DETAILED SOIL STUDY FOR COAL MINING RIGHT ON FARM TENBOSCH FARM NO.162 JU ALL PORTIONS (EXCLUDING PORTION 46, 74 & 90), VYEBOOM FARM NO.414 JU ALL PORTIONS (EXCLUDING PORTION 1) TURFBULT 593 JU ALL PORTIONS, TECKLENBURG 'S RANCH 548 JU ALL PORTIONS, MAGISTERIAL DISTRICT OF BARBETON, MPUMALANGA

DMR REF: MP 30/5/1/2/2/10216MR

PREPARED BY

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PREPARED FOR

Manzolwandle Investments (Pty) Ltd

Executive Summary

This document is a detailed soil study including soil classification and agricultural potential prepared for Coal mine, located on the farms:

Table 1-1: Farm names

Farm	Portion
Tenbosch farm no. 162 JU	All portions (excluding portion 46, 74 &90)
Vyeboom farm no.414 JU	All portions (excluding portion 1)
Turfbult 593 JU	All portions
Tecklenburg's Ranch 548 JU	All portions

Situated in the Magisterial District of Barberton, Mpumalanga province. Manzolwande Investments (Pty) Ltd appointed Singo consulting (Pty) Ltd to conduct this soil study. The main aim of conducting this study is to find information with regards to the soil potential, land use as well as land capability

Importance of the study

- The main significance of soil study is to conduct an Environmental Impact Assessment for the soils, land capability and land use, and propose mitigation measures for significant impacts.
- To assess the nature of the site in relation to the overall environmental state before mining and determine the impact to be caused by the proposed mining activity. It also gives a permanent record of the present soil resources in the area that are potentially going to be affected by the proposed mining right.
- The study is also going to assess present land use and land capability within the proposed surface disturbance. The study also helps to estimate how the soil will be impacted by mining activities.

Description of the scope of the proposed overall activity

The mining method proposed involves open cast extraction of coal from a pit to be established on virgin ground. The topsoil and overburden soil will be stockpiled and reserved for rehabilitation. Coal will be stockpiled on the topsoil and all activities will be contained within the boundaries of the mining site. Therefore, almost all of the topsoil within the applied area will be disturbed during mining activities.

The general activities that will take place will include:

- Development of the road, load out stations and associated infrastructure
- Development of coal stock yard and stockpiles
- Development of water facilities
- Development of beneficiation plants and associated infrastructure
- New road or conveyors to fines recovery area
- New control gate and park area

The construction of all infrastructure associated with the project will be within the Coal Mine project boundary. This report describes the soil types and properties present thereby giving a detailed baseline soil assessment of the undisturbed areas. The major soil types present, as recorded during the site specific assessment, include Hutton and Westleigh soils. The dominating soil property is deep red and yellow soils represented by high sand content, low clay content and therefore low fertility.

The soils are generally deeper than 1.5 m as measured by using a standard handheld soil auger measuring 1.5 m in length. The available soil volumes (to be stripped and stockpiled) were calculated using estimated site sizes as well as the various soil depths as indicated through hand augering of the soils.

In terms of **stripping**, topsoil will be stripped to a minimum of 300 mm down to a maximum of 1.5 m and will be stockpiled together. Anything deeper that may be required to be stripped (deeper than 1.5 m) will be removed and stockpiled separately from the initial stripping that will be undertaken. The land capability of the surveyed sites is classified as agriculture, limited to grazing animals because the prevailing rainfall limits arable crop production.

Potential impacts on soil

Construction phase

During the expansion and **construction phase** of the listed project activities, the work carried out will mainly be the construction of the fuel storage depot, beneficiation plants and associated infrastructure, conveyors, power line, gate, new roads and construction of stock yard and stockpiles. This will entail the clearing of areas and the disturbance of the topsoil through excavations as well as the construction of a soil stockpile.

The topography and natural drainage lines may also be disturbed. The overall impact will be loss of topsoil as a result of erosion as well as potential contamination of the soil by coal dust, fuel and oils (hydrocarbons) as a result of general construction activities. Soil compaction caused by heavy vehicles and machinery may also be an additional problem.

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

Operational phase

Soil erosion through wind and storm water run-off, soil pollution by means of hydrocarbon contamination and potentially coal dust may be encountered during the operational phase. Water runoff from roads and plant areas must be controlled and managed by means of proper storm water management facilities in order to prevent soil erosion. Diesel and oil spills are common at mine sites due to the large volumes of diesel and oil consumed by construction vehicles. Pollution may however be localised. Small pockets of localised pollution may be cleared up easily using commercially available hydrocarbon emergency clean-up kits.

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

Decommissioning Phase

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

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1 Introduction

Soil basically has no official and concise definition, but is often defined in terms of its composition, functions as well as the Origin and formation. In terms of composition soil is a mixture of partially weathered rock and mineral fragments, organic matter, Air and water in the pore spaces. The soil or pedosphere is a sink and source for nutrients, water and gasses in the ecosystem and plays an important role in the cycling of nitrogen, phosphorus, sulphur, carbon, water and other elements between the hydrosphere, lithosphere and biosphere.

Human beings have utilised soil as a building and engineering medium for millennia. Magnificent structures, such as the Egyptian pyramids and the Mayan temples at Chichen Itza and Uxmal, illustrate the insight ancient Mediterranean and Mesoamerican civilisations had on the interactions between structures and the soil. In modern day engineering the designing and construction of any structure, e.g. foundations, dams, tunnels, roads, mines, hazardous waste landfills etc, require insight into the engineering properties of soil.

The vast majority of plants cannot survive or reproduce without soil. Soil anchors plants and supplies it with water and nutrients. Whether it is a forest, wetland or grassland, the vigour of these ecosystems is linked with the health of the soil and its ability to supply the plants it supports with nutrients and water.

The decomposition of organic matter in the soil releases nutrients, which in turn, are assimilated by living organisms. Soil is a terrestrial depository or reservoir for nitrogen, phosphorus, sulphur, as well as carbon and plays an important role in the cycling of these elements on earth. All this information tells us how important soil studies are and therefore studies like this one are relevant with an aim of protecting soil that could not possibly be negatively impacted by human activities.

This report discusses the dominating soils present within the proposed mining site, including the physical and chemical properties which characterize the soil. Furthermore, the results from the assessment have been used to determine the existing land capability and current Land Use within the listed proposed expansion development footprint areas.

