Soils, Land Capability, and Land Use Assessment for the Environmental Impact Assessment for Lanxess Chrome Mining

Environmental Impact Assessment

Project Number:

LAN3111

Prepared for:

Lanxess Chrome Mining (Pty) Ltd

March 2015

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EXECUTIVE SUMMARY

The conservation of South Africa's limited soil resources is essential for human survival. In the past misuse of land due to not classifying the soils and their capability/potential correctly has led to loss of these resources through erosion and destabilisation of the natural systems.

In order to identify soils accurately, it is necessary to undertake a soil survey, in accordance with standard procedures. The aim is to provide an accurate record of the soil resources of an area. Land capability and land potential is then determined from these results. The objective of determining the land capability/potential is to identify the most sustainable use of the soil resource without degrading the system.

Therefor soil mapping is essential to determine the types of soils present, their depths, their land capability/land potential, and their stripping ratios. These results will then be used to give practical recommendations on preserving and managing the stripping and stockpiling of the soil resource.

Lanxess Chrome Mine is located 7 km east of Kroondal and 11 km south-east of Rustenburg and falls within the Rustenburg Local Municipality of the North West Province. The current mining rights of Lanxess cover various portions of the farms Kroondal 304 JQ, Rietfontein 338 JQ and Klipfontein 300 JQ. The mine is part of a mineral deposit known as the Bushveld Igneous Complex which holds the majority of South Africa's chrome ore deposits.

The soils were investigated In February 2015 by making observations with the use of a bucket type auger to a maximum depth of 1200 mm or to the depth of refusal. At each observation point the South African Taxonomic Soil Classification System (Soil Classification Working Group, 2nd edition 1991) was used to describe and classify the soil. The classification system categorise soil types in an upper soil form level.

Land capability 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 (Schoeman, et al., 2000) (Smith, 2006).

The project area was dominated by dark well-structured clayey soils (Arcadia and Valsrivier). These soils accounted for 373.77 ha (97.3%). The north-western portion of the site contained shallow rocky soils (Mispah and Glenrosa) type soils, which accounted for 10.32 ha (2.7%).

The dominant land capability for the area is the Class III capability (373.77 ha), with the Class VIII capability (10.32 ha) in the north-western portion of the project area.

The dominant land use in the Lanxess project area is that of cultivation (320.83 ha) as shown in Figure 5-6, sorghum is being grown in these heavy clay soils.

The land use summary is as follows:

- Cultivated (320.77 ha);
- Grazing (13.04 ha);
- Natural (47.21 ha);
- Infrastructure (1.74 ha); and
- Disturbed (1.27 ha).

The general best practice for soil stripping and stockpiling is to strip the top 0.3 m separately from the rest of the soil profile.

The soil should be stripped and stockpiled together to a maximum of 4 m (practical tipping height for dump trucks without the risk of compaction).

The potential impacts associated with open cast mining on soils are broken up into the following:

- Loss of Topsoil;
- Erosion;
- Misplacement of stockpiles;
- Incorrect usage of stockpiles;
- Incorrect stripping of topsoil;
- Stockpiling well drained soils with wetland soils;
- Compaction;
- Loss of Land Capability;
- Soil contamination through hydrocarbon spills;
- Replacement of topsoil not to pre-land capability specifications; and
- Low soil fertility.

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1 Introduction

The conservation of South Africa's limited soil resources is essential for human survival. In the past misuse of land due to not classifying the soils and their capability/potential correctly has led to loss of these resources through erosion and destabilisation of the natural systems.

In order to identify soils accurately, it is necessary to undertake a soil survey, in accordance with standard procedures. The aim is to provide an accurate record of the soil resources of an area. Land capability and land potential is then determined from these results. The objective of determining the land capability/potential is to identify the most sustainable use of the soil resource without degrading the system.

Therefor soil mapping is essential to determine the types of soils present, their depths, their land capability/land potential, and their stripping ratios. These results will then be used to give practical recommendations on preserving and managing the stripping and stockpiling of the soil resource.

2 Terms of Reference

Digby Wells Environmental (hereafter Digby Wells) has been commissioned by Lanxess Chrome Mining (Pty) Ltd (herein referred to as Lanxess) to conduct a soil survey of the opencast pit and the surrounding project area for the Amendment of the existing Environmental Management Programme (EMP) Report for its Lanxess Chrome Mine (LCM). The relevant project components include the following:

- The delineation of soil types;
- Determining the existing land capability while current land use will be determined and mapped for the project;
- The identification of the major soils in the area as well as mapping the soils for land capability purposes; and
- The undertaking of an impact assessment and mitigation measures.

3 Description of Study Area

3.1 Background

Lanxess Chrome mine is a well-established chrome mine in the Rustenburg area which has been operational since 1958. Currently only the underground mining of chrome is taking place at the site. Chromite ore is used in the ferrochrome industry as well as the production of chrome chemicals, where the primary use is as leather tanning agents.

Lanxess has proposed an expansion of their existing underground chrome operations into neighbouring portions as well as the establishment of an open pit operation within their existing mining rights area.

The proposed project is obligated to comply with the requirements of the Minerals and Petroleum Resources Development Act, Act 28 of 2002 (MPRDA) and the Environmental Impact Assessment Regulations, 2014, promulgated in terms of Sections 24(5) and 44 of the National Environmental Management Act, 1998 (GN R982 of 4 December 2014). Lanxess currently has an Environmental Impact Assessment and Environmental Management Plan (EIA/EMP) in line with the MPRDA and would, therefore, need to amend the existing approved document to include the details of the proposed opencast mining operations as well as the extension of the underground sections (Segment 1, 2, 3 and 4) as part of a Section 102 amendment.

An amendment to the existing Integrated Water Use License Application (IWULA) submitted to the Department of Water Affairs (DWA) will also be required.

3.2 Location

Lanxess Chrome Mine is located 7 km east of Kroondal and 11 km south-east of Rustenburg and falls within the Rustenburg Local Municipality of the North West Province. The current mining rights of Lanxess cover various portions of the farms Kroondal 304 JQ, Rietfontein 338 JQ and Klipfontein 300 JQ. The mine is part of a mineral deposit known as the Bushveld Igneous Complex which holds the majority of South Africa’s chrome ore deposits.

The process will involve the authorisation of the proposed open pit mining operation on the farm Rietfontein 338 JQ (owned by the mine) and the proposed underground mining operations on portions of the farms Kroondal 304 JQ, Klipfontein 300 JQ and Brakspruit 299 JQ. Glencore Operations South Africa (Pty) (Ltd) (formally known as Xstrata) currently holds the mining rights for some of these areas which are currently in the legal process of being transferred to Lanxess.

The registered descriptions of the land for the amended applications are;

- Portion 95 of Kroondal 304 JQ
- Portion 96 of Kroondal 304 JQ
- Portion 97 of Kroondal 304 JQ
- Portion 98 of Kroondal 304 JQ
- Re of portion 2 of the farm Klipfontein 300 JQ)
- Re of portion 1 and portions 1, 14, 32, 34, 10 and 11 of the farm Rietfontein 338JQ.
- A portion of mineral area No.2
- Wonderkop area: Portion 1 of the farm Spruitfontein 341JQ and portion 17, 18 and 19 (Portions of Portion 12), the remainder of Portion 12 and the Re Portion of the farm Brakspriut 299JQ.

3.3 Mining Activities

Currently the only mining that is taking place is done underground with the ore broken underground and brought to the surface on conveyor belts.

Proposed future mining activities will include the expansion into the neighbouring Glencore underground areas as well the opening of a pit within the existing Lanxess mining right area.

3.3.1 Opencast Mining

Access to the shallow resource will be by an opencast pit cut 1 374m in strike length and down to a vertical depth between 50m and 70m below surface. The programme indicates that there will be free digging up to ±14m.b.s where after opencast blasting operations will take over mining 100m x 300m block sizes at 10m cuts (using LHD with excavators and dump trucks). The opencast mining sequence will start on the eastern side of the proposed pit area and progress towards the west. The final void area will be at the western extent of the opencast pit. Waste rock and topsoil will be stockpiled separately to the south of the opencast area. As the opencast mining progresses, the voids created will be backfilled with overburden from the progressive opencast mining, and then overlain by the various soil horizons and rehabilitated. The design of the highwall has been adapted to fit the topography and crown pillar position with an angle of 60°.

Ore production rate is estimated to be 40 000 tons per month with a LOM of 5 years for the opencast pit.

3.3.2 Underground Mining

The underground mining method used will be the standard bord and pillar system. The pillar dimensions and bord widths are such that a safety factor of 1.6 is maintained. Primary extraction is carried out by using drill rigs to drill the faces and conventional explosives. Access to the underground chrome reserves is gained by means of surface declines that are developed from the reef outcrop. Run of Mine clearance is facilitated by a series of conveyor belts fed by underground Load Haul Dump loaders.

