Agricultural Potential Assessment for the proposed expansion of the Manungu Colliery

Mpumalanga, South Africa

January 2018

CLIENT

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Report Name	**Agricultural Potential Assessment for the proposed expansion of the Manungu Colliery**	
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EXECUTIVE SUMMARY

Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed to undertake relevant applications and amendment applications to existing authorisations and/or licences pertaining to the Manungu Colliery.

The Biodiversity Company was commissioned to conduct a comprehensive soil assessment for the Manungu Colliery. An assessment of the agricultural potential of the soil was conducted from the 15th to the 22nd of January 2018.

During the survey, six (6) dominant soil forms were identified, namely Katspruit, Tukulu, Milkwood, and Bonheim which makes up the bulk of the wetlands within 500m from the project boundaries. Soil forms outside of the delineated wetland areas include Oakleaf and Inhoek as well as areas characterised by disturbed land (areas influenced by current and historic impacts originating from mine related activities).

The Climate capability for this region was determined to be C6 classification. C6 (Severe limitation rating): Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops that frequently experience yield loss, (Smith, 2006).

The land capability was determined by using the guidelines described in “The farming handbook” (Smith, 2006). A breakdown of the land capability classes is shown in Table 1: Land capability class and intensity of use (Smith, 2006).

The Land Capability for the project area is illustrated in Table 13 and shown in Figure 10. All of the soils within wetland areas have been rated a land capability score of “V” (Vlei) except for Tukulu “wet” and Bonheim which has been rated a land capability of class “IV” (Light Cultivation/ Intensive Grazing). The Mispah soil form has been rated a score of “VI” (Moderate Grazing). The non-wetland areas however have been scored a land capability rating of “III” (Moderate Cultivation) due to the lack of clay within the topsoil and the depth of the soil profile.

The Land Potential of the project area is shown in Figure 11 and the land potential groups are described previously.

The class III land capability was rated as L4 land potential (moderate potential), the class IV land capability was rated L5 (restricted potential) and the class VI has been rated L6 (very restricted potential). The Class V land capability was determined to be a **Vlei**.

The major impacts associated with mining are the disturbance of natural occurring soil profiles consisting of layers or soil horizons. Rehabilitation of disturbed areas aims to restore land capability, however, the norm in South Africa is that post mining land capability usually decreases compared to pre-mining land capability. Soil formation is determined by a combination of five interacting main soil formation factors. These factors are time, climate, slope, organisms and parent material. Soil formation is an extremely slow process and soil can therefore be considered as a non-renewable resource.

Soil quality deteriorates during stockpiling and replacement of these soil materials into soil profiles during rehabilitation cannot imitate pre-mining soil quality properties. Depth however can be imitated but the combined soil quality deterioration and resultant compaction by the machines used in rehabilitation leads to a net loss of land capability. A change in land capability then forces a change in land use.

The impact on soil is high because natural soil layers will be stripped and stockpiled for later use in rehabilitation. In addition, soil fertility is impacted because stripped soil layers are usually thicker than the defined topsoil layer.

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Declaration

I, Ivan Baker declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Ivan Baker

Soil Specialist

The Biodiversity Company

30 January 2018

1 Introduction

Environmental Impact Management Services (Pty) Ltd (EIMS) has been appointed to undertake relevant applications and amendment applications to existing authorisations and/or licences pertaining to the Manungu Colliery including:

- New Integrated Environmental Authorisation (Scoping and Environmental Impact Report (S&EIR));
- New Integrated Water Use Licence (IWUL);
- Amendments to existing Environmental Authorisation and Environmental Management Plan;
- Amendments to the existing IWUL; and
- Section 102 Amendment.

The Biodiversity Company was commissioned to conduct a comprehensive soil assessment for the Manungu Colliery. An assessment of the agricultural potential of the soil was conducted from the 15th to the 22nd of January 2018.

The conservation of South Africa's limited soil resources is essential. In the past misuse and poor management of the soil resource has led to the loss of these resources through erosion and destabilisation of the natural systems. In addition, loss of high potential agricultural land due to land use changes is a big concern presently in South Africa.

Soils can be seen as the foundation for ecological function as shown in Figure 1. Without a healthy soil system for microbes to thrive in, both flora and fauna would be negatively impacted, which in turn feeds the natural soil system with organics and nutrients.

Desktop data will be compiled prior to the site-based assessment to support the findings from the survey as well as throughout the report. To identify soils accurately, it is necessary to undertake a soil survey. The aim is to provide an accurate record of the soil resources of the proposed project area. Land capability and land potential is then determined from these results. The objective of determining the land capability/potential is to find and identify the most sustainable use of the soil resource without degrading the system.

Soil mapping is essential to determine the types of soils present, their depths, their land capability and land potential. These results will then be used to provide practical recommendations on preserving and managing the soil resource.

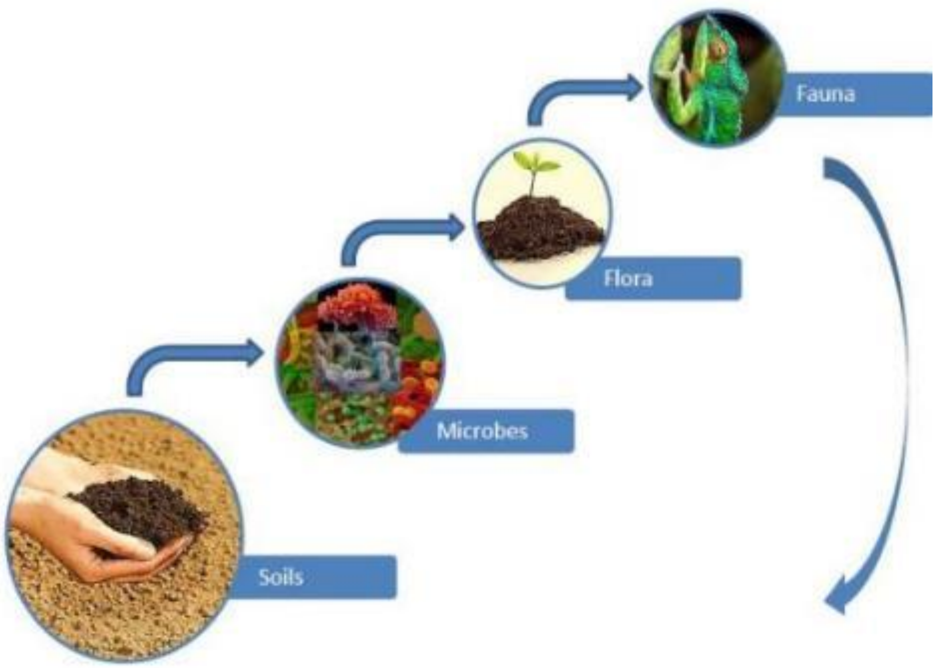


Figure 1: The relationship between soil and above-ground ecological succession

1.1 Objectives

It was requested that an agricultural potential assessment be conducted on the project area as per the Provincial and National Departments of Agriculture recommendations:

- Assess and discuss historic climate statistics;
- Assess and discuss geological information;
- Assess and discuss the terrain features using 5 m contours;
- Source best recent satellite or aerial imagery and georeferenced;
- Assess and discuss current agricultural land use on site;
- Conduct soil assessment as described in the methodology;
- Assess and discuss agricultural land potential (eight class scale); and
- Compile informative reports and maps on current land use and agricultural land potential.

The results will be mapped in GIS format and will include the following maps:

- A soil distribution map;
- A current land use map; and

- An agricultural potential map.

1.2 Study Area

The Manungu Colliery is located approximately 7 km south of Delmas, on farm portions Wellaagte 271 IR and Welgevonden 54 IT, in the Mpumalanga Province, South Africa. The area surrounding the project site consisted predominantly of agricultural fields and several coal mining operations (Figure 2).

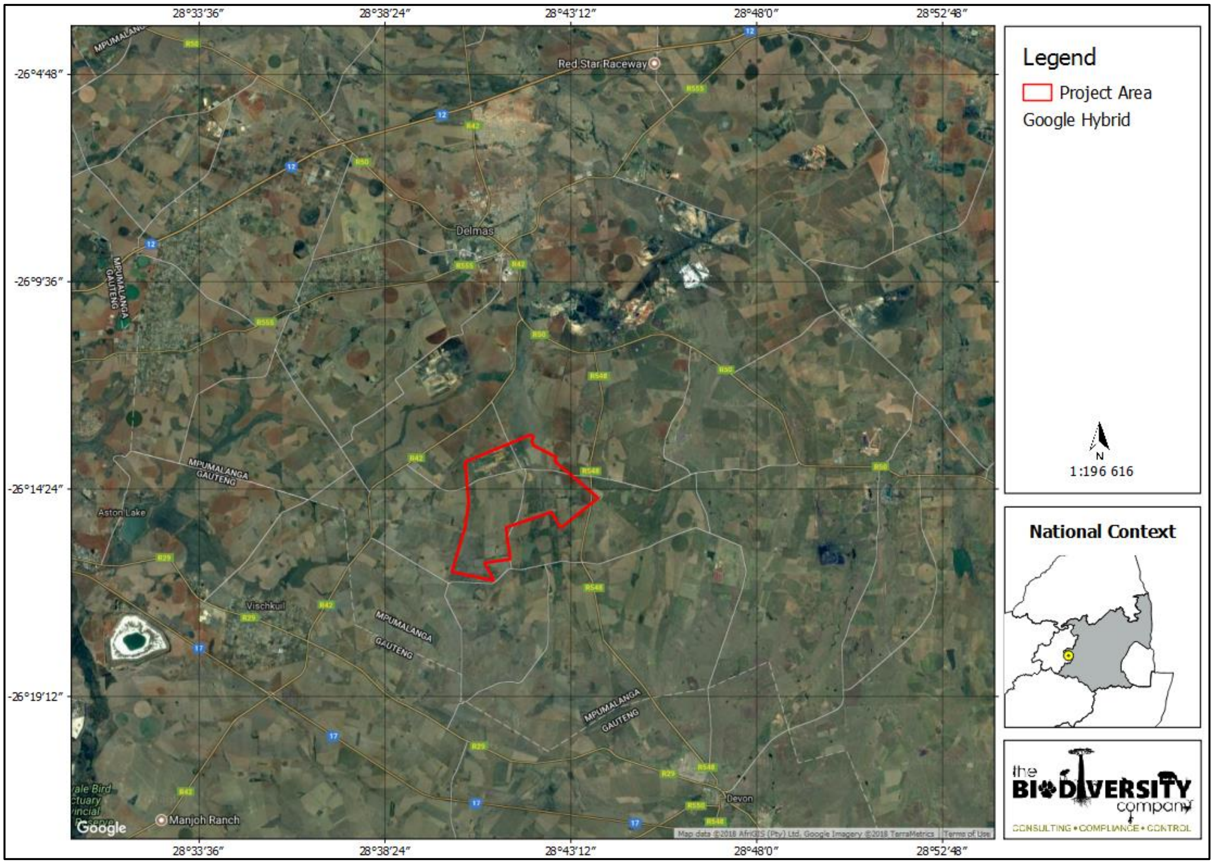


Figure 2: Map showing the project area

2 Scope of Work

The main purpose of the above-mentioned specialist study is to provide an EIA/EMP Report for the proposed mine extension as well as input into identified impacts list.

2.1 Soil Specific Scope

The soil specific scope required is as follows:

- A soils study was conducted which includes a description of the physical properties which characterise the soil within the proposed area of development of the relevant portions of the property.
- 20 soil samples have been taken from the opencast area to be sent away for chemical analyses. The results thereof will be used to complete a fertility assessment of the top soil and subsoil of which the stockpiles consist.
- The findings from the study were used to determine the existing land capability and current land use of the entire surface area of the relevant portions of the study area.
- Soil sampling during the field work was based on a grid of 150 x 150 m for the areas where opencast mining will occur, while a grid of 300 x 300 m was required for the remaining surface areas.
- The soil classification was done according to the Taxonomic Soil Classification System for South Africa, 1991. The following attributes must be included at each observation:
    - Soil form and family (Taxonomic Soil Classification System for South Africa, 1991);
    - Soil depth;
    - Estimated soil texture;
    - Soil structure, coarse fragments, calcareousness;
    - Buffer capacities;
    - Underlying material;
    - Current land use; and
    - Land capability.

3 Methodology

The agricultural assessment was conducted using the Provincial and National Departments of Agriculture recommendations. The assessment was broken into two phases. Phase 1 was a desktop assessment to determine the following:

- Historic climatic conditions;
- The terrain features using 5m contours;
- The base soils information from the land type database (Land Type Survey Staff, 1972 - 2006); and
- The geology for the proposed project site.

Phase 2 of the assessment was to conduct a soil survey to determine the actual agricultural potential. During this phase the current land use was also surveyed.

3.1 Desktop Assessment

As part of the desktop assessment, baseline soil information was obtained using published South African Land Type Data. Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 - 2006). The land type data is presented at a scale of 1:250 000 and comprises of the division of land into land types.

3.2 Field Survey

A study of the soils present within the project area was conducted during field visit in January 2018. The site was traversed by vehicle and on foot. A soil auger was used to determine the soil form/family and depth. The soil was hand augured to the first restricting layer or 1.5 m after which a sample from 10 sites' top soil and subsoil layers were taken. Soil survey positions were recorded as waypoints using a handheld GPS. Soils were identified to the soil family level as per the "Soil Classification: A Taxonomic System for South Africa" (Soil Classification Working Group, 1991). Landscape features such as existing open trenches were also helpful in determining soil types and depth. The sampling locations are shown in Figure 3. Only areas that have not been disturbed could be sampled.