2 Project Description

Mineral Applied For: Coal, Pusedocoal and Torbonite/Oilshale resources

Mining Methods: Open Cast Mining and Underground Mining

Life of Mine: 30 years lifespan

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

The extent of the mining right entails a life of mine of more than 30 years and covers the above-mentioned farm portions. The proposed project relates to the opencast mining extracting the No. 2, 3, 4U and 4L coal seams of approximately 20 million tons per annum (Mtpa) of high-grade coal over a period of approximately thirty years. When coal seams are near the surface, it is economical to extract the coal using open cast (also referred to as open cut, open pit, or strip) mining method. Open cast coal mining recovers a greater proportion of the coal deposit than underground methods, as more of the coal seams in the strata may be exploited.

In 2012 ZYL mining undertook an aeromagnetic survey of the PR area by the drilling of some geophysically logged percussion holes. From the company's survey it was evident that numerous dolerite dykes and sills transgress the strata. These are the source of heat and pressure needed for the rank increase of the coal and the anthracite development. All of these maps were made available and the 2014 exploration was planned on the basis that only areas with less dolerite intrusions would be targeted. Access was also taken into consideration and it was decided to drill the holes on the farm **Techlenburg's Ranch**. On the 16th of June 2014 boreholes were all cored and the intersected coal seams were analyzed by an accredited laboratory. All the 2014 holes were drilled using HQ-wireline methods.

Very thick dolerite sills were intersected: 75 m thick in borehole 1/53 and 100 m thick in borehole 3/54. All the historical data was captured but seam correlations is not possible due to the wide spread of the boreholes and the displacement caused by the dolerites. Boreholes PO2 and PO7 have good coal intersections and coal seams were analyzed.

Several dolerite dykes and sills were intersected. The combined thickens of these intrusive adds to 130 m in some boreholes like P03. In P04 the coal was totally destroyed and assimilated by a 61 m thick dolerite sill. Diamond and reverse circulation boreholes were drilled for the south of the prospecting area (south of the N4 National Highway). The Zyl mining company's encounters gave confidence to Manzolwandle Investment (Pty) Ltd Company, thus the necessity of the proposed project.

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The underground will be accessed via a boxcut audit. It is proposed that the boxcut, plant and associated mine infrastructure be located on the farm Tecklenburg's Ranch 548 JU Portion.

Infrastructures that will be used:

- ❖ Access & Haul roads (with necessary security) including the upgrading of the access point to the gravel road
- ❖ Contractor's Yard with septic/chemical ablution facilities;
- ❖ Offices;
- ❖ Weighbridge, workshop and stores (with septic/chemical ablution facilities);
- ❖ Rail Siding;
- ❖ Diesel facilities and a hardstand;
- ❖ Power and Water;
- ❖ Boxcut;
- ❖ Stockpiles (topsoil, overburden, subsoil/softs, ROM);
- ❖ Surface water management measures (storm water diversion berms and trenches, pollution control dams, tailings dam etc.)
- ❖ Crushing, screening & wash facility; and
- ❖ Disposal dump.

Coal will be transferred from the underground to surface by means of a conveyor belt. Whereby, it will be sent to the plant area for processing (crushing, screening and washing). Mine residue from the plant will be disposed of onto an integrated discard dump. Product coal will be sized and stockpiled in designated areas for pre-qualification prior to being transported to the market. It is currently anticipated that the plant will run 24/7.

3 Terms of Reference

The following tasks were undertaken in the compilation of the soil assessment, land use and land capability study:

3.1 Soil Study

- ❖ A detailed baseline soil assessment of the proposed project development footprint areas associated within the proposed Coal Mine's site
- ❖ The soil classification was done according to the Taxonomic Soil Classification System for South Africa, 1991. The following attributes were included at each observation:

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- Soil form and family
- Soil depth
- Estimated soil texture
- Soil structure
- Underlying material
- Current land use
- Land capability

4 Expertise of the specialist

Junior Hydrogeologist (Mutshidzi Munyai)

Mutshidzi Munyai holds a BSc geology degree (Majoring in Geology and Soil Science) from the university of Pretoria as well as an honours degree in Geohydrology from the University of the Free State.

Mutshidzi Munyai is competent and can write comprehensive reports applying the combination of the knowledge obtained from the tertiary level education.

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Junior Environment Consultant (Livhuwani Sigwadi)

Livhuwani Sigwadi holds an honours degree in Environmental Management obtained from the University of Venda. He posses supreme experience in the environmental field especially on conducting soil surveys and doing technical analysis thereof.

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5 Soil survey Methodology

5.1 Soil survey procedures

This allows soil surveyors to enter and study colour, texture, structure and other soil properties as well to differentiate between horizons. This allows for classification. Chemical tests can be

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carried out in the field (e.g. pH, test for carbonates and test for Mn oxides). Classification is done at this stage, which provides information on the chemical, physical and mineralogical characterization of the soil. Soil scientists that map the area, familiarize themselves with soils they expect to find and use characteristics to distinguish them from other soils in the area by doing desktop study.

Delineating soil boundaries

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

5.2 Soil and land capability

Land capability 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).

5.3 Structure of the SA classification system

Procedure to follow when identifying a soil:

- Demarcate master horizons in profile.
- Identify diagnostic horizons/materials.
- Establish soil form
- Identify family differentiae.
- Establish soil family.
- Determine textural class.

5.4 Land use

Present land use was determined during the soil survey.

5.5 Environmental Impact Assessment

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the Input-Output model. As discussed above, it has to be stressed that the purpose of this process is not to provide an incontrovertible rating of the

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significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context. This gives the project proponent a greater understanding of the impacts of this project and the issues which need to be addressed by mitigation and also give the regulators information on which to base their decisions.

The significance rating process follows the established impact/risk assessment formula:

Significance= Consequence x Probability

Where

Consequence = Severity + Spatial Scale + Duration

Probability = Likelihood of an impact occurring

The matrix calculates the rating out of 147, whereby Severity, Spatial Scale, Duration and Probability are each rated out of seven as indicated in Table 5-1. Weighting can be applied to the various parameters.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the Environmental Management Plans (EMP). The significance of an impact is then determined and categorised into one of four categories, as indicated in Table 5-2, which supports Table 5-3. Management actions will be assigned for all identified impacts.

A neutral impact implies that it causes the area to return to a pre-project state. This is not regarded as positive, as there would be no need for this activity if the operation was not carried out.

Table 5-1: Impact assessment parameter ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation	Certain/Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact	Almost certain/Highly probable It is most likely that the impact will occur
5	Very serious, long term environmental impairment of ecosystem function that may take several years to rehabilitate	Very serious widespread social impacts. Irreparable damage to highly valued items.	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the project	Likely The impact may occur
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year On	On-going serious social issues. Significant damage to structures / items of cultural significance	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur
3	Moderate, short-term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month	On-going social issues. Damage to items of cultural significance. Local	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur

2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment.	Low-level repairable damage to commonplace structures	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen

Table 5-2: Probability Consequence Matrix

Significance										
		Consequence (severity + scale + duration)								
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Table 5-3: Impact significance threshold limits

Significance		
High	108- 147	
Medium-High	73 - 107	
Medium-Low	36 - 72	
Low	0 - 35	

6 Description of the Receiving Environment

The Manzolwande Coal mining right area comprises approximately 17 975 (ha) hectares and the project area is approximately 31 km from Malelane, using the N4 to Mozambique, approximately 93 km east of Nelspruit and it is 10 km west of Lebombo border control under Ehlanzeni District Municipality and Nkomazi Local Municipality, Mpumalanga Province of South Africa.

