surpassed only by the Renosterveld. Given that most rare and threatened plant species in South Africa's summer rainfall region are restricted to high-rainfall grasslands, this type of vegetation is in the most urgent need of protection (60% destroyed and only 2.2% conserved).

According Figure 5, the project site is located within the North-Eastern Mountain Grassland. Mountain grassland (also referred to as meadow) is characterized by an absence or very low cover of trees and shrubs, and dominance by grasses and forbs. Species composition changes substantially with soil conditions, and grazing history (Redders 2003a).

5.4.2 Fauna

The biome of Grassland is characterized by a high diversity of fauna (animals), including many endangered taxa. The following fauna is likely to occur in the proposed Mining Right area: -

- Mammals
- Birds
- Reptiles and,
- Amphibians

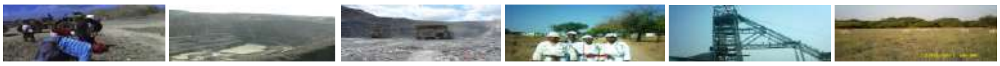
Mammals: No Species of Conservation Concern (SCC) were observed during site assessment. However, there are three SCC known to frequent the area from time to time. These include *Crycteropus afer (aardvark NE), Poecilogale albinucha (African Stripped Weasel NE) and Pronolagus crassicaudatus ruddi (Natal Red Rock Rabbit, NE)*. Common species expected to frequent the area include *Yellow Mangoose, Vervet Monkey and Meerkat.*

Birds: Habitats are typically associated with grasslands, but the loss of habitat has affected diversity due to site clearing (historical and current). The proposed Mining Right area showed intermediate diversity of bird species which included seed eaters and insectivores.

No SCC was observed during site assessment. SCC likely to occur in the area include *emimacronyc chloris (Yellowbreasted Pipit (Vulnerable) Balearica reguloru (Grey Crowned Crane (vulnerable), Eupodotis senegalensis (white Bellied Bustard (vulnerable).*

Possibility of common bird species to occur in the project area include *axicola torquatus (African Stonechat, Upupa africana (African Hoopoe), Threskiornis aethiopicus (African Sacred Ibis), Elanus caeruleus (Blackshouldered Kite), Vanellus armatus (Blacksmith Lapwing), Passer melanurus (Cape Sparrow) and Motacilla capensis (Cape Wagtail).*

Reptiles: Reptile faunal environment is called intermediate, reptiles are naturally adaptable, and can live in different environments. The inhabitant suits both the reptiles and their prey. No



SCC were observed in the project site. The likelihood of SCC to occur in the area may be low due to the high level of human activity in the area.

No common reptile species were observed during field assessment. This may be due to the season in which the assessment was done.

Amphibians: Because of extreme salinization of the freshwater environment, the general habitat vulnerability for amphibians is considered relatively poor. There were no SCC observed during site assessment. However, the likelihood of the species to occur in the area include *Pyxicephalus adspersus (African Bullfrog) may utilise the ephemeral system.*

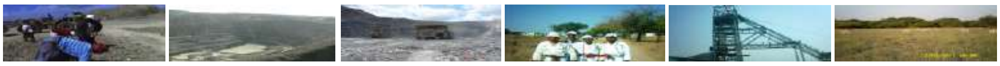
No common species were observed although there are common species which are likely to occur during rainy/wet season and these include *Bufo gutturalis (Guttural Toad) Bufo rangeri (Rangers Toad), Cacosternum boettgeri (Boettger's Dainty Frog), Hyperolius marmoratus (Marbled Reed Frog), Kassina senegalensis (Senegal Running Frog) Ptychadena porosissima (Grassland Ridged Frog), Afrana angolensis (Angola River Frog), Afrana fuscigula (Cape River Frog), Strongylopus fasciatus (Striped Stream Frog), Strongylopus grayii (Gray's Stream Frog), Tomopterna natalensis (Natal Sand Frog) and Xenopus laevis (African Clawed Frog).*

5.6 Surface and Ground Water

The fractured aquifer consists of the various lithologies of siltstone, shale, sandstone and the coal seams. The pores of the geological units are generally well cemented, and the principle flow mechanism is fractured flow along secondary structures e.g. faults, bedding plane fractures etc. The intrusion of the fractured aquifer by dolerite dykes and sills has led to the formation of preferential flow paths along the contacts of these lithologies due to the formation of cooling joints. The dykes may act as permeable or semi-permeable features to impede flow across the dykes.

The flow mechanism is fracture flow as can be expected from the crystalline nature of the shale rocks. The water quality is generally characterized by high fluoride levels which limits exploitation of this aquifer in combination with the general low yields, deep (expensive) drilling and the low recharge (Grobbelaar et al, 2004). Mining of the coal seams has resulted in the introduction of an artificial aquifer system which generally dominates the groundwater flow on a local and regional scale.

Below is a cross sectional figure of a typical fractured aquifer. Water exists in fractures in Karoo weathered aquifers. Two important characterizations that exist in the study area is the upper weathered aquifer system and the lower fractured aquifer system. If the purpose of drilling boreholes is for the supply of water, drillers will usually be directed to drill targeting the fault zones, however in the present study where the boreholes to be drilled are for arsenic, barite, asbestos, copper, fluorspar, lime, tin, thorium, uranium, gold. silver & coal exploration, fault



zones and contacts should be avoided at all costs, to minimize the impact to groundwater. The boreholes drilled must be cased to avoid clogging and contamination.

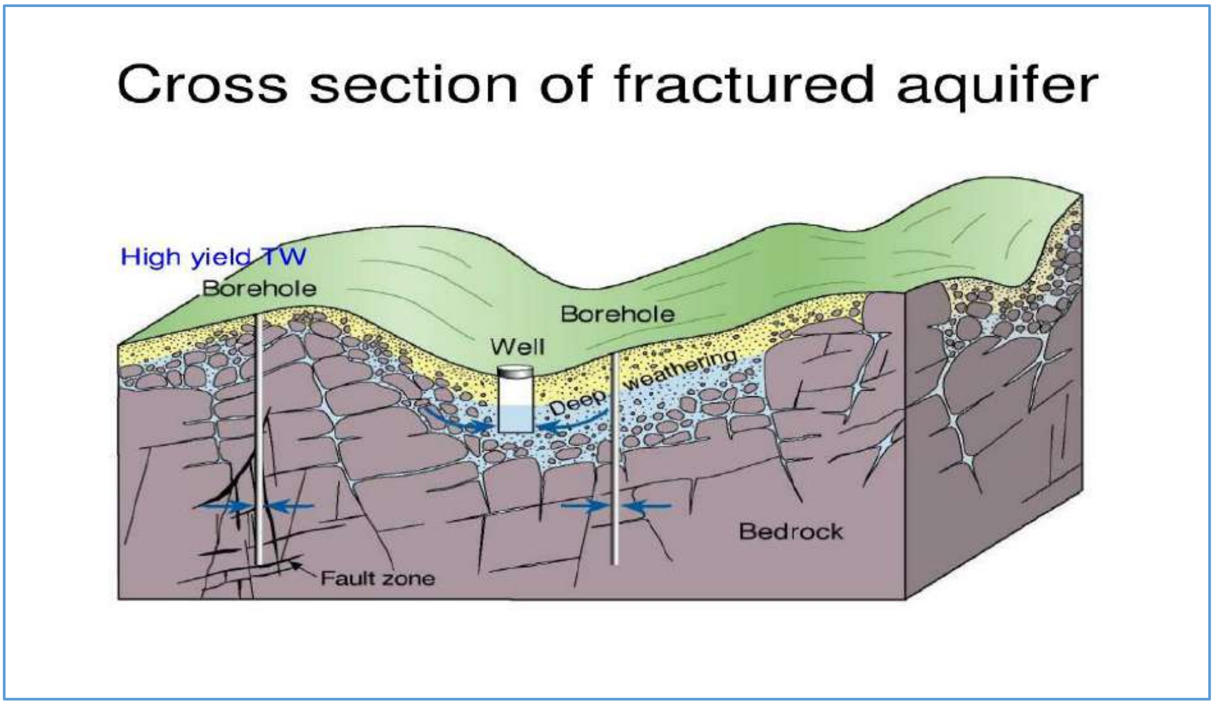


Figure 6: Cross section of a fractured aquifer

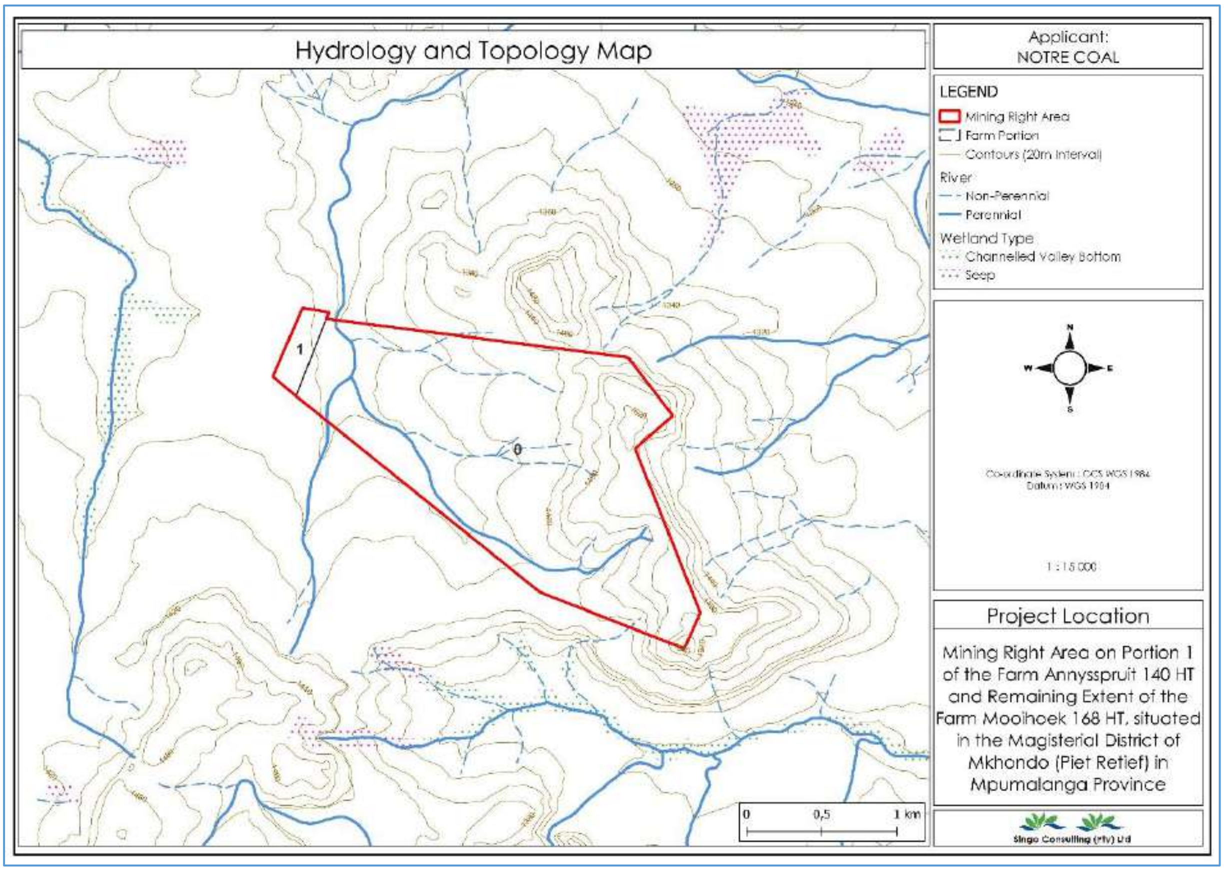
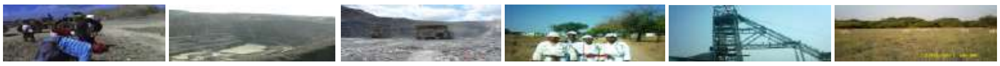


Figure 7: Hydrological map of the study area



7 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.