It is calculated that the production rate will be 30000 to 40000 tons per month with a total Life of Mine of 14 years.

3.3.3 Reprocessing of tailings

Lanxess has applied in terms of Section102 to obtain the rights to the PGM in the orebody they are mining. If this is granted they intend to re-mine all the tailings facilities to extract the chrome left in the tailings. The tailings generated as a result of the re-miming of the tailings facilities, containing the PGM's will be sold to potential buyers. The volume of the dump has been surveyed and shows a contained volume of 1,735m^3 with an average content of chromite reporting to the tailings to be between 20 and 23% Cr_2O_3.

3.3.4 Mineral deposit

Lanxess produce four products namely; lumpy ore, metallurgical grade chrome ore, foundry grade chrome ore and chemical grade chrome ore:

- Lumpy (metallurgical) ore with typically 38 – 41% Cr_2O_3 and a specified size distribution is sold to the ferrochrome industry where it is processed together with coal in an electric furnace to form ferrochrome. Ferrochrome is the master alloy used in the production of a wide range of corrosion and heat resistant stainless steel.
- Metallurgical grade chrome ore with 44% chrome is sold to the local ferrochrome industry where it is processed together with coal in an electric furnace to form ferrochrome.
- Foundry grade chrome ore with a Cr_2O_3 content of typically 46.5% and a strictly specified grain size distribution is used for the manufacture of casting moulds in foundries. The same material is also used in the production of refractory materials.
- Chemical grade chrome ore with a typical Cr_2O_3 content of 46.0% is the raw material for the production of sodium dichromate processed by Lanxess in their other operations (chemical plants), which is the main constituent of all chrome chemicals. Chrome chemicals are used for example as leather tanning agents.

Table 3-1: Product

List of Product	Tons/year	% of total
Lumpy	324 kt	27%
Foundry sand	120 kt	10%
Chemical Grade	384 kt	32%
Metallurgical Concentrate	372 kt	31%
Total	*1 200 kt*	*100*

3.3.5 Processing

The Lanxess Chrome Mine processing plant treats LG6 ore to produce the four chrome products by means of Heavy Medium Separation (HMS) in the HMS Plant and Gravity Concentration in the Gravity and Pilot Plants. The HMS plant has a capacity of 3600 tonnes per day and the gravity plant has a capacity of 1800 tons per day. This processing plant will remain in operation and will not be impacted by the proposed activities.

All products are sold to external clients. Chemical grade is also sold to other Lanxess business sites for the production of chrome chemicals. A high level block flow diagram of the processing plant is shown in Figure 3-1.

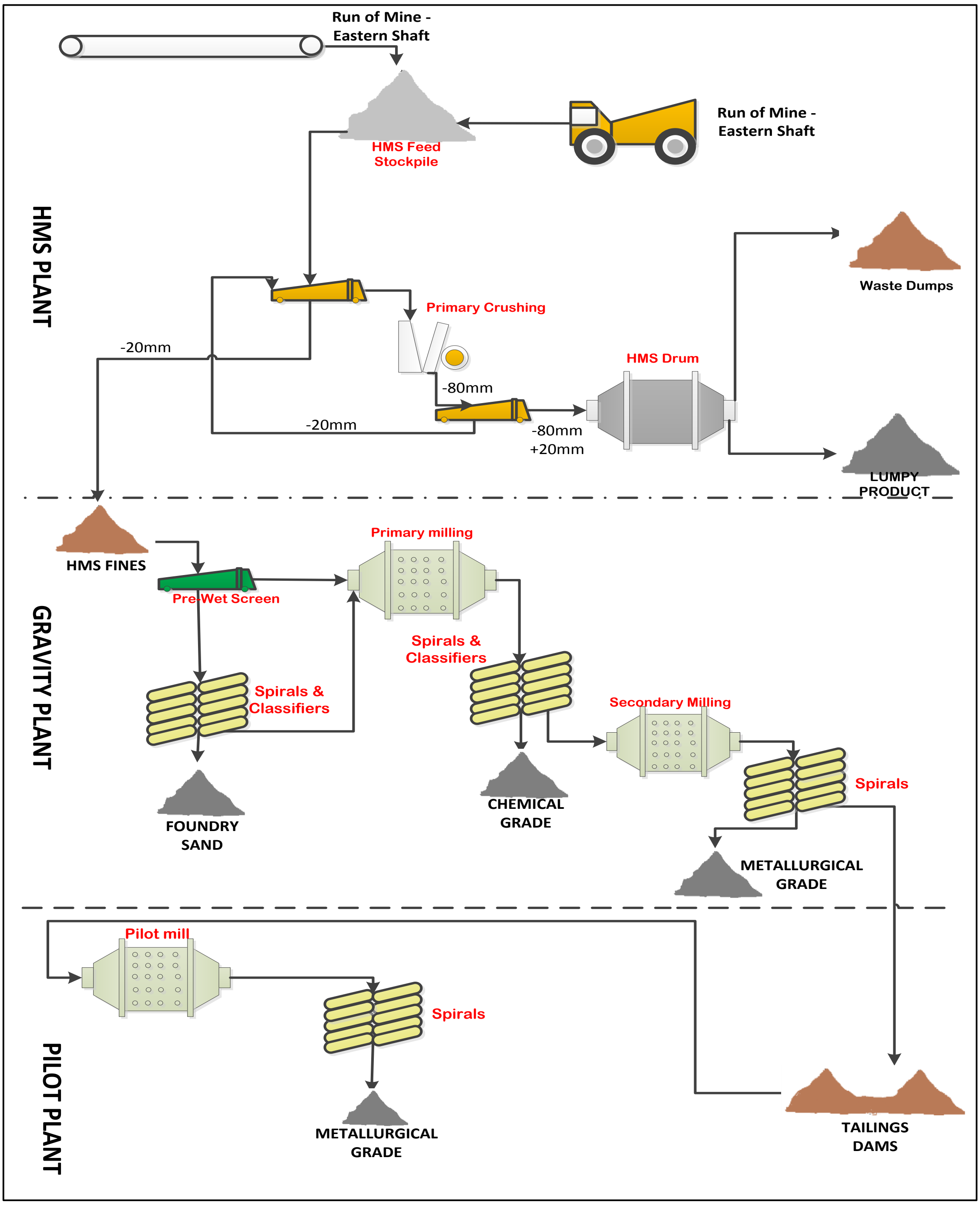


Figure 3-1: Flow diagram of the processing plant

3.4 Infrastructure Requirements

Lanxess is a well-established mine with existing infrastructure which has been operational since 1958. As a result minimal additional infrastructure will be required for the expansion of the activities as the plant has capacity for the proposed 80 000tpm.

3.4.1 Current Surface Infrastructure

Currently the following infrastructure is in place on the mine and will remain in operation as seen in Table 3-2.

Table 3-2: Infrastructure in place on the mine

Infrastructure	Associated Activities
Incline and Shafts (vertical and ventilation)	Provide access to the underground workings.
Underground workings	Drilling and blasting. Loading and transfer of ore to conveyors. Conveyor belt transport ore to plant.
Processing facilities ■ Crusher ■ Settlers ■ HMS (Heavy Medium Separator) ■ Gravity plant ■ Reclamation plant	Beneficiation. Crushing and screening. HMS Plant: The coarse fraction >19mm is fed into a heavy media separation plant in order to separate the remaining waste from lumpy ore which is then sold as lumpy ore into the ferrochrome industry. Gravity Plant: The fine fraction of ROM (<19mm) is upgraded to foundry sand (CO4) and chemical grade (CO1) by milling, screening spiralling and hydro-classification. Regrinding of the waste material leaving from the foundry sands and chemical grade circuits and subsequently re-classification, results in the metallurgical grade products (CO6) Plant for the reclamation of 12 year old tailings dam.
Waste rock dumps	Dumping of waste rock.
Stockpiles: ■ ROM ■ Lumpy Ore ■ Crusher Fines ■ HMS Fines ■ CO1 ■ CO4 ■ CO6	Stockpiling of material before use or transport. (Bunded).
Tailings dams	Tailings material from processing is pumped by pipeline to the tailings dam. Tailings deposition. Waste management facility.