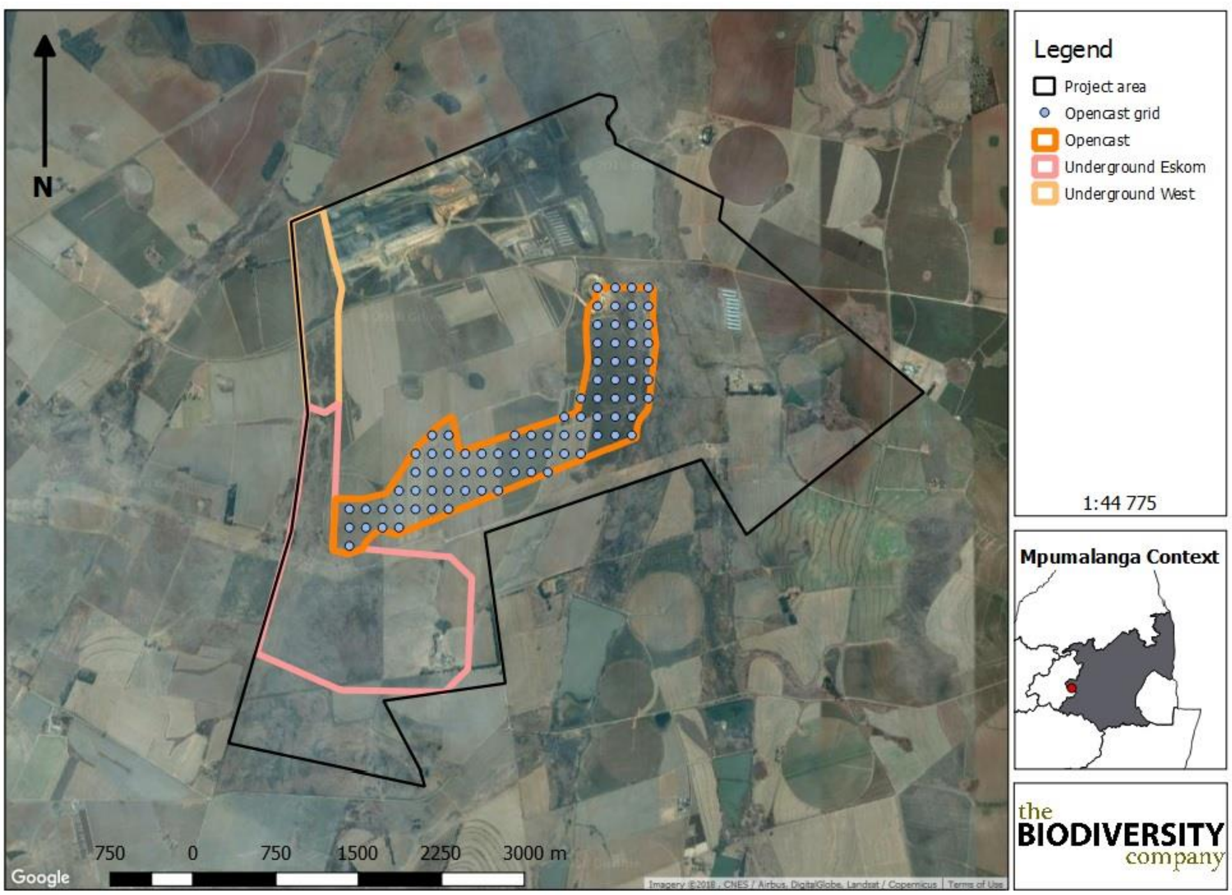


Figure 3: The sampling points for the agricultural potential assessment

3.3 Agricultural Potential Assessment

Land capability and agricultural potential is determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes (Smith, 2006)

Land capability is divided into eight classes and these may be divided into three capability groups. Table 1 shows how the land classes and groups are arranged in order of decreasing capability and ranges of use. The risk of use increases from class I to class VIII (Smith, 2006).

Table 1: Land capability class and intensity of use (Smith, 2006)

Land Capability Class	**Increased Intensity of Use**									**Land Capability Groups**
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable Land**
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC			
IV	W	F	LG	MG	IG	LC				
V	W	F	LG	MG						**Grazing Land**
VI	W	F	LG	MG						
VII	W	F	LG							
VIII	W									**Wildlife**
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**					

The land potential classes are determined by combining the land capability results and the climate capability of a region as shown in Table 2. The final land potential results are then described in Table 3.

Table 2: The combination table for land potential classification

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	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
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 3: The Land Potential Classes.

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, temperatures or rainfall. Appropriate permission is required before ploughing virgin land.
L5	Restricted potential: Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.
L6	Very restricted potential: Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L7	Low potential: Severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L8	Very low potential: Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable

3.4 Current Land Use

Land use was identified using aerial imagery and then ground-truthed while out in the field. The possible land use categories are:

- Mining;
- Bare areas;
- Agriculture crops;
- Natural veld;
- Grazing lands;
- Forest;
- Plantation;
- Urban;
- Built-up;
- Waterbodies; and
- Wetlands.

3.5 Impact Assessment Methodology

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

4 Legislative & Policy Framework

Currently, various pieces of legislation and related policies exist that guide and direct the land user in terms of land use planning both on a national and provincial level. This legislation includes, but is not limited to:

- The Constitution of the Republic of South Africa (Act 108 of 1996);
- Sub-division of Agricultural Land Act (Act 70 of 1970);
- Municipal Structures Act (Act 117 of 1998);
- Municipal Systems Act (Act 32 of 2000); and
- Spatial Planning and Land Use Management Act, 16 of 2013 (not yet implemented).

The above mentioned are supported by additional legislation that aims to manage the impact of development on the environment and the natural resource base of the country. Related legislation to this effect includes:

- Conservation of Agricultural Resources Act (Act 43 of 1983);
- Environment Conservation Act (Act 73 of 1989);
- National Environmental Management Act (Act 107 of 1998); and
- National Water Act (Act 36 of 1998).

5 Desktop Information

5.1 Climate

The project area falls within the Rand Highveld Grassland region (Gm11) (Mucina & Rutherford, 2006). The region has a strongly seasonal summer-rainfall, with very dry winters. MAP is 654 mm, ranging between 570 mm and 730 mm. The coefficient of variation of MAP is 28% in the west and 26-27% in the east and varies only slightly from 25% to 29% across the unit. The incidence of frost is higher in the west (30-40 days) than in the east (10-35 days). The mean annual temperature is 15.8 ºC. The mean annual evaporation is approximately 2184mm.

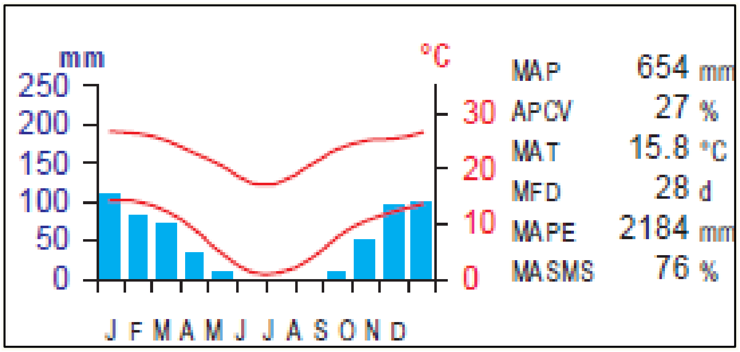


Figure 4: The climate summary for the Rand Highveld Grassland (Gm 11) region (Mucina & Rutherford, 2006)

The Climate capability for this region was determined to be C6 classification. C6 (Severe limitation rating): Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops that frequently experience yield loss, (Smith, 2006).

5.2 Terrain

A National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) (V3.0, 1 arcsec resolution) Digital Elevation Model (DEM) was obtained from the United States Geological Survey (USGS) Earth Explorer website. Basic terrain analysis was performed on this DEM using the SAGA GIS software that encompassed a slope and channel network analyses in order to detect catchment areas and potential drainage lines respectively. The following processes have been considered for the desktop assessment:

- **The relief map (Figure 5):** The project area is flat throughout with an elevation range from approximately 1560 meter above sea level (masl) to 1640 masl. The lower laying regions are characterised by various signs of wetness including hydrophites, wetland soils, historic signs of wetness and current signs of wetness.
- **The slope map (Figure 6):** The project area is flat with slopes between 0% and 5% without any major height changes within the project boundaries.
- **The aspect map (Figure 7):** The map shows that most of project area is east facing.