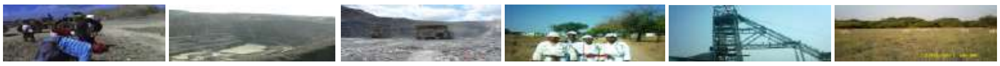
The key legislation governing the requirements for legislation for rehabilitation is contained in the following acts:

- 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)

7.1 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.



7.2 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)

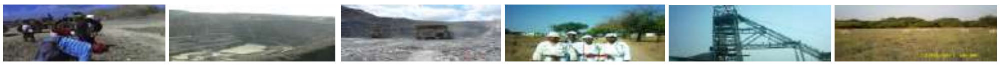
(a) apply to all prospecting and mining operations, as the case may be, and any matter relating to such operation; and

(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.

7.3 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.

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

The Mining Right 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.517).

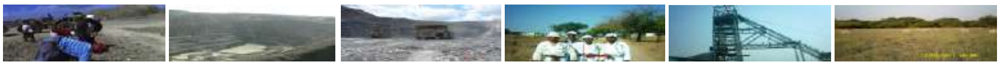
7.4.1 Rehabilitation

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).

7.4.2 Responsibility for and Management of Adverse Impacts

Section 38 (1) (e) of the MPRDA states that the holder of the Mining Right 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.



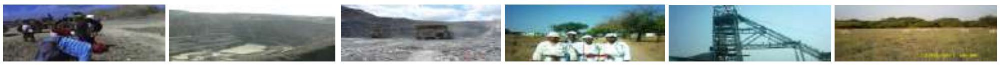
7.5 Financial Provision (Sections 23 and 41 and Regulations 10, 52 – 54 of GN R527)

The applicant for a Mining Right must make financial provision for the prevention, management or rehabilitation of adverse environmental impacts before mining commences. In terms of Section 23, a Mining Right 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 Right has the technical ability or access thereto to conduct the mining activities and to mitigate and rehabilitate relevant environmental impacts.

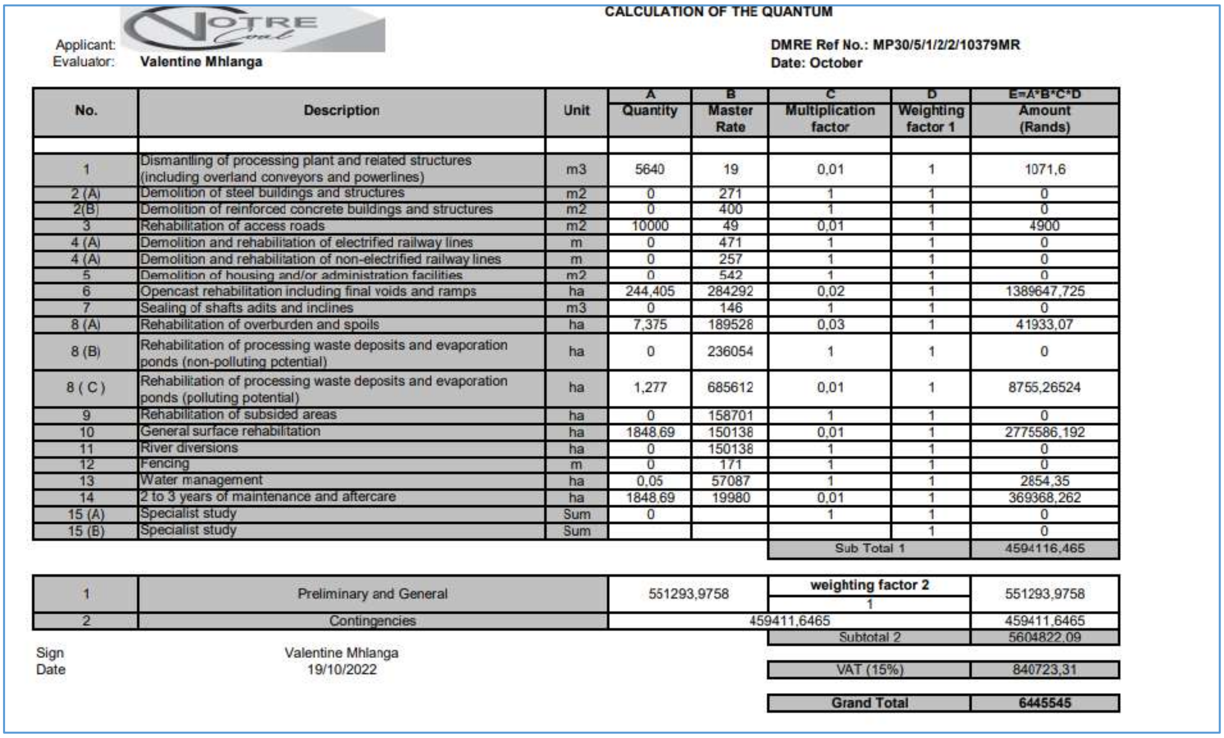
Section 41 stipulates that approval of an EMPr can only be granted once financial provision for rehabilitation or management of negative environmental impacts has been made.

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.



8.6 Financial Provision of the Project



CALCULATION OF THE QUANTUM

Applicant: NOTRE Coal
Evaluator: **Valentine Mhlanga**

DMRE Ref No.: MP30/5/1/2/2/10379MR
Date: October

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	5640	19	0,01	1	1071,6
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	10000	49	0,01	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	244,405	284292	0,02	1	1389647,725
7	Sealing of shafts adits and inclines	m3	0	146	1	1	0
8 (A)	Rehabilitation of overburden and spoils	ha	7,375	189528	0,03	1	41933,07
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	1,277	685612	0,01	1	8755,26524
9	Rehabilitation of subsided areas	ha	0	158701	1	1	0
10	General surface rehabilitation	ha	1848,69	150138	0,01	1	2775586,192
11	River diversions	ha	0	150138	1	1	0
12	Fencing	m	0	171	1	1	0
13	Water management	ha	0,05	57087	1	1	2854,35
14	2 to 3 years of maintenance and aftercare	ha	1848,69	19980	0,01	1	369368,262
15 (A)	Specialist study	Sum	0		1	1	0
15 (B)	Specialist study	Sum				1	0
					Sub Total 1		4594116,465

1	Preliminary and General	551293,9758	**weighting factor 2** 1	551293,9758
2	Contingencies		459411,6465	459411,6465
			Subtotal 2	5604822,09
			VAT (15%)	840723,31
			Grand Total	**6445545**

Sign Valentine Mhlanga
Date 19/10/2022

The amount of **R6445545** 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.

8 Mine Closure

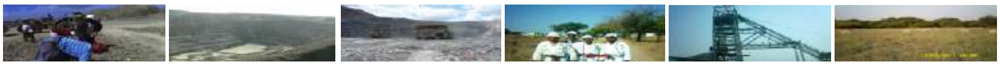
8.1 Principles of Mine Closure

Regulation 56 of the Regulations provides that the holder of a prospecting right, mining permit, retention permit or Mining Right 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.

8.2 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 Right 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.

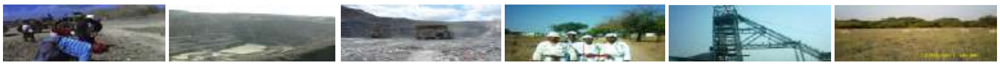
Regulation 5 – Restrictions on Use of Material

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.

8.3 CONCEPTUAL REHABILITATION PLAN

The rehabilitation of the Notre Coal (Pty) Ltd 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 30 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 rehabilitation for Notre Coal (Pty) Ltd project area after completion of the project, the project area will be used for tourism purpose for the benefit of the community.

Figure 8: *Typical example of open cast mining*

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

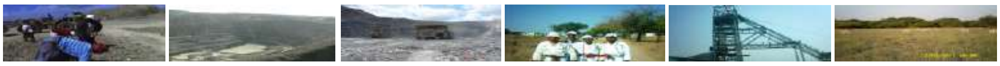
Table 1: Highlighted points that should be considered during construction phase

Activity	Recommended Control Measures
Mine Planning	Mine planning should minimise 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.

8.5 Soil Management Plan

9.5.1 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.



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. All these areas constitute a dominant soil type, namely Red apedal and Yellow apedal soil with plinthic horizon.

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).

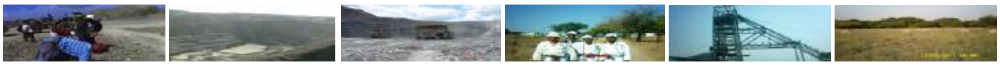
The positions of the soil stockpiles should be indicated on a map and the soil stockpiles should be protected using a fence because soil loss due to unauthorized use can and will occur. The topsoil stockpile should be re-vegetated to protect the soil from water and wind erosion.

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 **Notre Coal (Pty) Ltd** 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.

8.6 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.

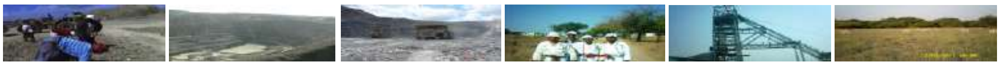
The soil, land use and land capability assessment report by Singo Consulting (Pty) Ltd describes the baseline soil conditions, the physical and chemical characteristics, land capability and current land uses of the mining area. This report should be consulted before areas are cleared in preparation for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

8.6.1 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.

8.6.2 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.

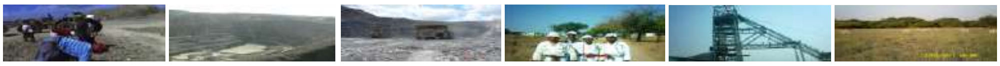
A soil balance sheet needs to be developed to record all soil types and stripping volumes transported to the stockpiles. This soil balance sheet will aid in the management of the soil stockpiles in addition to keeping record of available soil volumes for rehabilitation.

8.6.3 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.

8.6.4 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).



8.6.5 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.

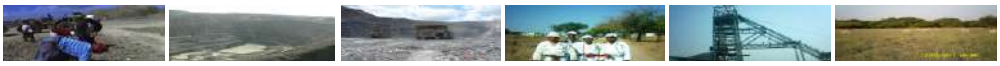
The steps that should be taken during soil stockpiling are as follows:

- 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.

8.6.6 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.

8.6.7 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.

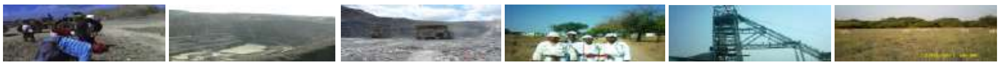
Stockpiles that are placed in drainage lines result in soils becoming waterlogged and a loss of desirable physical and chemical characteristics. Such situations also result in a loss of soils due to erosion. If stockpiles need to be placed in drainage lines, hydromorphic soils should be stockpiled in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

8.6.8 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.