Infrastructure	Associated Activities
Transport infrastructure ▪ Conveyor belt ▪ Roads	Load-Haul-Dump vehicles transport broken ore to the nearest conveyor belt loading point. Ore is then transported to a central point on surface by a network of conveyor systems, with a total length of more than 18 km, where it is dumped on the run of mine stockpile. Earthworks. Transport of material (road to siding for further transport via rail).
Water management facilities ▪ Sewage treatment ▪ Settling ponds ▪ Return water dams ▪ Boreholes	Treatment of sewage generated on the site (hostels, villages, change rooms etc.). Chemicals are used at sewage treatment plant. Spillages (solids) are picked up and suspended with water to be transferred to the settling ponds. A flocculent is used to produce sludge to be transferred to the tailings dam. A cyclone is used to remove ultra-fine chrome. Return water dams to manage water from tailings dam and recycle.
Support infrastructure ▪ Stores (including magazines) ▪ Workshops ▪ Offices ▪ Power lines ▪ Access roads	Storage of materials, equipment and explosives. Maintenance. Administration and management.
Housing	The mine's employees do not live on the mine property.

3.4.2 Proposed Surface Infrastructure

The following associated surface infrastructure will be constructed in support of the additional mining activities proposed for the site.

- Haul Roads and Service Road – Approximately 3km of haul roads to accommodate two lanes of traffic. A service road will be constructed to provide access to opencast pit from the southern boundary of the site. These roads will be gravel or tarred;
- Dump – An additional waste rock dump will be required alongside the opencast pit for overburden removed during mining;
- Stockpile – An additional topsoil stockpile will be located between the waste rock dump and the N4 highway. This will be screened off by trees; and

- A small workshop, office block and parking area will be built in the area of the opencast pit.

No additional infrastructure is required for the underground areas.

4 Methodology

4.1 Soil Classification

The soils were investigated In February 2015 by making observations with the use of a bucket type auger to a maximum depth of 1200 mm, or to the depth of refusal. At each observation point the South African Taxonomic Soil Classification System (Soil Classification Working Group, 2nd edition 1991) was used to describe and classify the soil. The classification system categorise soil types in an upper soil form level.

4.2 Pre-Mining land capability

Land capability 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 (Schoeman, et al., 2000) (Smith, 2006).

Land capability is divided into eight classes and these may be divided into three capability groups. Table 4-1 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 4-1: 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		LG	MG						**Grazing Land**
VI	W	F	LG	MG						
VII	W	F	LG							
VIII	W									**Wildlife**

W - Wildlife
F- Forestry
LG - Light Grazing
MG - Moderate Grazing
IG - Intensive Grazing
LC - Light Cultivation
MC - Moderate Cultivation
IC - Intensive Cultivation
VIC - Very Intensive Cultivation

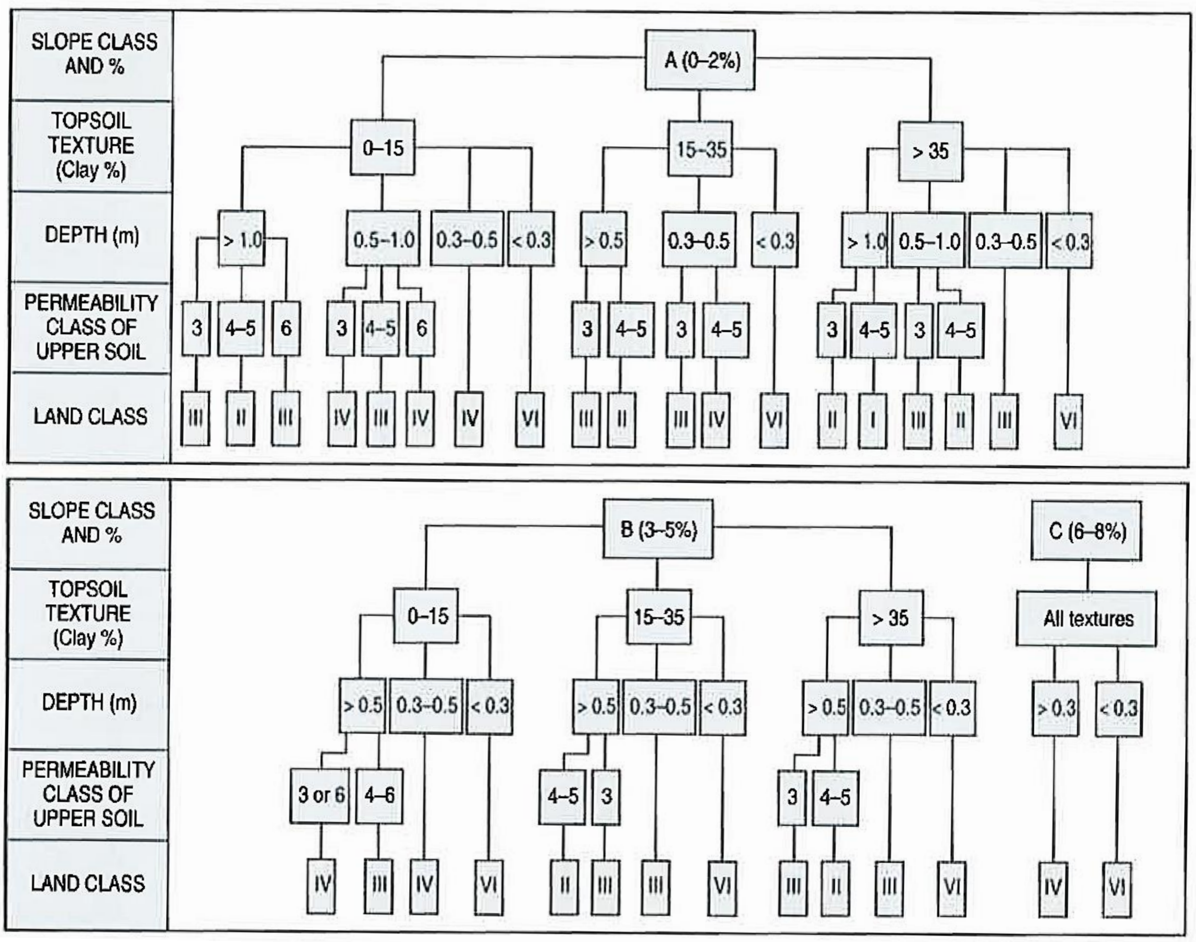
4.2.1 Land capability flow chart

The land capability flow chart shown in Table 4-2 was chosen as the rainfall in the area is less than 750mm and is used to classify the land capability based on the following criteria;

- Slope (%);
- Topsoil Texture (clay %);
- Effective rooting depth; and
- Permeability class topsoil.

Once a land capability is derived from this the capability class is adjusted using the soil characteristics discussed in the sections to follow.

Table 4-2: Land capability flow chart for areas with rainfall of below 750mm and soils are eutrophic (high base status) (Smith, 2006)



4.2.2 Soil characteristics to determine and adjust land capability

The tables below are to be used to adjust the land capability that was derived from the flow chart (Table 4-2) above.

4.2.2.1 Soil permeability

Soil permeability is calculated using an infield test technique, by applying a couple of drops of water to the soil surface and recording the amount of seconds it takes to be absorbed into the soil. Table 4-3 shows the classification system. The permeability class is then used to adjust the value from the flow chart as per Table 4-4

Table 4-3: The soil permeability classes (Smith, 2006)

Class	Rate (seconds)	Description	Texture
7	<1	Extremely Rapid	Gravel and coarse sand, 0 to 10% clay
6	1 to 3	Rapid	5 to 10% clay
5	4 to 8	Good	> 10% clay
4	9 to 20	Slightly restricted	
3	21 to 40	Restricted	Strong structure, grey colour, mottled, >35% clay
2	41 to 60	Severely restricted	Strong structure, weathered rock, >35% clay
1	>60	Impermeable	Rock and very strong structure, >35% clay

Table 4-4: The soil permeability adjustment factors (Smith, 2006)

Permeability Class	Adjustment to be made
1 to 2	If in subsoil, rooting is likely to be limited. Use the permeability of topsoil in the flow chart. If this is the permeability of the topsoil, then the topsoil is probably dark structured clay, in which case a permeability class 3 can be used in the flow chart.
3 to 5	Classify as indicated in the flow chart
6	Topsoil should have < 15% clay - use the flow chart
7	Downgrade land classes I -III to land class IV

4.2.2.2 Soil wetness factors

Soil wetness is divided into the five categories shown in Table 4-5; these describe varying degrees of wetness at various depths. Wetness affects plant production when the roots are wet for extended periods of time near the surface, and as a result this will downgrade a soils land capability based on the below definitions.