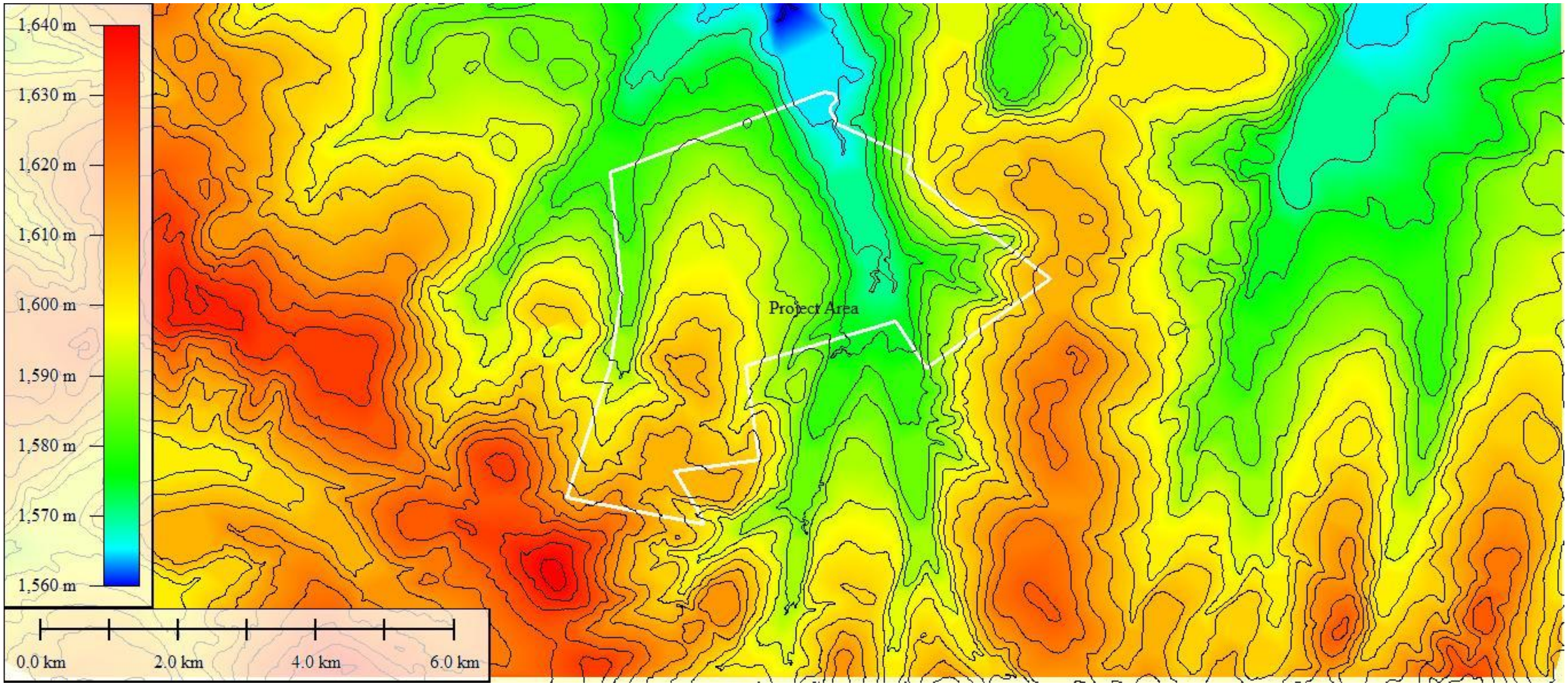


Figure 5: The relief map for the project area

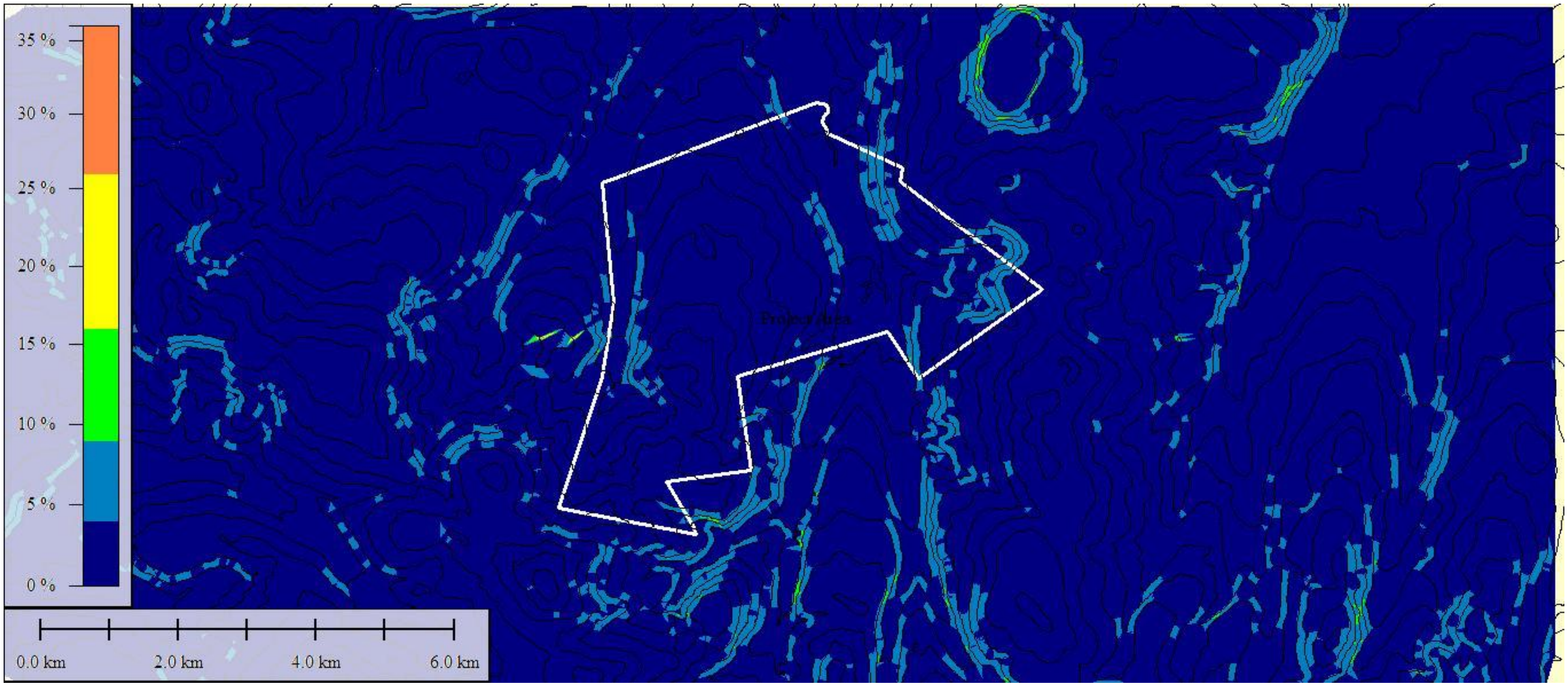


Figure 6: The Slope Percentage map for project area

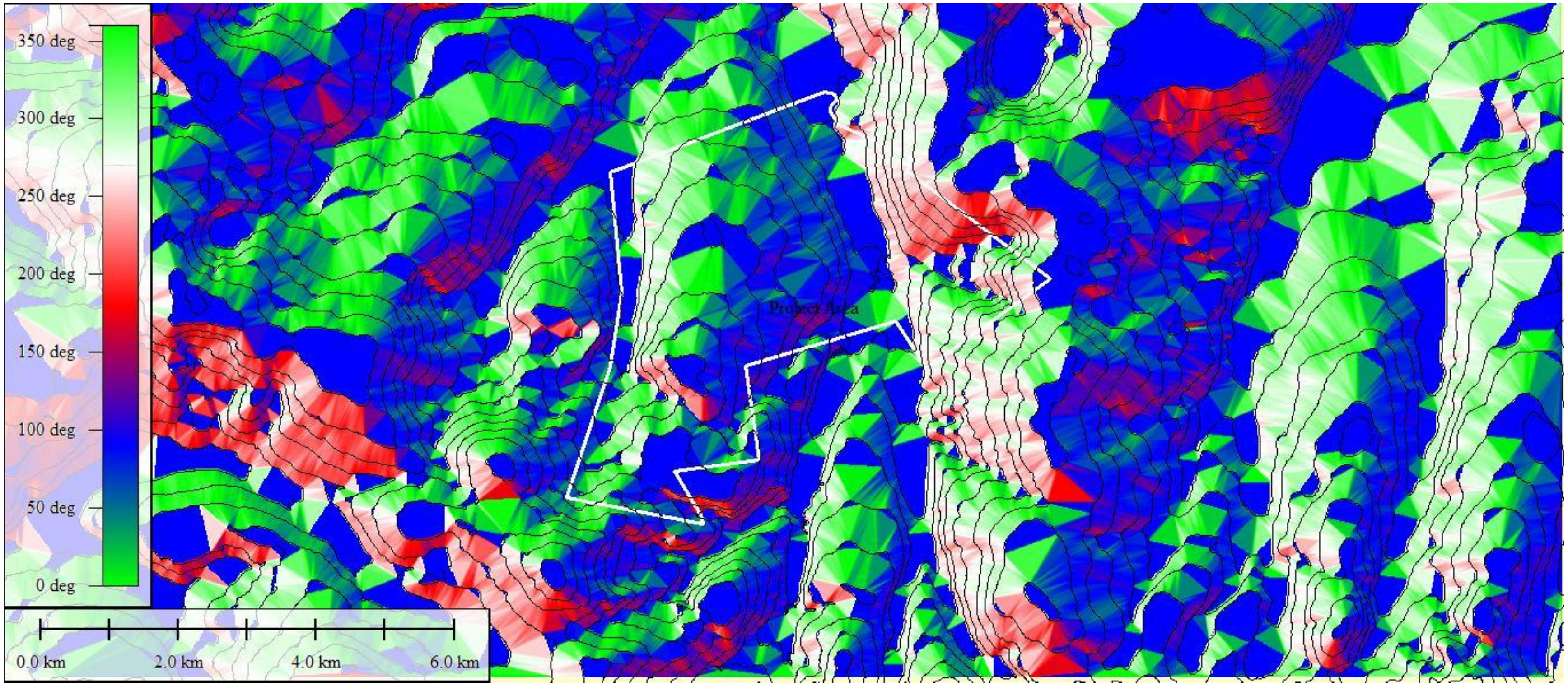


Figure 7: The Slope Aspect map for project area

5.3 Soils & Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006) the project falls within the Ea15, Ea20 and Bb3 land type. These land types are described in Table 4.

Table 4: The expected soil features for the Land types present

Land Type	Expected Soil Features
Ea15 & Ea20	One or more of: Vertic, Melanic, red structured diagnostic horizons; undifferentiated.
Bb3	Plinthic catena: Upland duplex and margalitic soils rare. Dystrophic and/or mesotrophic; red soils not widespread.

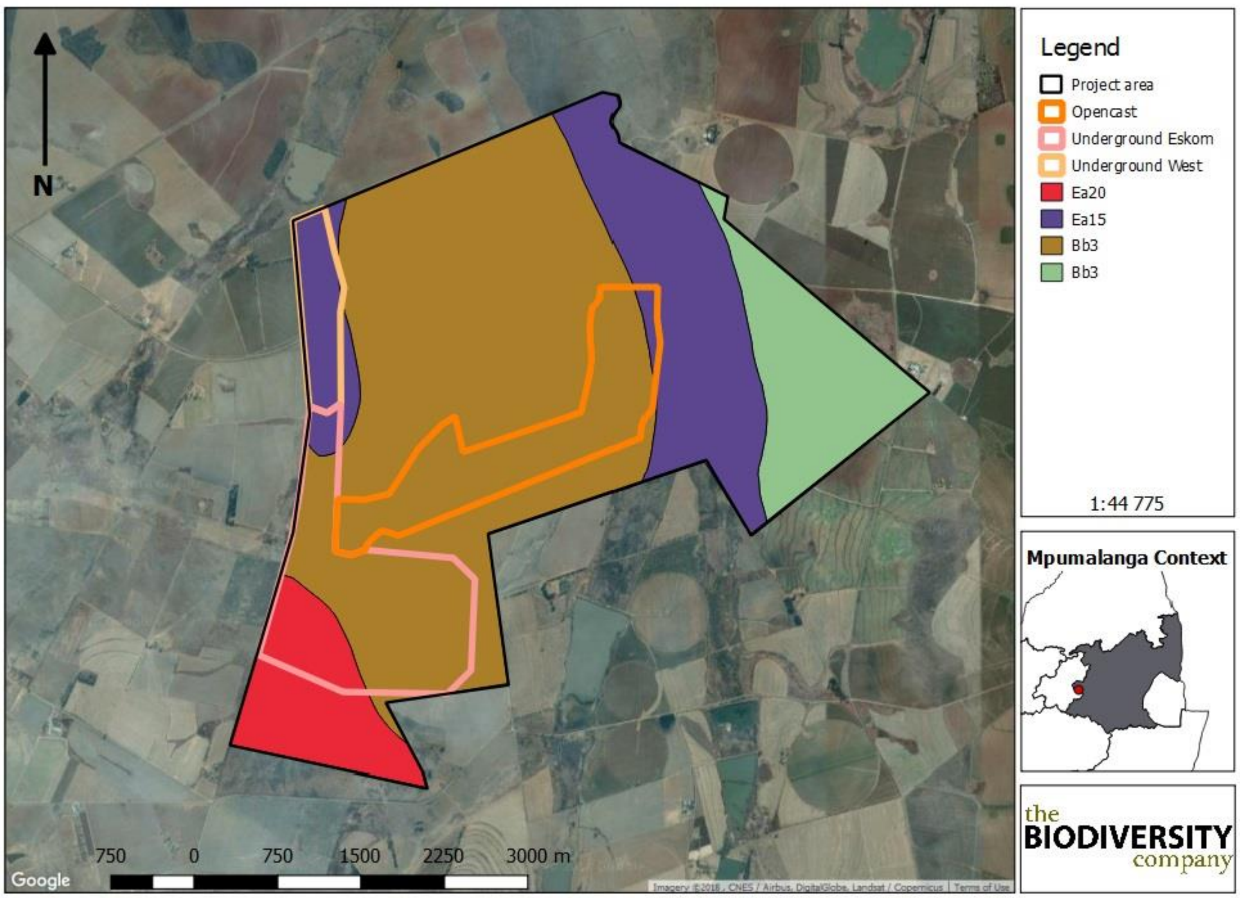


Figure 8: Land type map for the project area

5.4 Landscape and Vegetation Features

Highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra, P. welwitschii, Acacia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Rhus* (especially *R. magalismonata*) is most prominent (Mucina & Rutherford, 2006).

6 Baseline Environment

6.1 Field Survey Findings

A detailed soil survey was conducted for the project site from the 15th until the 22nd of January using a hand-held auger and a GPS to log all information in the field. The soils were classified to the family level as per the “Soil Classification - A Taxonomic System for South Africa” (Soil Classification Working Group, 1991). The following information was recorded in the field:

- A horizon depth, colour and estimated clay percentage;
- B horizon depth, colour and estimated clay percentage;
- Signs of wetness;
- Rockiness of the profile;
- Surface crusting (if any); and
- Slope at the survey point.

6.1.1 Soil Summary

The project area is characterised by a relatively flat and uniform relief. The soils delineation is shown in Figure 9. The soil distribution is shown in

Table 5. The “underground west” area is characterised by Willowbrook, Katspruit and Oakleaf soil forms. A fraction of this area is characterised by “disturbed soils” as well. The Willowbrook and Katspruit areas are part of the delineated wetlands within 500m from the project boundaries. The “Undergound Eskom” area consists of the same soil forms with the addition of Bonheim, Inhoek, and Mispah soil forms. Only the Bonheim soil form is characterised as wetland soils for this specific site. In the opencast area, only Tukulu and Katspruit soil forms are present with a small fraction of the area being disturbed soils. The Tukulu soil form has been divided into five different categories, depending on signs of wetness and depth of horizons.

During the field survey, the depth and clay percentage for the A-horizon and B-horizons have been estimated on site. Additionally, signs of wetness, rockiness and surface crusting have been considered. The resulting data is illustrated in Table 12.

6.1.2 A-horizons

The Tukulu soil forms (Tukulu A, B, C and D) within the opencast area has very shallow A-horizons owed to the fact that the soil is ripped and cultivated regularly throughout the year which subsequently mixes the A-horizon and the B-horizon.

All of the above mentioned Tukulu soil forms has an A-horizon depth of approximately 300mm. Therefore, the entire opencast area (except for the wetland area) should be stripped at 300mm and stockpiles together seeing that their physical properties are very similar.

6.1.3 B-horizons

The Neocutanic B-horizons from each of the Tukulu soil forms (Tukulu A, B, C and D) differ in depths. Tukulu A’s B-horizon depth ranges from 300mm underneath the surface up to 400mm. Tukulu B’s B-horizon ranges from 300mm to 500mm. Tukulu C’s B-horizon ranges from 300mm up to 600mm and lastly Tukulu D’s B-horizon ranges from 300mm up to 700mm before reaching the C-horizon. The Tukulu soil form across the opencast area therefore experience and increase in its B-horizon’s depth from west to east.

The stripped material should however be stockpiled together seeing that the only aspect separating the soils are depths.

6.1.4 C-horizon

The C-horizons from the Tukulu soil form was classified as soft plinthite. Similarly to the B-horizons, the C-horizons differ in depth. Tukulu A’s C-horizon should be stripped from 400mm to 1000mm, Tukulu B’s C-horizon should be stripped from 500mm to 1000mm, Tukulu C’s C-horizon should be stripped from 600mm to 1000mm and Tukulu D’s C-horizon should be stripped from 700mm to 1000mm.