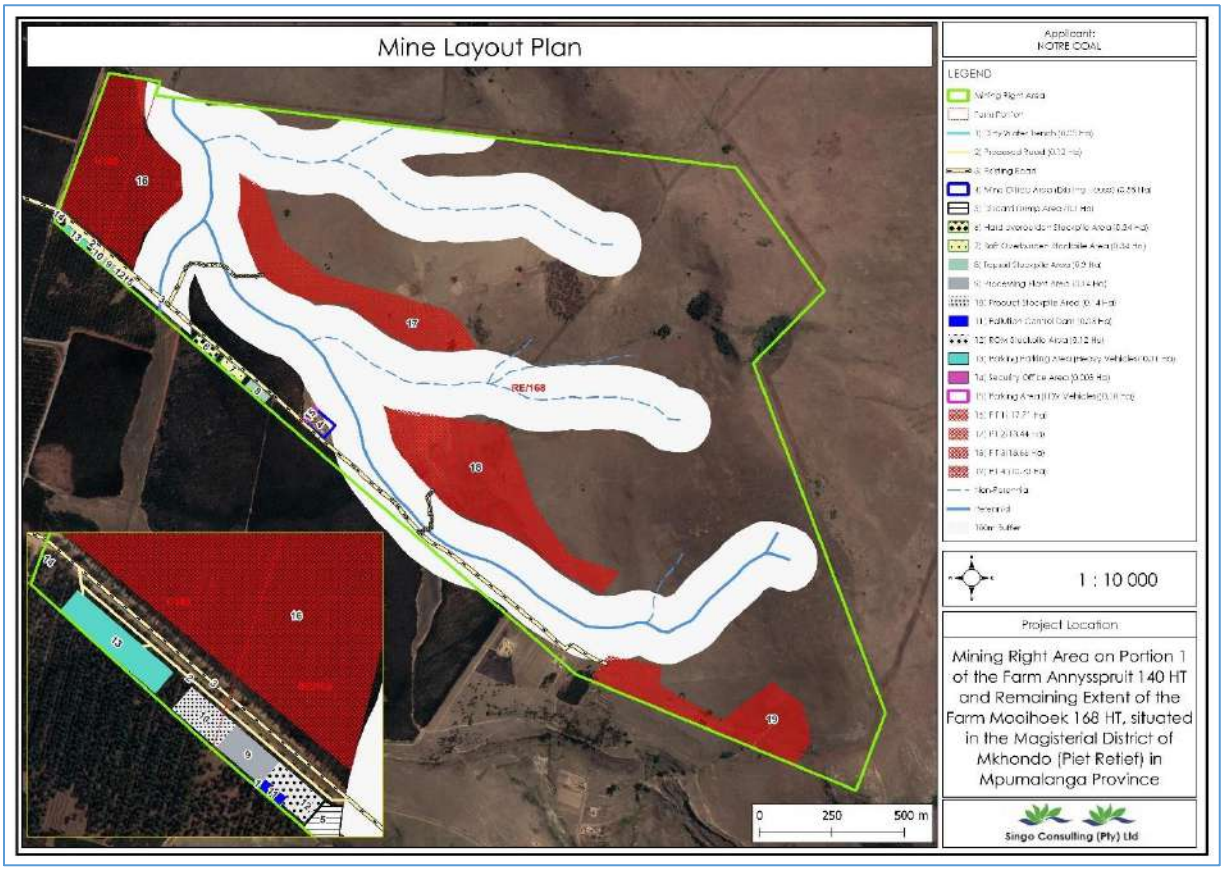


Figure 9: Mine Layout plan according to the proposed activities.

8.6.9 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.

8.6.10 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.

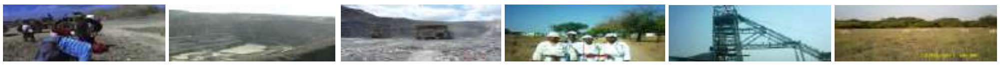
Stockpiles should be re-vegetated to avoid soil loss due to erosion and weed colonisation if stockpiles remain in the same location for more than one growing season and have not revegetated naturally. A similar seed mixture to the final mixture recommended for rehabilitation should be used. The looseness 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.

8.6.11Compaction 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.



8.6.12 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 compactability 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.

8.6.14 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

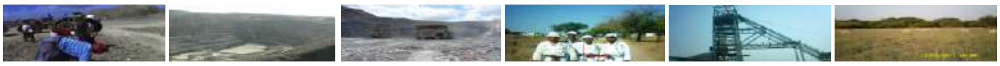
The steps that should be taken during the improvement of soils are as follows:

- 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

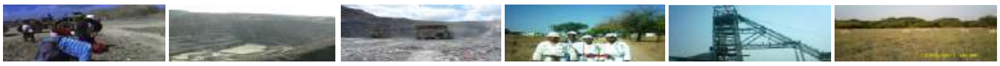
After mining has stopped the processing facilities, administration, mining, transport and storage facilities should be removed in order to meet the requirements of the post closure land use (Cultivation). In some cases, portions of the existing infrastructure can be used by land users after closure. 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 specialised 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.

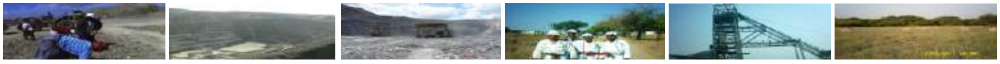
8.8.4 Final Landform

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.

8.8.7 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.

8.8.12 Drainage Channel Designs

The construction of erosion management channels on the rehabilitated areas should be avoided as so 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.

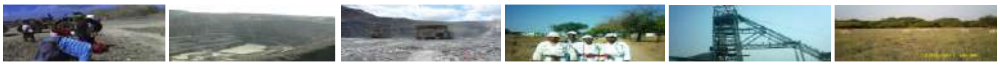
The consolidation of mine spoils takes many years to complete and once mining stops the water table re-establishes and also the wetting-up of the overburden materials could end in any settlement. This could be countered by constructing slopes within the contour banks that are significantly steeper than 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.

9. Vegetation and Fertiliser 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.



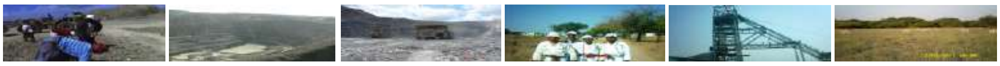
The common ways that used to establish vegetation include seeding and hydroseeding. Flat areas should be seeded using tractor implements and slopes too steep for tractors should be hydroseeded. among the event where soils are stripped and came back directly (i.e. no stockpiling) and therefore the areas stripped have good vegetation cover with applicable species present, natural re-colonisation 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

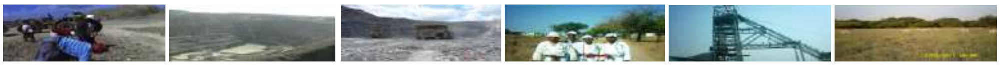
The common ways in which used to establish vegetation include seeding and hydroseeding. Flat areas should be seeded using tractor implements and slopes too steep for tractors should be hydroseeded. within the event where soils are stripped and came back directly (i.e. no stockpiling) and therefore the 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

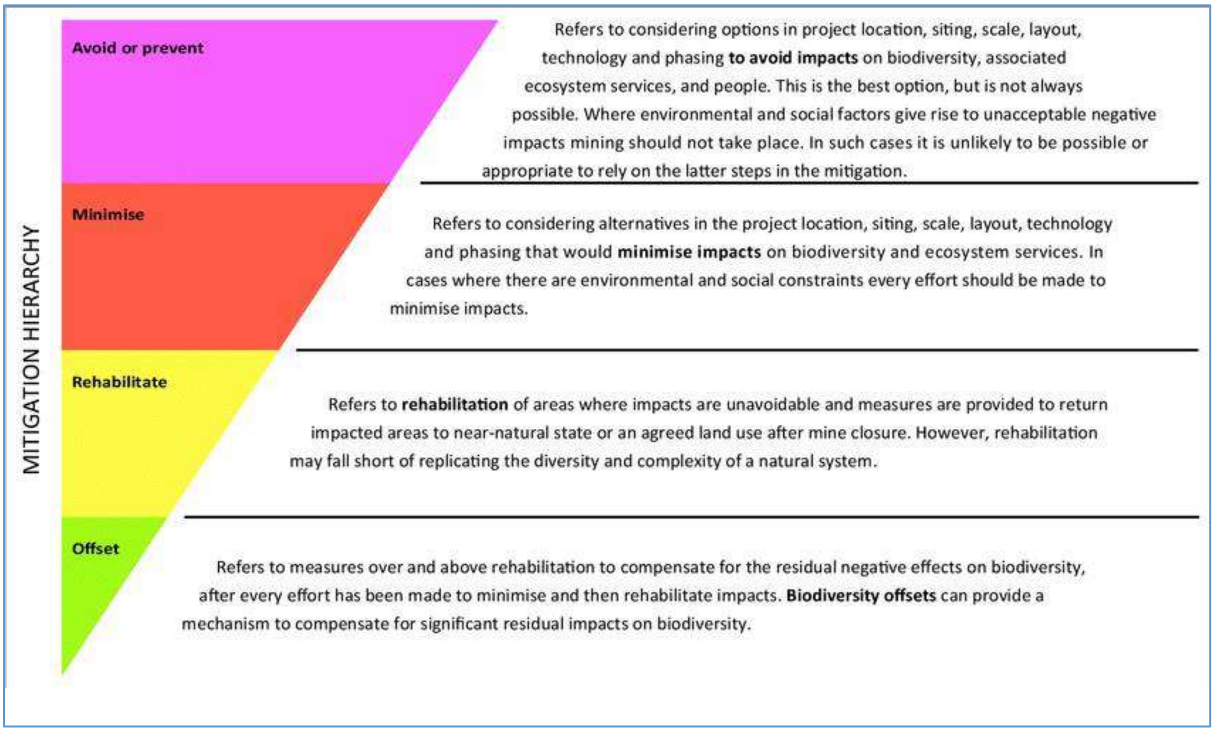
The most successful plantation is done after the first rains and freshly prepared fine tilled seedbeds. Water seed zone will stimulate germination and can be supported by the application of light vegetation.

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.



Refers to considering options in project location, siting, scale, layout, technology and phasing **to avoid impacts** on biodiversity, associated ecosystem services, and people. This is the best option, but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts mining should not take place. In such cases it is unlikely to be possible or appropriate to rely on the latter steps in the mitigation.

Refers to considering alternatives in the project location, siting, scale, layout, technology and phasing that would **minimise impacts** on biodiversity and ecosystem services. In cases where there are environmental and social constraints every effort should be made to minimise impacts.

Refers to **rehabilitation** of areas where impacts are unavoidable and measures are provided to return impacted areas to near-natural state or an agreed land use after mine closure. However, rehabilitation may fall short of replicating the diversity and complexity of a natural system.

Refers to measures over and above rehabilitation to compensate for the residual negative effects on biodiversity, after every effort has been made to minimise and then rehabilitate impacts. **Biodiversity offsets** can provide a mechanism to compensate for significant residual impacts on biodiversity.

Figure 10: The mitigation hierarchy for dealing with negative impacts on biodiversity

9.2 Fertiliser Management

9.2.1 Soil Fertilisation

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 can need 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.

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:

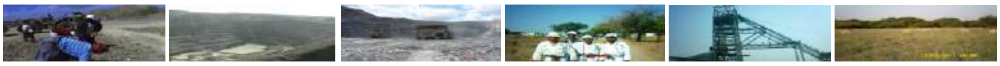
- **Category 1**: Declared weeds that are prohibited on any land or water surface in South Africa. These species must be controlled, or eradicated where possible
- **Category 2:** Declared invader species that are only allowed in demarcated areas under controlled conditions and prohibited within 30m 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.

11 Monitoring and Maintenance

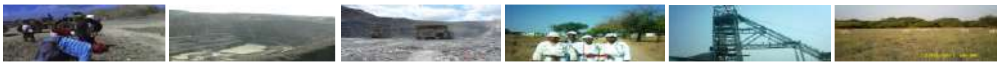
The main purpose of monitoring is to make sure that the objectives of rehabilitation are met and that the rehabilitation process is followed. The physical aspects of rehabilitation should be carefully monitored as well as during the progress of establishment of desired final ecosystems.

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.

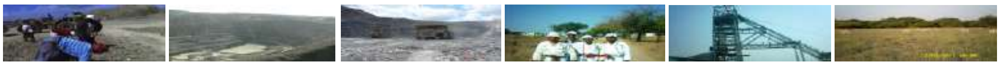
11.4 Surface Water

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.

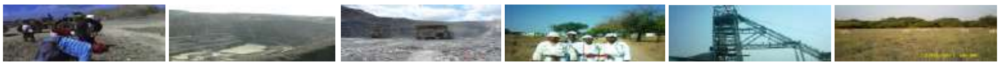
11.8 Monitoring of Erosion

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.

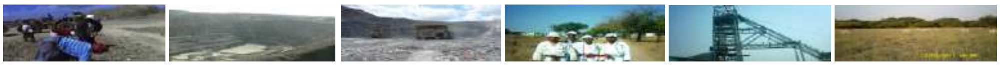
12 CONCLUSION AND RECOMMENDATIONS

12.1 Conclusion

- Life of the mine is expected to last a period of 30 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.



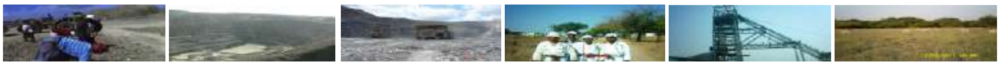
- The surrounding land uses are associated with plantation, waterbodies and mining activities.
- These planned project activities that may be implemented within the applied land will change the land capability for the lifetime of mine, whereas land use is modified from wild to mining among the mine sites.
- 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.

