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REPORT

Soil, land capability and land use assessment of proposed opencast and underground mining areas as well as the footprints of various proposed mining infrastructure related to the Tweefontein Optimization Project Amendment

Requested By

Clean Stream Environmental Consultants

Compiled By

Rehab Green Monitoring Consultants CC
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Declaration of Independence

In terms of Section 32 of the EIA Regulations 2010 published in terms of Chapter 5 of the National Environmental Management Act (Act 107 of 1998) specialists involved in Impact Assessment processes must declare their independence and furnish details of experience.

I, Piet Steenekamp, hereby declare that I have no conflict of interest related to the work of this report. Specially, I declare that I have no personal financial interests in the property and/or development being assessed in this report, and that I have no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the development. I declare that the opinions expressed in this report are my own and a true reflection of my professional expertise.

P.I. STEENEKAMP

Date: 6 October 2013

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1. INTRODUCTION

1.1 Project background

Xstrata South Africa (Pty) Ltd, a member of the Glencore group of companies plan to optimize their Tweefontein colliery by obtaining environmental authorization for proposed opencast and underground mining sections as well as various proposed mining infrastructure which includes borrow pits, pollution control dams, a tailings dam, pipelines, haul roads, coal stockpiles, an explosives magazine and golf course. The project is referred to as the Tweefontein Optimization Project Amendment (TOPA).

The proposed TOPA activities are situated on the farms Vlaklaagte 330 JS, Waterpan 8 IS, Tweefontein 13 IS, Zaaiwater 11 IS and Klipplaat 14 IS. The TOPA area, demarcated in green in Figure 1, is situated approximately 6 km east of Ogies and 15km southwest of Witbank in Mpumalanga province.

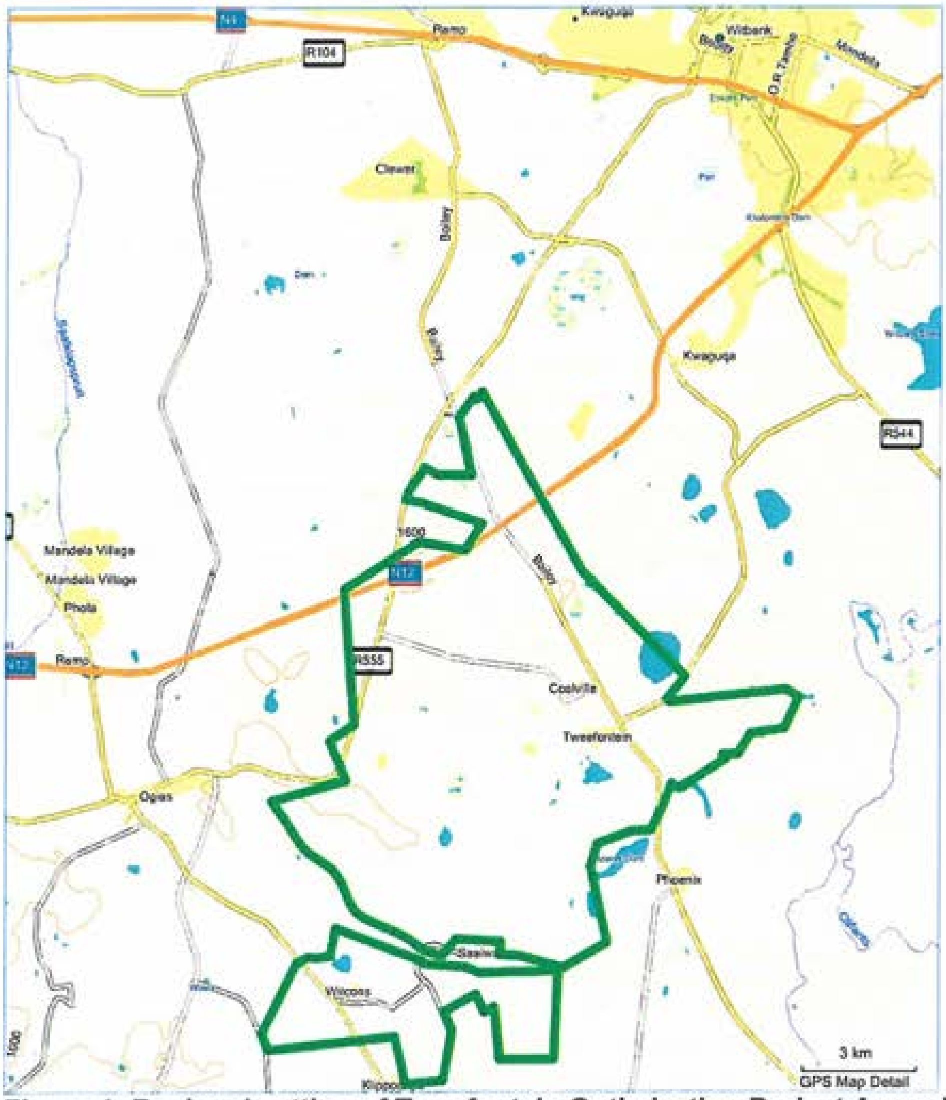


Figure 1: Regional setting of Tweefontein Optimization Project Amendment Area

1.2 Scope of work

Rehab Green Monitoring Consultants cc was requested to conduct a soil, land capability and land use assessment of the proposed opencast and underground mining areas as well as the footprints of proposed mining infrastructure which involves borrow pits, pollution control dams, a tailings dam, pipelines, haul roads, coal stockpiles, an explosives magazine and a golf course as shown in Figures 2a-2e. The field assessment was done during September and October 2012.

The study provides input to the Environmental Impact Assessment (EIA) as required in terms of the Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002 and the National Environmental Management Act (NEMA), Act 107 of 1998. The Acts require that pollution and/or degradation of the environment is to be avoided, or where either aspect cannot be avoided, is to be minimized and remedied.

1.3 Assumptions

Only subsoil material will be removed from the borrow pits. All topsoil will be stripped and stored and will be available for rehabilitation of the pits afterwards.

2. STUDY OBJECTIVES

The study objectives were to:

- Conduct a detailed soil assessment within the extent of proposed mining activities and infrastructure footprints;
- Classify and map soil forms according to the South African Taxonomic Soil Classification System, 1991;
- Derive and map land capability based on soil properties;
- Identify soil properties related to wetness to enable the delineation of zones with similar degrees of wetness categorized in permanent, seasonal or temporary wetland zones or riparian zones based on guidelines of the Department of Water Affairs;
- Map all pre-mining and current land uses;
- Determine all possible impacts by the proposed activities and provide associated mitigation measures; and
- Compile a soil stripping and stockpiling plan with rehabilitation guidelines and mitigation measures for proposed opencast mining areas.

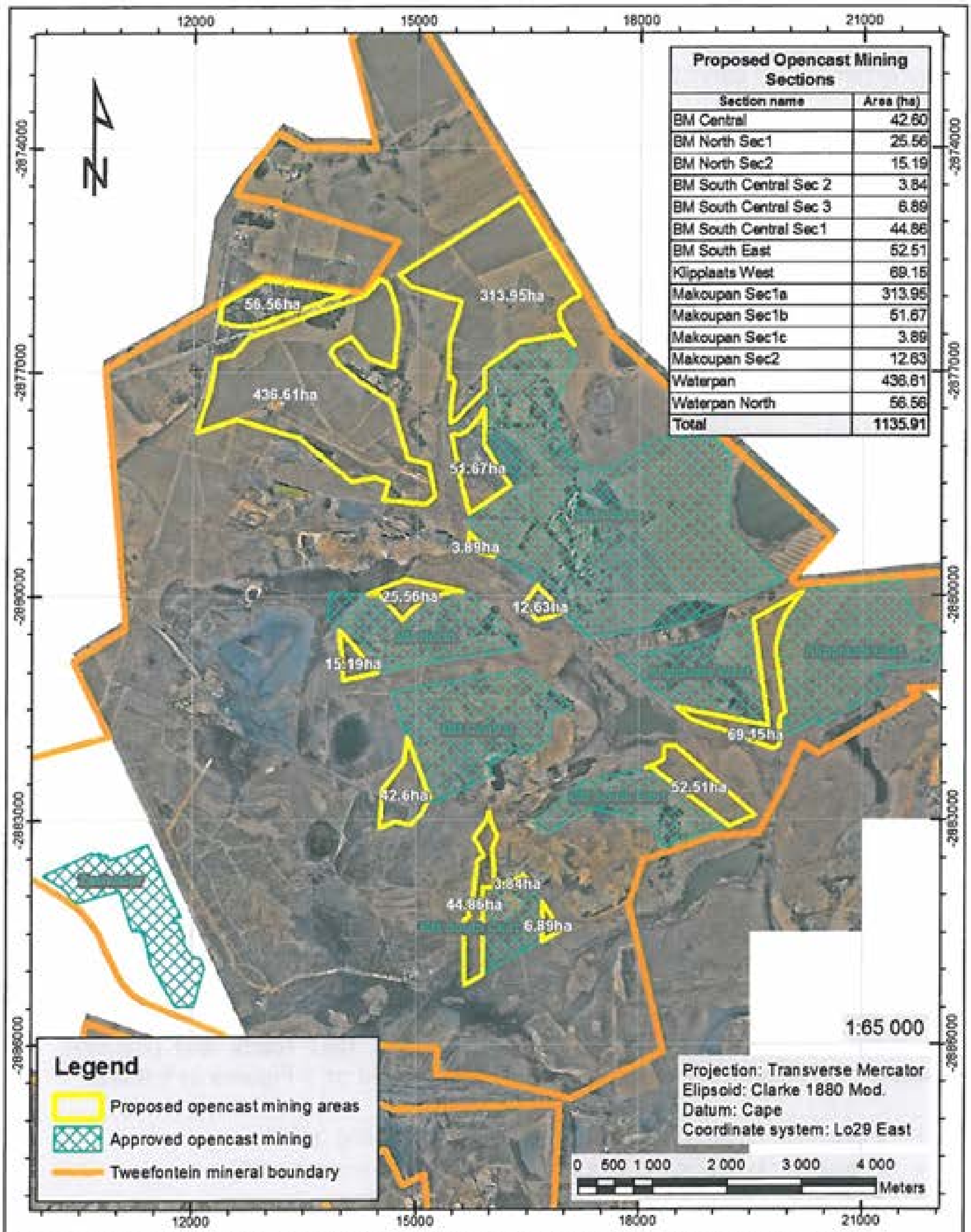
3. STUDY AREA AND KEY COMPONENTS OF THE PROPOSED PROJECT

The proposed activities and structures of the TOPA which influences soil, land capability and land uses were divided in 5 categories namely opencast mining areas, underground mining areas, areas occupied by borrow pits, areas occupied by pollution control dams, a tailings dam, coal stockpiles, an explosives magazine and golf course and areas occupied by linear structures i.e. roads, haul roads and pipelines. The locations of structures in these categories are displayed on 5 Figures as follows:

- Figure 2a: Localities of proposed opencast mining areas;
- Figure 2b: Localities of proposed underground mining areas;
- Figure 2c: Localities of proposed borrow pit areas;
- Figure 2d: Localities of proposed pollution control dams, Zaaiwater tailings dam, coal stockpiles, explosives magazine and golf course; and
- Figure 2e: Localities of proposed linear structures i.e. roads, haul roads and pipelines.

3.1 Proposed opencast areas

The proposed opencast areas are demarcated in yellow on Figure 2a and consist of 14 units covering a total area of 1135.91 ha. The existing approved opencast mining areas are hatched in turquoise. Figure 2a contains a table showing the name and area of each proposed opencast mining area.



Proposed Opencast Mining Sections	
Section name	Area (ha)
BM Central	42.60
BM North Sec1	25.56
BM North Sec2	15.19
BM South Central Sec 2	3.84
BM South Central Sec 3	6.89
BM South Central Sec1	44.86
BM South East	52.51
Klipplaats West	69.15
Makoupan Sec1a	313.95
Makoupan Sec1b	51.67
Makoupan Sec1c	3.89
Makoupan Sec2	12.63
Waterpan	436.61
Waterpan North	56.56
Total	1135.91

Figure 2a: Location of proposed opencast mining and approved opencast mining areas

3.2 Proposed underground mining areas

The proposed underground mining areas of seams 1, 2 and 5 are demarcated in green in Figure 2a, comprising a total of 2986.32 ha.

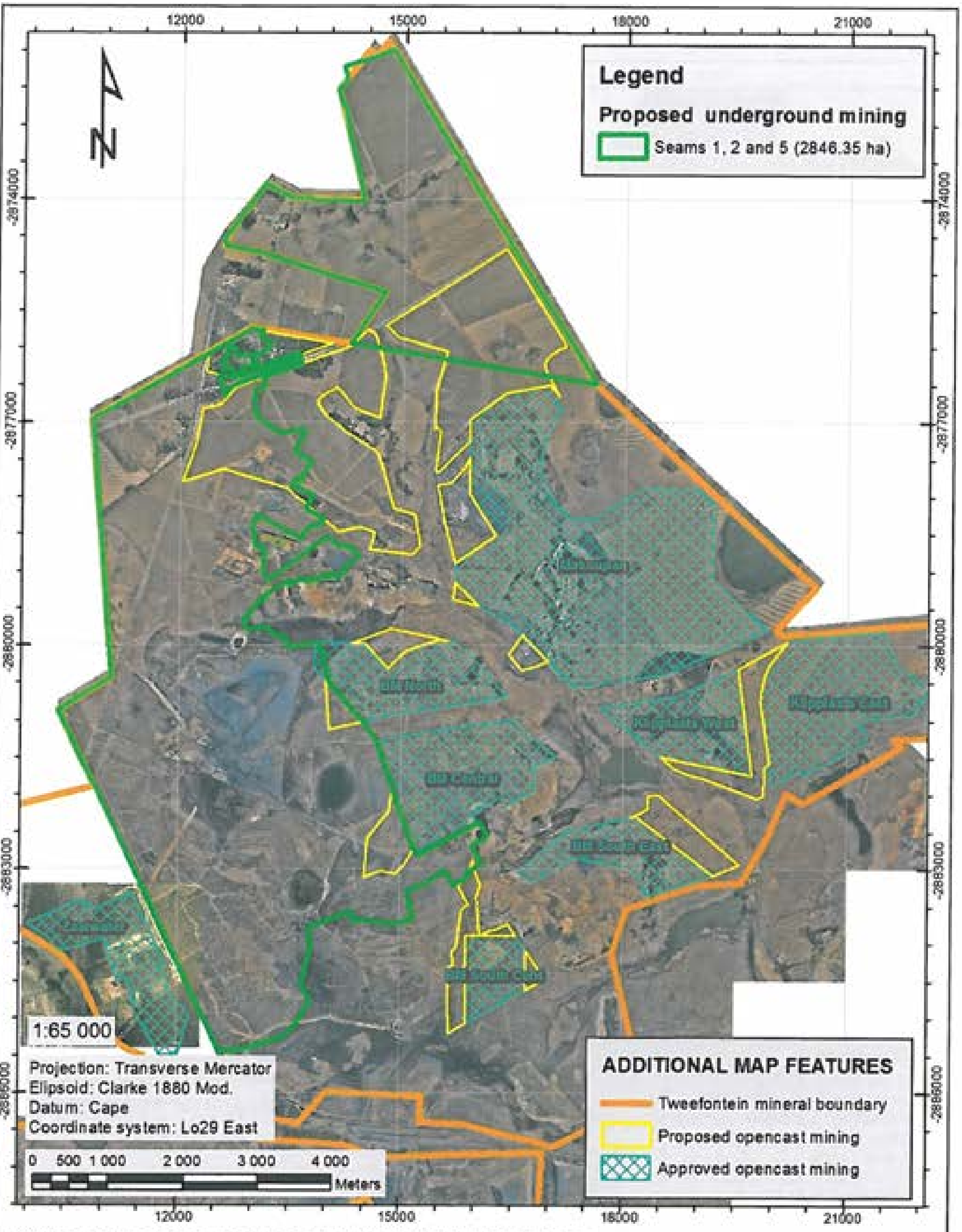


Figure 2b: Location of proposed underground mining areas

3.3 Proposed borrow pits

The proposed borrow pit areas are outlined in yellow in Figure 2c and consist of 7 units comprising a total area of 40.09 ha. The pits are labeled using the labels provided on the TOP 2012 Environmental Management Plan (Amendment Master Plan Rev CS). Figure 2c contains a table showing the number and size of each borrow pit.