Table 5: Shows the distribution of the soils surveyed

Proposed mining portion	Soil Forms	Total Area (ha)
"Underground west"	Willowbrook	32
	Katspruit	37
	Oakleaf	3
	Disturbed area	4
"Underground Eskom"	Willowbrook	28
	Katspruit	5
	Oakleaf	6
	Bonheim	49
	Inhoek	39
	Mispah	0.1
"Open cast"	Tukulu A	47.3
	Tukulu B	40.3
	Tukulu C	30.3
	Tukulu D	46.4
	Tukulu Wet	3
	Katspruit	13
	Disturbed area	3

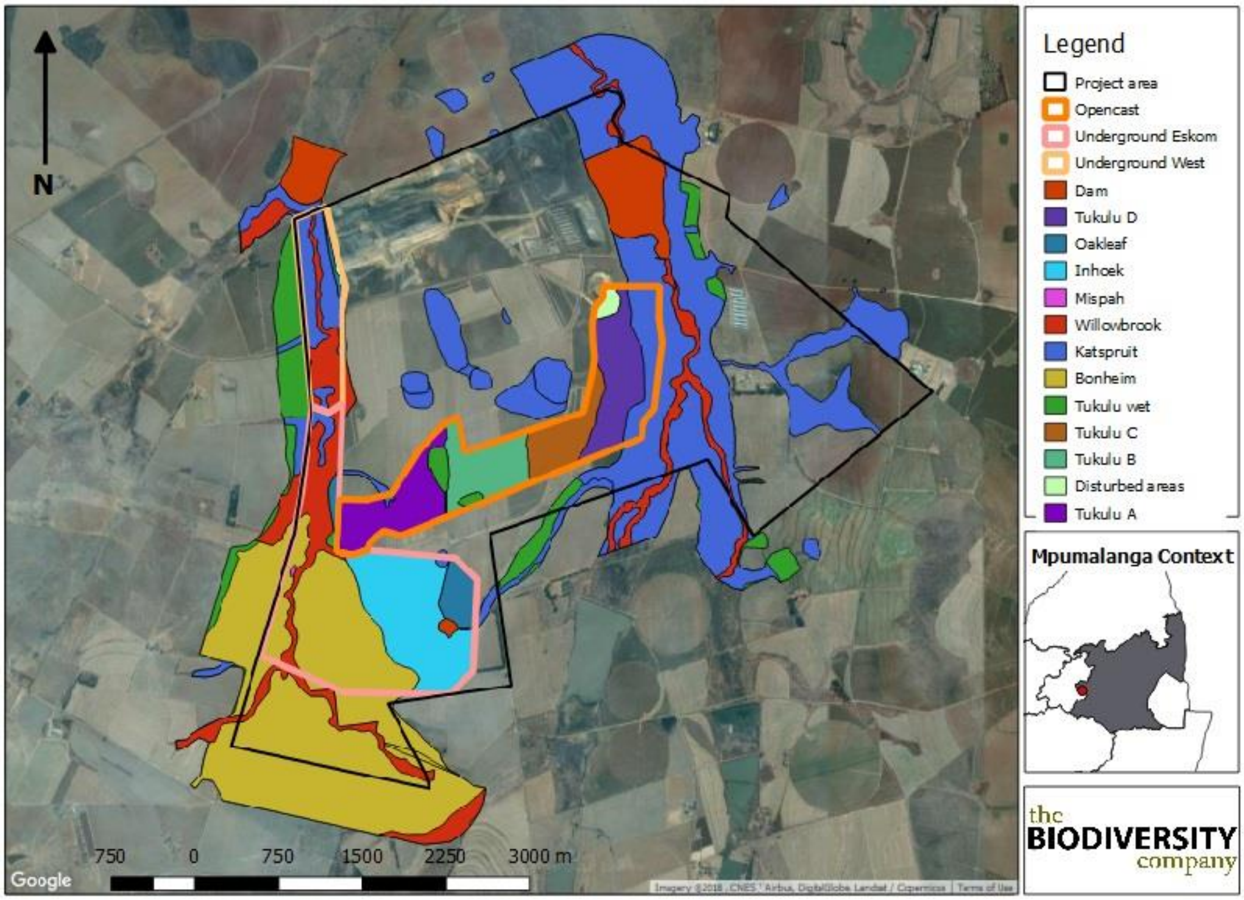


Figure 9: Soil map with the proposed underground and opencast mines as well as the surrounding wetlands

Table 6: Katspruit soils in the project area

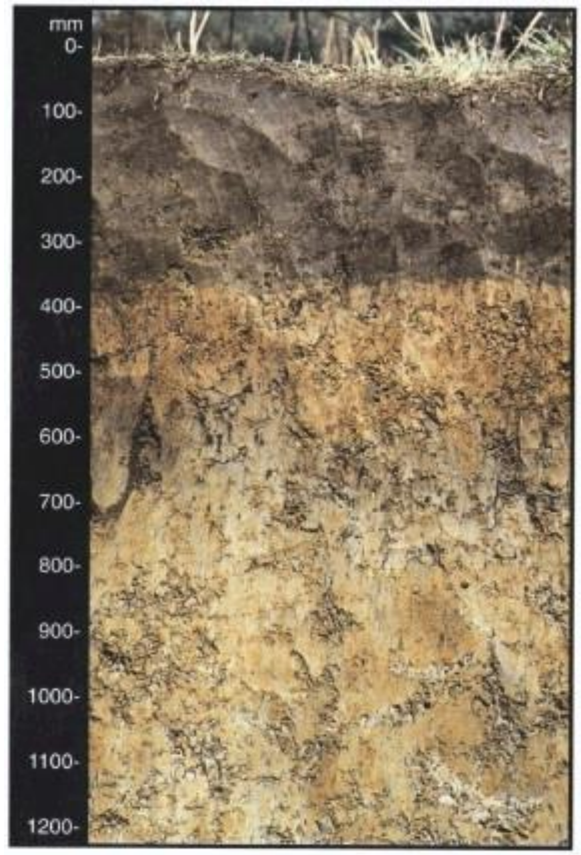
<table>
<tr><th colspan="4">Katspruit (Lammermoor 1000)</th></tr>
<tr><td rowspan="3">Horizons</td><td colspan="3">A typical cross section of a Katspruit soil (SASA, 1999).</td></tr>
<tr><td>Orthic A-horizon</td><td rowspan="2" colspan="2">
</td></tr>
<tr><td>G-horizon</td></tr>
<tr><td>Description</td><td colspan="3">The Katspruit soil form consists of an Orthic A-horizon on top of a saturated G-horizon. This soil form typically occurs at low lying areas where water tends to accumulate. A G-horizon is characterised by saturated conditions.</td></tr>
<tr><td>Site photos:
(Orthic A-horizon topsoil left and G-horizon subsoil on the right)</td><td colspan="2"></td><td></td></tr>
</table>

Table 7: Tukulu soils in the project area

Tukulu (Dikeni 1220)			
Horizons	Typical Cross Section of a Tukulu soil (SASA, 1999).		
	Orthic A-horizon		
	Neocutanic B-horizon		
	Unspecified material with signs of wetness C-horizon		
Description	The Neocutanic B-horizon is characterised by signs of a newly developed soil. This subsoil has a weak to moderate structure and consists mainly out of sand and loam with concentrations of cutans. Additionally, this soil profile is described as showing signs of wetness in the form of soft plinthite beneath the Neocutanic B-horizon.		
Site Photos: left to right, Orthic A-horizon, Neocutanic h-Horizon and soft plinthite.			

Table 8: Oakleaf soils in the project area

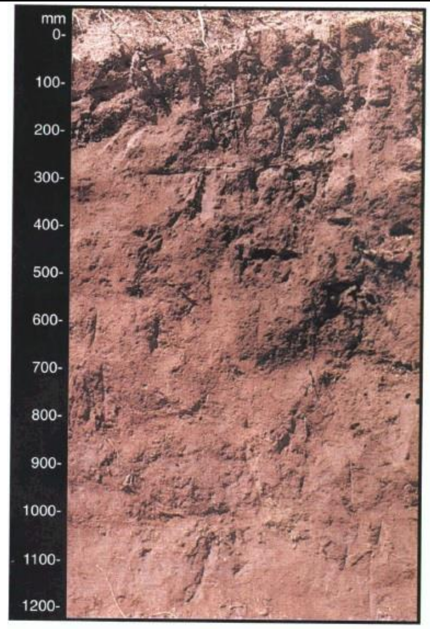
Oakleaf (Buchuberg 1120)		
Horizons	A typical cross section of a Oakleaf soil (SASA, 1999).	
	Orthic A-horizon	
	Neocutanic B-horizon	
	Unspecified material without signs of wetness C-horizon	
Description	The Oakleaf soil is labelled as a "newly formed" soil and often occurs in alluvial and colluvial deposits. This soil form has a relatively weak structure. Additionally, this soil profile is described as having no signs of wetness beneath the Neocutanic B-horizon.	
Site Photos: From left to right, an Orthic A-horizon and a Neocutanic B-horizon.		

Table 9: Willowbrook soils in the project area

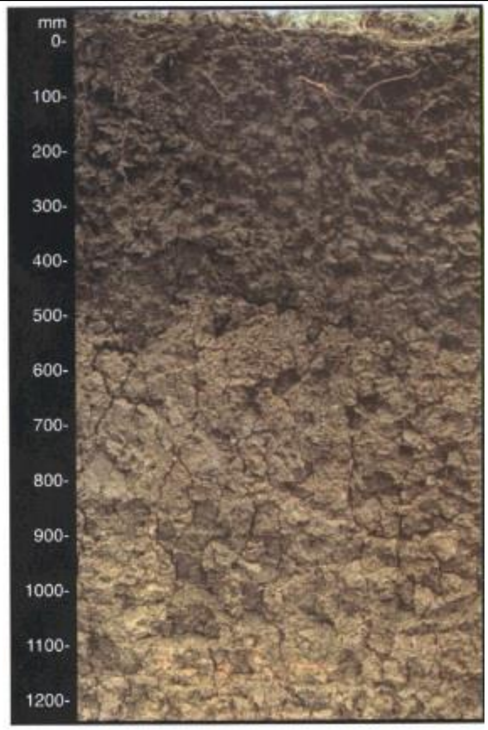
Willowbrook (Ottawa 1000)		
Horizons	A typical cross section of a Willowbrook soil (SASA, 1999).	
	Melanic A-horizon	
	G-horizon	
Description	A Willowbrook consists of a Melanic A-horizon which is well structured, black and blocky above a mottled, gleied G-horizon characterised by long periods of saturation.	
Site Photos: From left to right, a Melanic A-horizon and a G-horizon		

Table 10: Bonheim soils in the project area

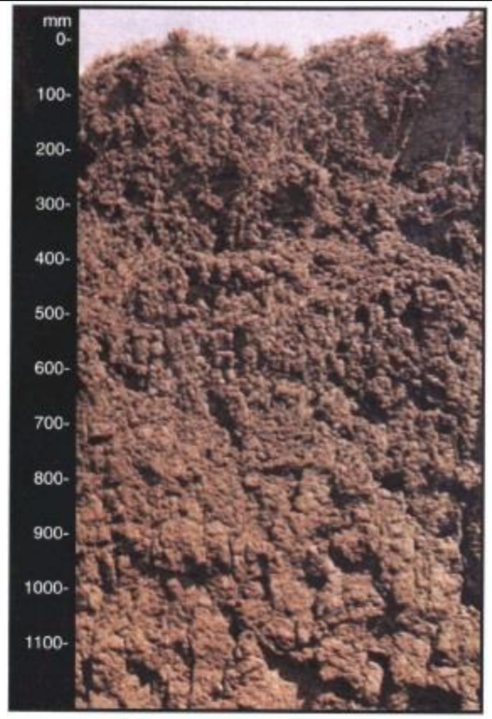
Bonheim (Eureka 1110)		
Horizons	A typical cross section of a Bonheim soil (SASA, 1999).	
	Melanic A-horizon	
	Pedocutanic B-horizon	
Description	A Bonheim consists of a Melanic A-Horizon on top of a Pedocutanic B-horizon. This soil can be located within or outside of a wetland, depending on external signs of wetness as well as internal signs of wetness within the first 500mm.	
Site Photos: Presentation of a Melanic A-Horizon on top of a Pedocutanic B-horizon		

Table 11: Inhoek soils in the project area

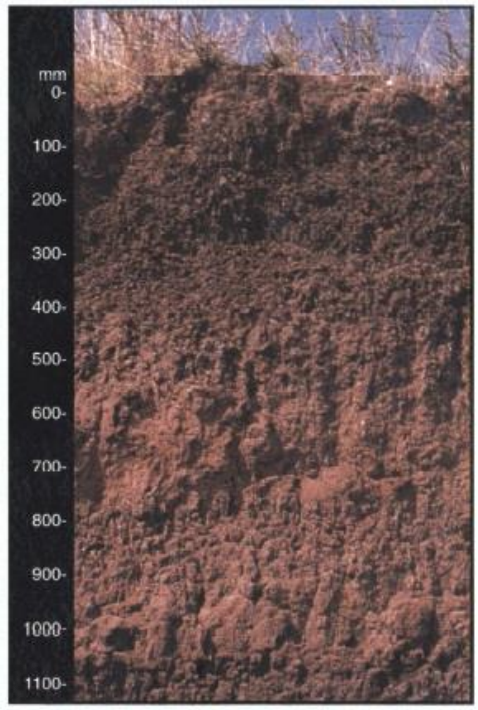
<table>
<tr><th colspan="3">Inhoek (Oatlands 1100)</th></tr>
<tr><td rowspan="3">Horizons</td><td colspan="2">A typical cross section of a Inhoek soil (SASA, 1999).</td></tr>
<tr><td>Melanic A-horizon</td><td rowspan="2">
</td></tr>
<tr><td>Unspecified material</td></tr>
<tr><td>Description</td><td colspan="2">A Inhoek soil form consists of a Melanic A-horizon on top of an unspecified material newly stratified by alluvium.</td></tr>
<tr><td>Site Photos:
Presentation of a Melanic A-horizon on top of an unspecified material</td><td></td><td></td></tr>
</table>

Table 12: Shows the distribution of the soils surveyed

Soil Forms	A-horizon					B-horizon				C-horizon			
	Depth (mm)	Clay	Signs of wetness	Rock	Surface crusting	Depth (mm)	Clay	Signs of wetness	Rock	Depth (mm)	Clay	Signs of wetness	Rocki
Willowbrook	400mm	>45%	350mm	0%	30%	>400mm	>45%	Throughout horizon	0%				
Katspruit	400mm	15%-35%	350mm	2%-10%	0%-10%	>400mm	>45%	Throughout horizon	0%				
Disturbed area	No survey done on disturbed soil												
Oakleaf	100mm	0-15%	None	0%	0%-10%	100mm->1000mm	12%-35%	None	2%-10%				
Bonheim	500mm	>45%	Within 500mm	0%	30%	>500mm	35%-75%	Throughout	2%-10%				
Inhoek	500mm	>45%	None	0%	30%	500mm->1000mm	15%-35%	None	2%-10%				
Mispah	100mm	0%	None	>30%	0%	Hard rock							
Tukulu (Wet)	200mm	0%-15%	None	0%	0%-15%	100mm-500mm	15%-35%	500mm	20%-30%	>500mm	15%-35%	500mm	>35%
Tukulu A	200mm	0%-15%	None	0%	0%-15%	200mm-400mm	15%-35%	None	20%-30%	>400mm	15%-35%	700mm	>35%
Tukulu B	200mm	0%-15%	None	0%	0%-15%	200mm-500mm	15%-35%	None	20%-30%	>500mm	15%-35%	700mm	>35%

Tukulu C	**200mm**	**0%-15%**	**None**	**0%**	**0%-15%**		**200mm-600mm**	**15%-35%**	**None**	**20%-30%**		**>600mm**	**15%-35%**	**700mm**	**>35%**
Tukulu D	**200mm**	**0%-15%**	**None**	**0%**	**0%-15%**		**200mm-700mm**	**15%-35%**	**None**	**20%-30%**		**>700mm**	**15%-35%**	**700mm**	**>35%**

6.2 Agricultural Potential

Agricultural potential is determined by a combination of soil, terrain and climate features. Land capability classes reflect the most intensive long-term use of land under rain-fed conditions.