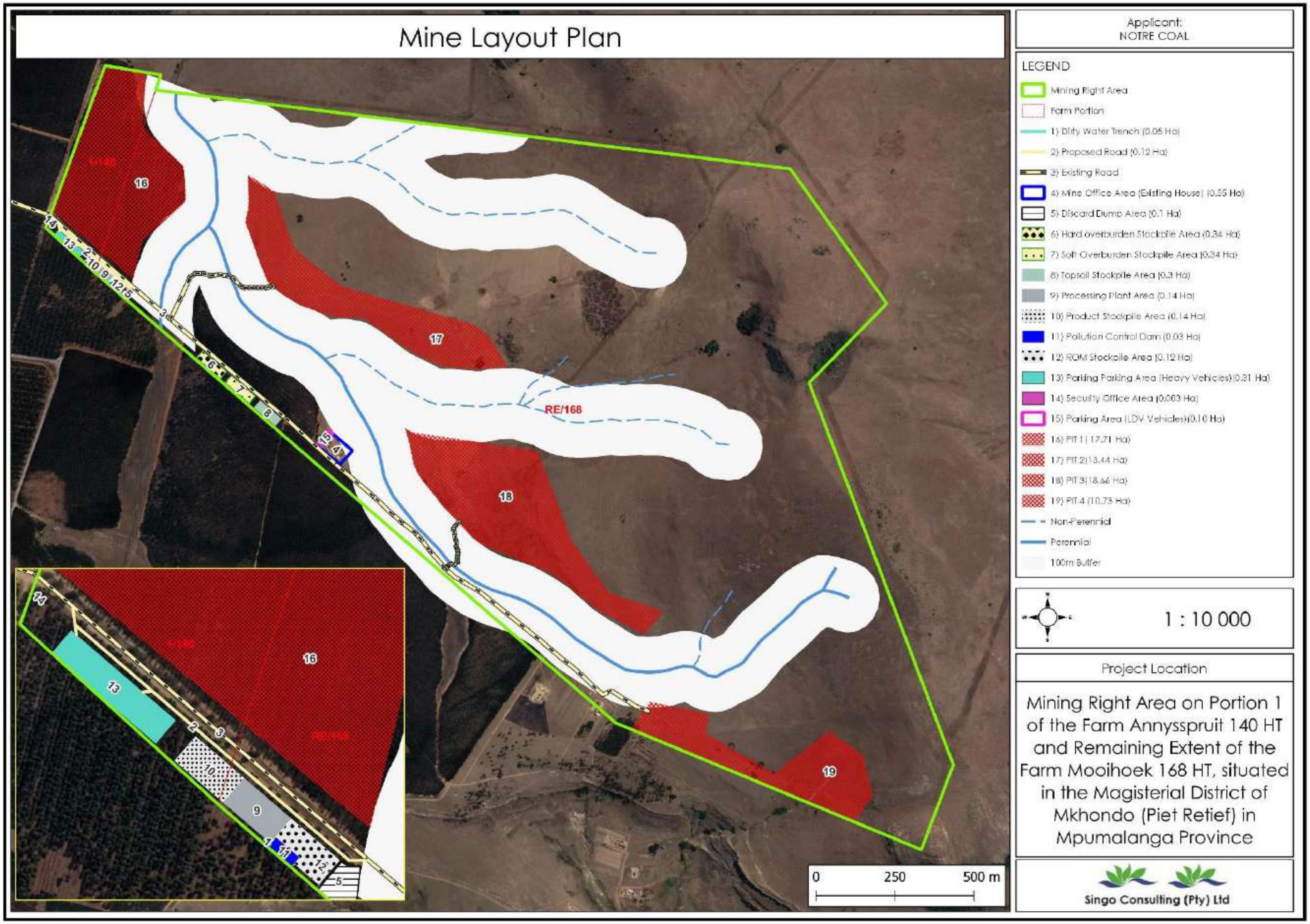


12.2 Recommendations

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




Mine Layout Plan
Applicant:
NOTRE COAL
LEGEND
Mining Right Area
Farm Portion
1) Dirty Water Trench (0.05 Ha)
2) Proposed Road (0.12 Ha)
3) Existing Road
4) Mine Office Area (Existing House) (0.55 Ha)
5) Discard Dump Area (0.1 Ha)
6) Hard overburden Stockpile Area (0.34 Ha)
7) Soft Overburden Stockpile Area (0.34 Ha)
8) Topsoil Stockpile Area (0.3 Ha)
9) Processing Plant Area (0.14 Ha)
10) Product Stockpile Area (0.14 Ha)
11) Pollution Control Dam (0.03 Ha)
12) ROM Stockpile Area (0.12 Ha)
13) Parking Parking Area (Heavy Vehicles)(0.31 Ha)
14) Security Office Area (0.003 Ha)
15) Parking Area (LDV Vehicles)(0.10 Ha)
16) PIT 1 (17.71 Ha)
17) PIT 2(13.44 Ha)
18) PIT 3(18.66 Ha)
19) PIT 4 (10.73 Ha)
Non-Perennial
Perennial
100m Buffer
1 : 10 000
Project Location
Mining Right Area on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated in the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province
Singo Consulting (Pty) Ltd
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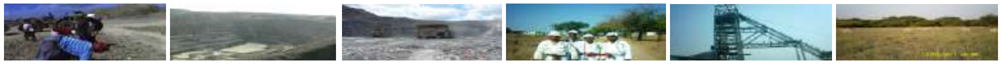

MINING RIGHT APPLICATION

SOIL, LAND USE AND LAND CAPABILITY STUDY

Soil, Land Use and Land Capability Study for the proposed Mining Right Application for Notre Coal (Pty) Ltd on Portion 1 of the Farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated under the Magisterial District of Mkhondo (Piet Retief) in Mpumalanga Province, South Africa.

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DMRE REF: MP 30/5/1/2/2/10384 MR

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 Right application within Portion 1 of the farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated under the Magisterial Districts of Mkhondo, Mpumalanga Province, South Africa.	
Mineral (s)	Coal resources	
Client	Notre Coal (Pty) Ltd	
Site location	Portion 1 of the farm Annysspruit 140 HT and Remaining Extent of the Farm Mooihoek 168 HT, situated under the Magisterial Districts of Mkhondo, Mpumalanga Province, South Africa.	
Version	1	
Date	01 September 2022	
		Electronic signatures
Compiled by	Mueletshedzi Nndwammbi (Hydrogeologist Intern) 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)	

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

Notre Coal (Pty) Ltd has appointed Singo Consulting (Pty) Ltd as an independent consulting company to conduct a specialist soil, land use and land capability study as part of the Mining Right Application which has been lodged with **DMRE Ref: MP 30/5/1/2/2/10384 MR** within Portion 1 of the farm Annysspruit 140 HT, and Remaining Extent of the Farm Mooihoek 168 HT, Situated in the Magisterial District of Mkhondo, Mpumalanga province, South Africa.

The study area is situated approximately 16.81 Km in the southwestern direction of Piet Retief.

High agricultural potential land is a scarce non-renewable resource, which necessitates an Agricultural Potential assessment prior to land development, particularly for purposes other than agricultural land use, as per Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). High potential agricultural land is defined as land having ‘’the soil and terrain quality, growing season and adequate available moisture supply to sustain crop production when treated and managed according to best possible farming practices” (Land Capability report ARC, 2006). Land Capability Classes (LCC) are used to determine the agricultural potential of soils within the Project Area due to the positive correlation between the agricultural potential and Land Capability Classification. Land Capability Classification is measured on a scale of I to VIII, with the classes of I to III considered as prime agricultural soils and classes V to VIII not suitable for cultivation.

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. Throughout the existence of the project ranging from construction until post mining phase, there are activities that will be undertaken to ensure that the operation is efficient and effective whilst upholding environmental sustainability. These activities have the potential to negatively affect the soil in the area, which could result in land capability loss or quality of soil.

1.2.1 Clearing of Vegetation

During Construction phase, vegetation will be cleared to create roads, erect building or space for mobile offices, and also to create mining area and trenches. This will decrease the vegetation in the general area.

1.2.2 Stripping of Topsoil

Topsoil will be stripped during the construction phase, as well as during the operation phase. Soil stripping will involve removing topsoil to create foundations, and also with the aim of removing any deep-rooted trees. The areas to be stripped include but not limited to mining area, roads, office area, and location of other infrastructures. The topsoil stripped will be piled elsewhere for rehabilitation post mining. And will be ensured to not mix with any other soil to avoid cross contamination. The topsoil can be used to create berms within the footprint of the study area.

1.2.3 Placement of infrastructures (Mobile Ablutions, mobile offices, Fuel Storages)

Prior to commencement of mining activities, infrastructures will be placed which are a necessity which include ablutions, offices and fuel storages. There are designated areas where such infrastructures will placed throughout the existence of the project. Ablutions will be maintained regularly to avoid overflow of chemicals which could lead to soil contamination, fuel storage tank will be bunded to avoid any potential leakage.

1.2.4 Resource Exploitation/ Mining Operation

The exploitation is most probably the most important phase of all the phases of mining. This will involve soil stripping, drilling and blasting to free the ore, which will then be loaded into the haul trucks. During the exploitation phase there will be movement of machinery, this will likely increase the likelihood of soil erosion. Most of the activities which will be undertaken, will form part of the mining phase.

1.2.5 Removal of mobile infrastructure and Rehabilitation

Mining is defined as a project, which implies that it has a set timeframe, as such once that timeframe has been reached, the ore is no longer economic and decommissioning of the project begins, which is then followed by the rehabilitation process. This will include the removal of any mobile structures, and then rehabilitation process which include but not limited to revegetation.

1.3 Terms of reference (ToR) and Scope of Work (SoW)

Singo Consulting (Pty) Ltd was appointed by Notre Coal (Pty) Ltd to conduct a detailed soil study for the Mining Right application on Portion 1 of the farm Annysspruit 140 HT, and Remaining Extent of the Farm Mooihoek 168 HT, situated under the Magisterial Districts of Mkhondo, Mpumalanga Province.

The Environmental Authorisation process of the soil, land use and land capability assessment entailed the following aspects:

- As part of the desktop study various data sets were consulted which includes but not limited to land type and capability maps, to establish broad baseline conditions and sensitivity of the study area both on environmental and agricultural perspective;
- Compile various maps depicting the on-site conditions based on desktop review of existing data;
- Conduct a soil classification survey within the study area.
- Assess the spatial distribution of various soil types within the study area and classify the dominant soil types according to the South African Soil Classification System: A Natural and Anthropogenic System for South Africa (Soil Classification Working Group, 2018);
- Identify and assess the potential impacts in relation to the proposed development using pre-defined impact assessment methodology; and
- Compile soil, land use and land capability report under current on-site conditions based on the field finding data.

1.4 Limitations and Assumptions

For the purpose of this assessment, the following assumptions and limitations are applicable:

- The soil survey conducted as part of the land capability assessment was confined within the Mining Right area (Study area).
- Since soils occur in a continuum with infinite variances, it is often problematic to classify any given soils as one form, or another. For this reason, the classifications presented in this report are based on the "best fit" to the soil classification system of South Africa.
- The compilation of this report was mostly based on the experience of the compiler, and the available data from studies conducted in that particular area or close to that area.
- Soil mapping on this report was undertaken at a high level, and the findings of this assessment were therefore inferred from extrapolations from individual observation points. The data collected is however deemed sufficient to support informed decision making.
- Due to safety reasons, certain areas could not be sampled. Which led to them not being sampled and or categorized under a certain soil form.

2 METHODOLOGY

2.1 Literature and Database Review

Prior to commencement of the field assessment, a background study, including a literature review, was conducted to collect the pre-determined soil, land use and land capability data in the vicinity of the investigated Study area. Various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references were utilised to fulfil the objectives for the assessment. This was followed by a field investigation exercise to ground truth the pre-determined soil results which were undertaken using desktop methods.