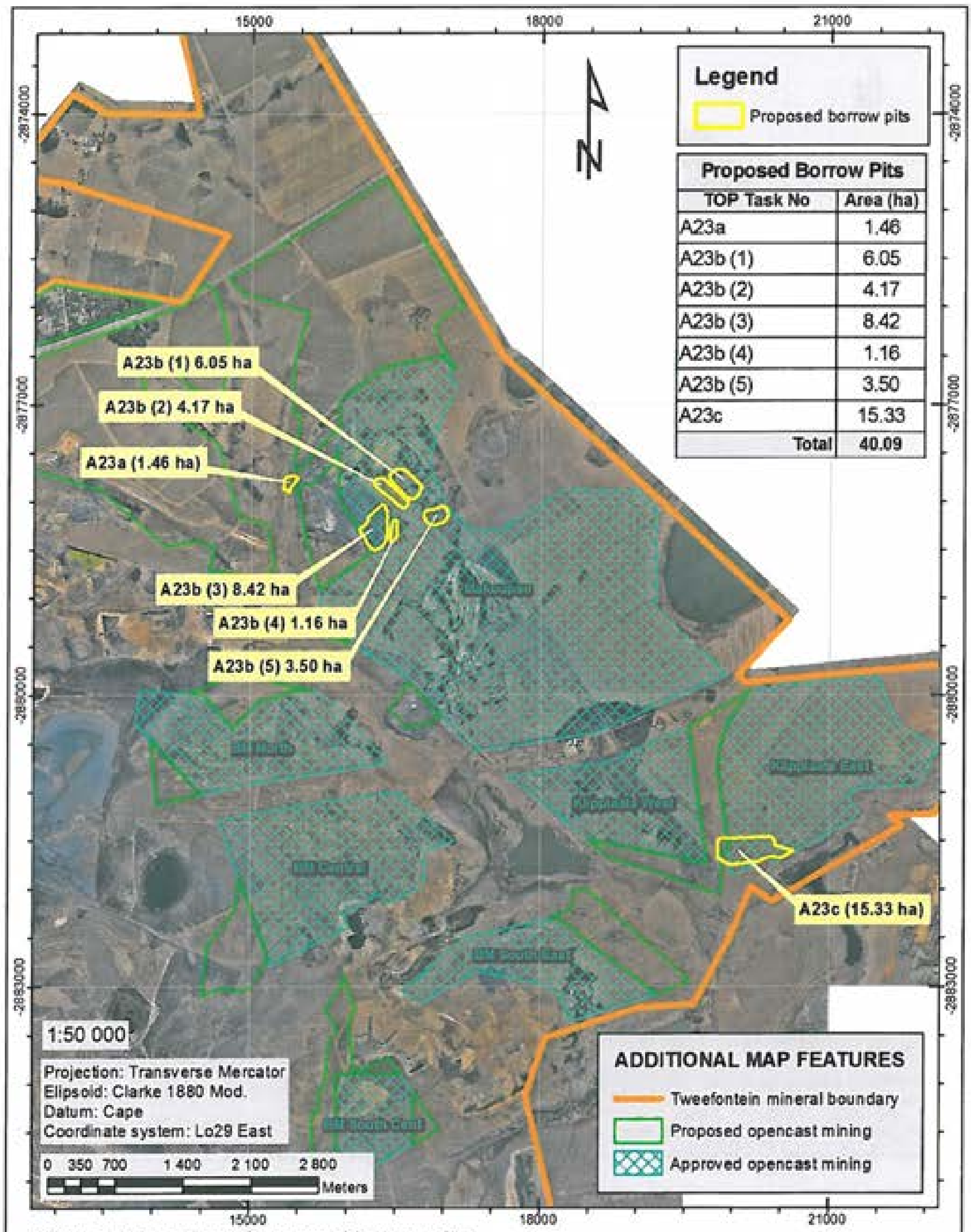
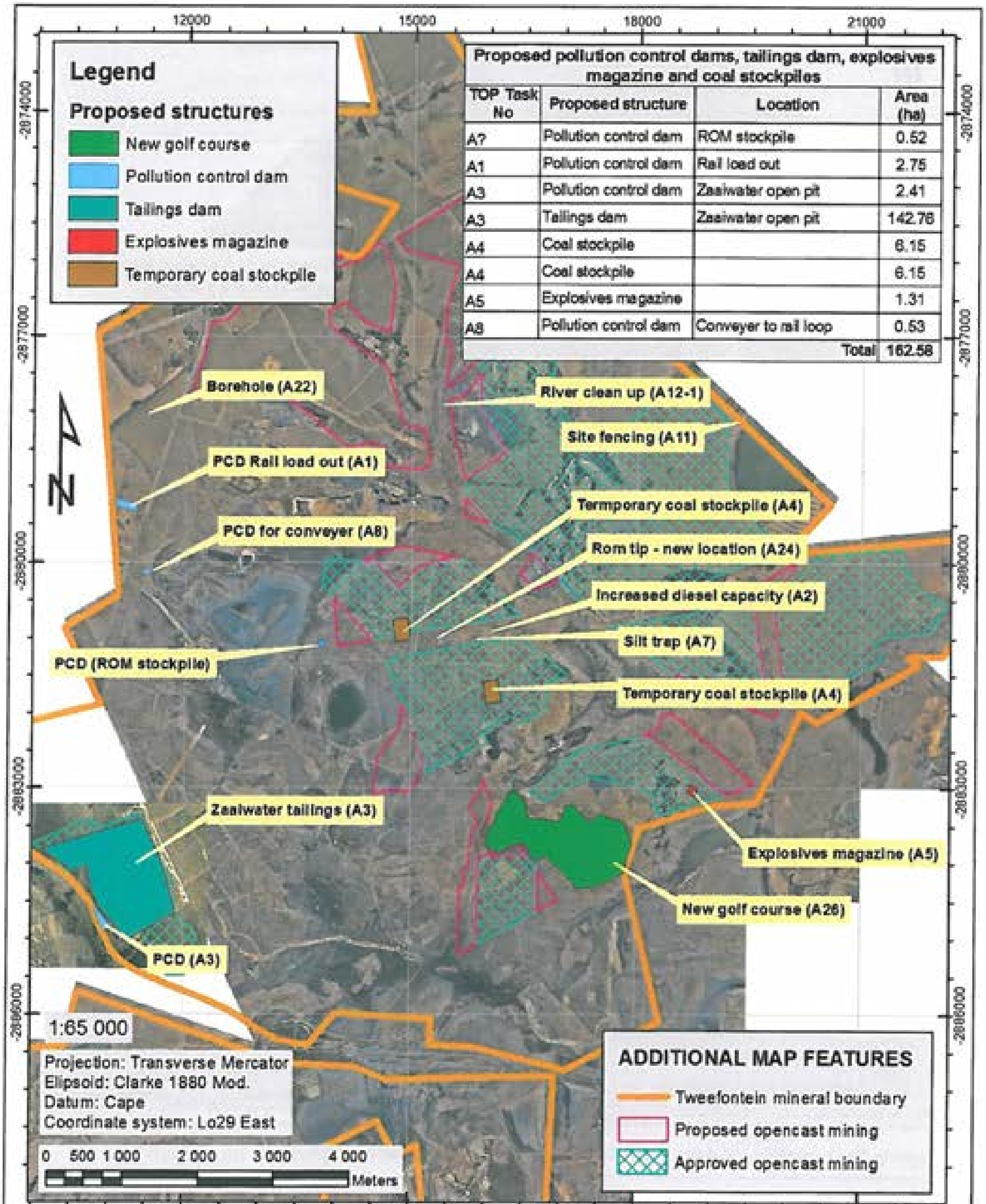


Figure 2c: Location of proposed borrow pits

3.4 Proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine, golf course and other as labeled

The location of proposed structures i.e. 4 pollution control dams (6 ha together), the Zaaiwater tailings dam (142 ha), 2 coal stockpiles (12 ha together), an explosives magazine (1 ha) and golf course (133 ha) is shown on Figure 2d. The structures are labeled using the labels provided on the TOP 2012 Environmental Management Plan (Amendment Master Plan - Rev CS). Figure 2d contains a table showing the area comprised by each structure.



Proposed pollution control dams, tailings dam, explosives magazine and coal stockpiles

TOP Task No	Proposed structure	Location	Area (ha)
A?	Pollution control dam	ROM stockpile	0.52
A1	Pollution control dam	Rail load out	2.75
A3	Pollution control dam	Zaaiwater open pit	2.41
A3	Tailings dam	Zaaiwater open pit	142.76
A4	Coal stockpile		6.15
A4	Coal stockpile		6.15
A5	Explosives magazine		1.31
A8	Pollution control dam	Conveyer to rail loop	0.53
		Total	162.58

Figure 2d: Location of proposed pollution control dams, Zaaiwater tailings dam, coal stockpiles, explosives magazine, golf course and other as labeled.

3.5 Proposed roads, haul roads and pipelines (linear structures)

The proposed linear structures, roads, haul roads and pipelines are shown on Figure 2e. Roads are shown as a green dotted line, haul roads as an orange dotted line and pipelines as blue solid lines. The task labels provided on the TOP 2012 Environmental Management Plan (Amendment Master Plan – Rev CS) is added to each label.

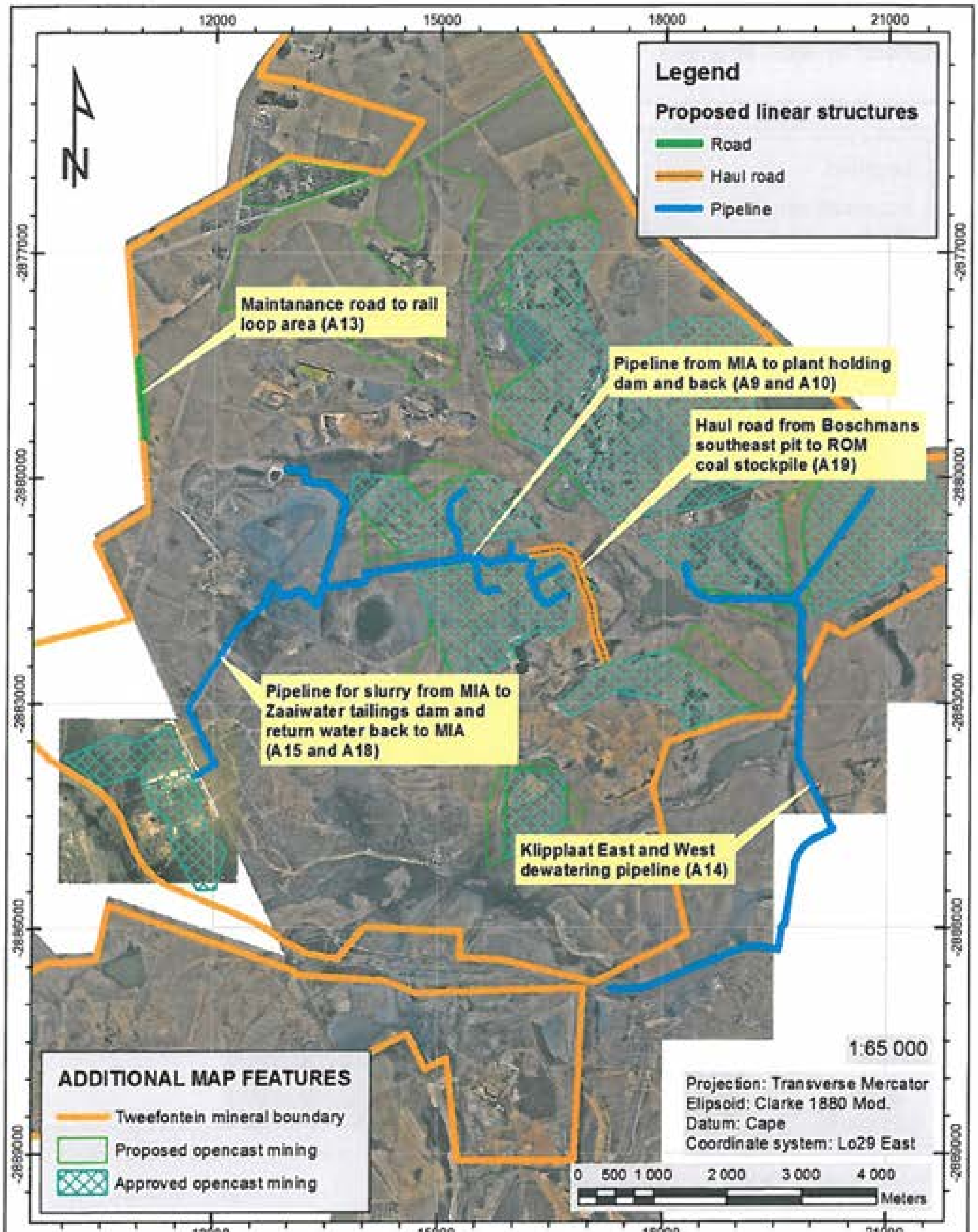


Figure 2e: Location of proposed linear structures i.e roads, haul roads and pipelines.

4. METHODOLOGY

4.1 Preparation of field maps

ArcGIS Geographic Information System (GIS) software was used to process all available data for accurate surveying. The location and extent of proposed structures and activities was obtained from Clean Stream Environmental Consultants in electronic dwg, dxf and pdf file formats.

The dwg and dxf files were converted to shapefile format and were superimposed on an aerial photo image. Field observation points with grid spacing of 150 x 150 m were generated. The coordinates of the observation points were calculated and loaded onto a Geographic Positioning System (GPS) to accurately locate the positions of the observation points in the field.

4.2 Soil classification

The soils of the proposed opencast, underground and borrow pit areas as well as infrastructure areas were investigated by means of auger holes at a grid spacing of 150 x 150 m and to a depth of 1500 mm or to refusal. Existing soil data were verified during the field assessment. Existing soil data layers (in shapefile format) was updated at areas which were mined or disturbed in the mean time. The soils were described and classified according to the South African Taxonomic Soil Classification System (Soil Classification Working Group, 2nd edition 1991). The system of soil classification is explained in Appendix A.

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

i) Identify applicable diagnostic horizons by noting the physical properties such as:

- Effective depth (depth of soil suitable for root development);
- Colour (in accordance with Munsell colour chart);
- Texture (refers to the particle size distribution);
- Structure (aggregation of soil particles into structural units);
- Mottling (alterations due to continued exposure to wetness);
- Concretions (cohesion of minerals into hard fragments);
- Leaching (removal of soluble constituents by percolating water);
- Gleying (reduction of ferric oxides under anaerobic conditions, resulting in grey, low chroma soil colours); and
- Illuviation of colloidal mater from one horizon to another, resulting in the development of grey sandy E-horizons and grey clay G-horizons.

ii) Determine the appropriate soil Form and soil Family according to the above properties.

The soil properties that were used to map fairly homogeneous soil types are discussed in Appendix B.

4.3 Soil sampling and analysis

The A-horizons (0-250 mm) of the dominant soil types were sampled and analysed at the Institute for Soil, Climate and Water. The analyses were conducted according to methods set out in the Handbook of Standard Testing for Advisory Purposes (Soil

Science Society of South Africa, 1990). The following analyses were conducted:

- Soil acidity (pH) in a 1:2.5 water solution;
- Extractable cations (Na, K, Ca and Mg) according to the ammonium acetate method; and
- Phosphorus status according to the Bray 1 method.

4.4 Land capability assessment

Land capability was assessed according to the definitions outlined in the guidelines for the rehabilitation of mined land by the Chamber of Mines of South Africa and Coaltech Research Association (2007). Soil types were classified into the following categories for areas that exclude wetlands:

- Arable land;
- Grazing land; and
- Wilderness.

4.5 Agricultural potential classification

The classification of agricultural potential of soils was based on soil properties noted during auger observations, such as effective soil depth, texture, terrain unit, slope, soil wetness and disturbances. The effective soil depth is the main soil characteristic that determined the agricultural potential. The criteria applied for the classification of the agricultural potential of soils are as follows:

- **High** – well-drained and moderately well-drained soils with an effective depth deeper than 900 mm.
- **Moderate** - well-drained and moderately well-drained soils with an effective depth of 600- 900 mm.
- **Low** - well-drained and moderately well-drained soils with an effective depth less than 600 mm or leached, grey, sandy soils showing evidence of periodic percolating water tables, or black and grey clay soils showing evidence of poor internal drainage or very sandy soils in low rainfall areas.

4.6 Wetland and riparian delineation

Wetland and riparian zones were delineated according to the practical field procedure for the identification and delineation of wetlands and riparian areas (Department of Water Affair and Forestry, 2005). Four indicators were used in the study to delineate wetland and riparian zones, namely:

- Terrain unit;
- Soil form;
- Soil wetness; and
- Wetland and riparian vegetation.

Auger observations were made systematically in transects towards the wetland at 50 m intervals in order to locate the point from where clear evidence of wetness occurs within 500 mm from surface. Further details on the delineation of wetland areas are included in Appendix C.

4.7 Land use mapping

The localities and extents of land use practices were surveyed during the time of the soil assessment.

4.8 Erodibility evaluation

Erodiblity was broadly assessed, based on soil texture, slope and the inherent stability of the parent rock (geology) from which the soil originated.

Low: Soils with stable physical and chemical properties which occur on flat to gentle slopes to ensure low erosion susceptibility in the natural state. Few erosion protection measures are necessary.

Moderate: Soils with low to moderately unstable physical or chemical properties or soils occurring on moderate to steep slopes. Sheet and rill erosion often occur in the natural state but may become severe when these soils are disturbed or due to any misuse such as overgrazing. Erosion protection measures are necessary.

High: Soils with unstable physical and chemical properties or soils occurring on very steep slopes. Rill and donga erosion often occur in the natural state and will become severe during any disturbance or misuse. Specialised erosion protection measures are necessary.

4.9 Map compilations

The field data was captured in shapefile format (shp) and processed and stored in a Geographic Information System called ArcGIS. The maps were compiled in a map extendable document format (mxd) and exported to Jpeg format. The shapefiles can be exported to a dxf or dwg format for CAD users.

The maps were generated in a projected coordinate system using the longitude of origin (LO) coordinate system based on the 29° East meridian, Clarke 1880 Mod. Elipsoid and Cape Datum.

4.10 Approach to impact assessment and management

The EIAMAP[1] is a comprehensive tool used to manage the negative environmental impacts associated with mining and related activities and consists of two key aspects.

Firstly, the EIAMAP includes a full impact assessment according to activity (mining or mining-related), mining phase (construction, operational and decommissioning), and environmental component.

Secondly, an Environmental Management Programme (EMP) proposed for the expected impacts is also provided in the EIAMAP. This section of the EIAMAP includes proposed mitigation measures, time frames for implementation of the proposed mitigation measures and relative financial provisioning for the implementation of the proposed mitigation measure. These aspects comply with applicable legislation, as described in detail below.

4.10.1 Impact assessment methodology

Section 31(2)(k), Chapter 3 of the R. 543 (2010) in terms of the NEMA[2], 1998 requires an assessment of the extent, duration, probability and significance of the identified potential environmental impacts of the proposed mining operation. In order to comply with best practice principles, the evaluation of impacts was conducted in terms of the

[1] EIAMAP: Environmental Impact Assessment and Management Action Plan.

[2] NEMA: National Environmental Management Act, 1998 (Act no: 107 of 1998).

criteria presented in **Table 1.1**.

The significance of the current impacts, which exist even with mitigation measures in place, was determined using the methodology indicated below.

Table 1.1: Impact assessment criteria

Status		
Positive	+	Impact will be beneficial to the environment (a benefit).
Negative	-	Impact will not be beneficial to the environment (a cost).
Neutral	0	Where a negative impact is offset by a positive impact, or mitigation measures, to have no overall effect.