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6.1 Climate

The climate in Barberton is warm and temperate. In winter, there is much less rainfall than in summer. The temperature here averages 20.0 °C. The rainfall here averages 861 mm. The driest month is June, with 11 mm of rain. Most precipitation falls in December, with an average of 141 mm. January is the warmest month of the year. The temperature in January averages 23.3 °C. In June, the average temperature is 15.2 °C. It is the lowest average temperature of the whole year.

6.2 Soil

From a desktop study that was conducted, a map in Figure 6-1 was produced. This map shows that the mining right area is covered with freely drained structureless soils, Association of classes 17 and 18: structureless soils and clays, soils with pedocutanic, 1 to 4: undifferentiated structureless soils, interpreted in Table 6-1 below.

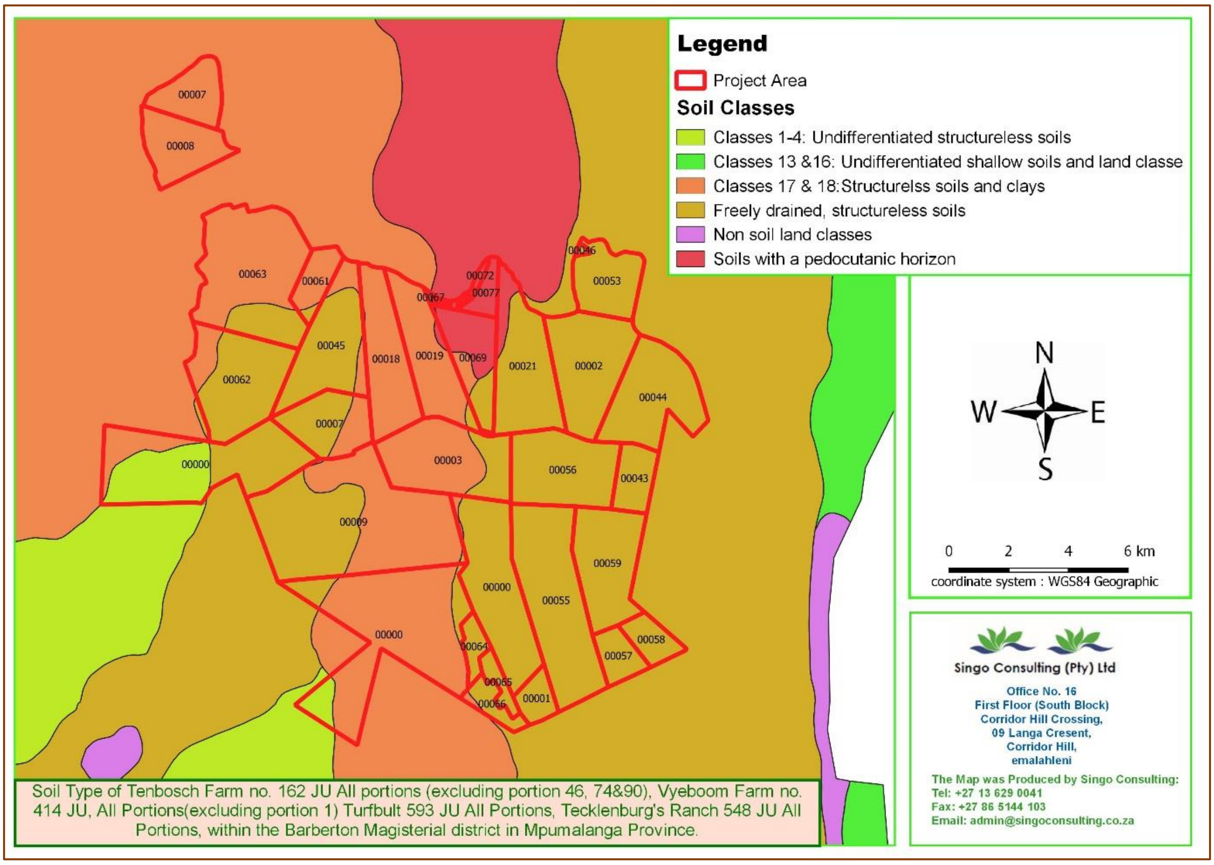

Figure 6-1: Soil classes map

Table 6-1: Soil classes table

Soil Classes	Land Capability
Class 1	Has few limitations that restrict its use; it may be used safely and profitably. Suitable land with negligible limitations and is highly productive requiring only simple management practices. When it used for crops it need ordinary management practice to maintain productivity. They are easily worked, and are also fairly well supplied with plant nutrients or are highly responsive to inputs of fertilizer.
Class 2	Has some limitations that reduce the choice of plants or require moderate conservation practice. Suitable land with minor limitations which either reduce production or require more than simple management practices to sustain the use. Slight to moderate salinity or sodicity, easily corrected, but likely to persist is taken to imply that strong subsoil acidity, costly to correct and likely to reappear, would disqualify land from Class II.
Class 3	Has severe limitations that reduce the choice of plants or require special conservation practices. Suitable land with moderate limitations which is moderately suited to a proposed use but which requires significant inputs to ensure sustainable use.
Class 4	Has very severe limitations that restrict the choice of plants, require very careful management. Marginal land with severe limitations which make it doubtful whether the inputs required to achieve and maintain production outweigh the benefits in the long term.
Class 5	Land in this class has little or no erosion hazard but have other limitations impractical to remove that limit its use largely to pasture, range, woodland or wildlife food and cover. These limitations restrict the kind of plants that can be grown and prevent normal tillage of cultivated crops. Pastures can be improved and benefits from proper management can be expected.
Freely drained, structureless soil and Red or yellow structureless soil	This type of soil is characterised by sand, red soil which is less productivity due to dominating of sand soils have severe limitations that reduce the choice of plants or that require special conservation practices, soils and miscellaneous areas have limitations that preclude commercial plant production and restrict their use to recreational purposes, wildlife habitat, or esthetic purposes.

6.3 Field soil identification

6.3.1 Soil sampling

Soil sampling took place on May 2019, at the Manzolwande mining right site. The main aim was to identify the soil moisture, colour, consistency, structure, soil type and origin (MSSCCO) of the soil. The soil form and family was also identified. The table below shows the MSSCCO of this area. Three samples were collected.