Table 4-5: The soil wetness adjustment factors (Smith, 2006)

Class	Definition	Land Class
W0	Well drained - no grey colour with mottling within 1,5m of the surface. Grey colour without mottling is acceptable.	No Change
W1	There is no evidence of wetness within the top 0,5m. Occasionally wet - grey colours and mottling begin between 0,5m and 1,5m from the surface	Downgrade Class I to Class II, otherwise no change
W2	Temporarily wet during the wet season. No mottling in the top 0,2m but grey colours and mottling occur between 0,2m and 0,5m from surface. Included are: soils with G horizons (highly gleyed and often clayey) at depths of more than 0,5m; soils with E horizon over G horizon where the depth to the G horizon is more than 0,5m.	Downgrade to Class IV
W3	Periodically wet. Mottling occurs in top 0,2m, and includes soils with a heavily gleyed or G horizon at a depth of less than 0,5m. Found in bottomlands.	Downgrade to Class V (a)
W4	Semi-permanently/permanently wet at or above soil surface throughout the wet season. Usually an organic topsoil or an undrained vlei. Found in bottomlands.	Downgrade to Class V (b)

4.2.2.3 Soil rockiness factors

Soil rockiness affects the management of a soil in a negative way. And the soils land capability will be reduced as described in Table 4-6 accordingly.

Table 4-6 : The soil rockiness adjustment factors (Smith, 2006)

Class	Definition	Land Class
R 0	No rockiness	No change
R 1	2 to 10% rockiness	Downgrade class I to class II, otherwise no change
R 2	10 to 20% rockiness	Downgrade class II to class III, otherwise no change
R 3	20 to 30% rockiness	Downgrade class I - III to class IV
R 4	>30% rockiness	Downgrade classes I, II, III, and IV to class VI

4.2.2.4 Surface crusting

Surface crusting has an effect on initial infiltration and could cause erosion to some degree. Table 4-7 shows how to adjust the flow chart results for land capability accordingly.

Table 4-7: The soil crusting adjustment factors (Smith, 2006)

Class	Definition	Land Class
t0	No surface crusting when dry	No Change
t1	Slight surface crusting when dry	Downgrade class I to II, no Change
t2	Unfavourable surface crusting when dry	Downgrade class I to II, no Change

4.3 Current Land use

Land use was identified using aerial imagery and then ground-truthed while in the field. The land use is classified as:

- Cultivated;
- Grazing;
- Natural;
- Wetlands;
- Infrastructure; or
- Disturbed.

4.4 Environmental Impact Assessment

The methodology utilised to assess the significance of potential social and heritage impacts is discussed in detail below. The significance rating formula is as follows:

Significance = Consequence x Probability

Where

Consequence = Type of Impact x (Intensity + Spatial Scale + Duration)

And

Probability = Likelihood of an Impact Occurring

In addition, the formula for calculating consequence:

Type of Impact = ***+1*** *(Positive Impact) or* ***-1*** *(Negative Impact)*

The weight assigned to the various parameters for positive and negative impacts is provided for in the formula and is presented in Table 4-8. The probability consequence matrix for social and heritage impacts is displayed in Table 4-9, with the impact significance rating described in Table 4-10.

Table 4-8: Impact Assessment Parameter Ratings

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts (Type of Impact = -1)	***Positive Impacts (Type of Impact = +1)***			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem. Persistent severe damage. Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	Noticeable, on-going social and environmental benefits which have improved the livelihoods and living standards of the local community in general and the environmental features.	International The effect will occur across international borders.	Permanent: No Mitigation The impact will remain long after the life of the Project.	Certain/ Definite. There are sound scientific reasons to expect that the impact will definitely occur.
6	Significant impact on highly valued species, habitat or ecosystem. Irreparable damage to highly valued items of cultural significance or breakdown of social order.	Great improvement to livelihoods and living standards of a large percentage of population, as well as significant increase in the quality of the receiving environment.	National Will affect the entire country.	Beyond Project Life The impact will remain for some time after the life of a Project.	Almost certain/Highly probable It is most likely that the impact will occur.

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts ***(Type of Impact = -1)***	***Positive Impacts*** ***(Type of Impact = +1)***			
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread positive benefits to local communities which improves livelihoods, as well as a positive improvement to the receiving environment.	Province/ Region Will affect the entire province or region.	Project Life The impact will cease after the operational life span of the Project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense social benefits to some people. Average to intense environmental enhancements.	Municipal Area Will affect the whole municipal area.	Long term 6-15 years.	Probable Has occurred here or elsewhere and could therefore occur.

Rating	Intensity		Spatial scale	Duration	Probability
	Negative Impacts (Type of Impact = -1)	***Positive Impacts (Type of Impact = +1)***			
3	Moderate, short-term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some.	Local Extending across the site and to nearby settlements.	Medium term 1-5 years.	Unlikely Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by very few of population.	Limited Limited to the site and its immediate surroundings.	Short term Less than 1 year.	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the Project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures.

<table>
<tr><th rowspan="2">Rating</th><th colspan="2">Intensity</th><th rowspan="2">Spatial scale</th><th rowspan="2">Duration</th><th rowspan="2">Probability</th></tr>
<tr><th>Negative Impacts
(Type of Impact = -1)</th><th>Positive Impacts
(Type of Impact = +1)</th></tr>
<tr><td>1</td><td>Limited damage to minimal area of low significance that will have no impact on the environment.
Minimal social impacts, low-level repairable damage to commonplace structures.</td><td>Some low-level social and environmental benefits felt by very few of the population.</td><td><u>Very limited</u>
Limited to specific isolated parts of the site.</td><td><u>Immediate</u>
Less than 1 month.</td><td><u>Highly unlikely/None</u>
Expected never to happen.</td></tr>
</table>

Table 4-9: Probability Consequence Matrix for Social and Heritage Impacts

Probability	Significance																		
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3
Consequence	**-21**	**-20**	**-19**	**-18**	**-17**	**-16**	**-15**	**-14**	**-13**	**-12**	**-11**	**-10**	**-9**	**-8**	**-7**	**-6**	**-5**	**-4**	**-3**

Probability	Significance																		
7	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Consequence	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**

Table 4-10: Significance Threshold Limits

Score	Description	Rating
109 to 147	A very beneficial impact which may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	**Major (positive)**
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive)
36 to 72	An important positive impact. The impact is insufficient by itself to justify the implementation of the Project. These impacts will usually result in positive medium to long-term effect on the social and/or natural environment.	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the social and/or natural environment.	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the social and/or natural environment.	Negligible (negative)
-36 to -72	An important negative impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the Project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the social and/or natural environment.	Minor (negative)

Score	Description	Rating
-73 to -108	A serious negative impact which may prevent the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe effects.	Moderate (negative)
-109 to -147	A very serious negative impact which may be sufficient by itself to prevent implementation of the Project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects.	Major (negative)

5 Results and Discussion

The project area is dominated by dark well-structured clayey soils (Arcadia and Valsrivier). These soils accounted for 373.77 ha (97.3 %). The north-western portion of the site contained shallow rocky soils (Mispah) type soils, which accounted for 10.32 ha (2.7 %) as shown in Figure 5-1. Table 5-1 provides a summary of the relevant soil survey information for the project.

Table 5-1: A summary table of the soil forms, depths, land capability, and land potential.

Soil form	Depth (m)	Final Land Capability Class
Arcadia (Ar)	1.2	III
Valsrivier (Va)	1.2	III
Mispah (Ms)	< 0.3	VIII