`Magnitude		
Minor	2	Negligible effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been altered significantly, and have little to no conservation importance (negligible sensitivity*).
Low	4	Minimal effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been largely modified, and / or have a low conservation importance (low sensitivity*).
Moderate	6	Notable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have already been moderately modified, and have a medium conservation importance (medium sensitivity*).
High	8	Considerable effects on biophysical or social functions / processes. Includes areas / environmental aspects which have been slightly modified and have a high conservation importance (high sensitivity*).
Very high	10	Severe effects on biophysical or social functions / processes. Includes areas / environmental aspects which have not previously been impacted upon and are pristine, thus of very high conservation importance (very high sensitivity*).
Extent		
Site only	1	Effect limited to the site and its immediate surroundings.
Local	2	Effect limited to within 3-5 km of the site.
Regional	3	Activity will have an impact on a regional scale.
National	4	Activity will have an impact on a national scale.
International	5	Activity will have an impact on an international scale.
Duration		
Immediate	1	Effect occurs periodically throughout the life of the activity.
Short term	2	Effect lasts for a period 0 to 5 years.
Medium term	3	Effect continues for a period between 5 and 15 years.
Long term	4	Effect will cease after the operational life of the activity either because of natural process or by human intervention.
Permanent	5	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.
Probability of occurrence		
Improbable	1	Less than 30% chance of occurrence.
Low	2	Between 30 and 50% chance of occurrence.
Medium	3	Between 50 and 70% chance of occurrence.
High	4	Greater than 70% chance of occurrence.
Definite	5	Will occur, or where applicable has occurred, regardless or in spite of any mitigation measures.

**Note for specialists – please use the sensitivity information / rankings you determine in your studies here.*

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

Significance = (Magnitude + Duration + Extent) x Probability

As is evident from the above equation, the extent (spatial scale), magnitude, duration (time scale) and the probability of occurrence of each identified impact should be assigned a value according to the impact assessment criteria (presented in Table 1.1, above) and used to calculate the significance of each impact.

A Significance Rating should then be calculated by multiplying the Severity Rating with the Probability, and is therefore a product of the probability and the severity of the impact. The maximum value that can be reached through the described impact evaluation process is 100 SP[3]. The scenarios for each environmental impact are rated as High (SP≥60), Moderate (SP 31-60) and Low (SP<30) significance as shown in **Table 1.2**.

Table 1.2: Definition of significance rating

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

Once the significance rating of an impact before mitigation has been determined, the reversibility of the impact, 'replaceability' of the affected resources and the potential of the impact to be further mitigated also need to be determined. These factors are explained in the table below, and play an important role in the determination of the level and type of mitigation performed or to be implemented. **Table 1.3** sets out the criteria that should be used to assess the reversibility, loss of resources and potential for further mitigation.

Table 1.3: Mitigation prediction criteria

Reversibility of impact		
Reversible	1	The impact on natural, cultural and / or social structures, functions and processes is totally reversible.
Partially	2	The impact on natural, cultural and / or social structures, functions and processes is partially reversible.
Irreversible	3	Where natural, cultural and / or social structures, functions or processes are altered to the extent that it will permanently cease, i.e. impact is irreversible.

[3]SP: Significant Points.

Irreplaceable loss of resources		
Replaceable	1	The impact will not result in the irreplaceable loss of resources.
Partially	2	The Impact will result in a partially irreplaceable loss of resources.
Irreplaceable	3	The impact will result in the irreplaceable loss of resources.

Potential of impacts to be mitigated		
High	1	High potential to mitigate negative impacts to the level of insignificant effects, or to improve management to enhance positive impacts.
Medium	2	Potential to mitigate negative impacts. However, the implementation of mitigation measures may still not prevent some negative effects.
Low	3	Little or no mechanism exists to mitigate negative impacts.

The EIAMAP (a template of which is attached for your use) also provides a column in the table that identifies a specific impact as an I&AP[4] concern and also indicates who raised the concern as well as cross referencing with the relevant public participation parts of this document for more detail (if you have this information, please include it, otherwise CSEC will do so once the Public Participation Process has come to a close).

The impacts expected to occur as result of the activities that are anticipated to take place at the proposed Project site may combine with those resulting from surrounding activities and land uses to form cumulative impacts, or to contribute to cumulative impacts that already exist. The EIAMAPs for cumulative impacts are slightly different from the others, since potential mitigation measures are excluded, as they will have been addressed in the other activity-specific EIAMAPs.

4.10.2. Environmental Management Plan (EMP)

Regulation 33 of the EIA Regulations GN R.543 (2010) under the NEMA (1998) sets out the requirements for an EMP. To address these requirements, the EIAMAPs should include the following aspects:

- **The mitigation management objectives and principles**– these should be identified to enable the mine to set goals for the environmental management of the proposed mining operations. Carefully planned management objectives and principles are the foundations of an effective EMP[5].
- Design plays a large role in the mitigation process, thereby ensuring that the project takes a proactive stance to environmental management. Therefore, **mitigation by design** is central to the implementation of this EMP. (Please use this column to briefly explain how the identified impact is expected to be mitigated through the design of the mine and / or infrastructure).
- **Proposed mitigation measures**– please use this column to propose mitigation measures / make recommendations that, when implemented, would enable the project to achieve the environmental management goals / objectives you will have identified in one of the previous columns. Mitigation measures identified should modify, remedy, control or stop any action, activity or process that is identified as possibly impacting adversely on the environment.
- **Time Frames**– please give an indication of the acceptable timeframe for the implementation of the proposed mitigation measures.

[4] I&AP: Interested and Affected Party/ies

[5] EMP: Environmental Management Programme.

- **Person responsible**– if you have an idea who should be responsible for the implementation of each mitigation measures, please include, but if not, please leave blank. CSEC the client will complete this column at a later stage.

5. SURVEY RESULTS

5.1 Dominant soil types

Soil types were mapped based on soil information gathered by means of auger observations on a 150 x 150 metre pre-determined grid. The soil information of the proposed opencast and underground mining areas as well as borrow pit and infrastructure footprints were compiled on 5 maps as follows:

- Figure 3a: Soil types within proposed opencast mining areas;
- Figure 3b: Soil types within proposed underground mining areas;
- Figure 3c: Soil types within proposed borrow pit areas;
- Figure 3d: Soil types within proposed pollution control dam, Zaaiwater tailings dam, coal stockpiles, explosives magazine and golf course footprint; and
- Figure 3e: Soil types intersecting proposed linear structures i.e. roads, haul roads and pipelines.

An additional 2 soil maps, covering the soils within the combined footprints of proposed structures (Figures 3a -3e) as well as soil types within the total TOPA area were compiled. Soil data for the majority of the TOPA area was available accept for 2 small portions to the south and east. The soil data used, was colleted over a number of years and some transformation or disturbances could have taken place at some places in the mean time. The maps were name as follows:

- Figure 3f: Soil types within the combined proposed structure footprints of the TOPA area;
- Figure 3g: Soil types within the total TOPA area;

Each figure contains an abbreviated soil legend. A detailed soil legend for each of the 5 maps is provided in Tables 2a-2e which describes the soils in terms of the following aspects:

- Dominant and subdominant soil forms and families;
- Average effective soil depth;
- The estimated clay content of the A and B or E or G-horizons;
- The derived texture class;
- A broad description of the dominant soil form;
- The soil's derived land capability; and
- The area and percentage comprised by each soil type.

5.1.1 Soil types within the proposed opencast mining areas

The proposed opencast mining areas consist of 14 sections of which most are small areas adjacent to existing approved opencast mining areas covering a total of 1135.93 ha. Soil types within the proposed opencast mining areas are shown in Figure 3a which contains an abbreviated soil legend.

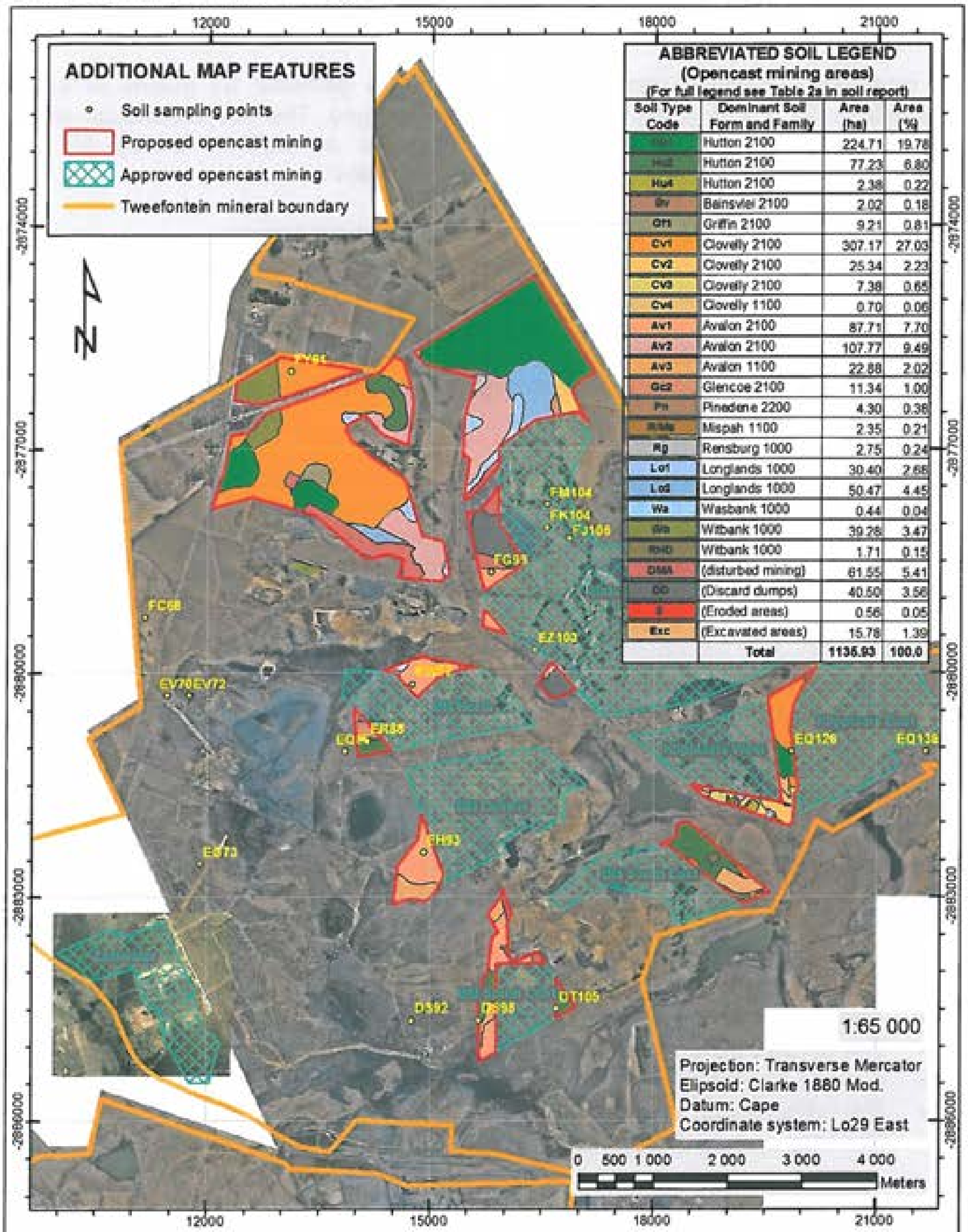


Figure 3a: Soil types within proposed opencast mining sections

A total of 25 soil types, based on dominant soil form, effective soil depth and internal drainage were identified during field observations and were symbolised as: Hu1, Hu2, Hu4, Bv, Gf1, Cv1, Cv2, Cv3, Cv4, Av1, Av2, Av3, Gc2, Pn, R/Ms, Rg, Lo1, Lo2, Wa, Wb, RHD, DMA, DD, E and Exc. The soil types are described in a comprehensive soil legend, Table 2a.

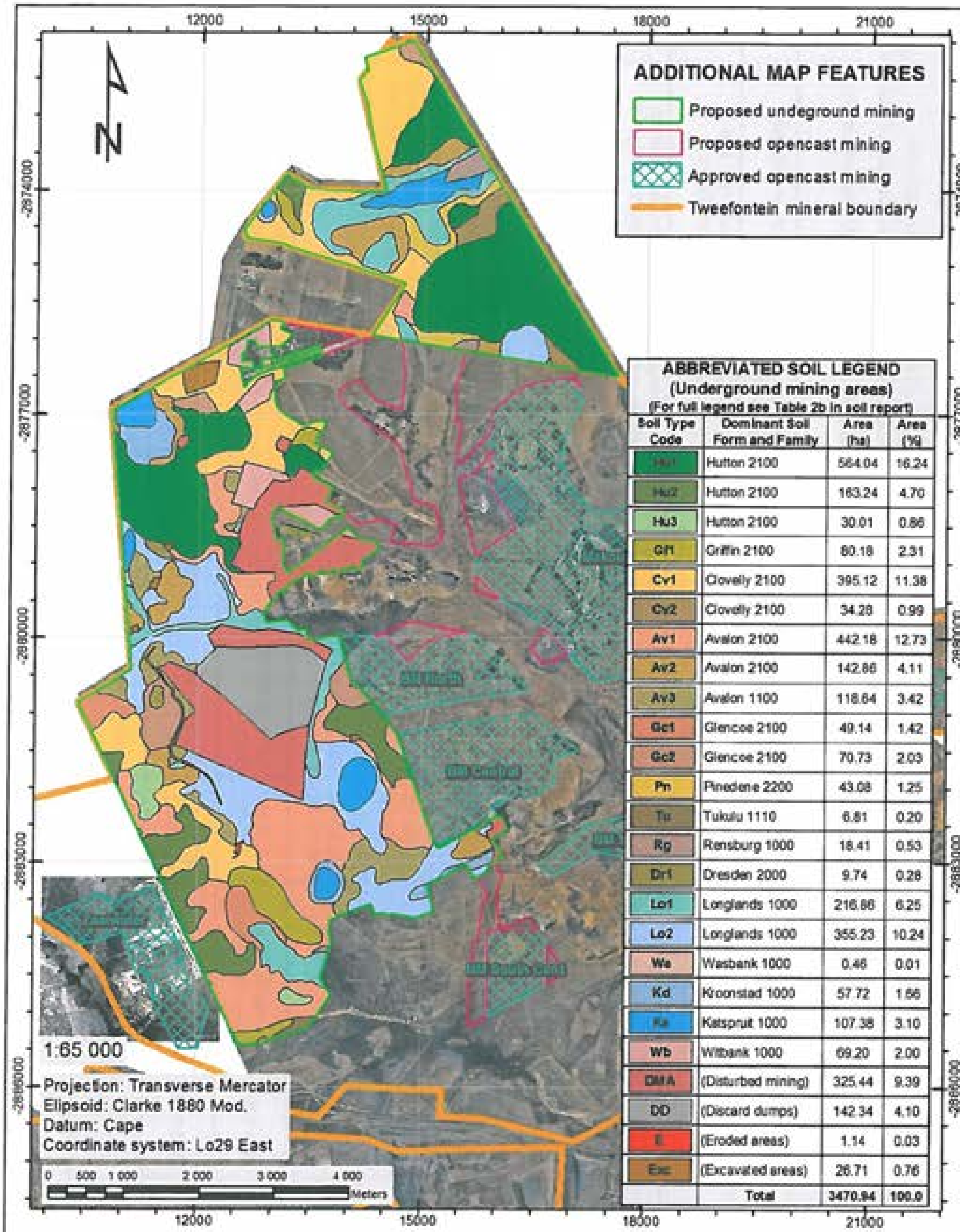
Table 2a: Soil legend – Proposed opencast mining areas

Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
Hu1	Hutton 2100	>1500	Bloemdal, Clovely	A: 25-38 B: 30-42	Sandy clay loam - clay loam	Very deep (>1500 mm), red, well drained, sandy clay loam to clay loam soils.	Arable	224.71	19.78
Hu2	Hutton 2100	>1500	Bloemdal, Clovely, Avalon, Griffin	A:15-25 B: 15-30	Sandy loam - sandy clay loam	Very deep (>1500 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils.	Arable	77.23	6.80
Hu4	Hutton 2100	500-1000	Bloemdal, Clovely, Avalon, Griffin	A: 15-20 B: 15-30	Sandy loam - sandy clay loam	Shallow to moderately deep (500-1000 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils underlain by weathered or hard rock.	Arable	2.38	0.22
Bv	Bainsvlei 2100	600-1200	Hutton, Bloemdal, Clovelly, Glencoe	A: 15-20 B: 15-30	Sandy loam - sandy clay loam	Moderately deep (600-1200 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils often containing 5-30% concretions in the B-horizon, underlain by soft plinthite.	Arable	2.02	0.18
Gf1	Griffin 2100	1200-1500	Clovelly, Avalon, Hutton, Bloemdal	A: 12-16 B: 15-25	Loamy sand - sandy clay loam	Deep (1200-1500 mm), orange to reddish yellow, well-drained, loamy sand to sandy loam soil gradually changing to orange red, sandy clay loam in the lower soil profile underlain by weathered rock.	Arable	9.21	0.81
Cv1	Clovelly 2100	900-1500	Avalon, Glencoe, Hutton, Bloemdal	A: 10-14 B: 12-18	Loamy sand - sandy loam	Deep (900-1500 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	307.17	27.03
Cv2	Clovelly 2100	600-900	Avalon, Glencoe, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Moderately deep (600-900 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	25.34	2.23
Cv3	Clovelly 2100	300-600	Glencoe, Mispah, Glenrosa, Cartref	A: 8-10 B: 8-12	Sandy-loamy sand	Shallow (300-600 mm), brownish yellow, well drained, sandy to loamy sand soils underlain by hard or weathered rock.	Grazing	7.38	0.65
Cv4	Clovelly 1100	900-1500	Glencoe, Avalon, Fernwood	A: 8-10 B: 8-10	Loamy sand	Deep (900-1500 mm), pale to brownish yellow, well drained, sandy soils underlain by weathered rock.	Grazing	0.70	0.06
Av1	Avalon 2100	900-1400	Glencoe, Clovelly, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Deep (900-1400 mm), brownish to orange yellow, moderately well-drained, loamy sand to sandy loam soils underlain by soft plinthite.	Arable	87.71	7.70
Av2	Avalon 2100	600-1000	Glencoe, Clovelly	A: 10-14 B: 12-16	Loamy sand - sandy loam	Moderately deep (600-1000 mm), brownish to orange yellow, moderately well-drained, loamy sand to sandy loam soils underlain by soft plinthite.	Arable	107.77	9.49
Av3	Avalon 1100	500-1000	Glencoe, Wasbank, Dresden, Constantia	A: 8-10 B: 7-12	Sandy to loamy sand	Moderately deep (500-1000 mm), pale to brownish yellow, moderately well-drained, sandy to loamy sand soils underlain by soft plinthite with occasional wet spots.	Grazing	22.88	2.02
Gc2	Glencoe 2100	600-1000	Clovelly, Avalon	A: 10-13 B:	Loamy sand - sandy loam	Moderately deep (600-1000 mm), brownish yellow, moderately well-drained, loamy sand to sandy loam soils underlain by hardpan ferricrete.	Arable	11.34	1.00

Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
Pn	Pinedene 2200	500-700	Avalon, Kroonstad, Wasbank	A: 10-15 B: 10-16	Loamy sand - sandy loam	Shallow (500-700 mm), pale yellow, imperfectly drained, structureless, sandy loam soils, underlain by gleyed clay.	Grazing	4.30	0.38
R/Ms	Mispah 1100	0-400	Mispah 2100, Cartref, Glenrosa, Clovelly	A: 10-15 B: 14-20	Loamy sand	Rock outcrops (20-80% surface rock) with shallow, well-drained, yellowish brown loamy sand soils and shallow, grey imperfectly drained sandy soils underlain by rock.	Wilderness	2.35	0.21
Rg	Rensburg 1000	400-600	Arcadia 1100	A: 40-45 G: 40-55	Clay	Shallow (400-600 mm), dark brown to black, strong structured, poorly drained clay soils with shrink and expand properties, underlain by gleyed clay.	Wetland	2.75	0.24
Lo1	Longlands 1000	200-600	Wasbank, Kroonstad, Katspruit, Dresden	A: 5-10 E:1-8	Sandy	Shallow (200-600 mm), grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (drainage lines subject to seasonal and permanent wetness).	Wetland	30.40	2.68
Lo2	Longlands 1000	200-600	Wasbank, Kroonstad, Avalon, Dresden, Westleigh	A: 5-10 E: 4-8	Sandy	Shallow (200-600 mm), grey to yellowish grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (seepage zones on mid and footslopes subject to temporary and seasonal wetness).	Wetland	50.47	4.45
Wa	Wasbank 1000	200-600	Longlands, Kroonstad, Dresden	A: 5-10 E:1-8	Sandy	Shallow (200-600 mm), grey to greyish white, leached, imperfectly to poorly drained sandy soils, underlain by hardpan ferricrete (seepage zones on mid and footslopes subject to temporary and seasonal wetness).	Wetland	0.44	0.04
Wb	Witbank 1000	300-900	-	A: 12-20	Loamy sand - sandy loam	Poorly rehabilitated mined land: Shallow to moderately deep (300-900 mm), compacted, brownish yellow to red mixed and discontinuing soil horizons often contaminated with coal, spoil and discard material.	Grazing	39.28	3.47
RHD	Witbank 1000	200-500	-	-	-	Rehabilitated dump - mainly discard dumps covered with 200-500 topsoil	Wilderness	1.71	0.15
DMA	-	-	-	-	-	Disturbed mining areas mainly occupied by open pits but include discard dumps, subsoil and topsoil stockpiles as well as plants, shafts, haul roads, offices and various mining related infrastructure.	Not determined	61.55	5.41
DD	-	-	-	-	-	Discard dumps	Wilderness	40.50	3.56
E	-	0	-	-	-	No soil - deep erosion gullies	Wilderness	0.56	0.05
Exc	-	0	-	-	-	No soil - dry excavated areas (quarries and borrow pits)	Wilderness	15.78	1.39
							TOTAL	1135.93	100.0

5.1.2 Soil types within proposed underground mining areas

The proposed underground mining areas of seams 1, 2 and 5 are outlined in green in Figure 3b, comprising a total 2985.74 ha. Soil types within the proposed underground mining area are shown in Figure 3b which contains an abbreviated soil legend.



Soil Type Code	Dominant Soil Form and Family	Area (ha)	Area (%)
Hu1	Hutton 2100	564.04	16.24
Hu2	Hutton 2100	163.24	4.70
Hu3	Hutton 2100	30.01	0.86
Gf1	Griffin 2100	80.18	2.31
Cv1	Clovelly 2100	395.12	11.38
Cv2	Clovelly 2100	34.28	0.99
Av1	Avalon 2100	442.18	12.73
Av2	Avalon 2100	142.86	4.11
Av3	Avalon 1100	118.64	3.42
Gc1	Glencoe 2100	49.14	1.42
Gc2	Glencoe 2100	70.73	2.03
Pn	Pinedene 2200	43.08	1.25
Tu	Tukulu 1110	6.81	0.20
Rg	Rensburg 1000	18.41	0.53
Dr1	Dresden 2000	9.74	0.28
Lo1	Longlands 1000	216.86	6.25
Lo2	Longlands 1000	355.23	10.24
Wa	Wasbank 1000	0.46	0.01
Kd	Kroonstad 1000	57.72	1.66
Ka	Katspruit 1000	107.38	3.10
Wb	Witbank 1000	69.20	2.00
DMA	(Disturbed mining)	325.44	9.39
DD	(Discard dumps)	142.34	4.10
E	(Eroded areas)	1.14	0.03
Exc	(Excavated areas)	26.71	0.76
	Total	3470.94	100.0

Figure 3b: Soil types within proposed underground mining sections

A total of 25 soil types, based on dominant soil form, effective soil depth and internal drainage were identified during field observations and were symbolised as: Hu1, Hu2, Hu3, Gf1, Cv1, Cv2, Av1, Av2, Av3, Gc1, Gc2, Pn, Tu, Rg, Dr1, Lo1, Lo2, Wa, Kd, Ka, Wb, DMA, DD, E and Exc. The soil types are described in a comprehensive soil legend, Table 2b.

Table 2b: Soil legend – Proposed underground mining areas

Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
Hu1	Hutton 2100	>1500	Bloemdal, Clovely	A: 25-38 B: 30-42	Sandy clay loam - clay loam	Very deep (>1500 mm), red, well drained, sandy clay loam to clay loam soils.	Arable	564.04	16.24
Hu2	Hutton 2100	>1500	Bloemdal, Clovely, Avalon, Griffin	A:15-25 B: 15-30	Sandy loam - sandy clay loam	Very deep (>1500 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils.	Arable	163.24	4.70
Hu3	Hutton 2100	900-1500	Bloemdal, Clovely, Avalon, Griffin	A: 15-20 B: 15-30	Sandy loam - sandy clay loam	Deep (900-1500 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils underlain by weathered rock.	Arable	30.01	0.86
Gf1	Griffin 2100	1200-1500	Clovelly, Avalon, Hutton, Bloemdal	A: 12-16 B: 15-25	Loamy sand - sandy clay loam	Deep (1200-1500 mm), orange to reddish yellow, well-drained, loamy sand to sandy loam soil gradually changing to orange red, sandy clay loam in the lower soil profile underlain by weathered rock.	Arable	80.18	2.31
Cv1	Clovelly 2100	900-1500	Avalon, Glencoe, Hutton, Bloemdal	A: 10-14 B: 12-18	Loamy sand - sandy loam	Deep (900-1500 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	395.12	11.38
Cv2	Clovelly 2100	600-900	Avalon, Glencoe, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Moderately deep (600-900 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	34.28	0.99
Av1	Avalon 2100	900-1400	Glencoe, Clovelly, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Deep (900-1400 mm), brownish to orange yellow, moderately well-drained, loamy sand to sandy loam soils underlain by soft plinthite.	Arable	442.18	12.73
Av2	Avalon 2100	600-1000	Glencoe, Clovelly	A: 10-14 B: 12-16	Loamy sand - sandy loam	Moderately deep (600-1000 mm), brownish to orange yellow, moderately well-drained, loamy sand to sandy loam soils underlain by soft plinthite.	Arable	142.86	4.11
Av3	Avalon 1100	500-1000	Glencoe, Wasbank, Dresden, Constantia	A: 8-10 B: 7-12	Sandy to loamy sand	Moderately deep (500-1000 mm), pale to brownish yellow, moderately well-drained, sandy to loamy sand soils underlain by soft plinthite with occasional wet spots.	Grazing	118.64	3.42
Gc1	Glencoe 2100	900-1200	Clovelly, Avalon	A: 10-13 B: 10-16	Loamy sand - sandy loam	Deep (900-1200 mm), brownish yellow, moderately well-drained, loamy sand to sandy loam soils underlain by hardpan ferricrete.	Arable	49.14	1.42
Gc2	Glencoe 2100	600-1000	Clovelly, Avalon	A: 10-13 B:	Loamy sand - sandy loam	Moderately deep (600-1000 mm), brownish yellow, moderately well-drained, loamy sand to sandy loam soils underlain by hardpan ferricrete.	Arable	70.73	2.03

Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
Pn	Pinedene 2200	500-700	Avalon, Kroonstad, Wasbank	A: 10-15 B: 10-16	Loamy sand - sandy loam	Shallow (500-700 mm), pale yellow, imperfectly drained, structureless, sandy loam soils, underlain by gleyed clay.	Grazing	43.08	1.25
Tu	Tukulu 1110	600-900	Avalon, Clovelly, Oakleaf	A: 14-18 B: 15-20	Sandy loam	Moderately deep (600-900 mm), slightly mottled pale yellow, moderately well-drained, structureless, sandy loam soils underlain by soft plinthite.	Grazing	6.81	0.20
Rg	Rensburg 1000	400-600	Arcadia 1100	A: 40-45 G: 40-55	Clay	Shallow (400-600 mm), dark brown to black, strong structured, poorly drained clay soils with shrink and expand properties, underlain by gleyed clay.	Wetland	18.41	0.53
Dr1	Dresden 2000	200-400	Wasbank, Longlands, Glencoe	A: 7-10	Sandy	Shallow (100-400 mm), grey, imperfectly to somewhat poorly drained, sandy soils, underlain by hardpan ferricrete (seepage zone on midslopes subject to seasonal wetness).	Wetland	9.74	0.28
Lo1	Longlands 1000	200-600	Wasbank, Kroonstad, Katspruit, Dresden	A: 5-10 E:1-8	Sandy	Shallow (200-600 mm), grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (drainage lines subject to seasonal and permanent wetness).	Wetland	216.86	6.25
Lo2	Longlands 1000	200-600	Wasbank, Kroonstad, Avalon, Dresden, Westleigh	A: 5-10 E: 4-8	Sandy	Shallow (200-600 mm), grey to yellowish grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (seepage zones on mid and footslopes subject to temporary and seasonal wetness).	Wetland	355.23	10.24
Wa	Wasbank 1000	200-600	Longlands, Kroonstad, Dresden	A: 5-10 E:1-8	Sandy	Shallow (200-600 mm), grey to greyish white, leached, imperfectly to poorly drained sandy soils, underlain by hardpan ferricrete (seepage zones on mid and footslopes subject to temporary and seasonal wetness).	Wetland	0.46	0.01
Kd	Kroonstad 1000	200-600	Longlands, Wasbank, Dresden, Fernwood	A: 5-10 E:1-8 G: 35-45	Sandy	Shallow (200-600 mm), grey to greyish white, leached, imperfectly to poorly drained, sandy soils, underlain by gleyed clay (seepage zones, drainage lines and edges of pans subject to temporary and seasonal wetness).	Wetland	57.72	1.66
Ka	Katspruit 1000	200-400	Longlands, Wasbank, Kroonstad, Westleigh.	A: 10-20 G: 30-45	Loamy sand - clay	Shallow, grey, poorly drained, sandy loam soils underlain by gleyed clay (seepage zones, drainage lines and pans subject to seasonal and permanent wetness).	Wetland	107.38	3.10
Wb	Witbank 1000	300-900	-	A: 12-20	Loamy sand - sandy loam	Poorly rehabilitated mined land: Shallow to moderately deep (300-900 mm), compacted, brownish yellow to red mixed and discontinuing soil horizons often contaminated with coal, spoil and discard material.	Grazing	69.20	2.00
DMA	-	-	-	-	-	Disturbed mining areas mainly occupied by open pits but include discard dumps, subsoil and topsoil stockpiles as well as plants, shafts, haul roads, offices and various mining related infrastructure.	Not determined	325.44	9.39

Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
DD	-	-	-	-	-	Discard dumps	Wilderness	142.34	4.10
E	-	0	-	-	-	No soil - deep erosion gullies	Wilderness	1.14	0.03
Exc	-	0	-	-	-	No soil - dry excavated areas (quarries and borrow pits)	Wilderness	26.71	0.76
							TOTAL	**3470.94**	**100.0**

5.1.3 Soil types within proposed borrow pit areas

The proposed borrow pit areas are outlined in yellow in Figure 3c and consist of 7 units comprising a total area of 40.09 ha. The pits are labeled using the labels provided on the TOP 2012 Environmental Management Plan (Amendment Master Plan - Rev CS). Soil types within the proposed borrow pit areas are shown in Figure 3c which contains an abbreviated soil legend.

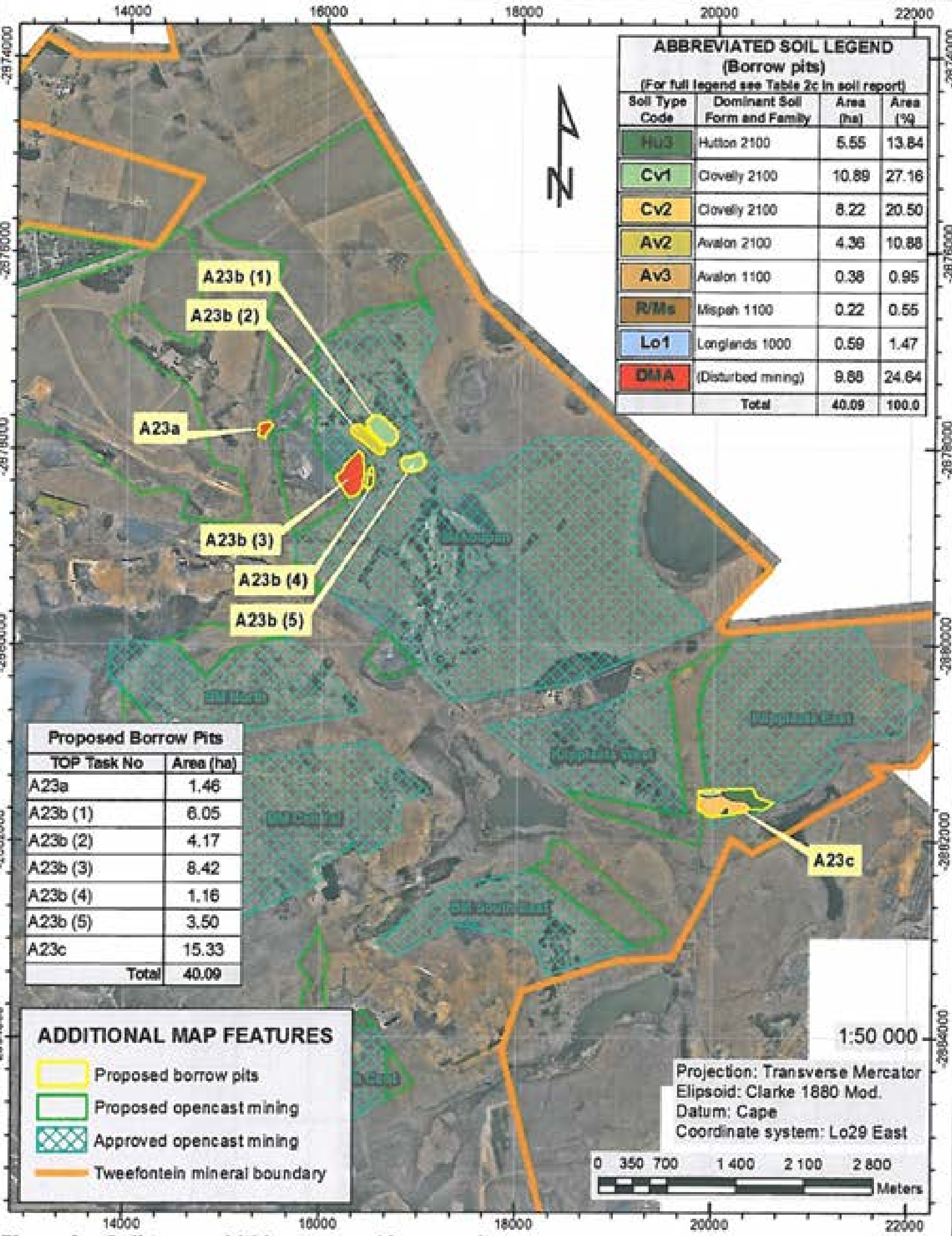


Figure 3c: Soil types whithin proposed borrow pits

A total of 8 soil types, based on dominant soil form, effective soil depth and internal drainage were identified during field observations and were symbolised as: Hu3, Cv1, Cv2, Av2, Av3, R/Ms, Lo1 and DMA. The soil types are described in a comprehensive soil legend, Table 2c.