The land capability is determined by the physical features of the landscape including the soils present. The land potential or agricultural potential is determined by combining the land capability results and the climate capability for the region.

6.2.1 Current Situation

The area is dominated by mining to the north. The rest of the project area is either covered with wetlands or crop fields of which wetland make up approximately 70% thereof.

6.2.2 Verified Agricultural Potential

The Climate capability for this region was determined to be C6 classification. C6 (Severe limitation rating): Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops that frequently experience yield loss, (Smith, 2006).

The land capability was determined by using the guidelines described in “The farming handbook” (Smith, 2006). A breakdown of the land capability classes is shown in Table 1: Land capability class and intensity of use (Smith, 2006).

The Land Capability for the project area is illustrated in Table 13 and shown in Figure 10. All of the soils within wetland areas have been rated a land capability score of “V” (Vlei) except for Tukulu “wet” and Bonheim which has been rated a land capability of class “IV” (Light Cultivation/ Intensive Grazing). The Mispah soil form has been rated a score of “VI” (Moderate Grazing). The non-wetland areas however have been scored a land capability rating of “III” (Moderate Cultivation) due to the lack of clay within the topsoil and the depth of the soil profile.

Table 13: Land capability for the soils within the Manungu project area

Soil Forms	Land capability class rating	Land potential
Willowbrook	Class V	Vlei
Katspruit	Class V	Vlei
Oakleaf	Class III	L4
Disturbed area	No assessment	-
Bonheim	Class IV	L5
Inhoek	Class III	L4
Mispah	Class VI	L6
Tukulu A	Class III	L4
Tukulu B	Class III	L4
Tukulu C	Class III	L4

Tukulu D	**Class III**	**L4**
Tukulu Wet	**Class IV**	**L5**

The Land Potential of the project area is shown in Figure 11 and the land potential groups are described previously in Table 2.

The class III land capability was rated as L4 land potential (moderate potential), the class IV land capability was rated L5 (restricted potential) and the class VI has been rated L6 (very restricted potential). The Class V land capability was determined to be a **Vlei**.

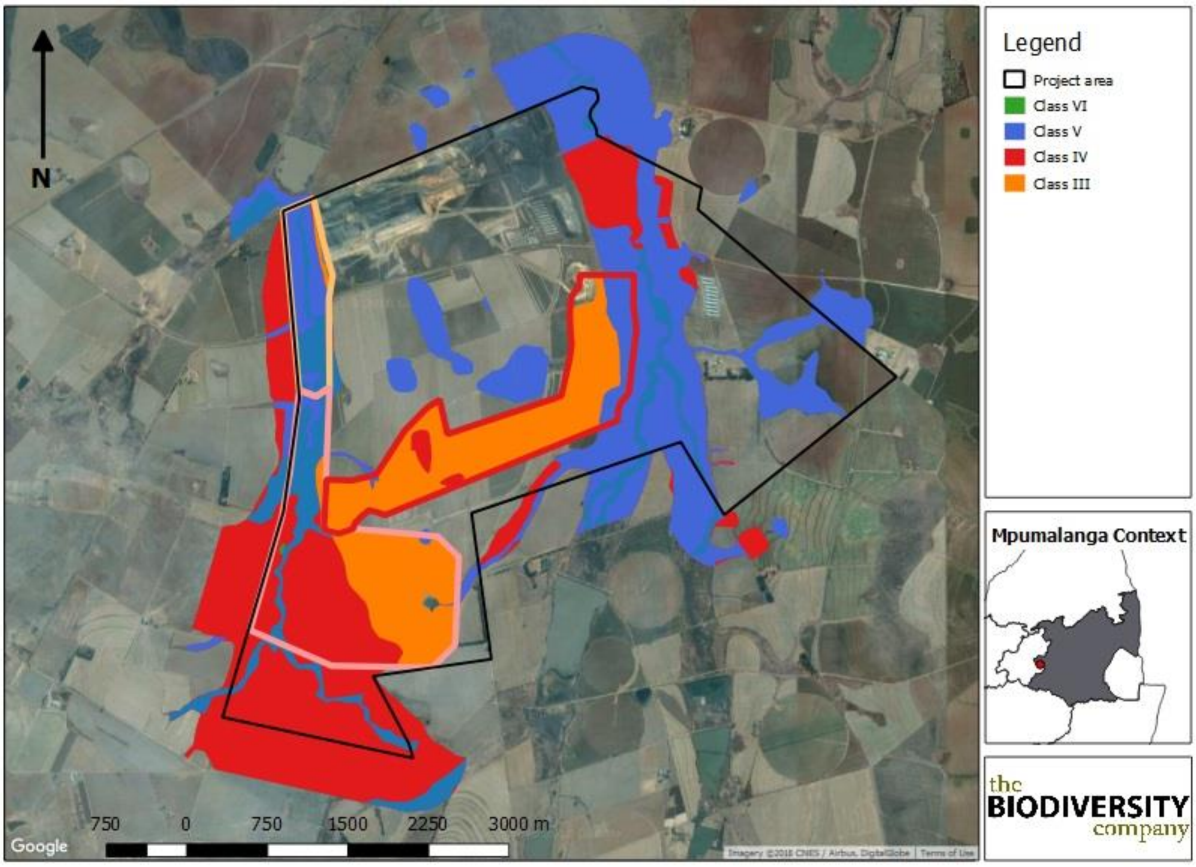


Figure 10: Land capability classes of different soil forms present within the Manungu project areas

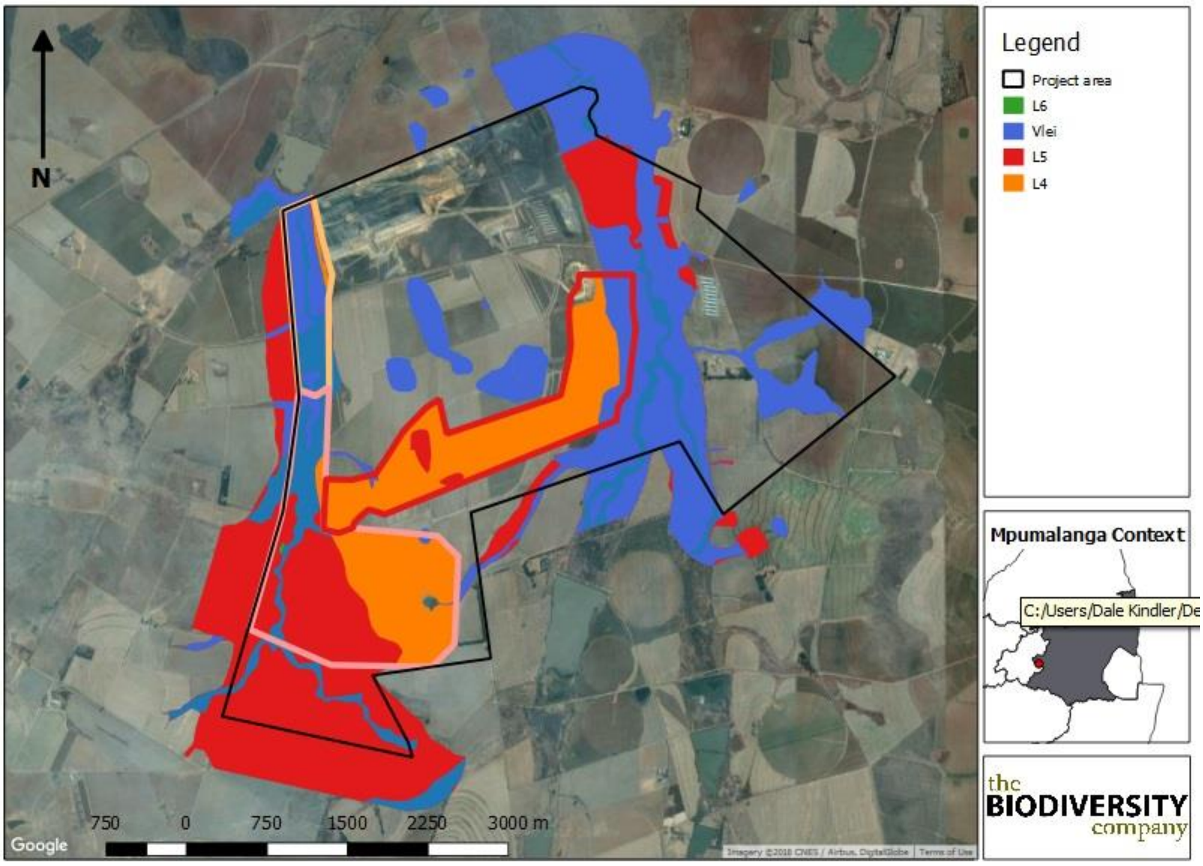


Figure 11: Land Potential Classes within the Manungu project boundaries

6.3 Current Land Use

The project area is approximately 500ha in size with agriculture (Figure 14) taking up approximately 25% of the space and wetlands (Figure 13) taking up the other half, see Figure 12.

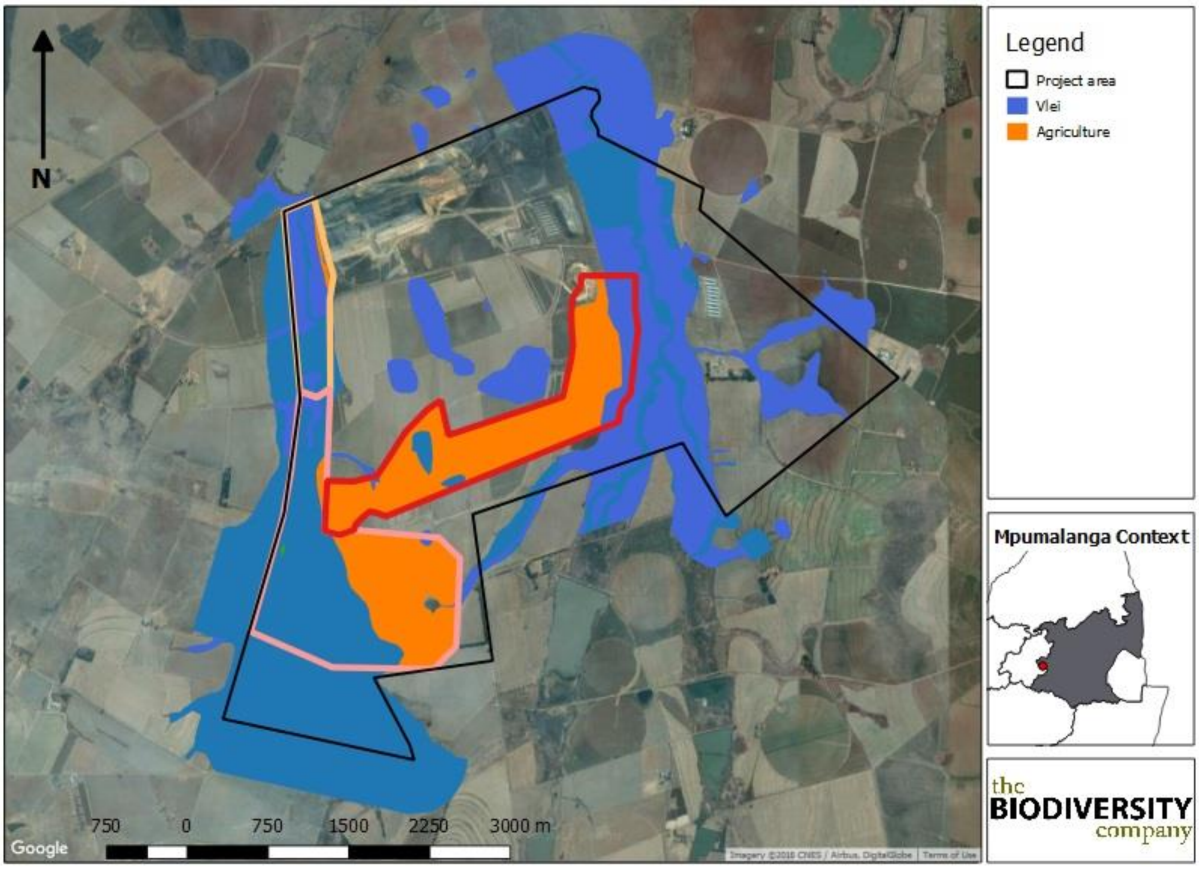


Figure 12: Map illustrating current land use areas

Figure 13: Example of wetlands within the project area

Figure 14: Example of crop fields within the project area

7 Impact Assessment

From an agricultural perspective, the loss of high value farm land and / or food security production, as a result of the proposed activities, is the primary concern of this assessment. In South Africa there is a scarcity of high potential agricultural land, with less than 14% of the total area being suitable for dry land crop production (Smith, 2006).