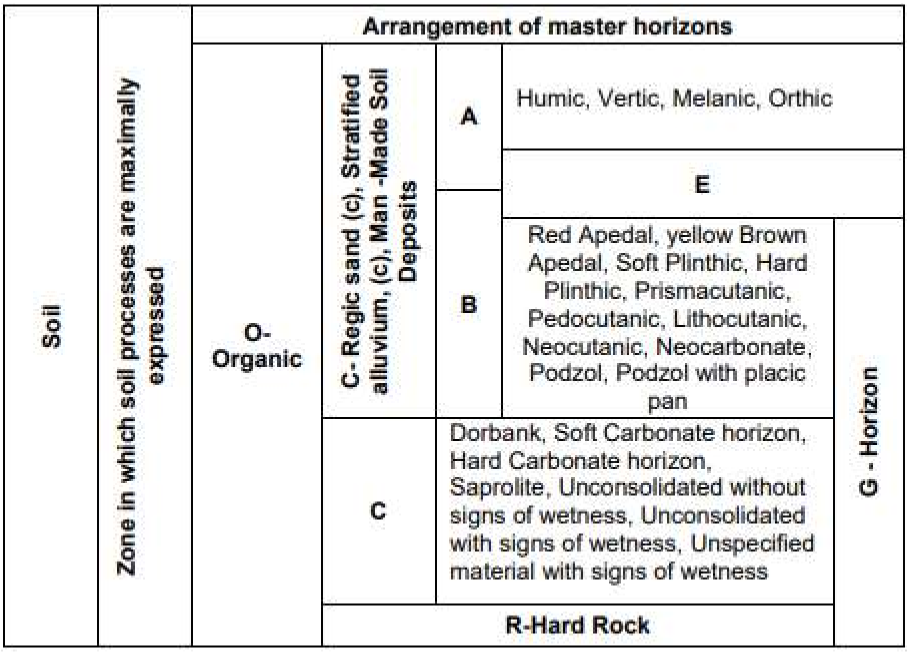
2.2 Soil Classification and Sampling

Following a database review, a soil survey was conducted in October 2022, at which time the identified soils within the Mining Right area were classified into soil forms according to the Soil Classification System: A Natural and Anthropogenic System for South Africa Soil Classification System (2018). This survey period is deemed appropriate since seasonality does not have an effect on the soil characteristics. Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses.

- Subsurface soil observations and sampling were made by means of a manual bucket hand auger;
- Dominant soil types were classified according to the South African Soil Classification System (Soil Classification Working Group, 1991);
- Assessed survey and sampling points were recorded on a Global Positioning System (GPS);
- Physical soil properties were described including the following parameters:
    - Terrain morphological unit (landscape position) description;
    - Diagnostic soil horizons and their respective sequence;
    - Depth of identified soil horizons;
    - Soil form classification name(s);
    - Observed land capability limitations of the identified soil forms; and
    - Soil data was analysed to assess the impacts of the proposed mining project under current conditions.

It was also the objective of the assessment to provide recommended mitigation measures and management practices to implement in order to comply with applicable articles of legislation.

Table 2: Typical Arrangement of master horizons



<table>
<tr><td rowspan="6">Soil</td><td rowspan="6">Zone in which soil processes are maximally expressed</td><td colspan="5">Arrangement of master horizons</td></tr>
<tr><td rowspan="5">O-Organic</td><td rowspan="3">C- Regic sand (c), Stratified alluvium, (c), Man -Made Soil Deposits</td><td rowspan="2">A</td><td colspan="2">Humic, Vertic, Melanic, Orthic</td></tr>
<tr><td colspan="2">E</td></tr>
<tr><td>B</td><td>Red Apedal, yellow Brown Apedal, Soft Plinthic, Hard Plinthic, Prismacutanic, Pedocutanic, Lithocutanic, Neocutanic, Neocarbonate, Podzol, Podzol with placic pan</td><td rowspan="3">G - Horizon</td></tr>
<tr><td>C</td><td colspan="2">Dorbank, Soft Carbonate horizon, Hard Carbonate horizon, Saprolite, Unconsolidated without signs of wetness, Unconsolidated with signs of wetness, Unspecified material with signs of wetness</td></tr>
<tr><td colspan="3">R-Hard Rock</td></tr>
</table>

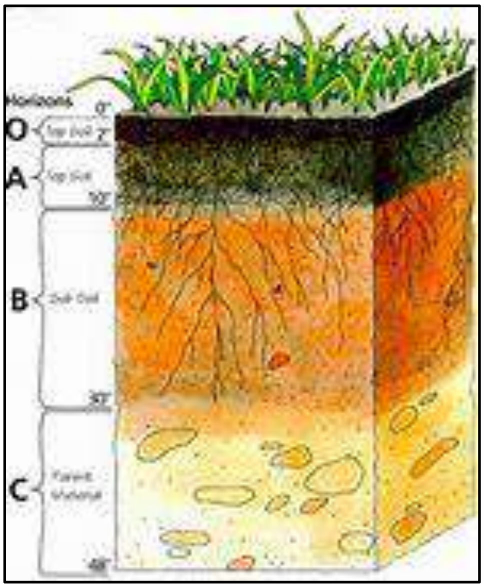


Figure 1: Soil Profile Diagram

2.3 Analysis of Soil 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 Portion 1 of the farm Annysspruit 140 HT, and Remaining Extent of the Farm Mooihoek 168 HT, situated under the Magisterial Districts of Mkhondo, Mpumalanga Province, South Africa, 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.

2.4 Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table 3 below; with Classes I to III classified as prime agricultural land that is well suited for annual cultivated crops, whereas Class IV soils may be cultivated under certain circumstances and specific or intensive management practices, and Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of C1 to C8, as illustrated in Table 4 below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were assessed to inform the necessary mitigation measures.

Table 3: Land capability Classification (Smith, 2006)

Land Capability Class	**Increased intensity of Use**									**Land Capability Groups**	**Limitations**
I	**W**	**F**	**LG**	**MG**	**IG**	**LC**	**MC**	**IC**	**VIC**	**Arable land**	**No or Few Limitations**
II	**W**	**F**	**LG**	**MG**	**IG**	**LC**	**MC**	**IC**			
III	**W**	**F**	**LG**	**MG**	**IG**	**LC**	**MC**	**IC**			
IV	**W**	**F**	**LG**	**MG**	**IG**	**LC**					
V	**W**	**F**	**LG**	**MG**						**Grazing Land**	**Water course and Land with wetness limitations**

VI	**W**	**F**	**LG**	**MG**							**Limitations preclude cultivation. Suitable for perennial**
VII	**W**	**F**	**LG**								**Severe Limitations. Suitable for natural vegetations**
VIII	**W**									**Wildlife**	**Extremely severe limitations. Not suitable for grazing and afforestation**
W- Wildlife				**MG – Moderate Grazing**					**MC – Moderate Cultivation**		
F- Forestry				**IG – Intensive Grazing**					**IC – Intensive Cultivation**		
LG – Light Grazing				**LC – Light Cultivation**					**VIC – Very Intensive Cultivation**		

Table 4: Climate Capability Classification (Scotney, et al., 1987)

Climate Capability Class	**Limitation Rating**	**Description**
C1	None to Slight	Local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.

C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss
C7	Severe to very Severe	Severely restricted choice of crops due to heat, cold and/or moisture stress
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

The land potential assessment entails the combination of climatic, slope and soil condition characteristics to determine the agricultural land potential of the investigated area. The classification of agricultural land potential and knowledge of the geographical distribution of agricultural viable land within an area of interest. This is of importance for making an informed decision about land use. Table 5 below presents the land potential classes, whilst Table 6 presents a description thereof, according to Guy and Smith (1998).

Table 5: Land Potential Classes (Smith, 2006)

Land Capability Class	**Climate Capability Class**							
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
I	L1	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	(L3) Wetland	(L3) Wetland	(L4) Wetland	(L4) Wetland	(L5) Wetland	(L5) Wetland	(L6) Wetland	(L6)Wetland
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8

VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 6: Land Potential Class description, Adapted from Guy and Smith, 1998

Land Potential	**Description of Land Potential Class**
L1	**Very high potential:** No limitations. Appropriate contour protection must be implemented and inspected.
L2	**High potential:** Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L3	**Good potential:** Infrequent and/or moderate limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L4	**Moderate potential:** Moderately regular and/or severe to moderate limitations due to soil, slope, temperature or rainfall. Appropriate permission is required before ploughing virgin land.
L5	**Restricted potential:** Regular and/or moderate to severe limitations due to soil, slope, temperature or rainfall.
L6	**Very restricted potential**: Regular and/or severe limitations due to soil, slope, temperature or rainfall. Non-arable
L7	**Low potential:** Severe limitations due to soil, slope, temperature or rainfall. Non-arable.
L8	**Very low potential:** Very severe limitations due to soil, slope, temperature or rainfall. Non-arable.

3 PHYSIOGRAPHICAL AND SOIL SETTING

3.1 Project Location

The locality map created by the QGIS illustrates the location of the proposed area, the study area is situated on Portion 1 of the farm Annysspruit 140 HT, and Remaining Extent of the Farm Mooihoek 168 HT, situated in the magisterial district of Mkhondo, Mpumalanga province. The Mining Right area as indicated by red ribbon on Figure 2. The study area is located approximately 16.81 Km in the southwestern direction of piet Retief. The coordinates of the study area are **27° 6'0.44"S and 30°37'0.44"E.**

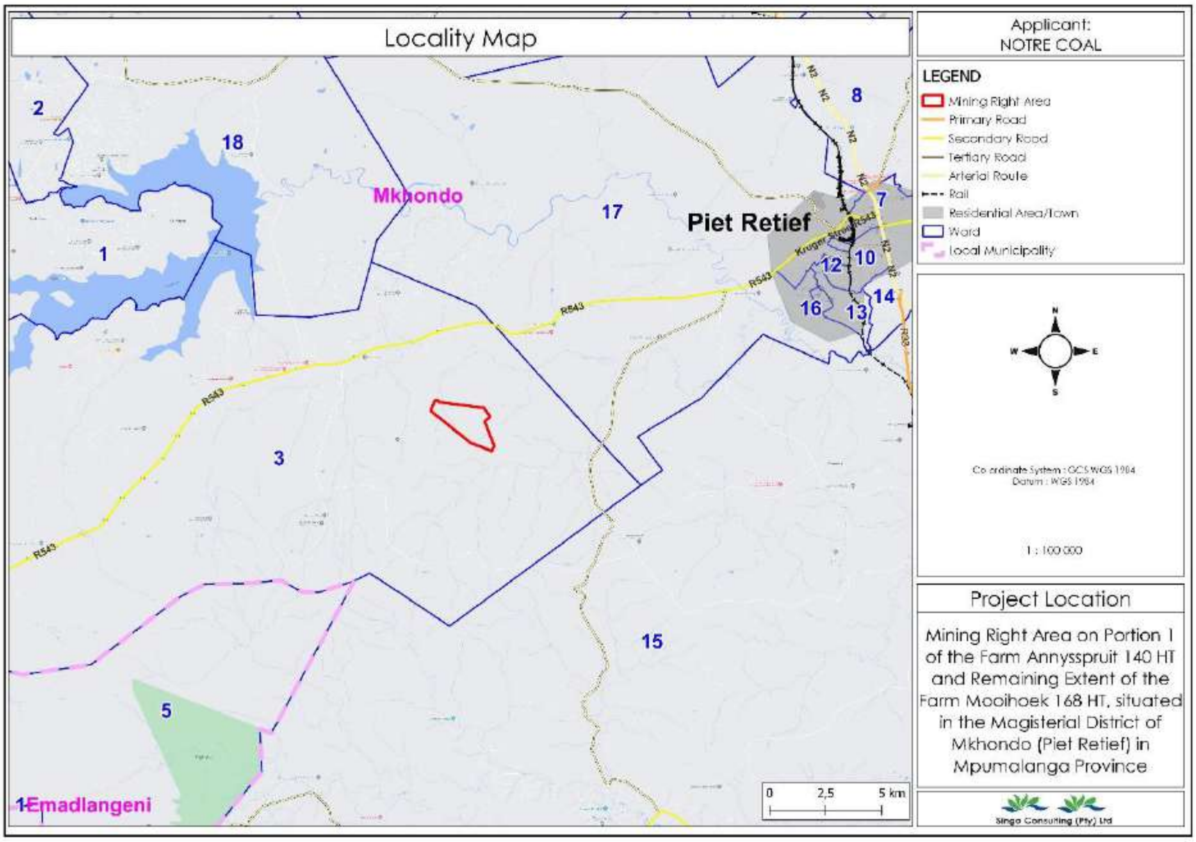


Figure 2: Locality Map of the study area

3.2 Climate

Climate is the state of the atmosphere over long time periods, 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 here is mild, and generally warm and temperate. According to Köppen and Geiger, this climate is classified as Cwb. In Mkhondo, the average annual temperature is 16.1 °C. About 601 - 1000 mm of precipitation falls annually. Precipitation is the lowest in June, with an average of 12 mm. The greatest amount of precipitation occurs in December, with an average of 165 mm. At an average temperature of 19.5 °C, February is the hottest month of the year. The lowest average temperatures in the year occur in July, when it is around 11.0 °C. Between the driest and wettest months, the difference in precipitation is 153 mm. The variation in temperatures throughout the year is 8.4 °C (Saws, 2011). Polygon in the southern direction is located where the mean minimum annual temperature is 2.1 4 degree Celsius.