Table 6-2: MSSCCO table

MSSCCO	Soil 1	Soil 2	Soil 3
Moisture	Moist	Moist	Dry
Colour	grey- blackish	Dark grey to blackish	Light reddish brown
Consistency	firm	firm	Loose
Structure	Intact	Intact	Micro-shattered
Soil type	Silty-sand	Sandy	Sandy
Origin	Colluvium	Colluvium	Alluvium

The pictures below were taken during the soil survey process on 16th May 2019.

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Soil types within the project area

Soil 1

Soil 2

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Soil 3

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6.3.2 Soil Texture

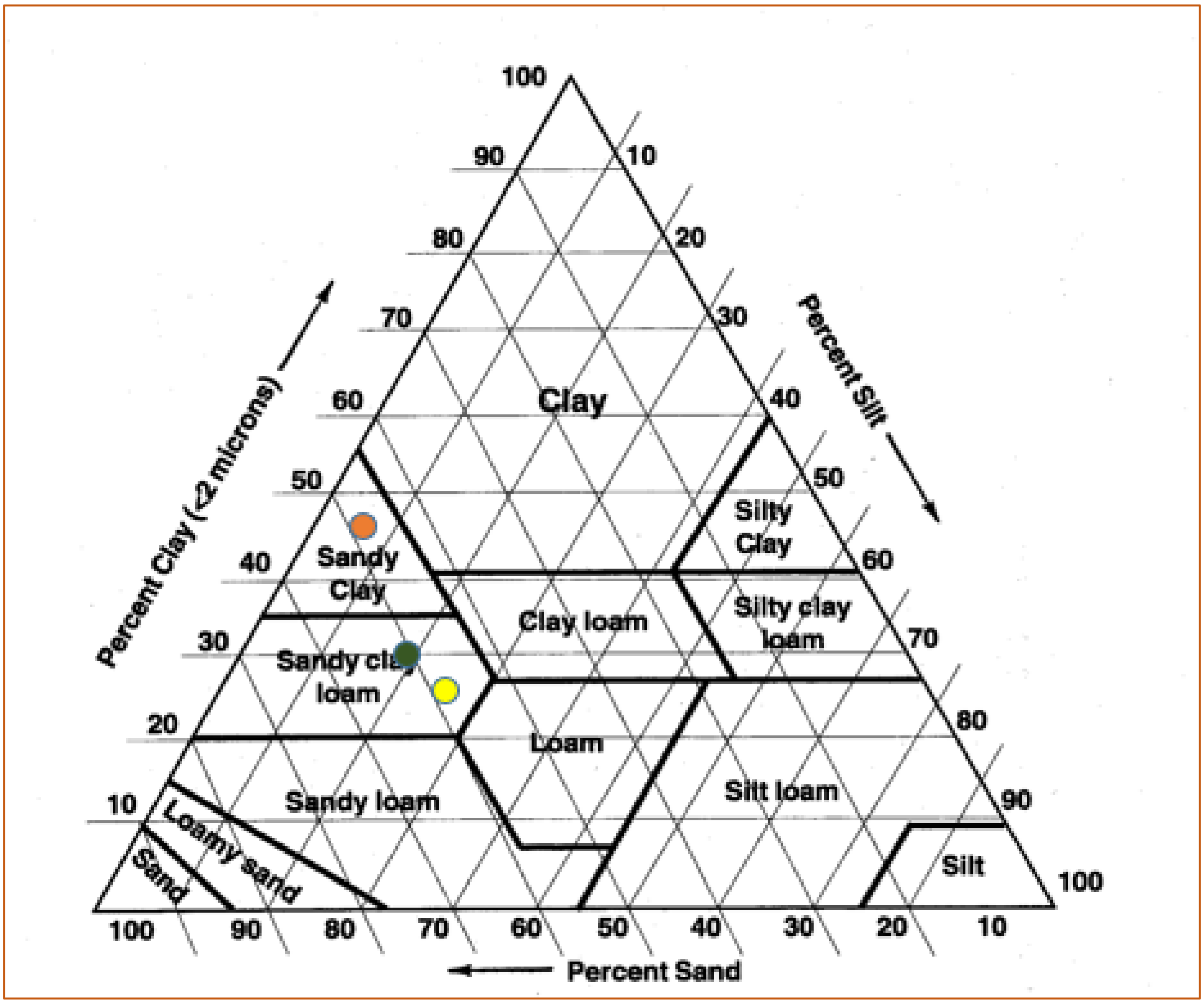

Figure 6-2: Soil texture ternary diagram

Legend:

Soil	Color
Soil 1	
Soil 2	
Soil 3	

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6.3.3 Soil family identification: Soil Profile description

Profile: Soil 1

Horizon	A	B
Transition	Gradual	
Depth	300mm	300-900mm
Moisture	Slightly moist	Dry
Colour	7.5YR 3/1	7.5 YR 4/2
Mottling	None	None
Texture	Sandy clay loam	Sandy clay loam
Consistence	loose	friable
Cementation	None	None
Carbonates	None	None
Structure	Subangular	weak
Concretions	None	None
Rocks	None	None
Roots	dominant	dominant
Permeability	Slightly Fast	slow
Underlying material		
General	30% clay	35% clay

Topsoil Horizon: Orthic A horizon

Second Horizon: Soft plinthic B horizon

Soil form: Westleigh form

Profile: Soil 2

Horizon	A	B
Transition	Gradual	
Depth	300mm	300-900mm
Moisture	Slightly moist	Dry
Colour	7.5YR 3/1	7.5 YR 4/2
Mottling	None	None
Texture	Sandy clay loam	Sandy clay loam
Consistence	firm	loose
Cementation	None	None

Carbonates	None	None
Structure	Subangular	weak
Concretions	None	None
Rocks	None	None
Roots	dominant	dominant
Permeability	Slightly Fast	slow
Underlying material		
General	30% clay	35% clay

Topsoil Horizon: Orthic A horizon

Second Horizon: Soft plinthic B horizon

Soil form: Westleigh form

<u>Profile: Soil 3</u>

Horizon	A	B	C
Transition	Gradual		
Depth	300mm	300-900mm	900mm+
Moisture	Dry	Dry	Dry
Colour	10YR 4/6	7.5 YR 4/4	7.5 YR 4/4
Mottling	None	None	None
Texture	Sandy clay	Sandy clay loam	Sandy loam
Consistence	loose	Friable	Friable
Cementation	None	None	None
Carbonates	None	None	None
Structure	weak	Weak	Weak
Concretions	None	None	None
Rocks	None	Seldom	Seldom
Roots	Seldom	Seldom	Seldom
Permeability	Slow	slow	slow
Underlying material			Unknown
General	30% clay	35% clay	35% clay

Topsoil Horizon: Orthic A horizon

Second Horizon: Red Apedal B

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Soil form: Hutton form

Interpretation: Lime containing soil forms depending on specific criteria regarding amount and type of lime present.