7.1 Project Components

The impact section will assess the impacts on soils and land capability for all the relevant components shown in Table 14**.** These alternatives are described below along with their respective impact ratings. The two main aspects that was considered for all components where:

- The loss of the land capability; and
- The loss of soil as a valuable resource.

Table 14: List of project components that has been considered for the impact assessment

Component Category		**Component description**
Various components	Mining	Open Cast
		Underground
	Wash plant and associated infrastructure	For existing coal beneficiation plant
	Discard dump for wash plant waste	Location of discard dump
		Degradation caused by pollution factor
	The construction of new residue stockpiles	Stockpiles for A-horizons
		Stockpiles for B-horizons
		Stockpiles for C-horizons

7.1.1 Opencast

Planning Phase (Table 15): a detailed Mining Program, Soil Stripping Guideline and Rehabilitation Plan must be completed before commencement. Poor planning of soil stripping stockpiling and rehabilitation will result in losses of land capability and soil as a valuable and irreplaceable resource.

Proper planning prior to construction would reduce the level of impacts from a Medium to a Low impact.

Table 15: Loss of land capability assessed for the proposed opencast area during the planning phase

Loss of Land Capability - Opencast					
Impact Name	**Loss of Land Capability**				
Alternative	**Opencast**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	3
Extent of Impact	1	1	Reversibility of Impact	3	2
Duration of Impact	5	2	Probability	5	2
Environmental Risk (Pre-mitigation)					-17,50
Mitigation Measures					
• Proper planning of mining sequences; • stripping and stockpiling guidelines; and • rehabilitation and monitoring plans.					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1,50
Final Significance					-6,00

Construction phase (Table 16): The impacts to consider are those relating to the disturbance of the natural soil state. When soil is stripped the physical properties are changed and this impacts on the soils health. When the soil is stockpiled, the soils chemical properties will deteriorate unless properly managed. These all lead to the loss of the topsoil layer as a natural resource. Soil is considered a slowly regenerating resource due to the fact that it takes hundreds of years for a soil profile to gain 10cm of additional soil through natural processes. During a single rainfall event on unprotected bare soil, erosion could remove that same amount of soil if not more.

Whilst the construction takes place vehicles will drive on the soil surface compacting it. This reduces infiltration rates as well as the ability for plant roots to penetrate the compacted soil. This then reduces vegetative cover and increases runoff potential. The increased runoff potential then leads to increased erosion hazards.

If the topsoil and subsoil are stripped and stockpiled as one unit, the topsoil's seed bank and natural fertility balance is diluted. This will affect the regrowth of vegetation on the stockpiles as well as the regrowth when they have been replaced during the rehabilitation process, therefor soils should be handled with care from the construction phase through to the decommissioning phase.

Operational phase (Table 16): During the operational phase, similar scores are expected regarding the extent of the impacts than those scored for the construction phase. The operational phase describes the processes taking place during the extraction of minerals within the open cast pit. The top soil is stripped during this process and stockpiled separately. It is of vital importance that the correct procedures be adhered to during this activity and that the different soil horizons be kept separate. During this phase, erosion is a major concern for these stockpiles, especially in cases where proper vegetation has not been established. Erosion within these sections will cause extensive sediment transport and ultimately pollution and degradation of healthy water courses and soil resources nearby.

These designated stockpiles often compact the soil underneath them due to their extremely high masses. Compaction of natural soil resources for extended time periods can cause irreversible degradation. Stockpiles themselves aren't the only aspect contributing to compaction. During the operational phase, a large degree of vehicle activity takes place to ensure that extracted minerals as well as additional waste material is transported to its designated storage areas. These heavy machinery vehicles compact the soil between the mining site and the mentioned storage areas severely. Additionally, such stockpiles tend to entail very fine sediment that is prone to be carried away by gusts of wind and ultimately contributes to dust pollution.

Table 16: Loss of land capability assessed for the proposed opencast during the construction and operational phase

Loss of Land Capability - Opencast					
Impact Name	**Loss of Land Capability**				
Alternative	**Opencast**				
Phase	**Construction and operational phase**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	5
Extent of Impact	2	2	Reversibility of Impact	5	4
Duration of Impact	5	4	Probability	5	4
Environmental Risk (Pre-mitigation)					-20,00
Mitigation Measures					
• Bush clearing of all bushes and trees taller than one meter; Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure; • The topsoil should be stripped by means of an excavator bucket, and loaded onto dump trucks; • Topsoil stockpiles are to be kept to a maximum height of 4m; • Topsoil is to be stripped when the soil is dry, as to reduce compaction; • Bush clearing contractors will only clear bushes and trees larger than 1m the remaining vegetation will be stripped with the top 0.3 m of topsoil to conserve as much of the nutrient cycle, organic matter and seed bank as possible; • The subsoil approximately 0.3 to the designated thickness in the stripping guidelines, will then be stripped and stockpiled separately; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate significantly; • Compaction of the removed topsoil must be avoided by prohibiting traffic on stockpiles; • Stockpiles should only be used for their designated final purposes; • The stockpiles will be vegetated (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. • Place the above cleared vegetation were the topsoil stockpiles are to be placed; and • Strip the topsoil and the remaining vegetation as per the rehabilitation guideline and place in the allocated locations for the various soil types, on top of the previously cleared bushes and trees.					
Environmental Risk (Post-mitigation)					-15,00
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					2
Low: Issue not raised in public responses					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3

The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,83
Final Significance	-27.5

Decommissioning phase (Table 17): During this phase, vehicle activity is likely to compact soils even further due to the necessary material. The infrastructure established during the construction phase is subsequently destroyed to ensure as little as possible is left after the relevant mining operations.

Table 17: Loss of land capability assessed for the proposed opencast during the decommissioning phase

Loss of Land Capability - Opencast					
Impact Name	**Loss of Land Capability**				
Alternative	**Opencast**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	2	2	Reversibility of Impact	5	3
Duration of Impact	5	3	Probability	5	3
Environmental Risk (Pre-mitigation)					-20,00
Mitigation Measures					
• Ensure proper storm water management designs are in place; • Ensure that proper phytostabilization takes place on top of the relevant stockpiles; • Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Implement land rehabilitation measures as defined in rehabilitation report. • Follow rehabilitation guidelines; • The topsoil should be moved by means of an excavator bucket, and loaded onto dump trucks; • Topsoil is to be moved when the soil is dry, as to reduce compaction; • After the completion of the project the area is to be cleared of all infrastructure; • The foundations to be removed; • Topsoil to be replaced for rehabilitation purposes; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate; • Stockpiles should only be used for their designated final purposes; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; and • Stockpiles should be reduced to smaller piles to ensure the ease of continues rehabilitation as well as to decrease the sheer weight thereof.					
Environmental Risk (Post-mitigation)					-8.25
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					2

Issue has received a meaningful and justifiable public response	
Cumulative Impacts	3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,83
Final Significance	-15,13

Rehabilitation and closure (Table 18): The responsibility of rehabilitating degraded (both direct and indirect) areas is allocated to the mine and is an absolute necessity to ensure that closure is given regarding the relevant mining operations. During this phase, monitoring and accompanied rehabilitation is the key concern for replaced soil, compacted soils, eroded areas, the quality of tailing storage facilities, and the different types of pollutions caused by these structures. The successful implementation of this phase will ensure a positive impact on the environment which is a significant improvement of the "pre-mitigation" risk rating.

The risk rating will be significantly improving to a positive from a negative state. The land capability will increase from nothing the what the rehabilitation guidelines have stipulated.

Table 18: Loss of land capability assessed for the proposed opencast during the rehabilitation and closure phase

Loss of Land Capability - Opencast					
Impact Name	**Loss of Land Capability**				
Alternative	**Opencast**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	1	Magnitude of Impact	3	3
Extent of Impact	2	2	Reversibility of Impact	4	3
Duration of Impact	3	3	Probability	4	3
Environmental Risk (Pre-mitigation)					-12.00
Mitigation Measures					

- The rehabilitated area must be assessed once a year for post mining land capability compaction, fertility, and erosion;
- The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies;
- Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated;
- If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place;
- If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion;
- Only the designated access routes are to be used to reduce any unnecessary compaction; and
- Areas of subsidence must be reported and remediated as soon as possible with the best practises at the time of occurrence.

Environmental Risk (Post-mitigation)	8,25
Degree of confidence in impact prediction:	Medium
Impact Prioritisation	
Public Response	2
Issue has received an intense meaningful and justifiable public response	
Cumulative Impacts	1
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,50
Final Significance	12,38

7.1.2 Underground Mining

Planning Phase (Table 19): a detailed mining program and rehabilitation plan must be completed before commencement. Poor planning of rehabilitation will result in losses of land capability and soil as a valuable and irreplaceable resource. Even though underground mining activities have less direct impacts and does not require stripping and stockpiling, indirect risks are expected.

Proper planning prior to construction would reduce the level of impacts from a Medium to a Low impact.

Table 19: Loss of land capability assessed for the proposed underground area during the planning phase

Loss of Land Capability – Underground mining					
Impact Name	**Loss of Land Capability**				
Alternative	**Underground mining**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	3
Extent of Impact	1	1	Reversibility of Impact	3	2
Duration of Impact	5	2	Probability	4	2
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
• Proper planning of mining sequences; and • rehabilitation and monitoring plans.					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2

Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,33
Final Significance	-5,33

Construction phase (Table 20): During the construction phase, compaction from increased vehicle activity and subsidence are the major areas of concern for underground mining activities. The stockpiled overburden will be constructed during this phase causing additional impacts in regard to compaction specifically. Stockpiles consisting of overburden could likely contaminate underground and water sources nearby by means of infiltration and percolation of rainwater. During this phase, dust pollution is likely to occur as well.

Operational phase (Table 20): During the operational phase, similar scores are expected regarding the extent of the impacts than those scored for the construction phase. The operational phase describes the processes taking place during the extraction of minerals within the underground mine. Erosion is a major concern for those stockpiles constructed to accommodate the excavated material, especially in cases where proper vegetation has not been established. Erosion within these sections will cause extensive sediment transport and ultimately pollution and degradation of healthy water courses and soil resources nearby.

These designated stockpiles often compact the soil underneath them due to their extremely high masses. Compaction of natural soil resources for extended time periods can cause irreversible degradation. Stockpiles themselves aren't the only aspect contributing to compaction. During the operational phase, a large degree of vehicle activity takes place to ensure that extracted minerals as well as additional waste material is transported to its designated storage areas. These heavy machinery vehicles compact the soil between the mining site and the mentioned storage areas severely. Additionally, such stockpiles tend to entail very fine sediment that is prone to be carried away by gusts of wind and ultimately contributes to dust pollution.

Table 20: Loss of land capability assessed for the underground mining during the construction and operational phase

Loss of Land Capability – Underground mining					
Impact Name	**Loss of Land Capability**				
Alternative	**Underground**				
Phase	**Construction and operational phase**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	2	2	Reversibility of Impact	3	3
Duration of Impact	5	4	Probability	4	3
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					

• Bush clearing of all bushes and trees taller than one meter; Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure; • Excavation stockpiles should only be used for their designated final purposes; and • The stockpiles will be vegetated (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.	
Environmental Risk (Post-mitigation)	-9,00
Degree of confidence in impact prediction:	Medium
Impact Prioritisation	
Public Response	2
Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,67
Final Significance	-15,00

Decommissioning phase (Table 21): During this phase, vehicle activity is likely to compact soils even further due to the necessary material. The infrastructure established during the construction phase is subsequently destroyed to ensure as little as possible is left after the relevant mining operations.

Table 21: Loss of land capability assessed for the underground mine during the decommissioning phase

Loss of Land Capability - Underground					
Impact Name	**Loss of Land Capability**				
Alternative	**Underground**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	3
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	5	3	Probability	5	3
Environmental Risk (Pre-mitigation)					-18,75
Mitigation Measures					
• Ensure proper storm water management designs are in place; • Ensure that proper phytostabilization takes place on top of the relevant stockpiles; • Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • Implement land rehabilitation measures as defined in rehabilitation report. • Follow rehabilitation guidelines;					

• After the completion of the project the area is to be cleared of all infrastructure; and • The foundations to be removed.	
Environmental Risk (Post-mitigation)	-7,50
Degree of confidence in impact prediction:	Medium
Impact Prioritisation	
Public Response	2
Issue has received a meaningful and justifiable public response	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,50
Final Significance	-11,25

Rehabilitation and closure (Table 22): The responsibility of rehabilitating degraded (both direct and indirect) areas is allocated to the mine and is an absolute necessity to ensure that closure is given regarding the relevant mining operations. During this phase, monitoring and accompanied rehabilitation is the key concern for replaced soil, compacted soils, subsidence, eroded areas, the quality of tailing storage facilities, and the different types of pollutions caused by these structures. The successful implementation of this phase will ensure a positive impact on the environment which is a significant improvement of the "pre-mitigation" risk rating.

The risk rating will be significantly improved to a positive from a negative state. The land capability will increase from nothing to what the rehabilitation guidelines have stipulated.

Table 22: Loss of land capability assessed for the underground mine during the rehabilitation and closure phase

Loss of Land Capability - Underground					
Impact Name	**Loss of Land Capability**				
Alternative	**Underground**				
Phase	**Rehabilitation and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	1	Magnitude of Impact	5	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-9,75
Mitigation Measures					
• The rehabilitated area must be assessed once a year for post mining land capability compaction, fertility, and erosion; • The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated;					

• If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Only the designated access routes are to be used to reduce any unnecessary compaction; and • Areas of subsidence must be reported and remediated as soon as possible with the best practises at the time of occurrence.	
Environmental Risk (Post-mitigation)	4,00
Degree of confidence in impact prediction:	Medium
Impact Prioritisation	
Public Response	2
Issue has received an intense meaningful and justifiable public response	
Cumulative Impacts	1
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,33
Final Significance	5,33

7.1.3 Stockpiles and Discard Dump

Planning Phase (Table 23): a detailed Mining Program and Rehabilitation Plan must be completed before commencement. Poor planning of rehabilitation will result in losses of land capability and soil as a valuable and irreplaceable resource.