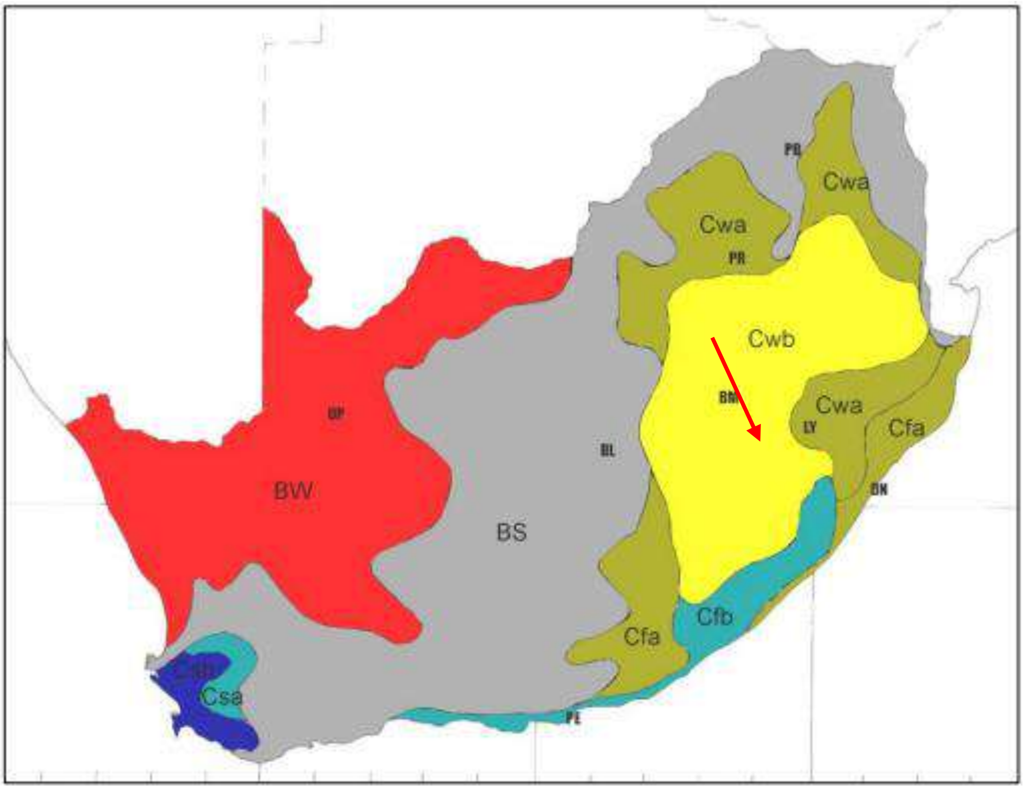


Figure 3: Köppen Geiger classification System (SAWS, 2011)

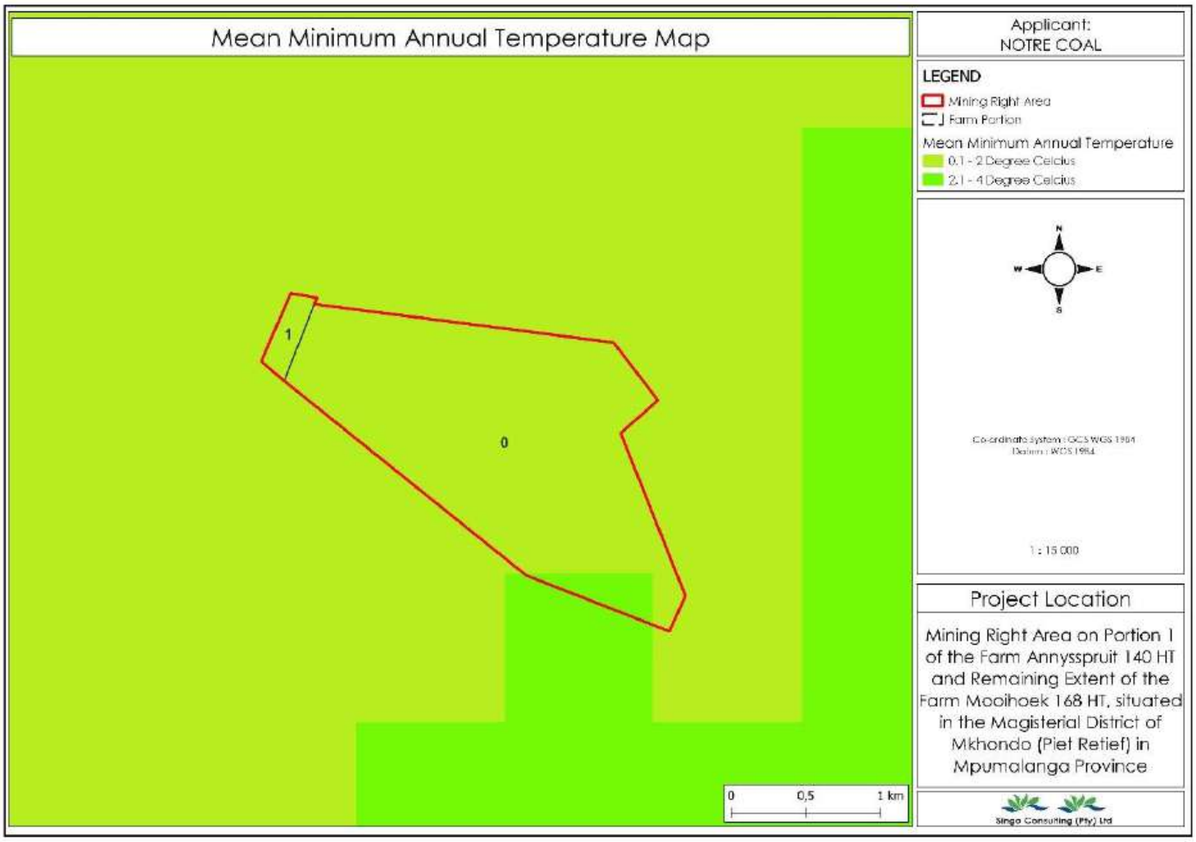


Figure 4: Mean minimum temperature map

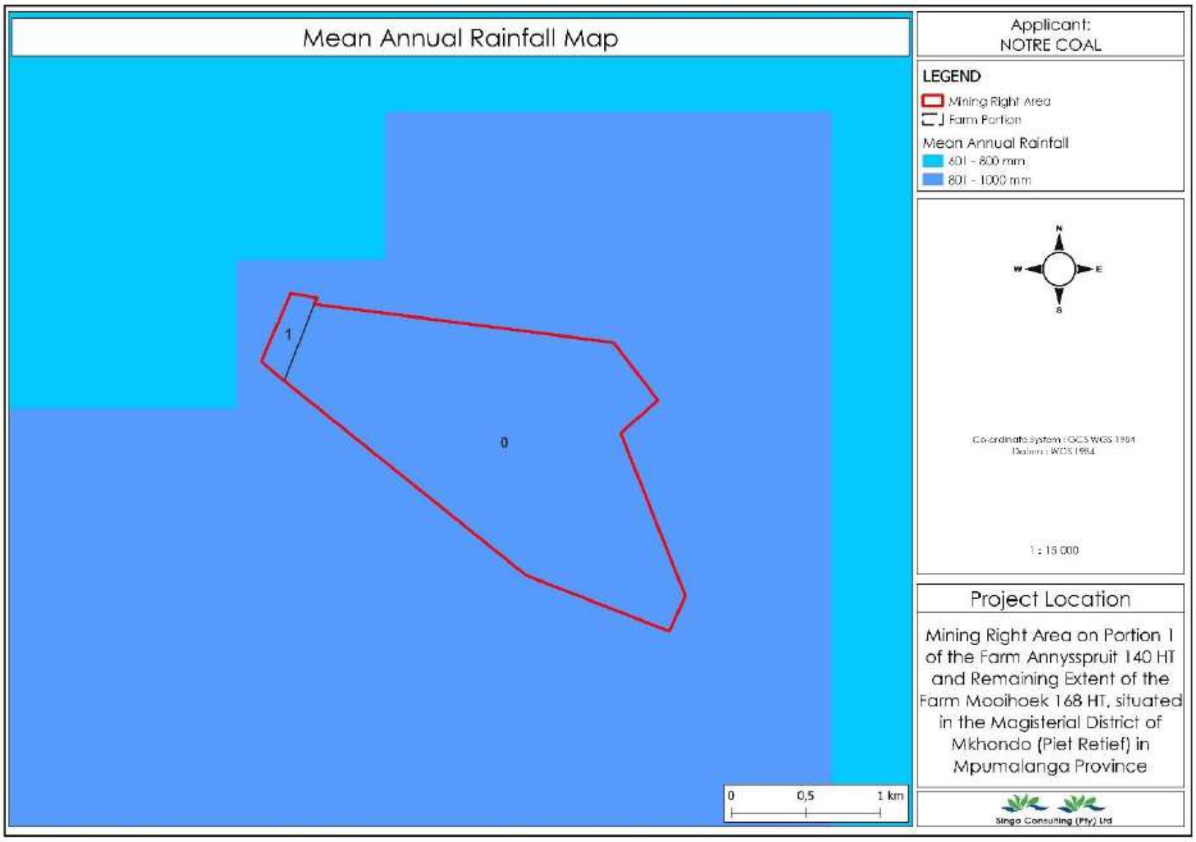


Figure 5: Mean Annual Rainfall map

4. FIELD ASSESSMENT / SITE ASSESSMENT

4.1 Current land use

Current land use activities associated with the study area are largely dominated by Plantations, Waterbodies, Built up area, animal farming.