6.4 Soil profiles Interpretation

Soft plinthic B-horizon: Has grey colors caused by gleiing. This horizon has in the non-concretionary parts of the horizon, a loose, friable or slightly firm consistence. This horizon is non-indurated and can be cut with a spade when wet, even though individual mottles may have hardened irreversibly to form concretions.

Red Apedal B horizon: Has a structure that is weaker than moderate blocky or prismatic in the moist state.

6.4.1 Dominant soil forms within land

The surveyed area is flat. 83% of land type Ah 85 is represented by the foot slopes terrain unit with slopes between 1% and 1.9%. The dominant soils within this terrain unit are well-drained red apedal soils of the Hutton form (Hu) consisting of 40% of the unit, and the Westleigh form consisting of about 60% of the unit. These soils have an apedal sandy structure with a clay content ranging between 2% and 6% in the A horizon and between 6% and 12% in the B horizon.

6.5 Land Use

The figure below is a guideline of the different land uses found in this area. The surrounding land uses are associated with cultivated, permanent, commercial sugarcane; wetlands and waterbodies; Woodlands (previously termed woodland and forests), Thicket bushland, bush clumps, high fynbos.

During site inspection a flowing stream was seen flowing within the mining right. Land use was identified using aerial imagery and then ground-truthed while in the field. The land use is classified clearly as:

- ❖ Cultivated, permanent, commercial sugarcane
- ❖ wetlands and waterbodies
- ❖ Woodlands (previously termed woodland and forests)
- ❖ Thicket bushland, bush clumps, high fynbos.

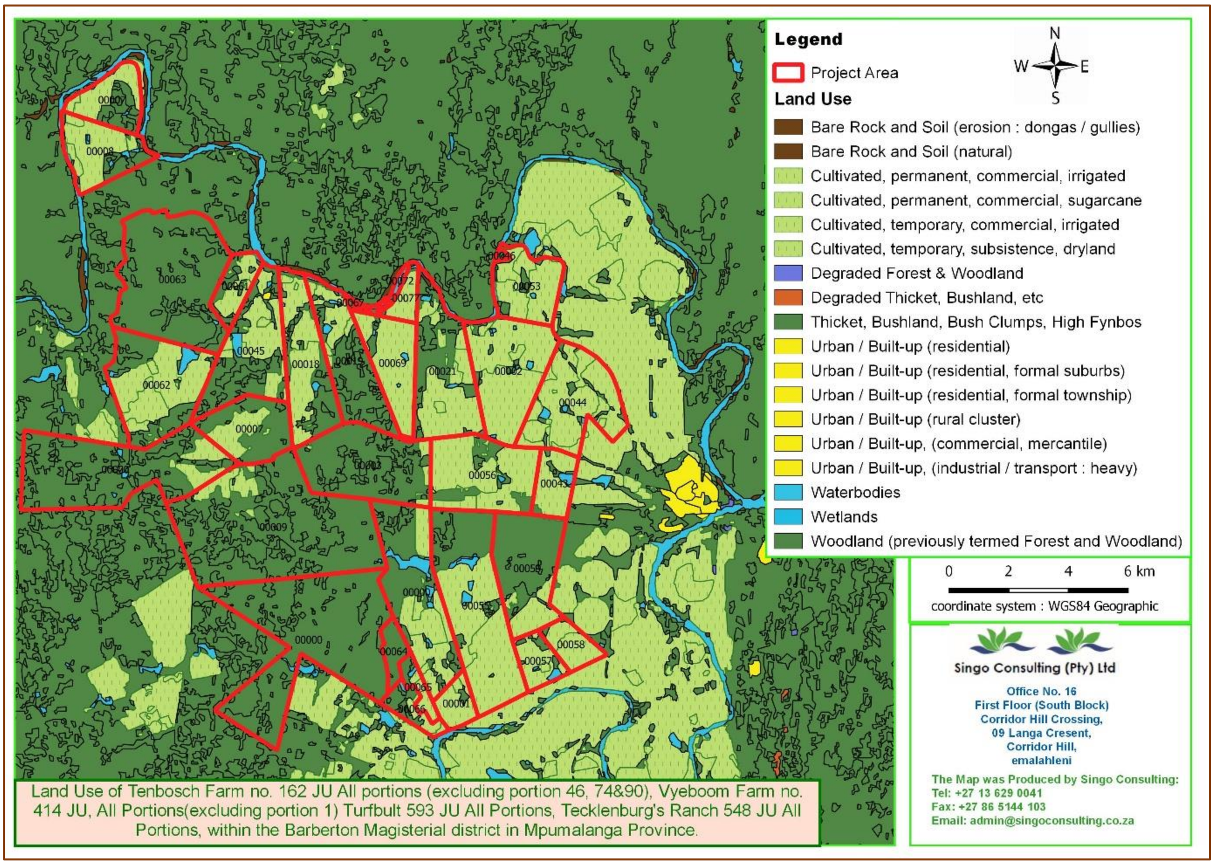

Figure 6-3: Land use map

7 Potential Environmental Impacts

- Access & Haul roads (with necessary security) including the upgrading of the access point to the gravel road
- Contractor's Yard with septic/chemical ablution facilities;
- Offices;
- Weighbridge, workshop and stores (with septic/chemical ablution facilities);
- Rail Siding;
- Diesel facilities and a hardstand;
- Power and Water;
- Boxcut;
- Stockpiles (topsoil, overburden, subsoil/softs, ROM);
- Surface water management measures (storm water diversion berms and trenches, pollution control dams, tailings dam etc.);
- Crushing, screening & wash facility; and
- Disposal dump.

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7.1 Construction Phase

During the expansion and construction phase of the above listed activities, the work carried out will mainly be the construction of the railway loop, fuel storage depot, beneficiation plants and associated infrastructure, conveyors, power line, gate, new roads and expansion of stock yard and stockpiles.

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

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

7.2 Operational Phase

Soil erosion through wind and storm water run-off and soil pollution by means of hydrocarbon contamination and potentially coal dust may be encountered during the operational phase. Water runoff from roads and plant areas must be controlled and managed by means of proper storm water management facilities in order to prevent soil erosion. Diesel and oil spills are common at mine sites due to the large volumes of diesel and oil consumed by construction vehicles. Pollution may however be localised. Small pockets of localised pollution may be cleared up easily using commercially available hydrocarbon emergency clean-up kits.