Table 2c: Soil legend – Proposed borrow pit areas

SOIL LEGEND									
Soil Type Code	**Dominant Soil Form and Family**	**Effective Soil Depth (mm)**	**Subdominant Soil Forms**	**% Clay per horizon A, E, G, B**	**Texture Class**	**Summarized description of dominant soil type**	**Land Capability**	**Area (ha)**	**Area (%)**
Hu3	Hutton 2100	900-1500	Bloemdal, Clovely, Avalon, Griffin	A: 15-20 B: 15-30	Sandy loam - sandy clay loam	Deep (900-1500 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils underlain by weathered rock.	Arable	5.55	13.84
Cv1	Clovelly 2100	900-1500	Avalon, Glencoe, Hutton, Bloemdal	A: 10-14 B: 12-18	Loamy sand - sandy loam	Deep (900-1500 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	10.89	27.16
Cv2	Clovelly 2100	600-900	Avalon, Glencoe, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Moderately deep (600-900 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	8.22	20.50
Av2	Avalon 2100	600-1000	Glencoe, Clovelly	A: 10-14 B: 12-16	Loamy sand - sandy loam	Moderately deep (600-1000 mm), brownish to orange yellow, moderately well-drained, loamy sand to sandy loam soils underlain by soft plinthite.	Arable	4.36	10.88
Av3	Avalon 1100	500-1000	Glencoe, Wasbank, Dresden, Constantia	A: 8-10 B: 7-12	Sandy to loamy sand	Moderately deep (500-1000 mm), pale to brownish yellow, moderately well-drained, sandy to loamy sand soils underlain by soft plinthite with occasional wet spots.	Grazing	0.38	0.95
R/Ms	Mispah 1100	0-400	Mispah 2100, Cartref, Glenrosa, Clovelly	A: 10-15 B: 14-20	Loamy sand	Rock outcrops (20-80% surface rock) with shallow, well-drained, yellowish brown loamy sand soils and shallow, grey imperfectly drained sandy soils underlain by rock.	Wilderness	0.22	0.55
Lo1	Longlands 1000	200-600	Wasbank, Kroonstad, Katspruit, Dresden	A: 5-10 E:1-8	Sandy	Shallow (200-600 mm), grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (drainage lines subject to seasonal and permanent wetness).	Wetland	0.59	1.47
DMA	-	-	-	-	-	Disturbed mining areas mainly occupied by open pits but include discard dumps, subsoil and topsoil stockpiles as well as plants, shafts, haul roads, offices and various mining related infrastructure.	Not determined	9.88	24.64
							TOTAL	**40.09**	**100.0**

5.1.4 Soil types within the footprints of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course

The soil types within the footprints of proposed structures i.e. 4 pollution control dams (6 ha), the Zaaiwater tailings dam (142 ha), 2 coal stockpiles (12 ha) and golf course (133 ha) is shown in Figure 3d which contains an abbreviated soil legend.

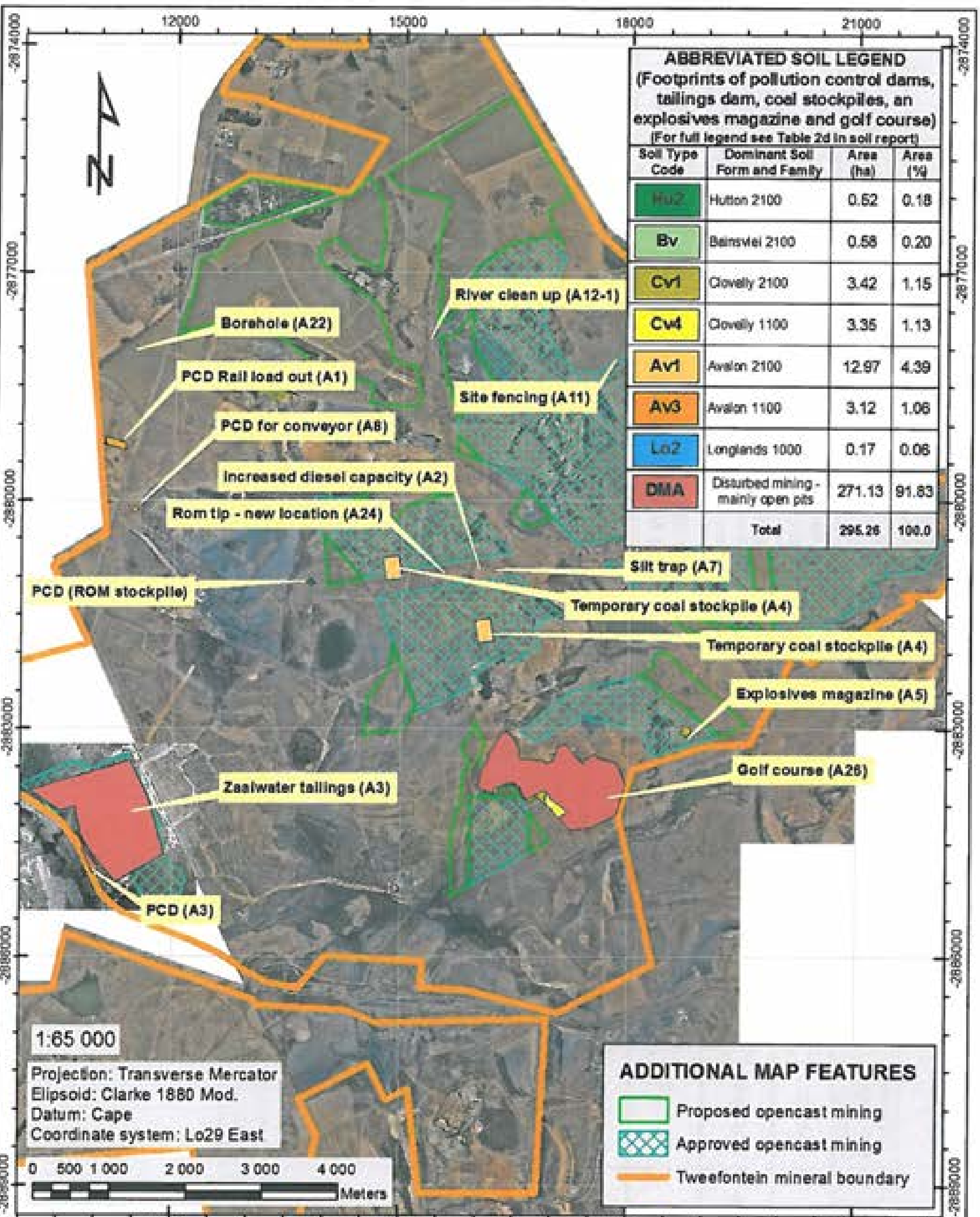


Figure 3d: Soil types within the footprint of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine, golf course and other as labeled

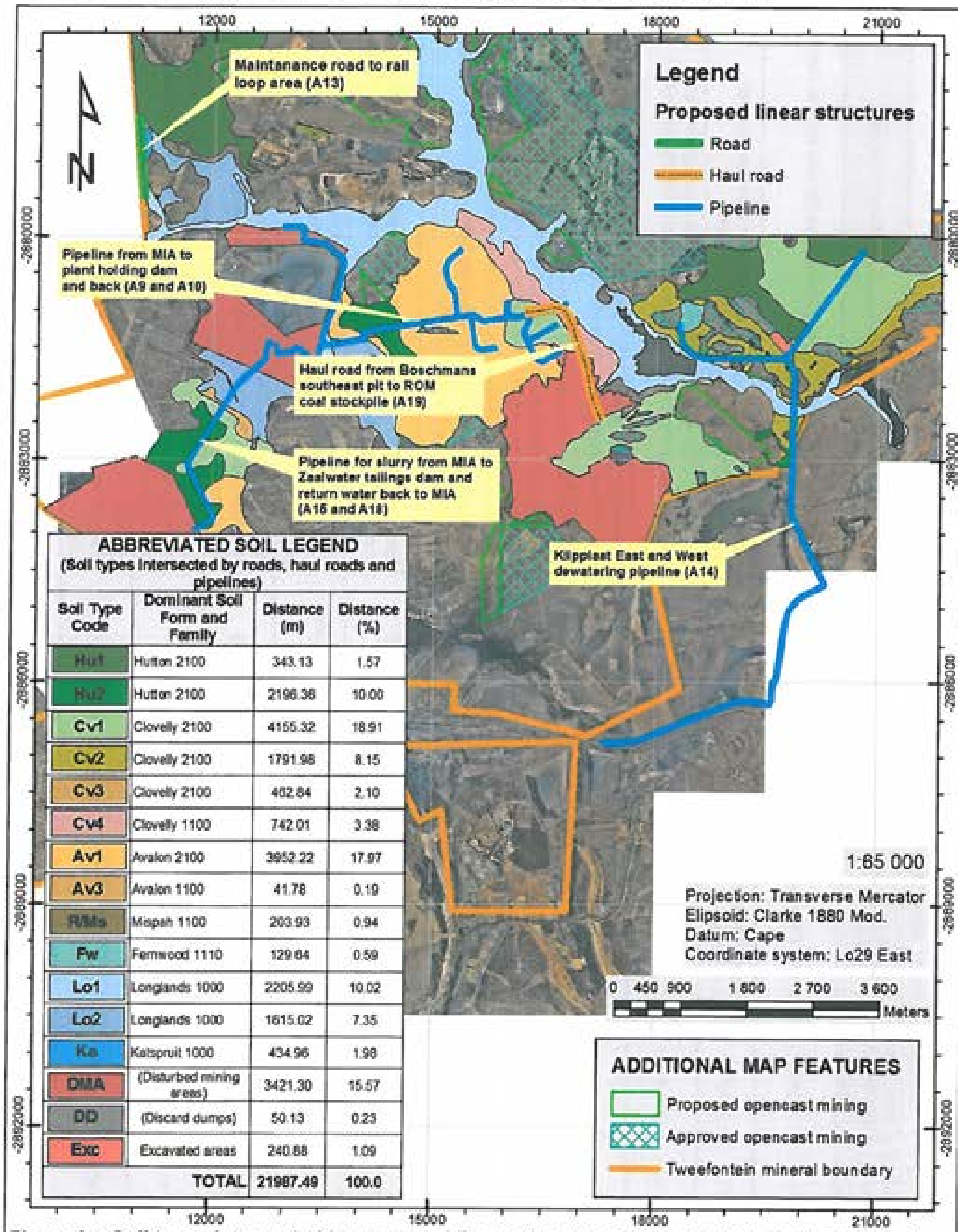
A total of 8 soil types, based on dominant soil form, effective soil depth and internal drainage were identified during field observations and were symbolised as: Hu2, Bv, Cv1, Cv4, Av1, Av3, Lo2 and DMA. The soil types are described in a comprehensive soil legend, Table 2d.

Table 2d: Soil legend – Proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course

SOIL LEGEND									
Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
Hu2	Hutton 2100	>1500	Bloemdal, Clovely, Avalon, Griffin	A:15-25 B: 15-30	Sandy loam - sandy clay loam	Very deep (>1500 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils.	Arable	0.52	0.18
Bv	Bainsvlei 2100	600-1200	Hutton, Bloemdal, Clovelly, Glencoe	A: 15-20 B: 15-30	Sandy loam - sandy clay loam	Moderately deep (600-1200 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils often containing 5-30% concretions in the B-horizon, underlain by soft plinthite.	Arable	0.58	0.20
Cv1	Clovelly 2100	900-1500	Avalon, Glencoe, Hutton, Bloemdal	A: 10-14 B: 12-18	Loamy sand - sandy loam	Deep (900-1500 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	3.42	1.15
Cv4	Clovelly 1100	900-1500	Glencoe, Avalon, Fernwood	A: 8-10 B: 8-10	Loamy sand	Deep (900-1500 mm), pale to brownish yellow, well drained, sandy soils underlain by weathered rock.	Grazing	3.35	1.13
Av1	Avalon 2100	900-1400	Glencoe, Clovelly, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Deep (900-1400 mm), brownish to orange yellow, moderately well-drained, loamy sand to sandy loam soils underlain by soft plinthite.	Arable	12.97	4.39
Av3	Avalon 1100	500-1000	Glencoe, Wasbank, Dresden, Constantia	A: 8-10 B: 7-12	Sandy to loamy sand	Moderately deep (500-1000 mm), pale to brownish yellow, moderately well-drained, sandy to loamy sand soils underlain by soft plinthite with occasional wet spots.	Grazing	3.12	1.06
Lo2	Longlands 1000	200-600	Wasbank, Kroonstad, Avalon, Dresden, Westleigh	A: 5-10 E: 4-8	Sandy	Shallow (200-600 mm), grey to yellowish grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (seepage zones on mid and footslopes subject to temporary and seasonal wetness).	Wetland	0.17	0.06
DMA	-	-	-	-	-	Disturbed mining areas mainly occupied by open pits but include discard dumps, subsoil and topsoil stockpiles as well as plants, shafts, haul roads, offices and various mining related infrastructure.	Not determined	271.13	91.83
							TOTAL	**295.26**	**100.0**

5.1.5 Soil types intersected by proposed roads, haul roads and pipelines

The soil types that are intersected by proposed linear structures i.e. roads, haul roads and pipelines are shown on Figure 3e which contains an abbreviated soil legend. Roads are shown as a green dotted line, haul roads as an orange dotted line and pipelines as blue solid lines. The task numbers provided on the TOP 2012 Environmental Management Plan (Amendment Master Plan) is added to each label.



ABBREVIATED SOIL LEGEND
(Soil types intersected by roads, haul roads and pipelines)

Soil Type Code	Dominant Soil Form and Family	Distance (m)	Distance (%)
Hu1	Hutton 2100	343.13	1.57
Hu2	Hutton 2100	2196.38	10.00
Cv1	Clovelly 2100	4155.32	18.91
Cv2	Clovelly 2100	1791.98	8.15
Cv3	Clovelly 2100	462.84	2.10
Cv4	Clovelly 1100	742.01	3.38
Av1	Avalon 2100	3952.22	17.97
Av3	Avalon 1100	41.78	0.19
R/Ms	Mispah 1100	203.93	0.94
Fw	Fernwood 1110	129.64	0.59
Lo1	Longlands 1000	2205.99	10.02
Lo2	Longlands 1000	1615.02	7.35
Ka	Katspruit 1000	434.96	1.98
DMA	(Disturbed mining areas)	3421.30	15.57
DD	(Discard dumps)	50.13	0.23
Exc	Excavated areas	240.88	1.09
	TOTAL	21987.49	100.0

Figure 3e: Soil types intersected by proposed linear structures i.e roads, haul roads and pipelines

A total of 16 soil types, based on dominant soil form, effective soil depth and internal drainage were identified during field observations and were symbolised as: Hu1, Hu2, Cv1, Cv2, Cv3, Cv4, Av1, Av3, R/Ms, Fw, Lo1, Lo2, Ka, DMA, DD and Exc. The soil types are described in a comprehensive soil legend, Table 2e.

Table 2e: Soil legend – Proposed linear structures i.e. roads, haul roads and pipelines

Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
Hu1	Hutton 2100	>1500	Bloemdal, Clovely	A: 25-38 B: 30-42	Sandy clay loam - clay loam	Very deep (>1500 mm), red, well drained, sandy clay loam to clay loam soils.	Arable	343.13	1.57
Hu2	Hutton 2100	>1500	Bloemdal, Clovely, Avalon, Griffin	A:15-25 B: 15-30	Sandy loam - sandy clay loam	Very deep (>1500 mm), red, yellowish red or orange red, well drained, sandy loam to sandy clay loam soils.	Arable	2196.36	10.00
Cv1	Clovelly 2100	900-1500	Avalon, Glencoe, Hutton, Bloemdal	A: 10-14 B: 12-18	Loamy sand - sandy loam	Deep (900-1500 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	4155.32	18.91
Cv2	Clovelly 2100	600-900	Avalon, Glencoe, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Moderately deep (600-900 mm), brownish yellow to orange yellow, well drained, loamy sand to sandy loam soils underlain by weathered rock.	Arable	1791.98	8.15
Cv3	Clovelly 2100	300-600	Glencoe, Mispah, Glenrosa, Cartref	A: 8-10 B: 8-12	Sandy-loamy sand	Shallow (300-600 mm), brownish yellow, well drained, sandy to loamy sand soils underlain by hard or weathered rock.	Grazing	462.84	2.10
Cv4	Clovelly 1100	900-1500	Glencoe, Avalon, Fernwood	A: 8-10 B: 8-10	Loamy sand	Deep (900-1500 mm), pale to brownish yellow, well drained, sandy soils underlain by weathered rock.	Grazing	742.01	3.38
Av1	Avalon 2100	900-1400	Glencoe, Clovelly, Hutton	A: 10-14 B: 12-16	Loamy sand - sandy loam	Deep (900-1400 mm), brownish to orange yellow, moderately well-drained, loamy sand to sandy loam soils underlain by soft plinthite.	Arable	3952.22	17.97
Av3	Avalon 1100	500-1000	Glencoe, Wasbank, Dresden, Constantia	A: 8-10 B: 7-12	Sandy to loamy sand	Moderately deep (500-1000 mm), pale to brownish yellow, moderately well-drained, sandy to loamy sand soils underlain by soft plinthite with occasional wet spots.	Grazing	41.78	0.19
R/Ms	Mispah 1100	0-400	Mispah 2100, Cartref, Glenrosa, Clovelly	A: 10-15 B: 14-20	Loamy sand	Rock outcrops (20-80% surface rock) with shallow, well-drained, yellowish brown loamy sand soils and shallow, grey imperfectly drained sandy soils underlain by rock.	Wilderness	203.93	0.94
Fw	Fernwood 1110	800-1500	Longlands, Wasbank, Avalon	A: 5-10 E: 1-8	Sandy	Deep (900-1500 mm), grey to greyish white, leached, imperfectly drained, sandy soils, subject to seasonal wetness (seepage zones on mid and footslopes and around depressions).	Wetland	129.64	0.59
Lo1	Longlands 1000	200-600	Wasbank, Kroonstad, Katspruit, Dresden	A: 5-10 E:1-8	Sandy	Shallow (200-600 mm), grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (drainage lines subject to seasonal and permanent wetness).	Wetland	2205.99	10.02

Soil Type Code	Dominant Soil Form and Family	Effective Soil Depth (mm)	Subdominant Soil Forms	% Clay per horizon A, E, G, B	Texture Class	Summarized description of dominant soil type	Land Capability	Area (ha)	Area (%)
Lo2	Longlands 1000	200-600	Wasbank, Kroonstad, Avalon, Dresden, Westleigh	A: 5-10 E: 4-8	Sandy	Shallow (200-600 mm), grey to yellowish grey, leached, imperfectly to poorly drained, sandy soils, underlain by soft plinthite (seepage zones on mid and footslopes subject to temporary and seasonal wetness).	Wetland	1615.02	7.35
Ka	Katspruit 1000	200-400	Longlands, Wasbank, Kroonstad, Westleigh.	A: 10-20 G: 30-45	Loamy sand - clay	Shallow, grey, poorly drained, sandy loam soils underlain by gleyed clay (seepage zones, drainage lines and pans subject to seasonal and permanent wetness).	Wetland	434.96	1.98
DMA	-	-	-	-	-	Disturbed mining areas mainly occupied by open pits but include discard dumps, subsoil and topsoil stockpiles as well as plants, shafts, haul roads, offices and various mining related infrastructure.	Not determined	3421.30	15.57
DD	-	-	-	-	-	Discard dumps	Wilderness	50.13	0.23
Exc	-	0	-	-	-	No soil - dry excavated areas (quarries and borrow pits)	Wilderness	240.88	1.09
							TOTAL	21987.49	100.0

5.1.6 Soil types within the combined proposed structure footprints of the TOPA area

Soil types within the combined footprints of the TOPA area is shown in Figure 3f and summarized in Table 2f.