Table 7: Current land use pictures

<table>
<tr><th colspan="2">Current land use within the study area</th></tr>
<tr><td>Built up area</td><td>Plantations observed and Landscape</td></tr>
<tr><td>Waterbodies</td><td>Sign of Animals on site</td></tr>
</table>

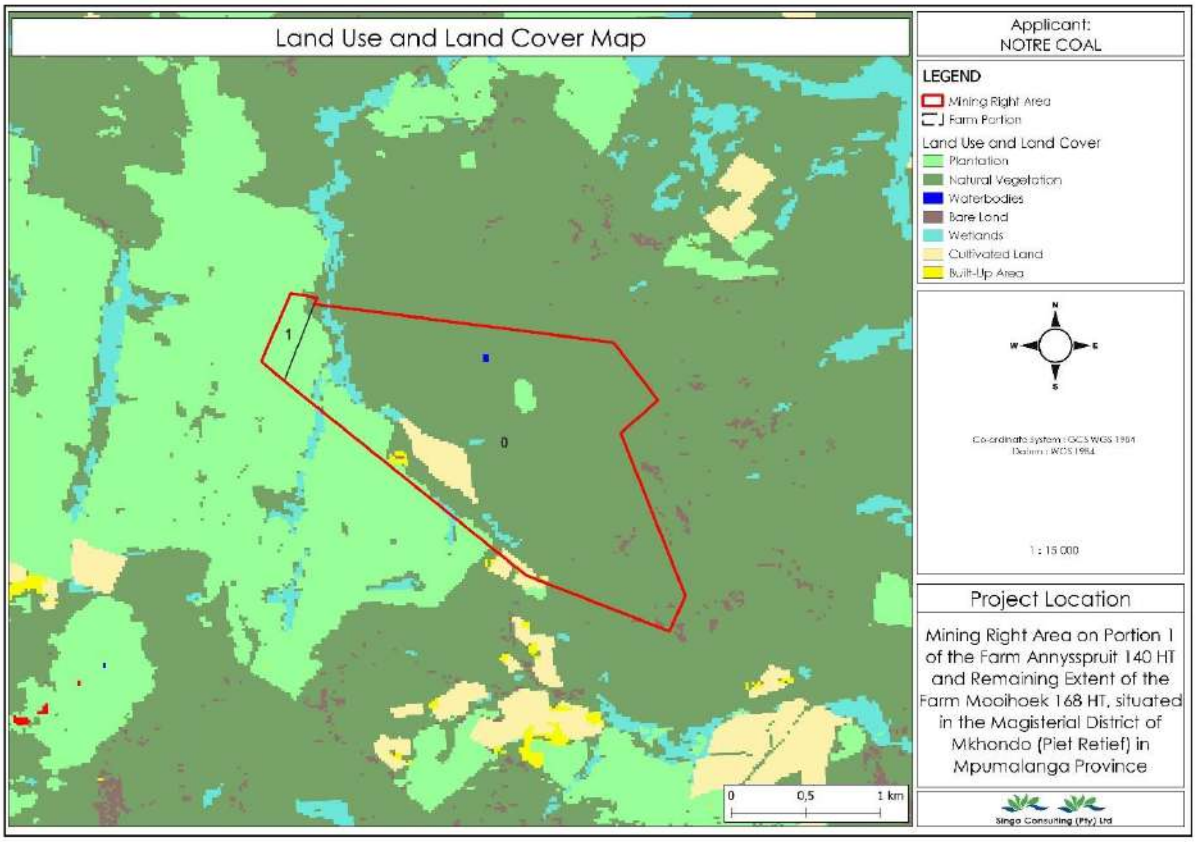


Figure 6: Land use and Land cover map of the study area

4.2 Soil Dominant Soils within the study area.

The study area was found to be comprised of two soil classes, which fall under the Association of classes 13 and 16: Undifferentiated Structureless Soils and Association of Classes 1 to 4 : Undifferentiated Structureless Soils.

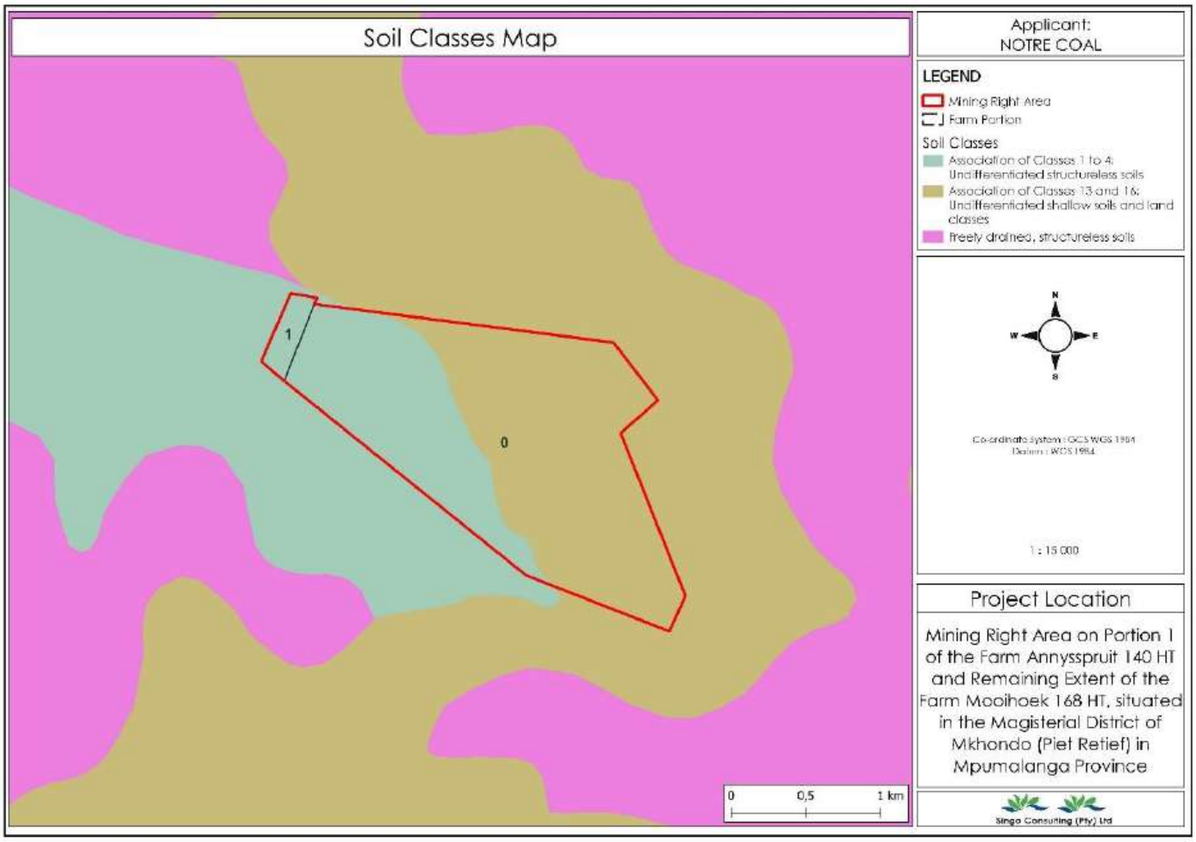


Figure 7: Soil Classes map of the study area

Table 8: Equipment's and description

equipment's	**Description**
The equipment's used included: ➢ Auger ➢ 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 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.

Table 9:MCCSSO Table

Soil identified on Site	**Moisture**	**Colour**	**Consistency**	**Structure**	**Soil type**	**Origin**
	Dry	Light brown	Loose	Structureless soils	Sandy Loam	Colluvium
						

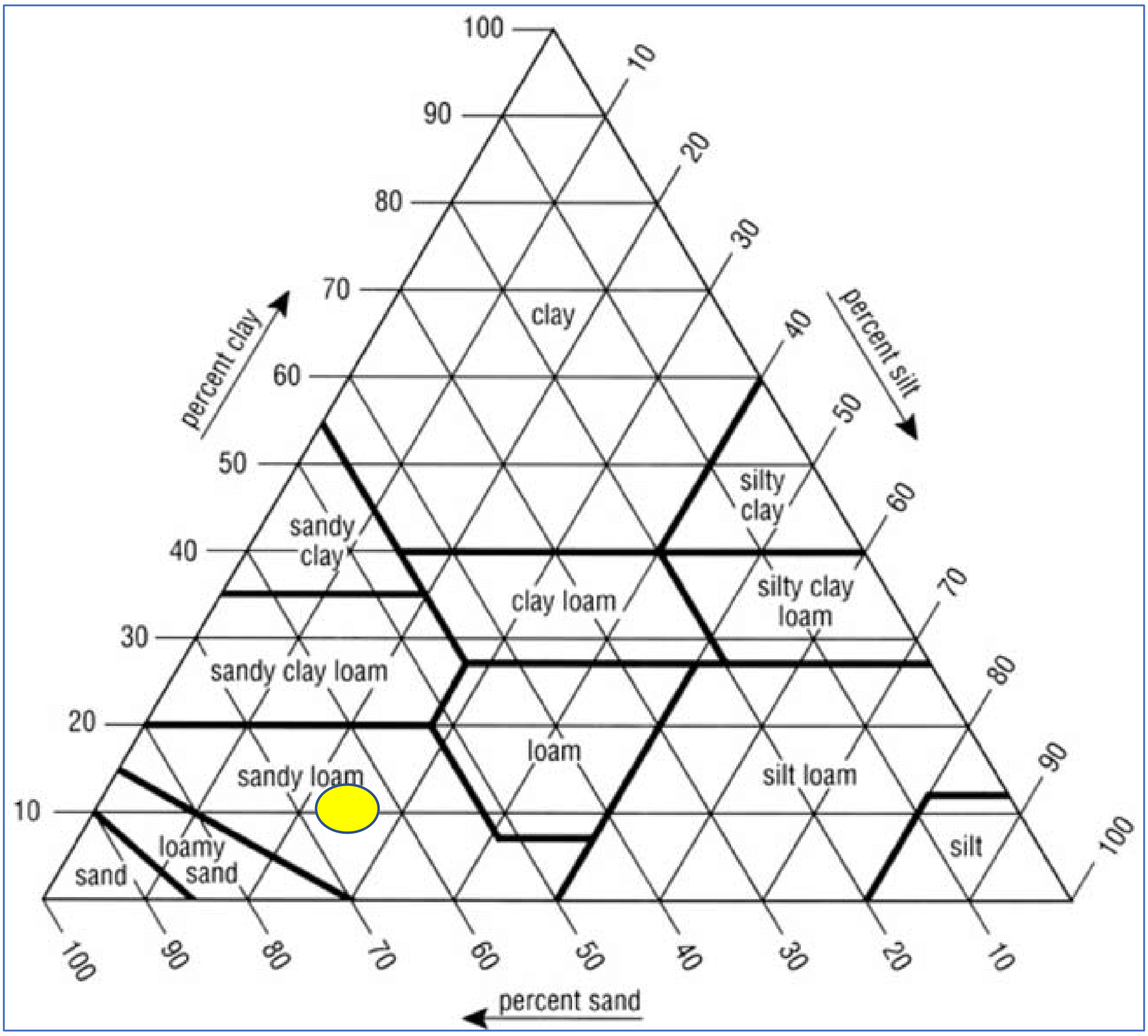


Figure 8: Soil texture ternary diagram

4.3 Land Capability Classification

Agricultural land capability in South Africa is generally restricted by climatic conditions, with specific mention to water availability (Rainfall). Even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics. High potential agricultural land is defined as having the soil and terrain quality, growing season and adequate available moisture supply needed to produce sustained economically high crops yields when treated and managed according to best possible farming practices (Scotney et al., 1987).

For the purpose of this assessment, land capability was inferred in consideration of observed limitations to land use due to physical soil properties and prevailing climatic conditions. Climate

Capability (measured on a scale of 1 to 8) was therefore considered in the agricultural potential classification. The Project Area falls into Climate Capability Class 7 due to the severely restricted choice of crops due to heat, cold and/or moisture stress. The present vegetation is mostly plantations which do not require extensive amount of water and are able to store water, as well as shrubs which were dry during the site assessment.

The study area consists of arable land and grazing 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.

The identified soils were classified into land capability and land potential classes using the Camp et. al, and Guy and Smith Classification system (Camp et al., 1987; Guy and Smith, 1998), as presented from Figure 9 below. The dashboard style aims to present all the pertinent information in a concise and visually appealing fashion.