Proper planning prior to construction would reduce the level of impacts from a Medium to a Low impact.

Table 23: Loss of land capability assessed for the proposed stockpiles and discard dump during the planning phase

Loss of Land Capability – Stockpiles and discard dump					
Impact Name	**Loss of Land Capability**				
Alternative	**Stockpiles and discard dump**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	1	1	Reversibility of Impact	3	2
Duration of Impact	5	2	Probability	4	2
Environmental Risk (Pre-mitigation)					-13,00
Mitigation Measures					
• Proper planning of mining sequences; • stripping and stockpiling guidelines; and • rehabilitation and monitoring plans.					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1

Low: Issue not raised in public responses	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,50
Final Significance	-6,00

Construction phase (Table 24): The impacts to consider are those relating to the disturbance of the natural soil state. When soil is stripped the physical properties are changed and this impacts on the soils health. When the soil is stockpiled, the soils chemical properties will deteriorate unless properly managed. These all lead to the loss of the topsoil layer as a natural resource.

Whilst the construction takes place vehicles will drive on the soil surface compacting it. This reduces infiltration rates as well as the ability for plant roots to penetrate the compacted soil. This then reduces vegetative cover and increases runoff potential. The increased runoff potential then leads to increased erosion hazards.

If the topsoil and subsoil are stripped and stockpiled as one unit, the topsoil's seed bank and natural fertility balance is diluted. This will affect the regrowth of vegetation on the stockpiles as well as the regrowth when they have been replaced during the rehabilitation process, therefor soils should be handled with care from the construction phase through to the decommissioning phase.

Operational phase (Table 24): During the operational phase, similar scores are expected regarding the extent of the impacts than those scored for the construction phase. The operational phase describes the processes taking place during lifespan of the stockpiles and discard dump. During this phase, erosion is a major concern for these stockpiles, especially in cases where proper vegetation has not been established. Erosion within these sections will cause extensive sediment transport, pollution from discard dumps and ultimately pollution and degradation of healthy water courses and soil resources nearby.

These designated stockpiles often compact the soil underneath them due to their extremely high masses. Compaction of natural soil resources for extended time periods can cause irreversible degradation. Stockpiles themselves aren't the only aspect contributing to compaction. During the operational phase, a large degree of vehicle activity takes place to ensure that extracted minerals as well as additional waste material is transported to its designated storage areas. These heavy machinery vehicles compact the soil between the mining site and the mentioned storage areas severely. Additionally, such stockpiles tend to entail very fine sediment that is prone to be carried away by gusts of wind and ultimately contributes to dust pollution.

Table 24: Loss of land capability assessed for the stockpiles and discard dump during the construction and operational phase

Loss of Land Capability – Stockpiles and discard dump					
Impact Name	**Loss of Land Capability**				
Alternative	**Stockpiles and discard dump**				
Phase	**Construction and operational phase**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	4	3
Duration of Impact	5	4	Probability	4	3
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
• Bush clearing of all bushes and trees taller than one meter; Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure; • Topsoil stockpiles are to be kept to a maximum height of 4m; • The subsoil approximately 0.3 to the designated thickness in the stripping guidelines, will then be stripped and stockpiled separately; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate significantly; • Compaction of the removed topsoil must be avoided by prohibiting traffic on stockpiles; • Stockpiles should only be used for their designated final purposes; • The stockpiles will be vegetated (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 • Place the above cleared vegetation were the topsoil stockpiles are to be placed.					
Environmental Risk (Post-mitigation)					-8,25
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Low: Issue not raised in public responses					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1,83
Final Significance					-15,13

Decommissioning phase (Table 25): During this phase, vehicle activity is likely to compact soils even further due to the clearance of established infrastructure on site. The infrastructure established during the construction phase is subsequently destroyed to ensure as little as possible is left after the relevant mining operations.

Table 25: Loss of land capability assessed for the stockpiles and discard dump during the decommissioning phase

Loss of Land Capability - Stockpiles and discard dump					
Impact Name	**Loss of Land Capability**				
Alternative	**Stockpiles and discard dump**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	4	3
Duration of Impact	5	3	Probability	4	2
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
• Ensure proper storm water management designs are in place; • Ensure that proper phytostabilization takes place on top of the relevant stockpiles; • Only the designated access routes are to be used to reduce any unnecessary compaction; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Implement land rehabilitation measures as defined in rehabilitation report. • Follow rehabilitation guidelines; • Topsoil is to be moved when the soil is dry, as to reduce compaction; • After the completion of the project the area is to be cleared of all infrastructure; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate; and • Stockpiles should only be used for their designated final purposes. • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; and • Stockpiles should be reduced to smaller piles to ensure the ease of continues rehabilitation as well as to decrease the sheer weight thereof					
Environmental Risk (Post-mitigation)					-5,00
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1,67
Final Significance					-8,33

Rehabilitation and closure (Table 26): The responsibility of rehabilitating degraded (both direct and indirect) areas is allocated to the mine and is an absolute necessity to ensure that closure is given regarding the relevant mining operations. During this phase, monitoring and accompanied rehabilitation is the key concern for replaced soil, compacted soils, eroded areas, the quality of tailing storage facilities, and the different types of pollutions caused by these structures. The successful implementation of this phase will ensure a positive impact on the environment which is a significant improvement of the “pre-mitigation” risk rating.

The risk rating will be significantly improve to a positive from a negative state. The land capability will increase from nothing the what the rehabilitation guidelines have stipulated.

Table 26: Loss of land capability assessed for the stockpiles and discard dump during rehabilitation and closure phase

Loss of Land Capability - Stockpiles and discard dump					
Impact Name	**Loss of Land Capability**				
Alternative	**Stockpiles and discard dump**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	1	Magnitude of Impact	4	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
• The rehabilitated area must be assessed once a year for post mining land capability compaction, fertility, and erosion; • The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; and • Areas of subsidence must be reported and remediated as soon as possible with the best practises at the time of occurrence.					
Environmental Risk (Post-mitigation)					4,00
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					2
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					1
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3

The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,50
Final Significance	6,00

7.1.4 Wash plant

Planning Phase (Table 27): a detailed Mining Program and Rehabilitation Plan must be completed before commencement. Poor planning of rehabilitation will result in losses of land capability and soil as a valuable and irreplaceable resource.

Proper planning prior to construction would reduce the level of impacts from a Medium to a Low impact.

Table 27: Loss of land capability assessed for the proposed wash plant during the planning phase

Loss of Land Capability – Wash plant					
Impact Name	**Loss of Land Capability**				
Alternative	**Wash plant**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	4
Extent of Impact	1	1	Reversibility of Impact	3	2
Duration of Impact	5	2	Probability	4	3
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
• Proper investigation into ideal locations for the proposed construction; and • Proper investigation into possible receiving bodies for the intended wash plant waste.					
Environmental Risk (Post-mitigation)					-6,75
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1,50
Final Significance					-10,13

Construction phase (Table 28): The impacts to consider are those relating to the disturbance of the natural soil state. During the construction phase, the physical properties are changed and this impacts on the soils health. This leads to the loss of the topsoil layer as a natural resource.

Whilst the construction takes place vehicles will drive on the soil surface compacting it. This reduces infiltration rates as well as the ability for plant roots to penetrate the compacted soil. This then reduces vegetative cover and increases runoff potential. The increased runoff potential then leads to increased erosion hazards. Contamination is another aspect contributing to expected impacts due to the nature of the material handled by the wash plant on a regular basis and the possibilities of leakages occurring.

Operational phase (Table 28): During the operational phase, similar scores are expected regarding the extent of the impacts than those scored for the construction phase. The operational phase describes the processes taking place during operations of the wash plant. During this phase, erosion is a major concern for the surface underneath the wash plant due to the fact that compaction and the clearance of vegetation already has taken place. Compaction of natural soil resources for extended time periods can cause irreversible degradation. During the operational phase, a large degree of vehicle activity takes place to accommodate material being transported to the wash plant. These heavy machinery vehicles compact the soil between the mining site and the mentioned wash plant.

Table 28: Loss of land capability assessed for the wash plant during the construction and operational phase

Loss of Land Capability – Wash plant					
Impact Name	**Loss of Land Capability**				
Alternative	**Wash plant**				
Phase	**Construction and operational phase**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	2	2	Reversibility of Impact	4	3
Duration of Impact	5	4	Probability	4	3
Environmental Risk (Pre-mitigation)					-15,00
Mitigation Measures					
• Bush clearing of all bushes and trees taller than one meter; Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure; and • During the construction phase, the vegetation naturally occurring in the area should be avoided as much as possible to ensure that the surface stays in its natural state and to avoid additional overland flow and the associated erosion.					
Environmental Risk (Post-mitigation)					-9,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Low: Issue not raised in public responses					
Cumulative Impacts					3

Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	1,83
Final Significance	-16,50

Decommissioning phase (Table 29): During this phase, vehicle activity is likely to compact soils even further. The infrastructure established during the construction phase is subsequently destroyed to ensure as little as possible is left after the relevant mining operations.

Table 29: Loss of land capability assessed for the wash plant during the decommissioning phase

Loss of Land Capability - Wash plant					
Impact Name	**Loss of Land Capability**				
Alternative	**Wash plant**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	3
Extent of Impact	2	2	Reversibility of Impact	4	3
Duration of Impact	5	3	Probability	4	3
Environmental Risk (Pre-mitigation)					-16,00
Mitigation Measures					
• Ensure proper storm water management designs are in place; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Ensure proper storm water management designs are in place; • Implement land rehabilitation measures as defined in rehabilitation report. • Follow rehabilitation guidelines; • After the completion of the project the area is to be cleared of all infrastructure; • The foundations to be removed; and • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated.					
Environmental Risk (Post-mitigation)					-8,25
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1,83

Final Significance	-15,13

Rehabilitation and closure (Table 30): The responsibility of rehabilitating degraded (both direct and indirect) areas is allocated to the mine and is an absolute necessity to ensure that closure is given regarding the relevant mining operations. During this phase, monitoring and accompanied rehabilitation is the key concern for replaced soil, compacted soils, eroded areas and the different types of pollutions caused by these structures. The successful implementation of this phase will ensure a positive impact on the environment which is a significant improvement of the "pre-mitigation" risk rating.

The risk rating will be significantly improving to a positive from a negative state. The land capability will increase from nothing the what the rehabilitation guidelines have stipulated.

Table 30: Loss of land capability assessed for the wash plant during the rehabilitation and closure phase

Loss of Land Capability – Wash plant					
Impact Name	**Loss of Land Capability**				
Alternative	**Wash plant**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	1	Magnitude of Impact	4	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	4	3
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
• The rehabilitated area must be assessed once a year for post mining land capability compaction, fertility, and erosion; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Only the designated access routes are to be used to reduce any unnecessary compaction; and • Areas of subsidence must be reported and remediated as soon as possible with the best practises at the time of occurrence.					
Environmental Risk (Post-mitigation)					6,00
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					2
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					1
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1,33
Final Significance					8,00

8 Site Constraints

- Some areas have been camped down and locked to enclose livestock, these areas could not be accessed. Extrapolations have been made in these areas for an accurate illustration of soil forms by means of desktop data; and
- 300m x 300m survey grids were used for the underground mining areas whereas 150m x 150m survey grids were used for the proposed opencast mine area. With the above mentioned in mind, possibilities do exist of sensitive areas being missed due to those areas falling between grids.

9 Mitigation Measures

Table 31 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators

Table 31: Mitigation measures including requirements for timeframes, roles and responsibilities

Activity	Mitigation Measures	Phase	Time Frame	Responsible party for implementation	Monitoring party (frequency)	Target	Performance indicator (Monitoring tool
• Relevant planning	• Proper planning of mining sequences; • stripping and stockpiling guidelines; • rehabilitation and monitoring plans;	Planning	Prior to kick-off of construction	Applicant	Applicant	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)
• Site clearance and topsoil removal prior to the commencement of physical construction activities. • Construction of surface infrastructure • The construction of stockpiles, including topsoil, overburden and coal stockpile	• Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure;	Construction Operation	Ongoing	Applicant Contractor ECO	Contractors EO (Daily) Mine EO (Weekly) ECO (Monthly)	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)

	• The topsoil should be stripped by means of an excavator bucket, and loaded onto dump trucks; • Topsoil stockpiles are to be kept to a maximum height of 4m; • Topsoil is to be stripped when the soil is dry, as to reduce compaction; • Bush clearing contractors will only clear bushes and trees larger than 1m the remaining vegetation will be stripped with the top 0.3 m of topsoil to conserve as much of the nutrient cycle, organic matter and seed bank as possible; • The subsoil approximately 0.3 – 0.8 m thick will then be stripped and stockpiled separately; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate significantly; • Compaction of the removed topsoil must be avoided by prohibiting traffic on stockpiles; • Stockpiles should only be sued for their designated final purposes; and • The stockpiles will be vegetated (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. • Prevent any spills from occurring. Machines must be parked within hard park areas and must be checked daily for fluid leaks; • If a spill occurs, it is to be cleaned up immediately and reported to the appropriate authorities; • All vehicles are to be serviced in a correctly bunded area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring; • Pipelines must be maintained; • Pipeline must be checked regularly for leaks; and • If there are leaks the pipelines must be repaired immediately.						
• Operation and maintenance of the topsoil stockpiles. • Demolition of infrastructure • Rehabilitation of the Project area will be undertaken. includes the ripping of the compacted soil surfaces, spreading of topsoil and establishment of vegetation.	• Ensure proper storm water management designs are in place; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion;	Operation, Decommissioning and Rehabilitation.	Ongoing	Applicant Contractor ECO	Contractors EO (Daily) Mine EO (Weekly) ECO (Monthly)	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)

	• Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • Implement land rehabilitation measures as defined in rehabilitation report. • Follow rehabilitation guidelines; • The topsoil should be moved by means of an excavator bucket, and loaded onto dump trucks; • Topsoil is to be moved when the soil is dry, as to reduce compaction; • After the completion of the project the area is to be cleared of all infrastructure; • The foundations to be removed; • Topsoil to be replaced for rehabilitation purposes; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate; and • Stockpiles should only be used for their designated final purposes. • Prevent any spills from occurring. Machines must be parked within hardpark areas						

	and must be checked daily for fluid leaks; • If a spill occurs, it is to be cleaned up immediately and reported to the appropriate authorities; • All vehicles are to be serviced in a correctly bunded area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring; • Pipelines must be maintained; • Pipeline must be checked regularly for leaks; and • If there are leaks the pipelines must be repaired immediately.						
• Rehabilitation of the Project area will be undertaken. includes the ripping of the compacted soil surfaces, spreading of topsoil and establishment of vegetation. • Post-closure monitoring and rehabilitation will determine the level of soil success of the rehabilitation, as well as to identify any additional measures that have to be undertaken to ensure that the mining area	• The rehabilitated area must be assessed once a year for compaction, fertility, and erosion; • The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any	Rehabilitation, Closure and monitoring	During monitoring	Applicant ECO Soil Specialist	ECO (Yearly) Soil Specialist (Yearly)	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)

is restored to an adequate state. Monitoring will include soil fertility and erosion.	further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; and • Areas of subsidence must be reported and remediated as soon as possible with the best practises at the time of occurrence.						