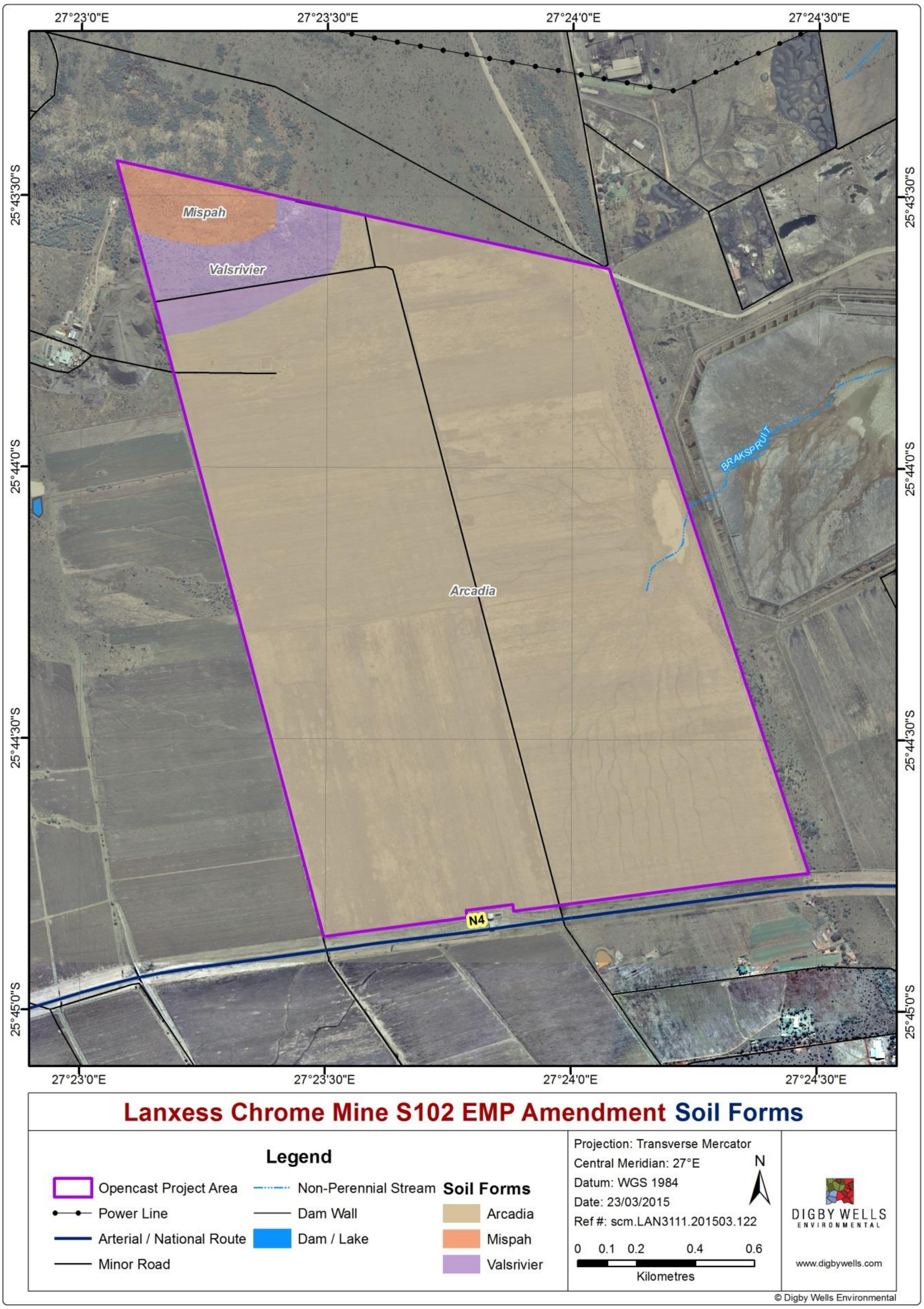


Figure 5-1: The soil forms present at the Lanxess site

5.1 Dominant soils found

Details of the dominant soils found within the study area are provided in the subsequent sections below.

5.1.1 Arcadia (Ar)

The Arcadia soil form as shown in Figure 5-2 consists of a Vertic A overlying an unspecified material which is usually a hard rock or saprolite horizon. The Vertic A consists predominantly of 2:1 clays. These clay types shrink in dry conditions and swell when wet conditions prevail, Figure 5-3 shows a cracking surface of a Vertic topsoil.

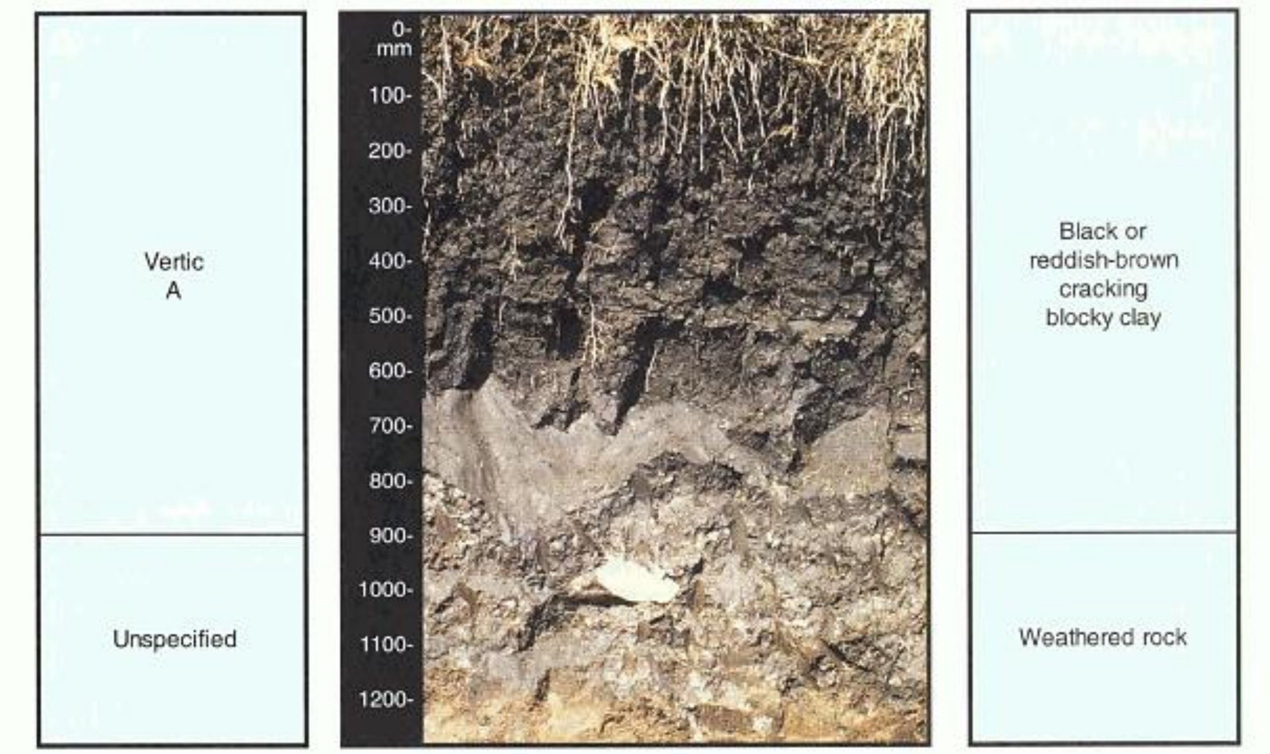


Figure 5-2: A typical cross section of the Arcadia Soil Form (Soil Classification Working Group, 1991)

Figure 5-3: The cracking of Vertic topsoil under dry conditions

5.1.2 The Valsrivier (Va) soil form

The Valsrivier soil form consists of an Orthic A horizon, Pedocutanic B horizon, on unconsolidated material without signs of wetness. These soils have a strongly structured B horizon which impede root and water penetration, therefor the effective crop rooting depth is generally limited to the A horizon (Figure 5-4). These soils are also highly erodible due to the dispersive nature of the B horizons. Once the A horizon has been removed by erosion the subsoil will erode rapidly and large gullies will be formed.

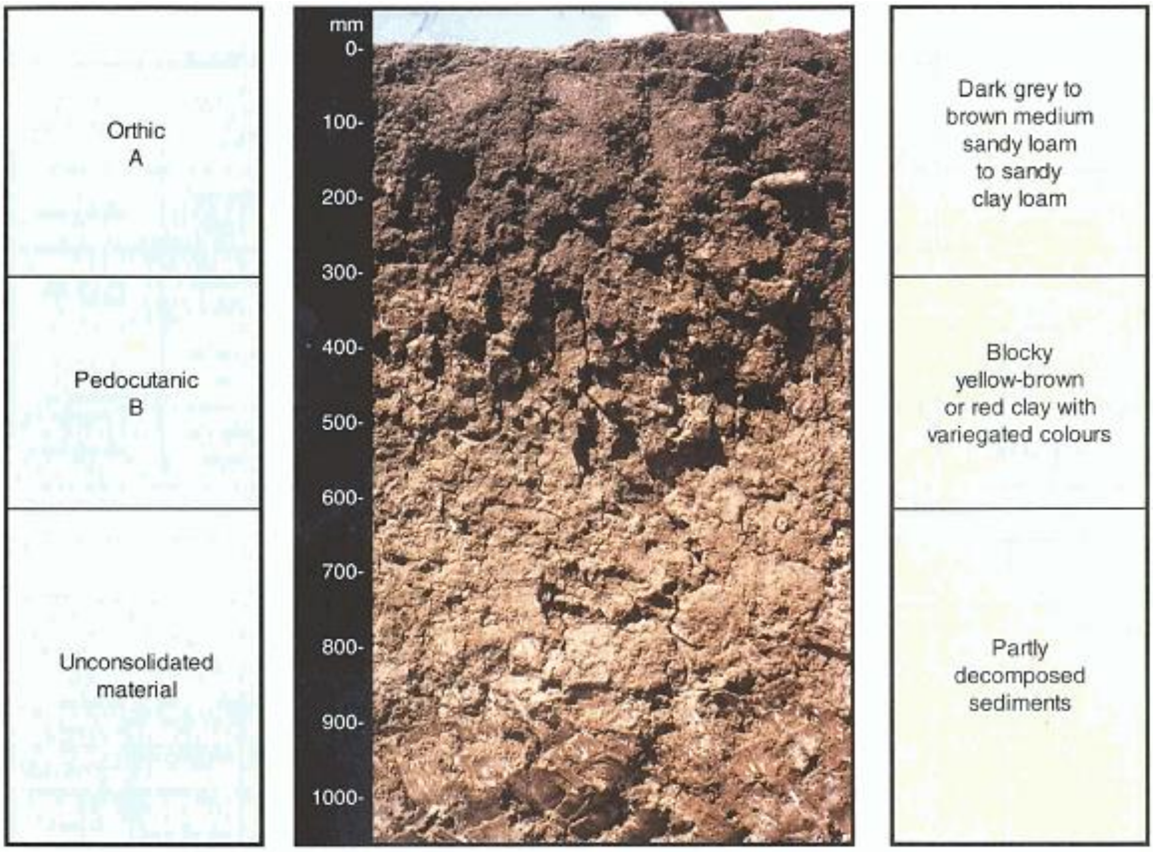


Figure 5-4: A typical cross section of a Valsrivier soil (Soil Classification Working Group, 1991)

5.1.3 Mispah

The Mispah soil form is a shallow rocky soil form often less than 30 cm deep.