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

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7.3 Decommissioning Phase

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

8 Impact Assessment

The environmental impact assessment is designed to identify impacts related to various mining activities and how to mitigate these impacts. However with the correct mitigation measures being put in place these impacts can be reduced. The rating of impacts is based on the type of activity that will be undertaken. Similar activities that will have the same impact to soil, land use and land capability have been grouped together and discussed for particular impacts, such as loss of topsoil as a resource. When the impact rating is significantly different as a result of the activity, a separate rating has been given for those particular activities. The activities, such as the expansion of the railway loop and gate across from the new warehouse construction would potentially have a slightly higher impact on soil, land capability and land use as these areas are less disturbed. For the purpose of this impact assessment activities that are located within relatively undisturbed areas have been rated together and all other activities falling with existing mining related impacted areas have been rated together with respect to the level of the impacts.

8.1 Construction Phase

When topsoil is removed from a soil profile, the profile loses effective rooting depth, water holding capacity and fertility. The largest volumes of topsoil will be removed for the construction of the proposed railway loop, roads and expansion of the existing coal stock yard and stockpiles. Foundation excavations will be needed for the proposed fuel storage depot, beneficiation plants and associated infrastructure, conveyors, power line and gate.

8.1.1 Impact: loss of topsoil as a resource, erosion and compaction

Criteria	Details / Discussion
Description of impact	During construction the land clearance and earthworks for railway way loop and gate across from the new warehouse will have a larger impact compared to the other areas, as these areas have already been disturbed and fall within areas that have been impacted by mining activities. Even though soil will be cleared from most of the areas where infrastructure will be placed, areas that are not disturbed by mining related impacts would have slightly higher impacts as these soils could be considered as virgin soils and have not really been impacted by mining related activities. During clearance of vegetation from the railway loop and proposed new gate across from the new warehouse there is a greater risk, when compared to other areas, that topsoil would be exposed and there is potential risks for increased erosion in these areas during rainfall events, resulting in a potential loss of soil as a resource. In addition wind erosion would be greater as these areas are exposed as a result of the removal of vegetation. Mitigation
Mitigation required	❖ 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. ❖ Stockpiles are to be maintained in a fertile and erosion free state by sampling them annually for macro nutrients and pH ❖ The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate ❖ Ensure stockpiles are placed on a free draining location so as to limit erosion loss ❖ Berms should be placed around stockpiled soil to prevent soil loss due to erosion ❖ Compaction of the removed topsoil should be avoided by prohibiting traffic on stockpiles ❖ Prevent unauthorised borrowing of stockpiled soil ❖ Minimise the period of exposure of soil disturbances through a planning schedule ❖ 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 and ❖ Soils will be stripped according to the soil types and recommended depths.

Wilderness Areas					
Parameters	Spatial	Duration	Severity	Probability	Significant rating

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Pre-Mitigation	2 (Limited)	5 (Project Life)	4 (Serious)	7 (Certain)	77 (Medium-High)
Post-Mitigation	2 (Limited)	5 (Project Life)	3(Moderate)	3(Unlikely)	30 (Low)
Disturbed Mining Areas					
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	2 (Limited)	5 (Project Life)	3 (Moderate)	5 (Likely)	50(Medium Low)
Post-Mitigation	2 (Limited)	5 (Project Life)	3(Moderate)	3(Unlikely)	30 (Low)

8.1.2 Impact: Hydrocarbon Pollution

Criteria	Details / Discussion
Description of impact	Hydrocarbon spills can occur when using heavy machinery, as they all use oils and diesel to run. There is a chance of these breaking down and/or leaking during construction activities of roads, removal of topsoil and digging excavations for building and plant foundations. It would be expected that impacts associated with the railway loop and gate across from the new warehouse, as they are located within an areas classified as wilderness, could be slightly higher if a spill had to occur as these soils have not been impacted by mining related activities.
Mitigation required	❖ 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 cleanup procedures and ❖ Leaking vehicles will have drip trays place under them where the leak is occurring

Wilderness Areas					
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	1 (very Limited)	7 (Permanent)	5 (Very Serious)	5 (Likely)	65(Medium-Low)
Post-Mitigation	2 (Very Limited)	1 (Immediate)	5 (Very Serious)	4(Probable)	36 (Medium-Low)
Disturbed Mining Areas					
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	5 (Very serious)	4(Probable)	52(Medium - Low)
Post-Mitigation	2 (Limited)	1 (Immediate)	4(Medium serious)	4(Probable)	36 (Medium-Low)

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8.1.3 Land capability and Land Use

Criteria	Details / Discussion				
Description of impact	Removal of soil layers will impact on the land capability because vegetation can no longer be supported. With respect to land use, impacts associated with areas currently considered as wilderness would be impacted upon more as there would be a change in land use from wilderness to mining related areas. With respect to areas already disturbed by mining related activities, there would be no real impact to the land use as these areas are already classified as mining areas.				
Mitigation required	No land capability mitigation is possible during this phase because the land use is changed from agriculture to mining.				
Wilderness Areas					
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	1 (very Limited)	5(project life)	5 (Very Serious)	7(definite)	77(Medium-High)
Post-Mitigation	2 (Very Limited)	5(project life)	4(Medium serious)	6(almost certain)	60 (Medium-Low)
Disturbed Mining Areas					
Pre-Mitigation	No change				
Post-Mitigation	No change				

8.2 Operational Phase

8.2.1 Impact: loss of stockpiled topsoil as a resource, erosion and compaction

Criteria	Details / Discussion
Description of impact	Topsoil losses can occur during the operational phases as a result of rain water runoff and wind erosion, especially from roads and soil stockpiles where steep slopes are present. Prevention is especially important because the dominant soils in the area are sandy and prone to erosion. The impact from vehicle movement on stockpiles would be a limited impact and can be mitigated against by designating stockpile areas and having these areas as no go areas.
Mitigation required	❖ Stockpiles are to be maintained in a fertile and erosion free state ❖ Ensure proper storm water management designs are in place ❖ If erosion occurs, corrective actions must be taken to minimize any further erosion from taking place ❖ Prepare stockpiles appropriately to ensure vegetation establishes itself ❖ Ensure stockpiles are placed on a free draining location so as to limit erosion loss ❖ Topsoil stockpiles should be maintained for effective rehabilitation following the closure of the mine

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	❖ 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 ❖ Topsoil stockpiles should be maintained for effective rehabilitation following the closure of the mine ❖ 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 and ❖ Unauthorised borrowing of stockpiled soil materials should be prevented.				
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	2 (Limited)	5 (Project Life)	4(Serious)	7(Certain)	77(Medium -High)
Post-Mitigation	2 (Limited)	5 (Project Life)	3(Moderate)	3(Unlikely)	30 (Low)