10 Proposed Monitoring Program

The following recommendations are suggested for the construction, operational, decommissioning and rehabilitation phase to ultimately ensure that closure is obtained within reasonable time after the LOM.

10.1 Monitoring During the Construction Phase

The entire project area should be monitored every three months for compaction and erosion. In cases where compaction and/or erosion does occur, action plans should be implemented to apply mitigation.

10.2 Monitoring During the Operational Phase

Soil samples should be taken on site by a soil scientist and sent away for fertility tests within the first month of the operational phase. By comparing the fertility results after the construction phase to the fertility of the top soil prior to construction, conclusions can be made regarding the degradation of the soil's chemical properties. Mitigation measures should be suggested by a soil scientist thereafter to rectify any degradation.

Compaction and erosion monitoring should take place every six months up until the start of the decommissioning phase. Refer to the mitigation measures to attend to any degradation.

10.3 Monitoring During the Decommissioning Phase

The entire project area should be monitored every month for compaction and erosion. In cases where compaction and/or erosion does occur, action plans should be implemented to apply mitigation and to avoid these areas as much as possible in the near future.

10.4 Monitoring During the Rehabilitation and Closure phase

Soil samples should be taken on site by a soil scientist and sent away for fertility tests within the first month of rehabilitation. The results thereof should be compared to the results obtained prior to construction and after construction to conclude the findings of the change in the top soil's chemical properties. Mitigation measures can be suggested by the relevant soil scientist thereafter to rectify any degradation. Thereafter, similar sampling should be carried out every year within the same season that the previous sampling has been done until closure is obtained.

Compaction and erosion should be monitored within the first month to gain knowledge of areas impacted upon during the decommissioning phase. Rehabilitation of these sites should take place by means of the rehabilitation guidelines provided. Thereafter, similar monitoring and the accompanied mitigation measures should be applied every six months until closure is obtained.

A post-mining land capability assessment should form part of a yearly monitioring program to assess the rehabilitated areas against the land capability targets set.

11 Action Plan for Implementation

Action plan				
Phase	Management action	Timeframe for implementation	Responsible party for implementation	Responsible party for monitoring/audit/review
Planning phase	Proper planning of mining sequences	At least 6 months prior to the implementation of soil stripping	Applicant	Applicant
	Acquire stripping and stockpiling guideline	At least 2 months prior to the implementation of soil stripping	Applicant	Applicant
	Acquire rehabilitation and monitoring plans	At least 2 months prior to the implementation of soil stripping	Applicant	Applicant
	Proper investigation into ideal locations for the construction of all the infrastructure on site	At least 5 months prior to the implementation of soil stripping	Applicant	Applicant
	Proper investigation into possible receiving bodies for the intended wash plant waste	At least 5 months prior to the implementation of soil stripping	Applicant	Applicant
Construction	Bush clearing of all bushes and trees taller than one meter	This activity should be finished at least a week prior to any stripping of top soil, excavations of underground	Applicant Contractor	Applicant Eco Environmental authority

		mining areas, the construction of stockpiles/discard dump and the construction of the wash plant.		
	Assign all access routes	This activity should be finished at least two weeks prior to any stripping of top soil, excavations of underground mining areas, the construction of stockpiles/discard dump and the construction of the wash plant.	Applicant ECO	Applicant Eco Environmental authority
	Stripping of topsoil	During the first month	Applicant ECO Contractor	Applicant Eco Environmental authority
	Stockpile the stripped soils in designated stockpile areas	During and after the soil stripping process.	Applicant ECO Contractor	Applicant Eco Environmental authority
	Vegetate these stockpiles according to the rehabilitation plan	During and after the completion of the stockpiles.	Applicant Contractor	Applicant Eco Environmental authority
Operation	Continuously monitor erosion on site	During the timeframe assigned for the Life of Mine (LOM).	Applicant	Applicant Eco

				Environmental authority
	Monitor compaction on site	During the timeframe assigned for the Life of Mine (LOM).	Applicant	Applicant Eco Environmental authority
Decommissioning	Assign proper storm water management plans	This activity would be part of the architectural layout during the construction phase. A site-based assessment should be carried out two months prior to the decommissioning phase to ensure that all storm water management plans are adequate.	Applicant ECO	Applicant Eco Environmental authority
	After the completion of the project the area is to be cleared of all infrastructure;	Within the first two months after the completion of the project.	Applicant ECO Contractor	Applicant Eco Environmental authority
	The foundations to be removed;	Directly after the completion of the area clearance.	Applicant ECO Contractor	Applicant Eco Environmental authority
	Topsoil to be replaced for rehabilitation purposes;	After the completion of the foundation removal.	Applicant ECO Contractor	Applicant Eco Environmental authority

Rehabilitation and closure	All rehabilitated areas should be assessed for signs of compaction, fertility and erosion.	Within the first month after the successful decommissioning of the area.	Applicant	Applicant Eco Environmental authority
	The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies;	Within the first month after successful rehabilitation as well as yearly for the next 5 years to ensure that a sustainable soil resource is established.	Applicant	Applicant Eco Environmental authority
	Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated;	Monitoring compaction should take place every six months. In cases where compaction is identified, ripping should take place within the next month after detection.	Applicant	Applicant Eco Environmental authority
	If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place;	Monitoring erosion should take place every six months whilst monitoring for compaction. In cases where erosion is identified, relevant mitigation measures should take place within the next month after detection.	Applicant	Applicant Eco Environmental authority

12 Recommendations

12.1 Stockpile Requirements

It is recommended that a height of maximum 4m is considered for all topsoil stockpiles. It is worth noting that the dimensions required for stockpiles have not been established, therefore, the exact locations of the stockpiles have not been part of the recommendations owing to the fact that the total area required for each stockpile is unknown.

It is however recommended that stockpiles be constructed on areas that have been disturbed, and once these areas have been used, stockpiles should be placed on the edge of the soils characterised by a land capability rating of “III” and “IV”. The Inhoek soil form specifically is the best suited for stockpiling seeing that this area falls outside of the proposed opencast area and is not suited for agriculture seeing that the topsoil consists of melanic clays. The soils with a land capability of IV and a land potential of L5 would under normal circumstances be ideal for stockpiling. However, seeing that these areas are borderlinking on wetland conditions and in close proximity to areas with land potential of “vlei”, stockpiling on these areas should be avoided.

When stockpile layouts are designed it must be noted that these stockpiles cannot impede and flow to wetlands both from surface flow and sub-surface flow.

12.1.1 A-horizons

The Tukulu soil forms (Tukulu A, B, C and D) within the opencast area has very shallow A-horizons owed to the fact that the soil is ripped and cultivated regularly throughout the year which subsequently mixes the A-horizon and the B-horizon.

All of the above mentioned Tukulu soil forms has an A-horizon depth of approximately 300mm. Therefore, the entire opencast area (except for the wetland area) should be stripped at 300mm and stockpiles together seeing that their physical properties are very similar.

12.1.2 B-horizons

The Neocutanic B-horizons from each of the Tukulu soil forms (Tukulu A, B, C and D) differ in depths. Tukulu A’s B-horizon depth ranges from 300mm underneath the surface up to 400mm. Tukulu B’s B-horizon ranges from 300mm to 500mm. Tukulu C’s B-horizon ranges from 300mm up to 600mm and lastly Tukulu D’s B-horizon ranges from 300mm up to 700mm before reaching the C-horizon. The Tukulu soil form across the opencast area therefore experience and increase in its B-horizon’s depth from west to east.

The stripped material should however be stockpiled together seeing that the only aspect separating the soils are depths.

12.1.3 C-horizon

The C-horizons from the Tukulu soil form was classified as soft plinthite. Similarly to the B-horizons, the C-horizons differ in depth. Tukulu A’s C-horizon should be stripped from 400mm to 1000mm, Tukulu B’s C-horizon should be stripped from 500mm to 1000mm, Tukulu C’s C-horizon should be stripped from 600mm to 1000mm and Tukulu D’s C-horizon should be stripped from 700mm to 1000mm.

12.1.4 Revegetation of Stockpiles

Mixed stands or mono cultures will work sufficiently for revegetation purposes. Mixed stands tend to blend in with indigenous vegetation species and are more natural. Mono cultures however could achieve high productivity. In general, indigenous vegetation should always be preferred due to various reasons including the aesthetical presence thereof as well as the ability of the species to adapt to its surroundings.

Plant phase plants which are characterised by fast growing and spreading conditions. Seed germination, seed density and seed size are key aspects to consider before implementing revegetation activities. The amount of seed should be limited to ensure that competition between plants are kept to a minimum. During the establishment of seed density, the percentage of seed germination should be taken into consideration. E curvula is one of the species recommended due to the ease of which it germinates. This species is also easily sown by means of hand propagation and hydro seeding.

The following species are recommended for rehabilitation purposes;

- *Eragrostis teff*
- *Cynodon species (Indigenous and altered types)*
- *Chloris gayana*
- *Panicum maximum*
- *Digitaria eriantha*
- *Anthephora pubescens*
- *Cenchrus ciliaris*

It is recommended that the following be completed;

- A soil stripping guideline; and
- An assessment of the fertility results obtained from the fertility tests done on the 20 samples.

13 Conclusion

During the survey, six (6) main soil forms were identified, namely Katspruit, Tukulu, Milkwood, and Bonheim which makes up the bulk of the wetlands within 500m from the project boundaries. Soil forms outside of the delineated wetland areas include Oakleaf and Inhoek as well as areas characterised by disturbed land (areas influenced by current and historic impacts originating from mine related activities).

The Climate capability for this region was determined to be C6 classification. C6 (Severe limitation rating): Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops that frequently experience yield loss, (Smith, 2006).

The land capability was determined by using the guidelines described in “The farming handbook” (Smith, 2006). A breakdown of the land capability classes is shown in Table 1: Land capability class and intensity of use (Smith, 2006).

The Land Capability for the project area is illustrated in Table 13 and shown in Figure 10. All of the soils within wetland areas have been rated a land capability score of “V” (Vlei) except for Tukulu “wet” and Bonheim which has been rated a land capability of class “IV” (Light

Cultivation/ Intensive Grazing). The Mispah soil form has been rated a score of “VI” (Moderate Grazing). The non-wetland areas however have been scored a land capability rating of “III” (Moderate Cultivation) due to the lack of clay within the topsoil and the depth of the soil profile.

The Land Potential of the project area is shown in Figure 11 and the land potential groups are described previously in Table 2.

The class III land capability was rated as L4 land potential (moderate potential), the class IV land capability was rated L5 (restricted potential) and the class VI has been rated L6 (very restricted potential). The Class V land capability was determined to be a **Vlei**.

The major impacts associated with mining are the disturbance of natural occurring soil profiles consisting of layers or soil horizons. Rehabilitation of disturbed areas aims to restore land capability, however, the norm in South Africa is that post mining land capability usually decreases compared to pre-mining land capability. Soil formation is determined by a combination of five interacting main soil formation factors. These factors are time, climate, slope, organisms and parent material. Soil formation is an extremely slow process and soil can therefore be considered as a non-renewable resource.

Soil quality deteriorates during stockpiling and replacement of these soil materials into soil profiles during rehabilitation cannot imitate pre-mining soil quality properties. Depth however can be imitated but the combined soil quality deterioration and resultant compaction by the machines used in rehabilitation leads to a net loss of land capability. A change in land capability then forces a change in land use.

The impact on soil is high because natural soil layers will be stripped and stockpiled for later use in rehabilitation. In addition, soil fertility is impacted because stripped soil layers are usually thicker than the defined topsoil layer.t

14 Assumptions, Uncertainties and Gaps in Knowledge

The following assumptions and limitations have been made:

- The information provided in this report is based on information gathered from site visits undertaken from the 15th of January until the 22nd of January 2018.
- The information contained in this report is based on auger points taken and observations on site. There may be variations in terms of the delineation of the soil forms presented compared to when stripping of soil is undertaken. If this is encountered the soil stripping plan may need to be updated to reflect these variations in terms of how soil is stripped and stockpiled;
- Soil samples for fertility have been taken and sent away for fertility tests; and
- The area surveyed was based on the mining layout presented by the Applicant.

15 References

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