5.2 Land Capability

Land capability is determined by a combination of soil, and terrain features. An indication is given about the permanent limitations associated with the different land use classes based on the soil physical properties as well as the slope of an area.

The dominant land capability for the area is the Class III (Moderate cultivation/ Intensive grazing) capability (373.77 ha), with the Class VIII (Wilderness) capability (10.32 ha) in the north-western portion of the project area as shown in Figure 5-5. The Class VIII capability was found on the steeper sloped soils with shallow soil depth. The land capability classification was calculated for each soil form as shown in Table 5-2.

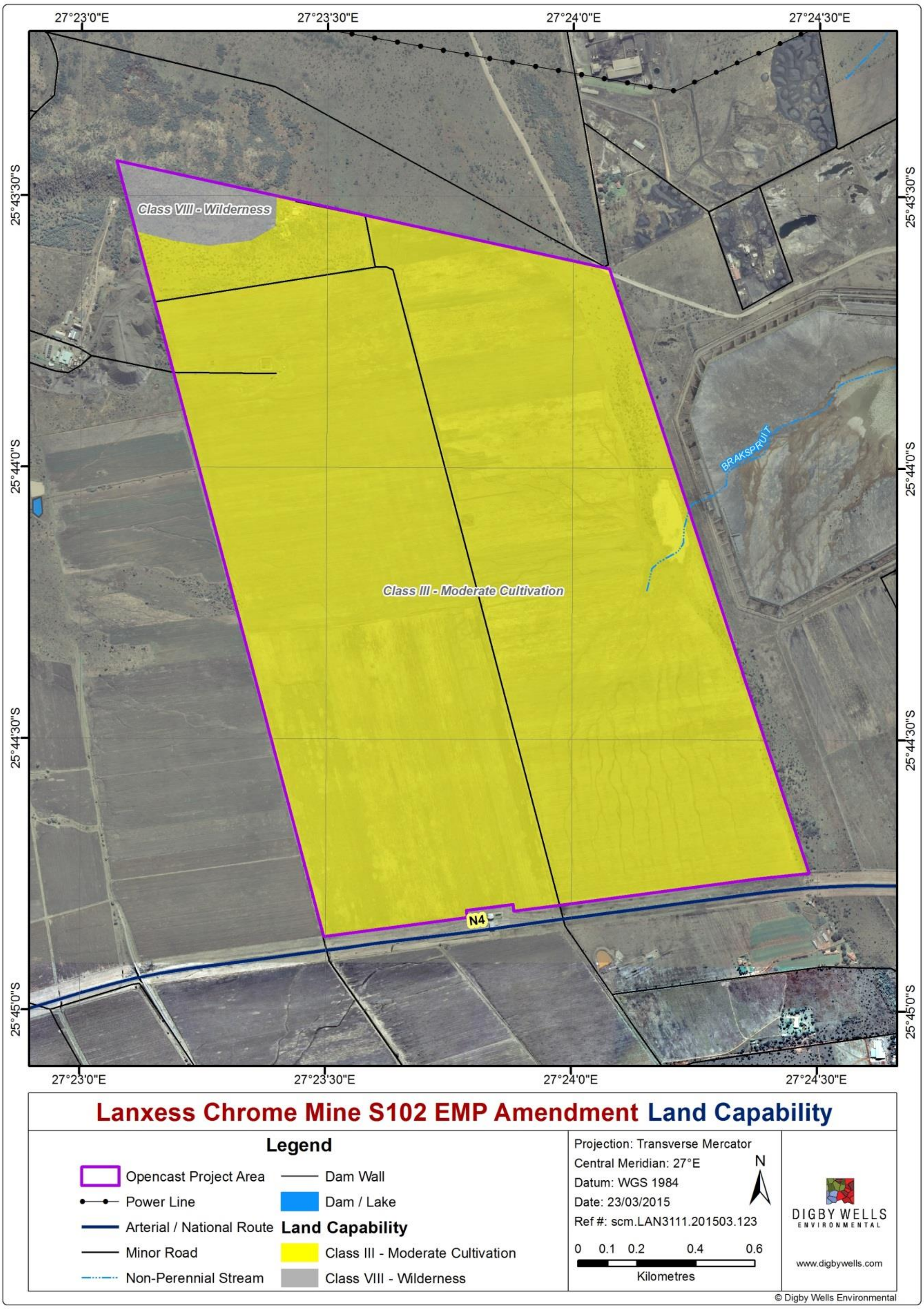


Figure 5-5: The land capability results for the Lanxess project area

Table 5-2: The land capability assessment results

Soil form	Depth (m)	Clay (%)	Slope (%)	Permeability Class	Land Capability	Permeability Adjustment	Wetness Adjustment	Rockiness Adjustment	Surface crusting Adjustment	Final Land Capability Class
Mispah (Ms)	0.1	5	8	5	VI (Moderate grazing)	No Change	W0	R 4	t0	VIII (Wilderness)
Arcadia (Ar)	1.2	50	3	3	III (Moderate cultivation)	No Change	W0	R 0	t0	III (Moderate cultivation)
Valsrivier (Va)	1.2	45	3	3	III (Moderate cultivation)	No Change	W0	R 0	t0	III (Moderate cultivation)

5.3 Current Land Use

The dominant land use in the Lanxess project area is that of cultivation (320.83 ha) as shown in Figure 5-6, sorghum is being grown in these heavy clay soils. The land use summary is as follows;

- Cultivated (320.77 ha);
- Grazing (13.04 ha);
- Natural (47.21 ha);
- Infrastructure (1.74 ha); and
- Disturbed (1.27 ha).