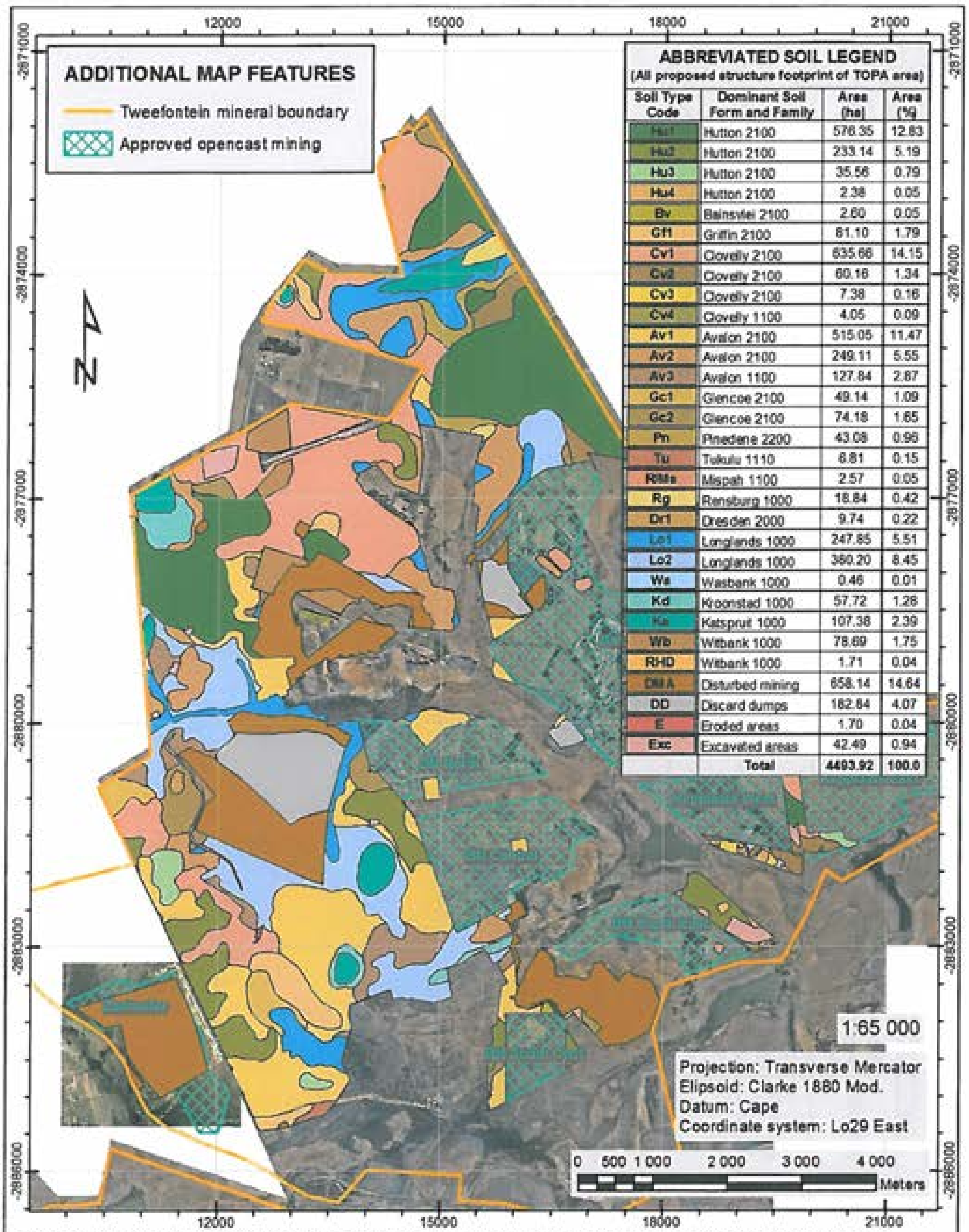


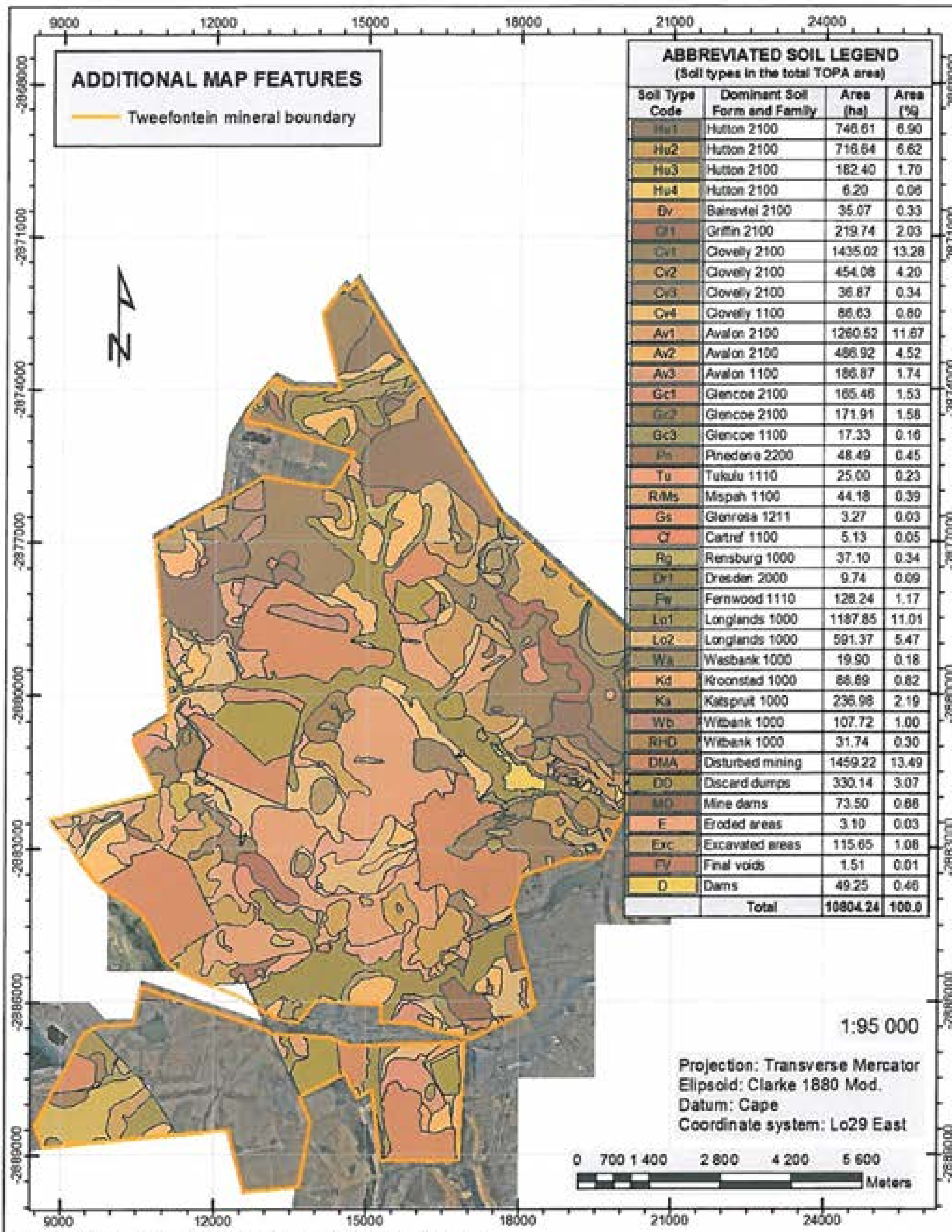
Figure 3f: Soil types within the combined proposed structure footprints of the TOPA area

Table 2f: Abbreviated soil legend – Combined proposed structure footprints of the TOPA area

Soil Type Code	Dominant Soil Form and Family	Area (ha)	Area (%)
Hu1	Hutton 2100	576.35	12.83
Hu2	Hutton 2100	233.14	5.19
Hu3	Hutton 2100	35.56	0.79
Hu4	Hutton 2100	2.38	0.05
Bv	Bainsvlei 2100	2.60	0.05
Gf1	Griffin 2100	81.10	1.79
Cv1	Clovelly 2100	635.66	14.15
Cv2	Clovelly 2100	60.16	1.34
Cv3	Clovelly 2100	7.38	0.16
Cv4	Clovelly 1100	4.05	0.09
Av1	Avalon 2100	515.05	11.47
Av2	Avalon 2100	249.11	5.55
Av3	Avalon 1100	127.84	2.87
Gc1	Glencoe 2100	49.14	1.09
Gc2	Glencoe 2100	74.18	1.65
Pn	Pinedene 2200	43.08	0.96
Tu	Tukulu 1110	6.81	0.15
R/Ms	Mispah 1100	2.57	0.05
Rg	Rensburg 1000	18.84	0.42
Dr1	Dresden 2000	9.74	0.22
Lo1	Longlands 1000	247.85	5.51
Lo2	Longlands 1000	380.20	8.45
Wa	Wasbank 1000	0.46	0.01
Kd	Kroonstad 1000	57.72	1.28
Ka	Katspruit 1000	107.38	2.39
Wb	Witbank 1000	78.69	1.75
RHD	Witbank 1000	1.71	0.04
Diverse land classes			
DMA	Disturbed mining areas	658.14	14.64
DD	Discard dumps	182.84	4.07
E	Eroded areas	1.70	0.04
Exc	Excavated areas	42.49	0.94
	Total	**4493.92**	**100.0**

5.1.7 Soil types within the total TOPA area

Soil types within the entire TOPA area, with the exception of a small potion to the south and east are shown in Figure 3g and are summarised in Table 2g.



ABBREVIATED SOIL LEGEND
(Soil types in the total TOPA area)

Soil Type Code	Dominant Soil Form and Family	Area (ha)	Area (%)
Hu1	Hutton 2100	746.61	6.90
Hu2	Hutton 2100	716.64	6.62
Hu3	Hutton 2100	182.40	1.70
Hu4	Hutton 2100	6.20	0.06
Bv	Bainsvlei 2100	35.07	0.33
Gf1	Griffin 2100	219.74	2.03
Cv1	Clovelly 2100	1435.02	13.28
Cv2	Clovelly 2100	454.08	4.20
Cv3	Clovelly 2100	36.87	0.34
Cv4	Clovelly 1100	86.63	0.80
Av1	Avalon 2100	1260.52	11.67
Av2	Avalon 2100	486.92	4.52
Av3	Avalon 1100	186.87	1.74
Gc1	Glencoe 2100	165.46	1.53
Gc2	Glencoe 2100	171.91	1.58
Gc3	Glencoe 1100	17.33	0.16
Pn	Pinedene 2200	48.49	0.45
Tu	Tukulu 1110	25.00	0.23
R/Ms	Mispah 1100	44.18	0.39
Gs	Glenrosa 1211	3.27	0.03
Cf	Cartref 1100	5.13	0.05
Rg	Rensburg 1000	37.10	0.34
Df1	Dresden 2000	9.74	0.09
Fw	Fernwood 1110	126.24	1.17
Lo1	Longlands 1000	1187.85	11.01
Lo2	Longlands 1000	591.37	5.47
Wa	Wasbank 1000	19.90	0.18
Kd	Kroonstad 1000	88.69	0.82
Ka	Katspruit 1000	236.98	2.19
Wb	Witbank 1000	107.72	1.00
RHD	Witbank 1000	31.74	0.30
DMA	Disturbed mining	1459.22	13.49
DD	Discard dumps	330.14	3.07
MD	Mine dams	73.50	0.68
E	Eroded areas	3.10	0.03
Exc	Excavated areas	115.65	1.08
FV	Final voids	1.51	0.01
D	Dams	49.25	0.46
	Total	10804.24	100.0

Figure 3g: Soil types within the total TOPA area

Table 2g: Abbreviated soil legend – Total TOPA area

Soil Type Code	Dominant Soil Form and Family	Area (ha)	Area (%)
Hu1	Hutton 2100	746.61	6.90
Hu2	Hutton 2100	716.64	6.62
Hu3	Hutton 2100	182.40	1.70
Hu4	Hutton 2100	6.20	0.06
Bv	Bainsvlei 2100	35.07	0.33
Gf1	Griffin 2100	219.74	2.03
Cv1	Clovelly 2100	1435.02	13.28
Cv2	Clovelly 2100	454.08	4.20
Cv3	Clovelly 2100	36.87	0.34
Cv4	Clovelly 1100	86.63	0.80
Av1	Avalon 2100	1260.52	11.67
Av2	Avalon 2100	486.92	4.52
Av3	Avalon 1100	186.87	1.74
Gc1	Glencoe 2100	165.46	1.53
Gc2	Glencoe 2100	171.91	1.58
Gc3	Glencoe 1100	17.33	0.16
Pn	Pinedene 2200	48.49	0.45
Tu	Tukulu 1110	25.00	0.23
R/Ms	Mispah 1100	44.18	0.39
Gs	Glenrosa 1211	3.27	0.03
Cf	Cartref 1100	5.13	0.05
Rg	Rensburg 1000	37.10	0.34
Dr1	Dresden 2000	9.74	0.09
Fw	Fernwood 1110	126.24	1.17
Lo1	Longlands 1000	1187.85	11.01
Lo2	Longlands 1000	591.37	5.47
Wa	Wasbank 1000	19.90	0.18
Kd	Kroonstad 1000	88.89	0.82
Ka	Katspruit 1000	236.98	2.19
Wb	Witbank 1000	107.72	1.00
RHD	Witbank 1000	31.74	0.30
Diverse land classes			
DMA	Disturbed mining	1459.22	13.49
DD	Discard dumps	330.14	3.07
MD	Mine dams	73.50	0.68
E	Eroded areas	3.10	0.03
Exc	Excavated areas	115.65	1.08
FV	Final voids	1.51	0.01
D	Dams	49.25	0.46
	Total	**10804.24**	**100.0**

5.2 Derived dry land crop production and irrigation potential

The derived crop production and irrigation potential (based on soil properties) of all soil types affected by proposed opencast and underground mining as well as borrow pits and infrastructure are summarised in Table 3. These soil qualities were rated as high, moderate and low with classifications in-between these.

Table 3: Derived dry land and irrigation potential

Soil Type (Code)	Dry land crop production potential	Irrigation potential
Hu1	Very high	Very high
Hu2	Very high	Very high
Hu3	High	High
Hu4	Moderate to high	Moderate to high
Bv	Moderate to high	Moderate to high
Gf1	High	High
Cv1	Moderate to high	Moderate to high
Cv2	Moderate	Moderate
Cv3	Low-moderate	Low
Cv4	Low-moderate	Low
Av1	Moderate to high	Moderate to high
Av2	Moderate	Moderate
Av3	Low-moderate	Low
Gc1	Moderate to high	Moderate to high
Gc2	Moderate	Moderate
Pn	Moderate	Moderate to low
Tu	Moderate	Moderate to low
R/Ms	Low	Very low to none
Rg	Low to moderate	Low
Fw	Low to none	Very low to none
Lo1	Low to none	Very low to none
Lo2	Low to none	Very low to none
Wa	Low to none	Very low to none
Kd	Low to none	Very low to none
Ka	Low to none	Very low to none
Wb	Low	Low
RHD	None	None
DMA	None	None
DD	None	None
E	None	None
Exc	None	None

5.3 Soil chemistry

The positions of the soil sampling points are shown on Figure 3a and coordinates are included in Appendix D, Table D1.

The soil analytical results of representative samples, collected from the A-horizon (0-250 mm) are shown in Table 4. The averages of base cations [potassium (K), calcium (Ca) magnesium (Mg) and sodium (Na)] as well as phosphorus and pH were calculated and highlighted in yellow.