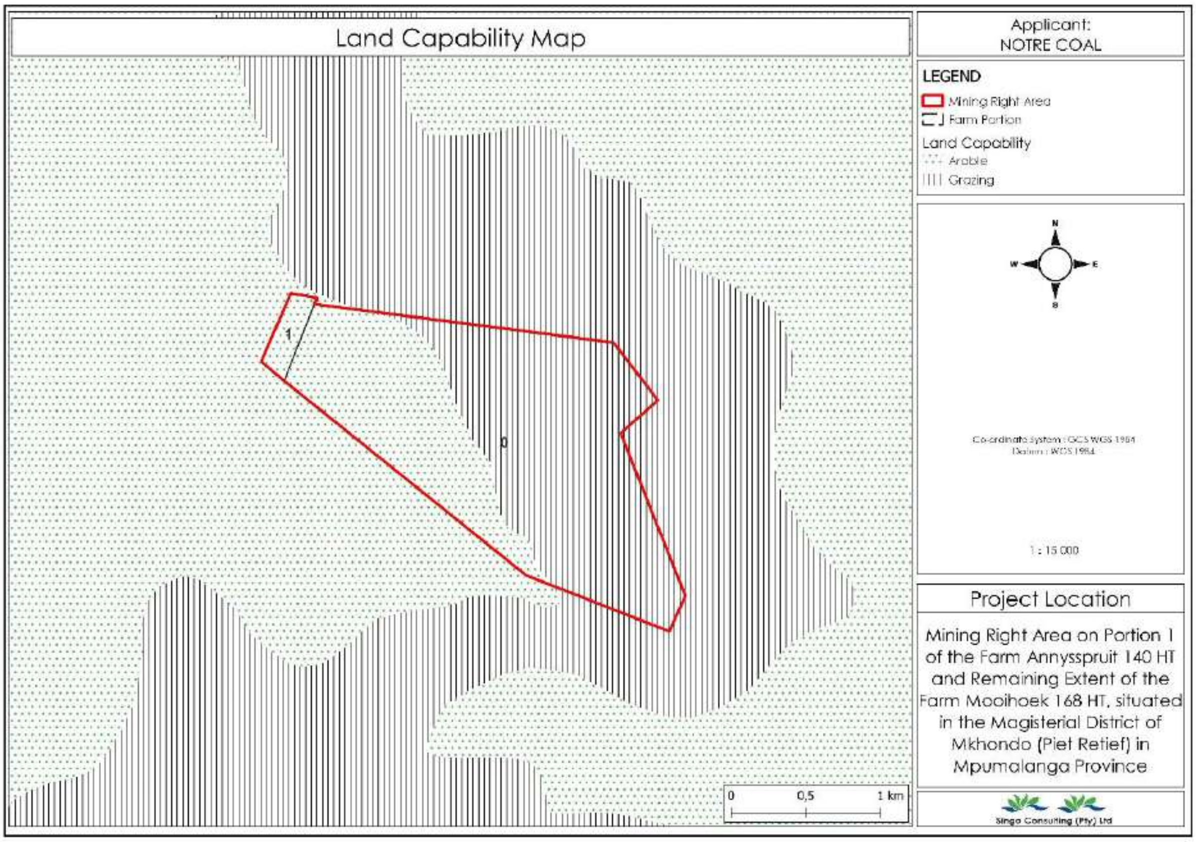


Figure 9: Land capability class of the study area

Table 10: Summary Discussion of the Arable (IV) (Dashboard style adopted from ZRC Report)

<table>
<tr><th colspan="4">Land Capability: Arable (Class IV) with Severe limitations.</th></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td>Soil Form</td><td>Physical Limitations</td><td>Land Potential</td></tr>
<tr><td>< 1 %, Relatively flat</td><td>Witbank Form</td><td>The soil has limited water bearing capability.</td><td>L5: Restricted potential: Regular and/or moderate to severe limitations due to soil, slope, temperature or rainfall.</td></tr>
<tr><td>Land Capability and Land Potential</td><td colspan="3">These soil forms are considered to have restricted potential with Class IV land Capability, suitable for arable agricultural land use with high management interventions. Therefore these soils are considered suitable for use for crop cultivation and are also well suited for other less intensive land uses such as Wildlife, Forestry, Light Grazing, Moderate Grazing, Light Cultivation and Intensive Cultivation.</td></tr>
</table>

4 IMPACT ASSESSMENT AND MITIGATION MEASURES

This section presents the significance of potential impacts on the identified soil resources associated with the impacts which have already taken place and the proposed developments. In addition, it also indicates the required mitigatory measures needed to minimise the perceived impacts associated with the proposed mining activity and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

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 on the identified soils.

5.2.1 Soil Erosion

Soil erosion is largely dependent on land use and soil management and is generally accelerated by anthropogenic activities. In the absence of detailed South African guidelines on erosion classification, the erosion potential and interpretation are based on field observations as well as observed soil profile characteristics. In general, soils with high clay content have a high-water retention capacity, thus less prone to erosion in comparison to sandy textured soils, which in contrast are more susceptible to erosion.

The proposed development footprint is located on a relatively mountainous plains. The soils of Wirbank Form occurring within the Project Area are susceptible to soil erosion due to their sandy nature and shallow depth. Soils which were vegetated prior to the proposed activities will be more susceptible to erosion during the construction phase if left bare or if not vegetated when in stockpile areas before the rainy season; thus, exposed to wind and storm water. Soil erosion is likely to have some negative impacts on soil and this will most likely lead to:

- Removal of organic matter and important soil nutrients essential for vegetation growth and thus reduced yield potential;
- Possible pollution and sedimentation of nearby water sources consequently affecting the water quality for livestock and
- Limited water availability essential for vegetation growth

Soil erosion will be attributed to the following activities throughout the life of the mine.

- **Construction Phase :**
    - Site clearing, removal and associated disturbances to soils, leading to, increased runoff, erosion and consequent loss of land capability in cleared areas. And Potential frequent movement of digging machinery within lose and exposed soils, leading to excessive erosion
- **Operation Phase :**
    - Constant disturbances of soils, resulting in risk of erosion.
    - Ongoing disturbances to soils, resulting in increased sedimentation and risk of erosion, arising from mining activities.

5.2.2 Soil Compaction

Heavy equipment traffic during construction and activities is anticipated to cause soil compaction. The Project Area is more prone to compaction as there will be a significant increase in the use of vehicle and heavy machinery during the construction phase and if work is done when the soil is wet this may increase the soils susceptibility to compaction. Soil compaction may potentially lead to:

- Increased bulk density and soil strength, reduced aeration and lower infiltration rate;
- Consequently, it lowers crop performance via stunted aboveground growth coupled with reduced root growth;
- Destroyed soil structure, causing it to become more massive with fewer natural voids with a high possibility of soil crusting. This situation can lead to stunted, drought-stressed plants as a result of restricted water and nutrient uptake, which results in reduced crop yields;
- Soil biodiversity is also influenced by reduced soil aeration. Severe soil compaction may cause reduced microbial biomass. Soil compaction may not influence the quantity, but the distribution of macro fauna that is vital for soil structure including earthworms due to reduction in large pores.

Soil Compaction will be attributed to the following activities throughout the life of the mine.

- **Construction Phase:**
    - Site clearing and associated disturbances to soils, leading to, increased runoff, soil compaction and consequent loss of land capability in cleared areas.

    - Potential frequent movement of digging machinery and construction vehicles within lose and exposed soils, leading to excessive soil compaction.
- **Operational Phase:**
    - Constant disturbances of soils, resulting in risk of compaction.
    - Movement of vehicles along the designated roads, this leads to soil compaction as well.

5.2.3 Potential Soil Contamination

Contamination sources are mostly unpredictable and often occur as incidental spills or leaks during the construction, operational phase and Decommissioning phase. Thus, the identified soils are considered equally predisposed to potential contamination. Therefore, strict waste management protocols as well as product stockpile management and activity specific Environmental Management Programme (EMPr) and monitoring guidelines should be adhered to during the construction, operational activities and Decommissioning phase. If the management protocols are not well managed this will more likely lead to:

- Contaminants leaching into the soil and thus potentially rendering the soil sterile. reducing the yield potential of soils.
- Potential reduction of water quality used for irrigation and for livestock use

<u>Potential soil contamination is attributed to the following activities</u>

- **Construction Phase:**
    - Spillage of petroleum hydrocarbons during construction of associated infrastructure
    - Disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.
- **Operational and Decommissioning Phase:**
    - Leaching of hydrocarbons chemicals into the soils, leading to alteration of the soil chemical status as well as contamination of ground water.
    - Disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.

5.2.4 Loss of Agricultural Land Capability

The loss of land capability is anticipated as dominant soils are considered ideal for cultivation. Large portions of arable soils will be stripped and stockpiled and thus potentially reducing the fertility status (sterilisation) of the soils and being prone to erosion. The proposed activities will

lead to a permanent change of land use if not properly mitigated. Consequently, the loss of agricultural soils and the permanent change in land use will be localized to within the Project Area.

Loss of agricultural land Capability is attributed to the following activities.

- **Construction phase:**
  - Site clearing, the removal of vegetation, and associated disturbances to soils, leading to increased nutrient leaching, runoff
  - Potential indiscriminate disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.
- **Operational Phase:**
  - Ongoing disturbances to soils, resulting in increased leaching of soil nutrients and risk of erosion, attributed to mining activities
  - Potential increase in concentrations of contaminant concentration in the soil.
  - Ongoing disturbance as a result of maintenance activities, leading to altered vegetation community structures, and consequently altering the quality and nutrient status of the soil

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 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.

Table 11: 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 30 cm below ground surface to alleviate compaction prior to re-vegetation.						

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.

6.4 Soil management during the closure phase

Table 12: Soil management during closure phase

Closure phase								
Impact		**Management**	**Severity**	**Duration**	**patial Scale**	**Consequence**	**obability**	**Significance**
Activity	Backfilling of the open cast pit areas							
	➢ Demolition of structures such as shaft complexes and ripping of soil and hard surfaces, leading to further soil disturbances leading to compaction	Unmanaged	M	L	L	L	L	L
		Managed	M	L	L	L	L	L
	➢ Restoration of natural topography and revegetation leading to further soil erosion, compaction, and contamination. Resurfacing may lead to water ponding if not done properly	Unmanaged	M	M	L	M	H	M
		Managed	M	L	L	L	L	L
Mitigation Measures	➢ 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.							

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

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. 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.

8 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion and Summary

Singo consulting (Pty) Ltd was appointed by Notre Coal (Pty) Ltd to conduct a soil, land capability and land use study as part of an Environmental Authorization Process for the proposed Mining Right application on Portion 1 of the farm Annysspruit 140 HT, and Remaining Extent of the Farm Mooihoek 168 HT, Situated in the magisterial district of Mkhondo. The Mining Right area is situated within Mkhondo Local Municipality, approximately 16.81 km Southwest of Piet Retief.

The study area as gathered from desktop study has mean annual minimum temperature of 0.1 – 2 and 2.1 – 4 degree Celsius and Mean annual rainfall of 601 – 1000 mm. this shows that with reference to climate, the study area can grow crops.

The current land use activities associated with the study area are plantations, diggings and natural vegetation. The study area is comprised of 1 soil form, namely the Witbank soil form. The Witbank soil form are characterized by shallow depth, surface layer which was defined as Orthic Horizon. The surface soil was classified as Association of Classes 1 to 4 and Association of Classes 13 and 16: Structureless soils, with low to moderate water holding capacity, and was classified silty loam.

The land capability is arable and grazing.

8.2 Recommendations

- The project operations must stay inside the clearly delineated footprint zones;
- During the construction period, bare soils within the access roads can be routinely moistened with water to minimize dust, especially when strong winds are anticipated according to the local weather prediction; and
- Soil Compaction is usually greatest when soils are moist, so soils should be stripped when moisture content is as low as possible. If they have to be moved when wet, truck and shovel methods should be used as bowl scrapers create excessive compaction when moving wet soils;
- As much as is practically possible, the projected development and construction activities' footprints should be clearly marked to limit vegetation clearing activities inside the infrastructural footprint;

- Usable topsoil from the construction of the surface infrastructure areas must be removed prior to construction and stockpiled separately within the demarcated areas with measures to protect this valuable resource from impacts such as chemical contamination as well as mixing with less valuable overburden types.
- Revegetate with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions.
- The post closure land use should be aimed at forestry with indigenous species.

Based on the stockpile management plan the following measures are proposed in order counteract the problems associated with limited topsoil stockpile:

- Ideally, infrastructure clearance once mining operations are over is usually considered. To minimize the quantity of topsoil stockpile needed for rehabilitation, all the structures on the site should be evaluated along with the authorities and the ultimate land users to determine which infrastructure areas could be utilised in the future.
- Where infrastructure is removed all the rubble and residual foundations need to be covered with at least one metre of cover material.
- The topsoil stockpile should be used only in areas where there is a likelihood for post closure use such as grazing, where the slopes are not too steep.

9 REFERENCES

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APPENDICES

Appendix A: Specialist’s qualifications Available upon request