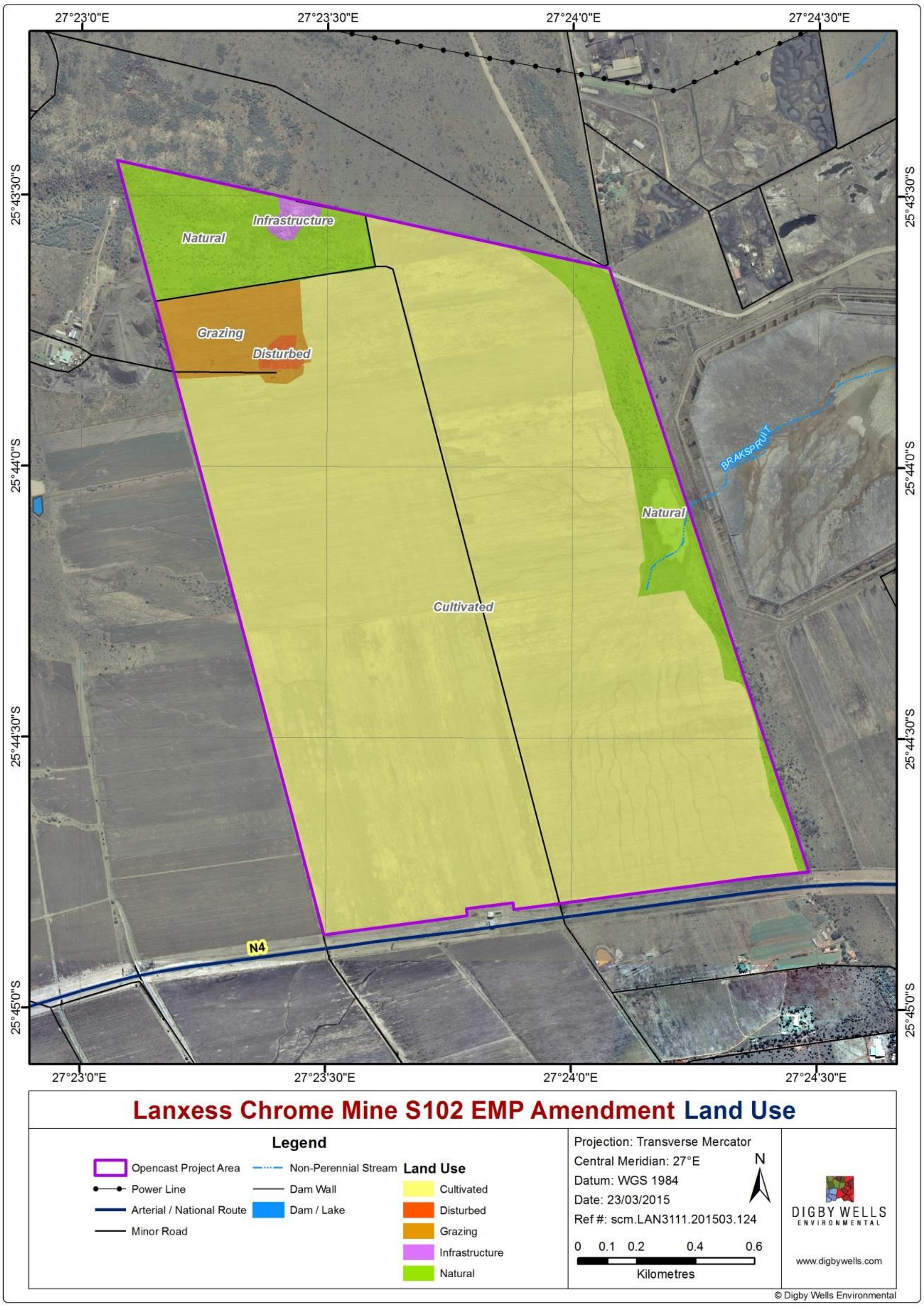


Figure 5-6: The land use delineation for the Lanxess project area

6 Potential Environmental Impacts

6.1 Construction Phase

During the construction phase the work carried out will mainly be the construction of the opencast mine and supporting infrastructure. This will entail the clearing of areas and the disturbance of the topsoil through excavations as well as the construction of a soil stockpile. The topography and natural drainage lines will be disturbed. The overall impact will be loss of topsoil as a result of erosion and possible contamination of the soil by dust, fuel, and oils due to the excavation activities. Soil compaction caused by heavy vehicles and machinery surrounding the pit areas could also be a problem.

Soil stripping will require the removal of all soil materials to a depth of at least 1.0 m. This activity will provide needed soil cover material for rehabilitation purposes. Construction activities will change the land use from arable farming to mining causing unsuitable conditions for any further commercial farming.

6.2 Operational Phase

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

7 Impact Assessment

The environmental impact assessment is designed to identify impacts related to various mining activities as provided in Table 7-1. However with the correct mitigation measures being put in place these impacts can be reduced. The activities impacting on soil as the receiving environment are shaded (**Brown**) and discussed within the related impact discussions.

Table 7-1: Proposed project activities

Activity No.	Activity
Construction Phase	
1	The transportation of construction material to the Project site via national, provincial and local roads.
2	Storage of fuel, lubricant and explosives in temporary facilities for the duration of the construction phase.
3	Site clearance and topsoil removal prior to the commencement of physical construction activities across the project area.

Activity No.	Activity
4	The construction of waste rock dumps.
5	The construction of topsoil stockpiles.
6	The establishment of the initial boxcut and access ramps to the open-pit mining areas.
7	The establishment of underground access shaft.
8	The construction of haul roads on site
9	The construction of the access or service road.
10	The construction of the hard park area (this is made up of the workshop, office block and parking lot).
Operational Phase	
11	Drilling and blasting of the overburden rock for easy removal by excavators and dump trucks.
12	Dumping of waste rock and maintenance of waste rock dump
13	Removal and loading of ore onto trucks (O/C) or conveyor (U/G) to the plant.
14	Continuing operation of existing processing plant (Crusher, settler, gravity plant and reclamation plant).
15	Storage of fuel in diesel tanks, as well as lubricant and explosives in facilities for the duration of the Project.
16	Vehicular activity on the proposed roads and maintenance activities
17	The operation of the TSF (dirty water from stormwater and dewatering mining activities) and the connected return water dam
18	Continuing operation and maintenance of the stockpiles, including topsoil and ROM stockpiles.
19	Waste and sewage generation and disposal.
20	Maintenance of secondary infrastructure (offices, parking)
21	Concurrent replacement of overburden and topsoil and the re-vegetation of mined out strips. The mined strip will be backfilled with the overburden and compacted. Subsequently, the topsoil will be placed on top of the overburden and the area will be vegetated.
Decommissioning Phase	
22	Removal of surface infrastructure (Plant machinery, shafts, conveyors)
23	Decommissioning of services (if necessary, depending on post landuse) incl. waste treatment and removal, power & water facilities)
24	Rehabilitation of roads and cleared areas (offices and workshop area)

Activity No.	Activity
25	Removal of fuel, lubricant and explosives
26	Safe closure of shafts and mine access ramps
27	Final replacement of overburden and topsoil and the establishment of vegetation on the final open cast void. Overburden will be backfilled into the final void and compacted. Subsequently, topsoil will placed and the area vegetated.
28	Waste handling of scrap metal and used oil as a result of the Decommissioning Phase will be undertaken.
Post-closure Phase	
29	Post-closure monitoring and rehabilitation will determine the level of success of the rehabilitation, as well as to identify any additional measures that have to be undertaken to ensure that the mining area is restored to an adequate state. Monitoring will include surface water, groundwater, soil fertility and erosion, natural vegetation and alien invasive species and dust generation from the discard dumps.

7.1 Construction Phase

When topsoil is removed from a soil profile, the profile loses effective rooting depth, water holding capacity and fertility. The largest volumes of topsoil will be removed in preparation for opencast mining.

7.1.1 Impact: loss of topsoil as a resource

Criteria	Details / Discussion
Description of impact	When vegetation is cleared and the topsoil is stripped, the soils natural structure is disturbed and as a result the natural cycle is broken exposing the bare soil to erosion. Construction vehicles driving on these soils cause compaction reduces the soils ability to be penetrated by root growth. Compaction also increases erosion potential. When soils are not stripped and stockpiled according to the soil stripping guidelines these soils would have lost their natural physical and chemical properties, reducing the topsoil's ability to be a plant growth medium. The above factors all contribute to a loss of the topsoil's ability to be a resource through alterations and removal.
Mitigation required	▪ The topsoil should be stripped by means of an excavator bucket, and loaded onto dump trucks; ▪ Stockpiles are to be kept to a maximum height of 4m (the practical tipping height of dump trucks); ▪ Topsoil is to be stripped when the soil is dry, as to reduce compaction;

Criteria	Details / Discussion				
	▪ The topsoil 0.3 m of the soil profile should be stripped first and stockpiled separately; ▪ The subsoil approximately 0.7 – 0.9 m thick will then be stripped and stockpiled separately; ▪ Soils to be stripped according to the rehabilitation soil management plan and stockpiled accordingly; ▪ Foundation excavated soil should also be stockpiled; ▪ Stockpiles are to be maintained in a fertile and erosion free state by sampling and analysing annually for macro nutrients and pH; ▪ The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate; ▪ Compaction of the removed topsoil should be avoided by prohibiting traffic on stockpiles; ▪ Prevent unauthorised borrowing of stockpiled soil; ▪ 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; ▪ Soils will be stripped using the delineated soil types as guide. Yellow and red soils may be stripped together. Wetland soils (if allowed) should be stripped and stockpiled separately but also in the order topsoil (0.3 m) then subsoil separately; and ▪ Access should be limited to prevent any unnecessary compaction from occurring.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	3 (Local)	5 (Project Life)	5 (Very Serious)	7 (Certain)	-91
Post-Mitigation	2 (Limited)	5 (Project Life)	3 (Moderate)	3 (Unlikely)	-30

7.1.2 Impact: Hydrocarbon Pollution

Criteria	Details / Discussion
Description of impact	When Hydrocarbons are spilled on a soil surface the soil becomes contaminated and therefor becomes toxic for plant growth.
Mitigation required	▪ Prevent any spills from occurring; ▪ If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; ▪ All vehicles are to be serviced in a correctly bunded area or at an off-site location; and ▪ Leaking vehicles will have drip trays place under them where the leak is occurring.