Table 4: Soil chemical analyses

Samp Point	Soil Form	Hor	Depth	K mg/kg	Ca mg/kg	Mg mg/kg	Na mg/kg	*Titr.Acid	*Acid saturat.	Resis-tance	P (Bray1) mg/kg	pH (H_2O)
				Ammonium acetate				cmol(+)/kg	%	ohm		
DS92	Cv2100	A	0-250	119	476	111	0.27			2470	10.3	5.67
DS98	Hu2100	A	0-250	48	157	31	0.25	0.65	35.885	2060	12.7	4.92
DT105	Hu2100	A	0-250	103	265	64	0.59	0.18	7.8516	1280	41.5	5.37
EG73	Hu2100	A	0-250	121	710	117	0.24			1870	40.2	6.92
EH93	Bd2100	A	0-250	119	566	64	0.22			2090	4.3	6.64
EQ86	Bd2100	A	0-250	118	340	68	0.25			2430	1.4	5.62
EQ126	Cv2100	A	0-250	33	400	104	0.23			2730	50.2	6.23
EQ138	Cv2100	A	0-250	16	68	12	0.16	1.2	71.4708	2780	1.4	4.36
ER88	Gc2100	A	0-250	106	364	61	0.26			1770	3.5	5.83
EV70	Av2100	A	0-250	107	257	121	0.31			3470	17.6	6.18
EV72	Av2100	A	0-250	50	117	29	0.22	0.53	35.8013	4750	2.2	5.04
EW92	Av2100	A	0-250	51	80	14	0.19	0.64	49.8108	3780	3.5	4.93
EZ103	Av2100	A	0-250	120	902	61	0.42			2030	3.9	6.57
FC68	Gc2100	A	0-250	117	709	167	0.34			1960	2.5	6.03
FG99	Av2100	A	0-250	119	304	51	0.22	0.12	5.0824	2150	3.7	5.42
FJ106	Hu2100	A	0-250	98	169	44	0.18	0.41	21.971	2660	1.6	5.16
FK104	Av2100	A	0-250	61	385	53	0.23			2730	1.2	6.04
FM104	Cv2100	A	0-250	89	70	13	0.17	0.74	51.9693	3560	7.4	4.83
FY81	Cv2100	A	0-250	45	45	7	1.09	1.41	78.0189	3050	19.1	4.16
Average				**86.3**	**336.0**	**62.7**	**0.3**			**2612**	**12.0**	**5.6**

*Analysis conducted when pH is below 5.5

5.3.1 Soil fertility status

The averages of the base cations (K, Ca, Mg, Na) as well as phosphorus and pH (highlighted in yellow, Table 4) were compared to general fertility guidelines (Fertilizer Association of South Africa, 2003) in Table 5.

Table 5: Soil fertility compared to broad fertility guidelines

<table>
<tr><th colspan="6">Guidelines (mg/kg)</th><th rowspan="2">Average calculated in Table 4 (mg/kg)</th><th rowspan="2">Status</th></tr>
<tr><th colspan="3"></th><th colspan="2">Low</th><th>High</th></tr>
<tr><td colspan="3">Potassium (K)</td><td colspan="2"><40</td><td>>250</td><td>86.3</td><td>Low-moderate</td></tr>
<tr><td colspan="3">Calcium (Ca)</td><td colspan="2"><200</td><td>>3000</td><td>336.0</td><td>Low-moderate</td></tr>
<tr><td colspan="3">Magnesium (Mg)</td><td colspan="2"><50</td><td>>300</td><td>62.7</td><td>Low-moderate</td></tr>
<tr><td colspan="3">Sodium (Na)</td><td colspan="2"><50</td><td>>200</td><td>0.3</td><td>Very low (which is positive)</td></tr>
<tr><td colspan="3">Phosphorus (P)</td><td colspan="2"><5</td><td>>35</td><td>12.0</td><td>Moderate</td></tr>
<tr><th colspan="6">pH(H_2O)</th><td></td><td></td></tr>
<tr><td>Very acid</td><td>Acid</td><td>Slightly acid</td><td>neutral</td><td>Slightly alkaline</td><td>Alkaline</td><td></td><td></td></tr>
<tr><td><4.9</td><td>5-5.9</td><td>6-6.7</td><td>6.8-7.2</td><td>7.3-8</td><td>>8</td><td>5.6</td><td>Acid</td></tr>
</table>

The averages of base cations (K, Ca and Mg) are low-moderate and reflect a somewhat build-up fertility status considering the general low natural (uncultivated) fertility status of soils on the eastern Highveld. The average sodium (Na) content of 0.3 mg/kg is very low, which is positive and indicates an absence of sodic soil conditions. The average pH value of 5.6 indicates fairly acid soil conditions. The average phosphorus content of the A-horizons (12.0 mg/kg) is moderate and indicates a well build-up status by fertilizers although very low and high values were found.

5.4 Land capability

The land capability and agricultural potential were derived form soil properties and classed according to the following categories:

- Arable potential
  - Moderately deep to deep, well and moderately well-drained soils,
- Grazing potential
  - Shallow well and moderately drained soils,
- Wetland and riparian zones
  - Imperfectly to poorly drained soils,
- Wilderness
  - Shallow, flat to steep rocky areas,
  - Rehabilitated dumps
  - Highly eroded areas
  - Excavated areas such as borrow pits, quarries and drainage channels
- Not determined
  - Disturbed mining areas which consist mainly of open pits but include also areas occupied by mining infrastructure such as stockpiles, dumps, roads, plants and offices. The post-mining land capability of theses areas should be determined by means of a detailed soil assessment after rehabilitation.

The land capability classes (based on soil properties) of the proposed opencast and underground mining areas as well as borrow pits and infrastructure footprints were compiled on 5 maps as follows:

- Figure 4a: Land capability of proposed opencast mining areas;
- Figure 4b: Land capability of proposed underground mining areas;
- Figure 4c: Land capability of proposed borrow pit areas;
- Figure 4d: Land capability of proposed pollution control dams, Zaaiwater tailings dam, coal stockpiles, explosives magazine and golf course footprint; and
- Figure 4e: Land capability of proposed linear structures i.e. roads, haul roads and pipelines.

An additional 2 maps covering the combined footprints of proposed structures of the TOPA (Figures 4a -4e) as well as land capability of the total TOPA area was compiled. The maps were name as follows:

- Figure 3f: Soil types within the combined proposed structure footprints of the TOPA area;
- Figure 3g: Soil types within the total TOPA area;

5.4.1 Land capability of the proposed opencast mining areas

The location and extent of land capability classes within the proposed opencast mining areas are shown in Figure 4a.

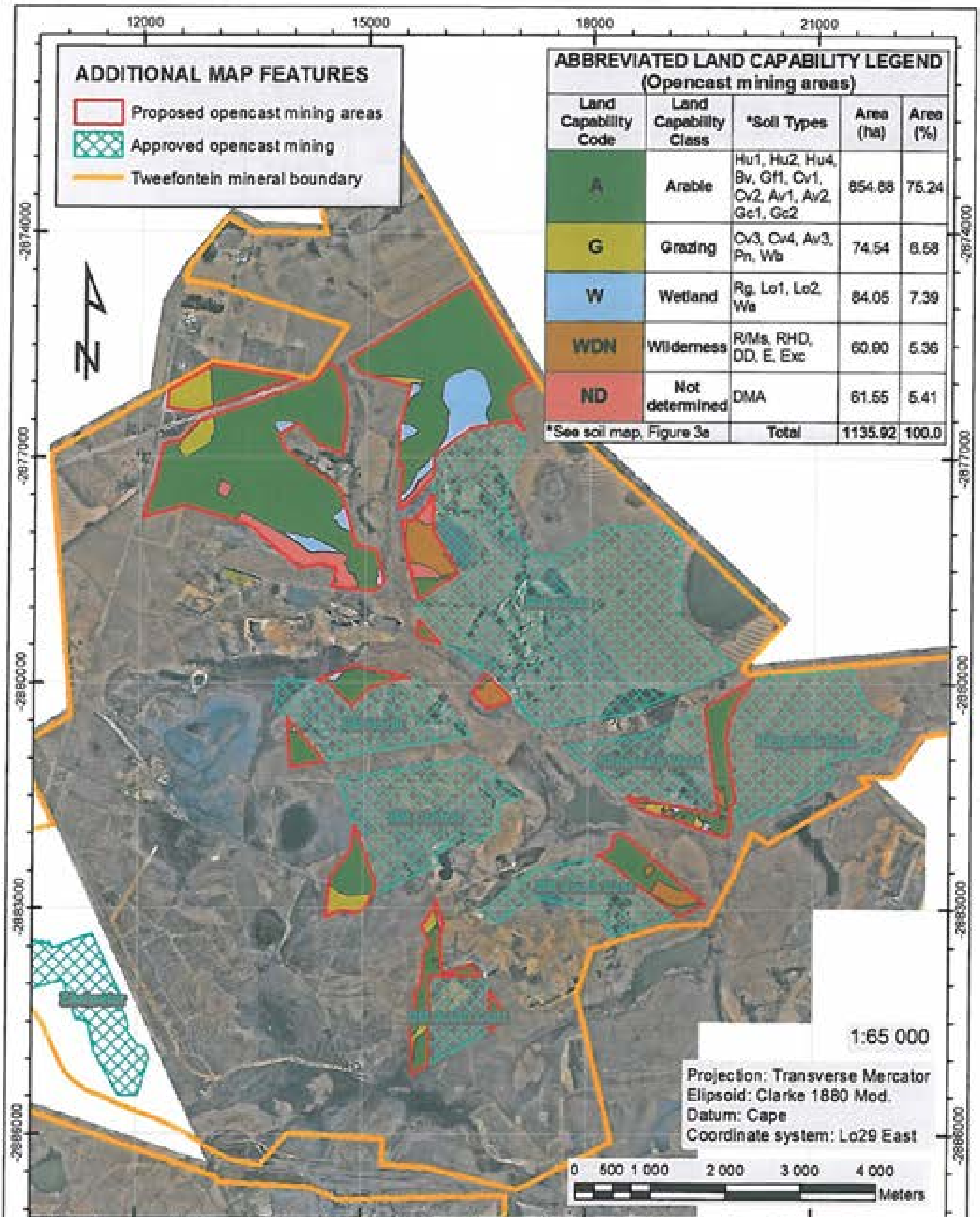


Figure 4a: Land capability of proposed opencast mining sections

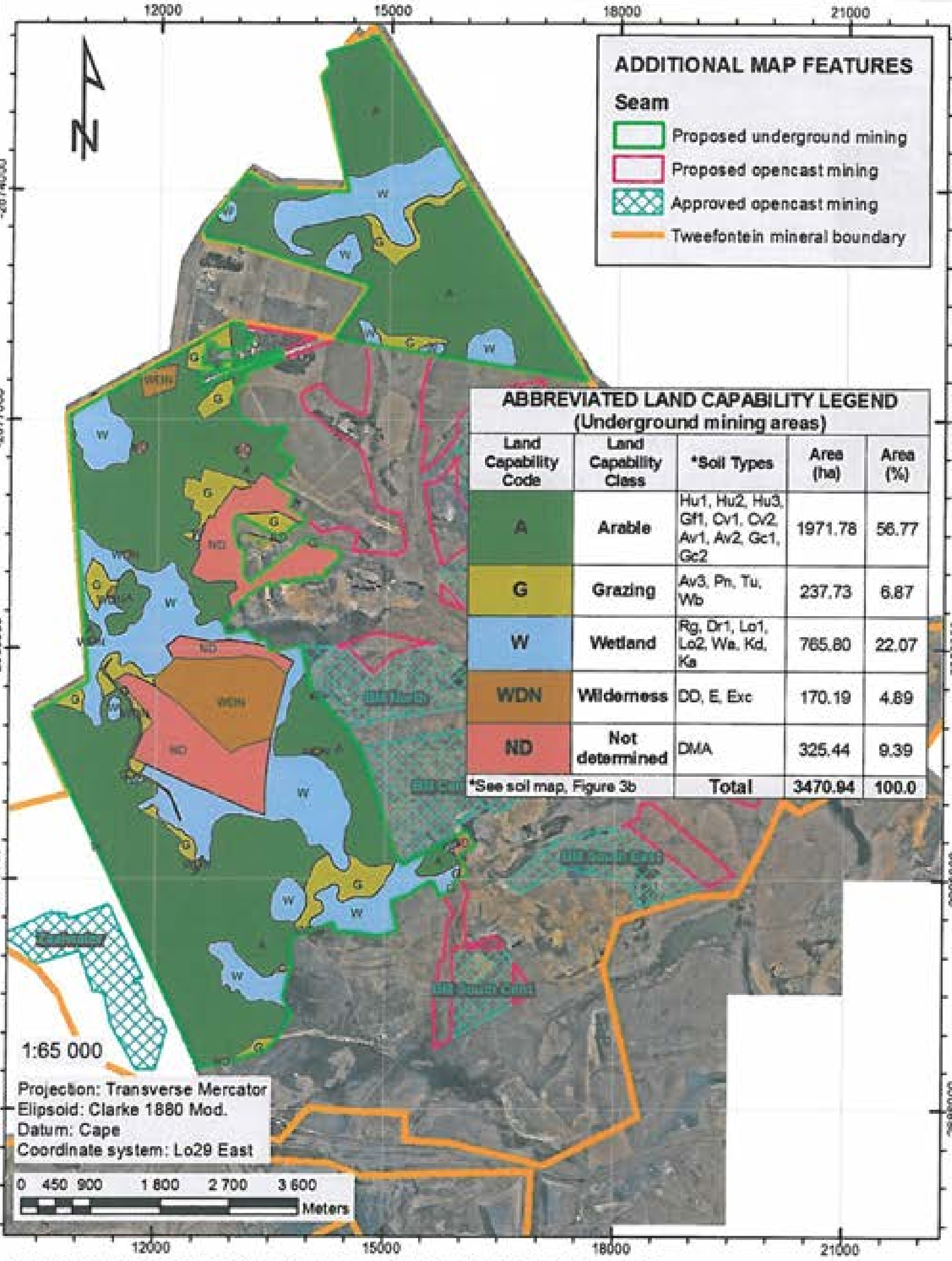
The land capability of the proposed opencast mining areas are summarised in Table 6a which shows the soil types which were grouped into each land capability class and the area and percentage comprised by each land capability class.

Table 6a: Land capability classes – Proposed opencast mining areas

ABBREVIATED LAND CAPABILITY LEGEND (Opencast mining areas)				
Land Capability Code	**Land Capability Class**	***Soil Types**	**Area (ha)**	**Area (%)**
A	**Arable**	Hu1, Hu2, Hu4, Bv, Gf1, Cv1, Cv2, Av1, Av2, Gc1, Gc2	854.88	75.24
G	**Grazing**	Cv3, Cv4, Av3, Pn, Wb	74.54	6.58
W	**Wetland**	Rg, Lo1, Lo2, Wa	84.05	7.39
WDN	**Wilderness**	R/Ms, RHD, DD, E, Exc	60.90	5.36
ND	**Not determined**	DMA	61.55	5.41
*See soil map, Figure 3a		**Total**	**1135.92**	**100.0**

5.4.2 Land capability of proposed underground mining areas

The location and extent of land capability classes within the proposed underground mining areas are shown on Figure 4b.



Land Capability Code	Land Capability Class	*Soil Types	Area (ha)	Area (%)
A	Arable	Hu1, Hu2, Hu3, Gf1, Cv1, Cv2, Av1, Av2, Gc1, Gc2	1971.78	56.77
G	Grazing	Av3, Pn, Tu, Wb	237.73	6.87
W	Wetland	Rg, Dr1, Lo1, Lo2, Wa, Kd, Ka	765.80	22.07
WDN	Wilderness	DD, E, Exc	170.19	4.89
ND	Not determined	DMA	325.44	9.39
*See soil map, Figure 3b		Total	3470.94	100.0

Figure 4b: Land capability of proposed underground mining areas

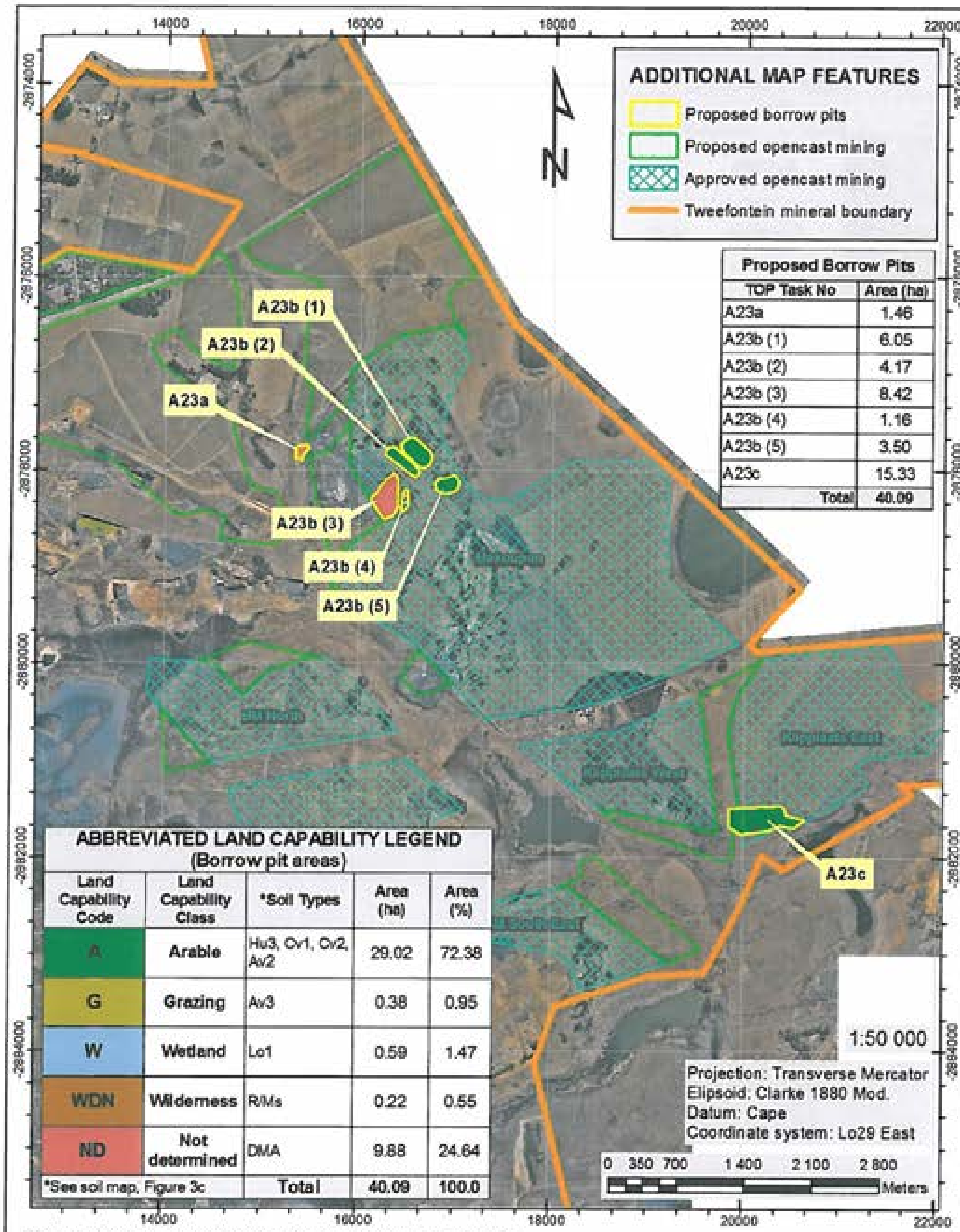
The land capability of the proposed underground mining areas are summarised in Table 6b which shows the soil types which were grouped into each land capability class and the area and percentage comprised by each land capability class.