8.2.2 Impact: Hydrocarbon Pollution

Criteria	**Details / Discussion**				
Description of impact	Hydrocarbon spills can occur where heavy machinery are parked such as the hard park area as they contain large volumes of lubricating oils, hydraulic oils and diesel to run. There is always a chance of these breaking down and/or leaking				
Mitigation required	❖ Prevent any spills from occurring ❖ Storage and use of fuels and lubricants should be confined to lined and bunded areas and comply with Waste Management Plan. The appropriate oil separators for recycling of hydrocarbons must be installed at these locations ❖ All heavy machinery operators and truck drivers should be instructed to stay in designated areas, such as construction sites and roads ❖ All maintenance should be restricted to appropriately designed workshops; with proper oil separators ❖ If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities ❖ All vehicles are to be serviced regularly in a correctly bunded areas ❖ Leaking vehicles will have drip trays place under them where the leak is occurring ❖ Hydrocarbon management procedure to contain details of emergency cleanup procedures and ❖ Leaking vehicles will have drip trays place under them where the leak is occurring				
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	5 (Very serious)	4(Probable)	52(Medium - Low)
Post-Mitigation	1 (Very Limited)	1 (Immediate)	4(Medium serious)	4(Probable)	36 (Medium-Low)

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8.3 Decommissioning Phase

8.3.1 Impact: Railway loop, road and building removals – restoring soil profile.

Criteria	Details / Discussion				
Description of impact	Decommissioning entails scaling down all operations to stop operation of the coal mine. The railway and all related infrastructure will need to be removed. All buildings, conveyors, power lines and plants will be removed. Building foundations will be backfilled using stockpiled materials. Backfilled sites need to be fertilised and revegetated using site specific best practices.				
Mitigation required	❖ Remove buildings to foundation level. All rubble to be relocated to a specified approved rubble dump ❖ Backfill foundations using stockpiled soil material ❖ Rip all roads and ❖ Re-vegetate the entire site (refer to rehabilitation plan for seed mixture).				
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	5 (Very serious)	6(very likely)	90(Medium - High)
Post-Mitigation	1 (Very Limited)	3 (Medium Term)	3(Moderate)	4(Probable)	28(Low)

8.3.2 Impact: Land use and land capability

Criteria	Details / Discussion				
Description of impact	Backfilling of soil layers will impact on the land capability by restoring the land capability because vegetation can be supported and therefore returned to grazing				
Mitigation required	Mitigation is possible because the land use is changed from mining back to the premining land use, if possible (Positive Impact).				
Parameters	Spatial	Duration	Severity	Probability	Significant rating
Pre-Mitigation	1 (Very Limited)	5(Project life)	6 (Significant)	7 (Definite)	84(Medium - High)
Post-Mitigation	1 (Very Limited)	5 (Project life))	4 (Serious medium term)	6 (almost certain)	60 (medium-low)

9 Soil Management Plan

9.1 Background

The Manzolwande mining right landscape is dominated by a relatively flat topography. The soil was weathered in situ from sandstone parent material and the majority of soils found in the landscape positions are therefore red and yellow apedal sandy soils as well as grey soils in other landscapes positions. The soil types present are homogeneous in nature, especially those that occupy the crest and midslope positions in the landscape. Therefore care must be taken during the reclamation process to prevent compaction on the one hand and to replace soil

volumes back to a representative pre-mining soil and land capability while emulating the pre mining landscape.

The natural fertility and water holding capacity is low due to the low clay content and very sandy nature of the soil. The resultant sandy and mostly deep soils are of low agricultural potential due to the low rainfall and high evaporation demand in the region.

The A-horizon is especially important because it is considered to be the most microbiologically active part of the soil where most **plant roots** are established. Microbes convert organic material into plant nutrients and nutrients into different plant available ionic species through cycles (e.g. carbon cycle, nitrogen cycle, Sulphur cycle). Disturbing the equilibrium by removing soil horizons through opencast mining or other excavation activities influence all soil physical and chemical properties.

Topsoil should be stored separately from subsoil because it contains more nutrients and microbes than subsoil. The topsoil stockpiles can also not be higher than 4-5 m in height (current practice is 2 m) because aeration is then compromised which in turn influences microbial activity.

Normally topsoil and subsoil should be kept separately at all times. Allowing subsoil to contaminate top soil dilutes the nutrient and organic matter content causing soil infertility. Infertility imbalances then have to be reclaimed by using costly fertilizers. However in the case of this coal mine the top and subsoil can be stripped and stockpiled together due to the low inherent fertility status and low clay content of the dominating soils present within the project sites. In terms of stripping, topsoil will be stripped to a minimum of 300 mm down to a maximum of 1.5 m and will be stockpiled together. Anything deeper that may be required to be stripped (deeper than 1.5 m) will be removed and stockpiled separately from the initial stripping that will be undertaken.

More important than chemical imbalances which can be easily restored at cost, is soil compaction and volumes of replacement during soil reclamation. Heavy mining equipment is used during soil reclamation and soil is compacted beyond agricultural reclamation leaving behind areas of low soil and land capabilities. Such areas have limited land use options and specialized management needs.

9.1.1 Hutton form (Hu)

The Hutton soil form comprises an orthic A-horizon overlying a red apedal B-horizon, underlain by unspecified material. The red apedal B-horizon has macroscopically weakly developed structure or is altogether without structure and reflects weathering under well drained, oxidized

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conditions. The clay fraction is dominated by non-swelling 1:1 clay minerals and the red colour of the soil is ascribed to iron oxide coatings on individual soil particles that consist of at least 15 percent hematite (Fe_2O_3).The soils of this form on the study area developed on silica rich parent material (sandstone).

9.1.2 Westleigh form (We)

The Westleigh soil form comprises an orthic A-horizon overlying a Soft plinthic B-horizon, Has grey colors caused by gleiing. This horizon has in the non-concretionary parts of the horizon, a loose, friable or slightly firm consistence. This horizon is non-indurated and can be cut with a spade when wet, even though individual mottles may have hardened irreversibly to form concretions.

9.2 Physical mitigation

Post mining soil reclamation is very difficult or near impossible if the stockpiled topsoil and subsoil materials are of inferior quality due to mismanagement during storage. Good quantity and quality topsoil is an essential ingredient in the process of soil reclamation. Factors leading to decay in soil quality are:

- ❖ Contamination impacts on soil quality
- ❖ Erosion impacts on soil volume
- ❖ Indiscriminate storage impacts on soil quality and
- ❖ Indiscriminate use impacts on soil volume.

Therefore care must be taken during the reclamation process to prevent compaction on the one hand and to replace soil volumes back to a representative pre-mining soil and land capability while emulating the pre mining landscape.