Criteria	Details / Discussion				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	7 (Very Serious)	6 (very Likely)	-90
Post-Mitigation	1 (Very Limited)	1 (Immediate)	7 (Very Serious)	5 (Likely)	-45

7.1.3 Impact: Loss of land capability

Criteria	Details / Discussion				
Description of impact	Removal of soil layers will impact on the land capability because vegetation can no longer be supported.				
Mitigation required	▪ No land capability mitigation is possible during the construction and operational phases because the land use is changed from agriculture to opencast; and ▪ Mitigation of land capability post mining is required through legislation through land rehabilitation.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	5 (project life)	6 (Significant)	7 (definite)	-84
Post-Mitigation	1 (Very Limited)	5 (project life)	5 (Very Serious)	6 (almost certain)	-66

7.2 Operational Phase

7.2.1 Impact: loss of topsoil as a resource

Criteria	Details / Discussion
Description of impact	Topsoil losses can occur during the operational phases as a result of rain water runoff and wind erosion, especially from roads and soil stockpiles where steep slopes are present.
Mitigation required	▪ Stockpiles are to be maintained in a fertile, vegetated, and erosion free state; ▪ Stockpiles are to be clearly demarcated; ▪ Ensure proper storm water management designs are in place; ▪ Access routes are to be kept to a minimum as to reduce any unnecessary compaction from occurring; ▪ If erosion occurs, corrective actions must be taken to minimize any further erosion from taking place; and ▪ Unauthorised borrowing of stockpiled soil materials should be prevented.

Criteria	**Details / Discussion**				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	3 (Local)	5 (Project Life)	5 (Very Serious)	7 (Certain)	-91
Post-Mitigation	2 (Limited)	5 (Project Life)	3 (Moderate)	3 (Unlikely)	-30

7.2.2 Impact: Hydrocarbon Pollution

Criteria	**Details / Discussion**				
Description of impact	Hydrocarbon spills can occur where heavy machinery are parked such as the hard park area because they contain large volumes of lubricating oils, hydraulic oils, and diesel to run. There is always a chance of these breaking down and/or leaking.				
Mitigation required	▪ Prevent any spills from occurring; ▪ 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 areas or at an off-site location; and ▪ Leaking vehicles will have drip trays place under them where the leak is occurring.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	7 (Very Serious)	6 (very Likely)	-90
Post-Mitigation	1 (Very Limited)	1 (Immediate)	7 (Very Serious)	5 (Likely)	-45

7.2.3 Impact: Loss of Land Use and Land Capability

Criteria	**Details / Discussion**
Description of impact	Impact on the rehabilitation of soil, soil quality and land capability. Backfilling of soil layers will impact on the land capability by restoring the land capability to some extent because vegetation will be supported and therefore returned to the planned post mining land capability such as arable and or grazing.
Mitigation required	▪ Mitigation is possible because the land use is changed from mining back to agriculture as follows: ▪ The spoil should be shaped taking the pre-mining landscape into consideration; ▪ The designed post mining landforms should be modelled to establish the post mining landscape stability by using a combination of GIS and erosion modelling techniques by a suitably qualified expert using site specific soil quality data;

Criteria	Details / Discussion				
	▪ The soil layers should be put back in the reverse order of stripping namely subsoil first then topsoil; ▪ The yellow and red soils should be replaced in upland landscape positions; ▪ Wetland soils should be put back in the reverse order of stripping; ▪ Wetland soils should be placed in lower landscape positions; ▪ The soil quality should be investigated prior to establishing vegetation on the rehabilitated soil through representative sampling and laboratory analysis; ▪ The analytical data should be evaluated by a suitably qualified expert and vegetation fertility and or soil acidity problems should be corrected prior to vegetation establishment; ▪ Clear targets incorporating medium to long term post mining land capability influencing land use, should be part of a potentially successful closure plan; and ▪ From a national food security viewpoint, ways need to be found of rendering land rehabilitated to arable standards suitable for the economic production of cash crops.				
Parameters	Spatial	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	5 (project life)	6 (Significant)	7 (definite)	-84
Post-Mitigation	1 (Very Limited)	5 (project life)	4 (Serious medium term)	6 (almost certain)	-60

7.1 Decommissioning/Rehabilitation Phase

7.1.1 Impact: loss of topsoil as a resource

Criteria	Details / Discussion
Description of impact	Topsoil losses can occur during the decommissioning phases as a result of rain water runoff and wind erosion, especially from roads and soil stockpiles where steep slopes are present. When infrastructure and roads are being demolished there could be additional compaction. Topsoil as a resource could lose its effectiveness if topsoil is not replaced back in to the order it was stripped hence reducing its ability to grow vegetation
Mitigation required	▪ Ensure proper storm water management designs are in place; ▪ Soil are to be replaced as per soil management and rehabilitation guidelines; ▪ Access routes are to be kept to a minimum as to reduce any unnecessary compaction from occurring;

Criteria	Details / Discussion				
	▪ If erosion occurs, corrective actions must be taken to minimize any further erosion from taking place; and ▪ Unauthorised borrowing of stockpiled soil materials should be prevented.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3 (Local)	5 (Project Life)	5 (Very Serious)	7 (Certain)	-91
Post-Mitigation	2 (Limited)	5 (Project Life)	3 (Moderate)	3 (Unlikely)	-30

7.1.2 Impact: Hydrocarbon Pollution

Criteria	Details / Discussion				
Description of impact	Hydrocarbon spills can occur where heavy machinery are parked such as the hard park area because they contain large volumes of lubricating oils, hydraulic oils, and diesel to run. There is always a chance of these breaking down and/or leaking.				
Mitigation required	▪ Prevent any spills from occurring; ▪ 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 areas or at an off-site location; and ▪ Leaking vehicles will have drip trays place under them where the leak is occurring.				
Parameters	*Spatial*	*Duration*	*Intensity*	*Probability*	*Significant rating*
Pre-Mitigation	1 (Very Limited)	7 (Permanent)	7 (Very Serious)	6 (very Likely)	-90
Post-Mitigation	1 (Very Limited)	1 (Immediate)	7 (Very Serious)	5 (Likely)	-45

7.1.3 Impact: Loss of Land Use and Land Capability

Criteria	Details / Discussion
Description of impact	Impact on the rehabilitation of soil, soil quality and land capability. Backfilling of soil layers will impact on the land capability by restoring the land capability to some extent because vegetation will be supported and therefore returned to the planned post mining land capability such as arable and or grazing.
Mitigation required	▪ Mitigation is possible because the land use is changed from mining back to agriculture as follows: ▪ The spoil should be shaped taking the pre-mining landscape into consideration;

<table>
<tr><th>Criteria</th><th colspan="5">Details / Discussion</th></tr>
<tr><td></td><td colspan="5">
▪ The designed post mining landforms should be modelled to establish the post mining landscape stability by using a combination of GIS and erosion modelling techniques by a suitably qualified expert using site specific soil quality data;
▪ The soil layers should be put back in the reverse order of stripping namely subsoil first then topsoil;
▪ The yellow and red soils should be replaced in upland landscape positions;
▪ Wetland soils should be put back in the reverse order of stripping;
▪ Wetland soils should be placed in lower landscape positions;
▪ The soil quality should be investigated prior to establishing vegetation on the rehabilitated soil through representative sampling and laboratory analysis;
▪ The analytical data should be evaluated by a suitably qualified expert and vegetation fertility and or soil acidity problems should be corrected prior to vegetation establishment;
▪ Clear targets incorporating medium to long term post mining land capability influencing land use, should be part of a potentially successful closure plan; and
▪ From a national food security viewpoint, ways need to be found of rendering land rehabilitated to arable standards suitable for the economic production of cash crops.
</td></tr>
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</table>

8 Conclusion

The project area was dominated by dark well-structured clayey soils (Arcadia and Valsrivier). These soils accounted for 373.77 ha (97.3 %). The north-western portion of the site contained shallow rocky soils (Mispah) type soils, which accounted for 10.32 ha (2.7 %).

The dominant land capability for the area is the Class III capability (373.77 ha), with the Class VIII capability (10.32 ha) in the north-western portion of the project area.

The dominant land use in the Lanxess project area is that of cultivation (320.83 ha) as shown in Figure 5-6, sorghum is being grown in these heavy clay soils. The land use summary is as follows:

- Cultivated (320.77 ha);
- Grazing (13.04 ha);
- Natural (47.21 ha);
- Infrastructure (1.74 ha); and

- Disturbed (1.27 ha).

The general best practice for soil stripping and stockpiling is to strip the top 0.3 m separately from the rest of the soil profile.

The soil should be stripped and stockpiled together to a maximum of 4 m (practical tipping height for dump trucks without the risk of compaction).

The potential impacts associated with open cast mining on soils are broken up into the following:

- Loss of Topsoil;
- Erosion;
- Misplacement of stockpiles;
- Incorrect usage of stockpiles;
- Incorrect stripping of topsoil;
- Stockpiling well drained soils with wetland soils;
- Compaction;
- Loss of Land Capability;
- Soil contamination through hydrocarbon spills;
- Replacement of topsoil not to pre-land capability specifications; and
- Low soil fertility.

9 References

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