An important factor in the management of stockpiles impacting on soil quality is the storage height of topsoil. The topsoil and subsoil stockpile should be constructed with great care to keep within accepted limits for example:

- ❖ The sides should be angled ensuring stability at 1:3 (18.5 degrees from horizontal)
- ❖ The location of the stockpile should be indicated within the rehabilitation plan document
- ❖ The stockpile area should be clearly demarcated, and strict access control practiced to prevent vehicles driving on the stockpile as well as unwanted borrowing of soil material for other purposes than rehabilitation and

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- ❖ Stockpile height should be limited to 4 - 5 m (current practice for stockpile height is 2 m) due to the sandy nature of the top and subsoil in this area.

Do not strip or redistribute top or subsoil if too wet. Use the stick test to determine if soil is too wet to redistribute. A sharpened broom sized stick must be pushed into and removed from the soil surface. If soil sticks to the stick then the soil is too wet to cultivate. Serious compaction may result if machine handling of wet soil continuous.

9.3 Soil quality indicators

Deciding on and monitoring soil quality indicators during soil impacts and reclamation can greatly improve the chances of reclaiming soil to a sustainable resource. The following actions should form part of monitoring soil quality and rehabilitation sustainability:

- ❖ Visual soil assessment by a specialist
- ❖ Soil quality monitoring system
- ❖ Visual assessment should include specialist scoring of water ponding, plant vigor, yield, tilth, earthworms, runoff, ease of tillage, soil colour, soil aroma, soil structure and cloddiness and
- ❖ Soil quality monitoring should include, bulk density, infiltration rate, water holding capacity, electrical conductivity, pH, soil nitrate and microbial activity.

To ensure sustainability from agricultural soil potential point of view soil reclamation should be reclaimed back to grazing land capability.

The defined land classified as low agricultural potential can be reclaimed back to grazing land capability. Grazing land can be reclaimed to a total soil depth of 300 – 600 mm.

Organic matter must be added back into the soil so soil should be pre-mixed with organic material and placed back last to a depth of at least 300 mm. Continuous visual and soil quality monitoring as mentioned under soil quality indicators above should ensure that the best possible soil reclamation procedure is followed.

Vehicle movements must be restricted on freshly dumped soil to prevent compaction as much as possible.

9.4 Soil Erosion

Soil erosion might pose a problem once vegetation cover is removed due to the sandy nature of the dominating Hutton and Westweigh soils present. Table 9-1 contains a summary of the erosivity of the soil forms present.

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Table 9-1: Soil type erosion potential

Soil form	Soil Horizon	Water and Wind Erosion Potential
Hutton	A	High
Westleigh	A	Medium

9.5 Soil Types for Stripping and Stockpiling

The Hutton and Westleigh soil types found can all be stripped and stockpiled together because the inherent soil properties are similar. The soil types are dominated by deep well drained red and yellow sandy soils. In terms of stripping, topsoil will be stripped to a minimum of 300 mm down to a maximum of 1.5 m and will be stockpiled together. Anything deeper that may be required to be stripped (deeper than 1.5 m) will be removed and stockpiled separately from the initial stripping that will be undertaken.

9.6 Estimated Available Soil Volumes

Table 9-2 below contains information regarding estimated volumes of stripped soil to be stockpiled for use in rehabilitation. The Table does not include the deeper than 1.5 m of subsoil volume of soil to be potentially stripped and excavated it is regarded to be a large volume of soil because the soil depth surveyed within most of the surveyed site is deeper than 1.5 m. It is recommended that the topsoil (usually the top 30 cm of any soil profile) be stripped together with the subsoil to 1.5 m or deeper, depending on practical engineering considerations. In terms of stripping, topsoil will be stripped to a minimum of 300 mm down to a maximum of 1.5 m and will be stockpiled together. Anything deeper that may be required to be stripped (deeper than 1.5 m) will be removed and stockpiled separately from the initial stripping that will be undertaken.

The stockpile height should be in the order of 4-5 m limited stockpile height as determined by the maximum height that a truck can dump once (current practice is 2 m). Such a height is ideal for sandy soil but practical for the contractor to tip once without having to drive on top of the stockpile. The stockpile should be re-vegetated and designed according to Chamber of Mines Rehabilitation Guidelines.

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Table 9-2: Estimated soil volumes to be stockpiled after stripping.

Soil type	Stripping depth (m)	Activity	Area(ha)	Estimated volume (m³)
Hutton/Westleigh	1.5	Stockyards	60.11	90 1650
	1.5	Laydown	29.6	44 4000
	1.5	Railway loop and shunt yard	16.5	247500
	1.5	Load out station	8.08	121200
	1.5	Tar road	1.04	15600
	1.5	Other stockpiles	1.33	19950
Total	1.5			1 749 900

10 Conclusion and Recommendations

10.1 Conclusions

The majority of the soils present in the proposed project sites are represented by deep yellow and grey sandy soils. These soils are dominated by Hutton and Westleigh soil types. The soils are relatively fertile due to the clay content and some are infertile due to the sandy nature of certain soils. Large volumes of soil need to be stripped and stockpiled for later use in mine site rehabilitation especially from the stockyards, laydown and railway loop sites.

Note: The use of stripped stockpiled soil for rehabilitation purposes needs to include detailed post rehabilitation but 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 listed project activities are:

- Access & Haul roads (with necessary security) including the upgrading of the access point to the gravel road
- Contractor's Yard with septic/chemical ablution facilities;
- Offices;
- Weighbridge, workshop and stores (with septic/chemical ablution facilities);
- Rail Siding;
- Diesel facilities and a hardstand;
- Power and Water;
- Boxcut;
- Stockpiles (topsoil, overburden, subsoil/softs, ROM);

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- Surface water management measures (storm water diversion berms and trenches, pollution control dams, tailings dam etc.);
- Crushing, screening & wash facility; and
- Disposal dump.

These project activities will change the land capability for the life of mine while land use will be changed from wilderness to mining within the mine site. However rehabilitation and mitigation can change the land capability at best back to grazing enabling the land use to also change to grazing.

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10.2 Recommendations

- The proposed mining land should be returned to its origin as before mining activities and the rehabilitation performance assessment in the proposed land must be done progressively (annually) during the operational phase by a soil specialist.
- Final surface rehabilitation of all disturbed areas during mine activities. Rehabilitation of unnecessary water management facilities once appropriate to do so.
- Specialists should be used to evaluate the erosion and other possible impacts during the entire mining process.
- Limit impacts to the footprints to keep physical impacts as small as possible. Areas for road, site lay-out should be minimized, dust generation.
- Soil samples must be collected during and after the mining operations and taken to the soil lab for rehabilitation as well as fertilizer recommendation.

11 References

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