Table 6b: Land capability classes – proposed underground mining areas

ABBREVIATED LAND CAPABILITY LEGEND (Underground mining areas)				
Land Capability Code	Land Capability Class	*Soil Types	Area (ha)	Area (%)
A	Arable	Hu1, Hu2, Hu3, Gf1, Cv1, Cv2, Av1, Av2, Gc1, Gc2	1971.78	56.77
G	Grazing	Av3, Pn, Tu, Wb	237.73	6.87
W	Wetland	Rg, Dr1, Lo1, Lo2, Wa, Kd, Ka	765.80	22.07
WDN	Wilderness	DD, E, Exc	170.19	4.89
ND	Not determined	DMA	325.44	9.39
*See soil map, Figure 3b		**Total**	**3470.94**	**100.0**

5.4.3 Land capability of proposed borrow pit areas

The location and extent of land capability classes within the proposed borrow pit areas are shown on Figure 4c.



Proposed Borrow Pits

TOP Task No	Area (ha)
A23a	1.46
A23b (1)	6.05
A23b (2)	4.17
A23b (3)	8.42
A23b (4)	1.16
A23b (5)	3.50
A23c	15.33
Total	40.09

ABBREVIATED LAND CAPABILITY LEGEND (Borrow pit areas)

Land Capability Code	Land Capability Class	*Soil Types	Area (ha)	Area (%)
A	Arable	Hu3, Cv1, Cv2, Av2	29.02	72.38
G	Grazing	Av3	0.38	0.95
W	Wetland	Lo1	0.59	1.47
WDN	Wilderness	R/Ms	0.22	0.55
ND	Not determined	DMA	9.88	24.64
*See soil map, Figure 3c		Total	40.09	100.0

Figure 4c: Land capability of proposed borrow pits

The land capability of the proposed borrow pit areas are summarised in Table 6c which shows the soil types which were grouped into each land capability class and the area and percentage comprised by each land capability class.

Table 6c: Land capability classes – Proposed borrow pit areas

ABBREVIATED LAND CAPABILITY LEGEND (Borrow pit areas)				
Land Capability Code	Land Capability Class	*Soil Types	Area (ha)	Area (%)
A	Arable	Hu3, Cv1, Cv2, Av2	29.02	72.38
G	Grazing	Av3	0.38	0.95
W	Wetland	Lo1	0.59	1.47
WDN	Wilderness	R/Ms	0.22	0.55
ND	Not determined	DMA	9.88	24.64
*See soil map, Figure 3c		Total	40.09	100.0

5.4.4 Land capability of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course

The location and extent of land capability classes within the footprint of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course are shown on Figure 4d.

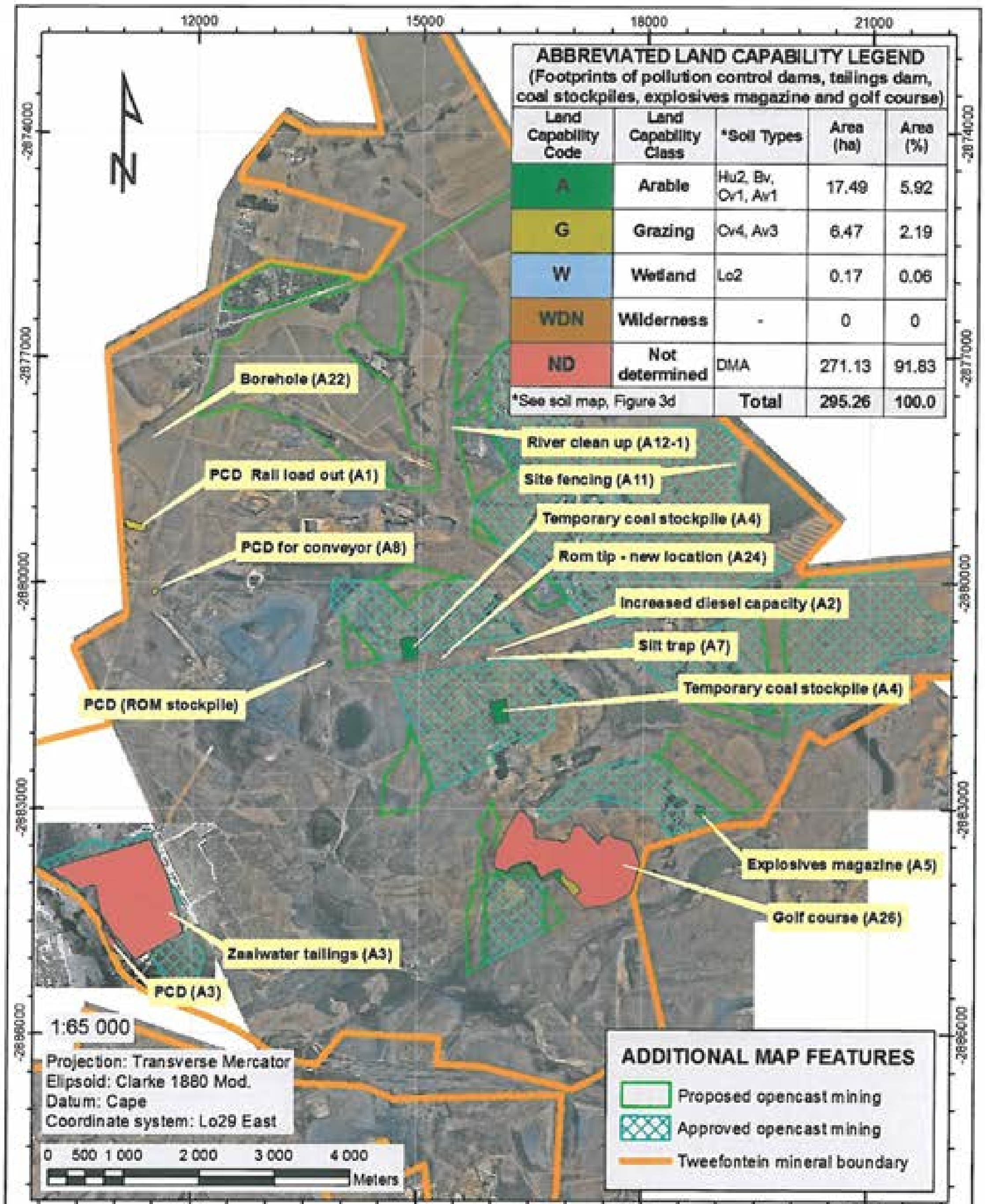


Figure 4d: Land capability of the footprints of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine, golf course and other as labeled.

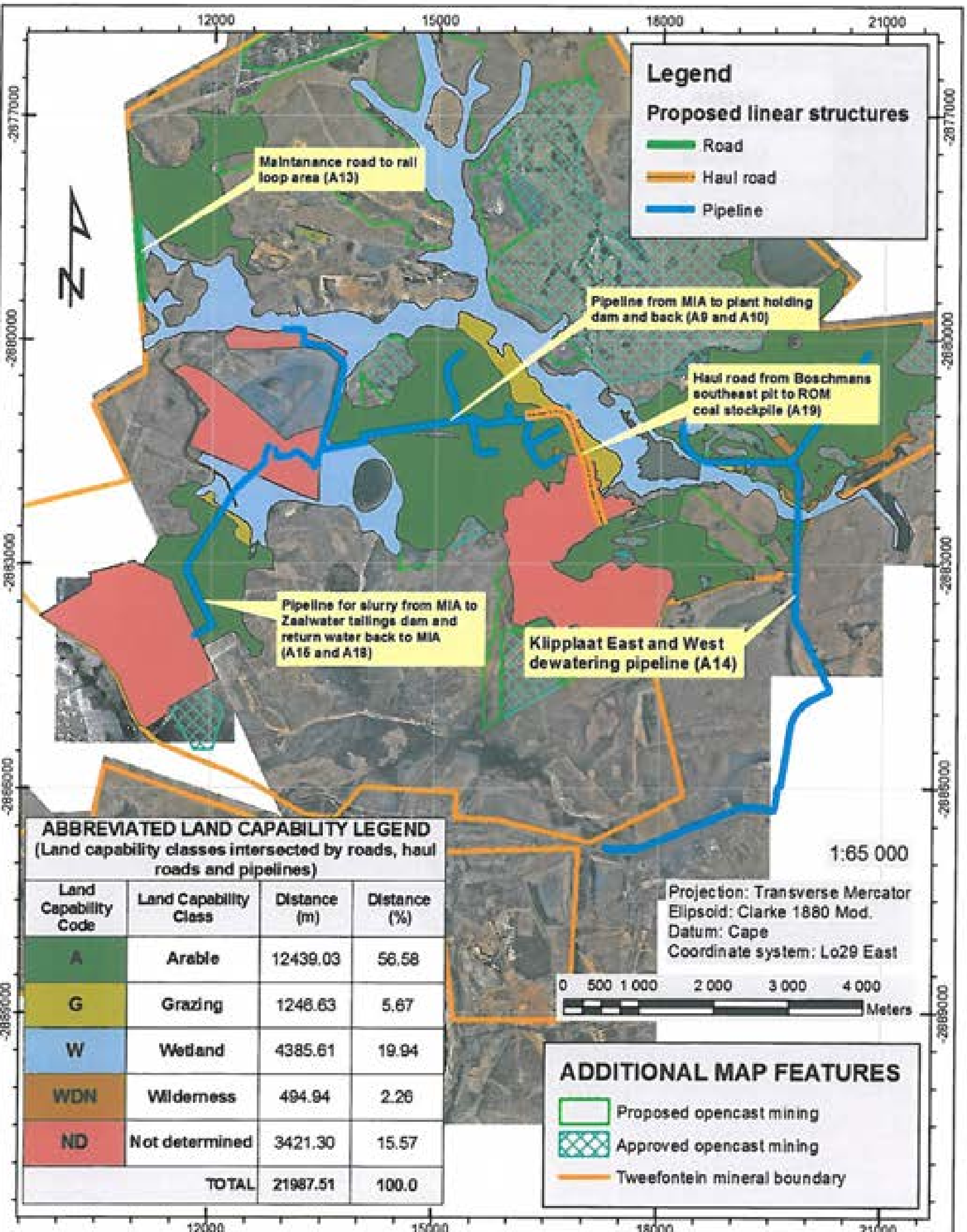
The land capability of the proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course are summarised in Table 6d which shows the soil types which were grouped into each land capability class and the area and percentage comprised by each land capability class.

Table 6d: Land capability classes – Proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course

ABBREVIATED LAND CAPABILITY LEGEND (Footprints of pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course)				
Land Capability Code	**Land Capability Class**	***Soil Types**	**Area (ha)**	**Area (%)**
A	**Arable**	Hu2, Bv, Cv1, Av1	17.49	5.92
G	**Grazing**	Cv4, Av3	6.47	2.19
W	**Wetland**	Lo2	0.17	0.06
WDN	**Wilderness**	-	0	0
ND	**Not determined**	DMA	271.13	91.83
*See soil map, Figure 3d		**Total**	**295.26**	**100.0**

5.4.5 Land capability classes intersected by proposed linear structures i.e. roads, haul roads and pipelines

Land capability classes intersected by proposed linear structures i.e. roads, haul roads and pipelines are shown on Figure 4e. Roads are shown as a green dotted line, haul roads as an orange dotted line and pipelines as blue solid lines. The task numbers provided on the TOP 2012 Environmental Management Plan (Amendment Master Plan) is added to each label



Land Capability Code	Land Capability Class	Distance (m)	Distance (%)
A	Arable	12439.03	56.58
G	Grazing	1246.63	5.67
W	Wetland	4385.61	19.94
WDN	Wilderness	494.94	2.26
ND	Not determined	3421.30	15.57
	TOTAL	21987.51	100.0

Figure 4e: Land capability along proposed linear structures i.e. roads, haul roads and pipelines

The extent of land capability classes intersected by linear structures are summarised in Table 6e which shows the distance and percentage covered by these structures within each land capability class.

Table 6e: Land capability classes – Proposed linear structures i.e. roads, haul roads and pipelines

ABBREVIATED LAND CAPABILITY LEGEND (Land capability classes intersected by roads, haul roads and pipelines)			
Land Capability Code	Land Capability Class	Distance (m)	Distance (%)
A	Arable	12439.03	56.58
G	Grazing	1246.63	5.67
W	Wetland	4385.61	19.94
WDN	Wilderness	494.94	2.26
ND	Not determined	3421.30	15.57
(*See soil map, Figure 3e) **TOTAL**		**21987.51**	**100.0**

5.4.6 Land capability within the combined proposed structure footprints of the TOPA area

Land capability of the combined footprints of the TOPA area is shown in Figure 4f and summarized in Table 6f.

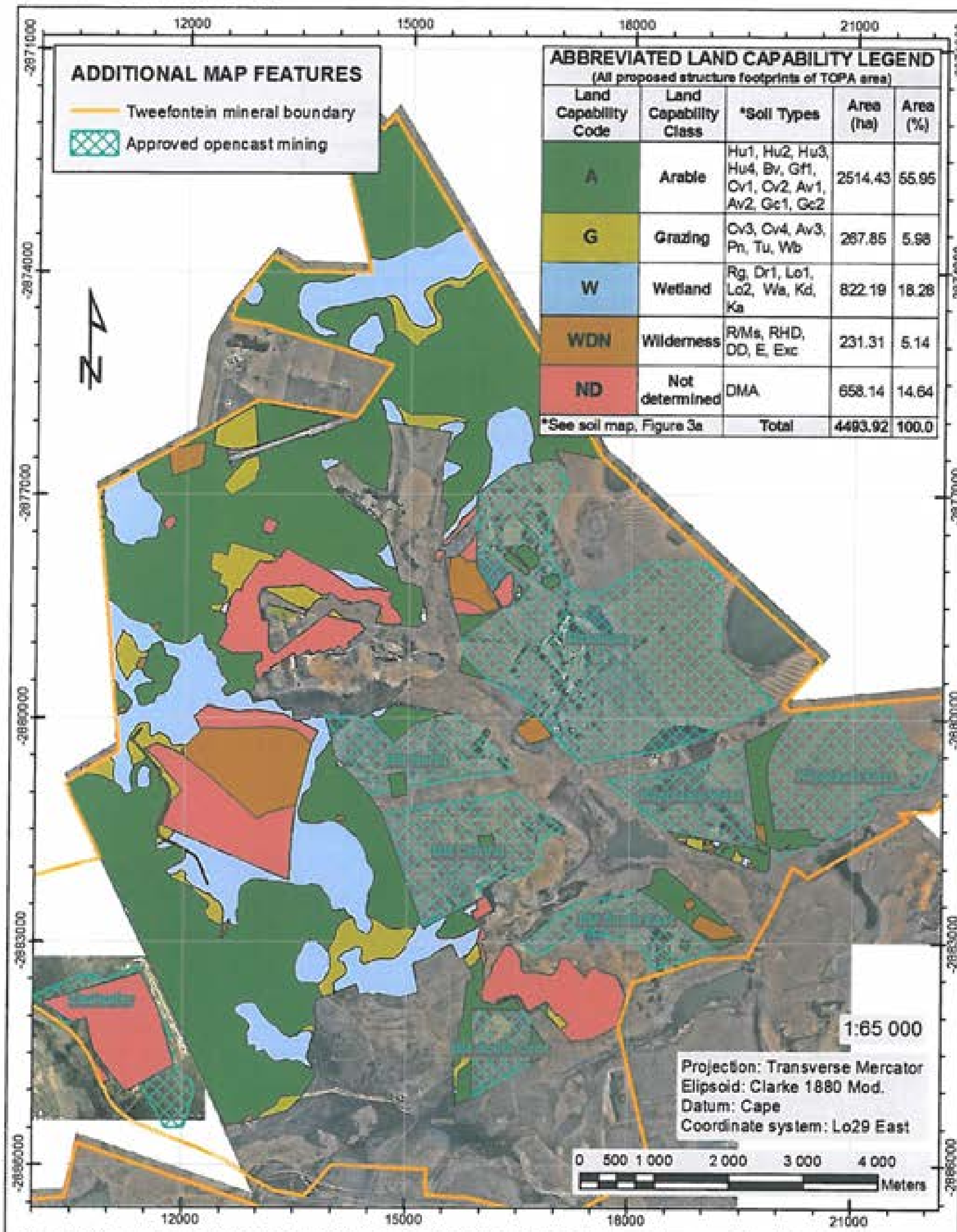


Figure 4f: Land capability of soil types affected by proposed structures within the TOPA area

Table 6f: Land capability of the combined proposed structure footprints of the TOPA area

ABBREVIATED LAND CAPABILITY LEGEND (All proposed structure footprints of TOPA area)				
Land Capability Code	Land Capability Class	*Soil Types	Area (ha)	Area (%)
A	Arable	Hu1, Hu2, Hu3, Hu4, Bv, Gf1, Cv1, Cv2, Av1, Av2, Gc1, Gc2	2514.43	55.95
G	Grazing	Cv3, Cv4, Av3, Pn, Tu, Wb	267.85	5.98
W	Wetland	Rg, Dr1, Lo1, Lo2, Wa, Kd, Ka	822.19	18.28
WDN	Wilderness	R/Ms, RHD, DD, E, Exc	231.31	5.14
ND	Not determined	DMA	658.14	14.64
*See soil map, Figure 3a		Total	**4493.92**	**100.0**

5.4.7 Land capability of the total TOPA area

Land capability of the entire TOPA area, with the exception of a small potion to the south and east are shown in Figure 4g and are summarised in Table 6g.

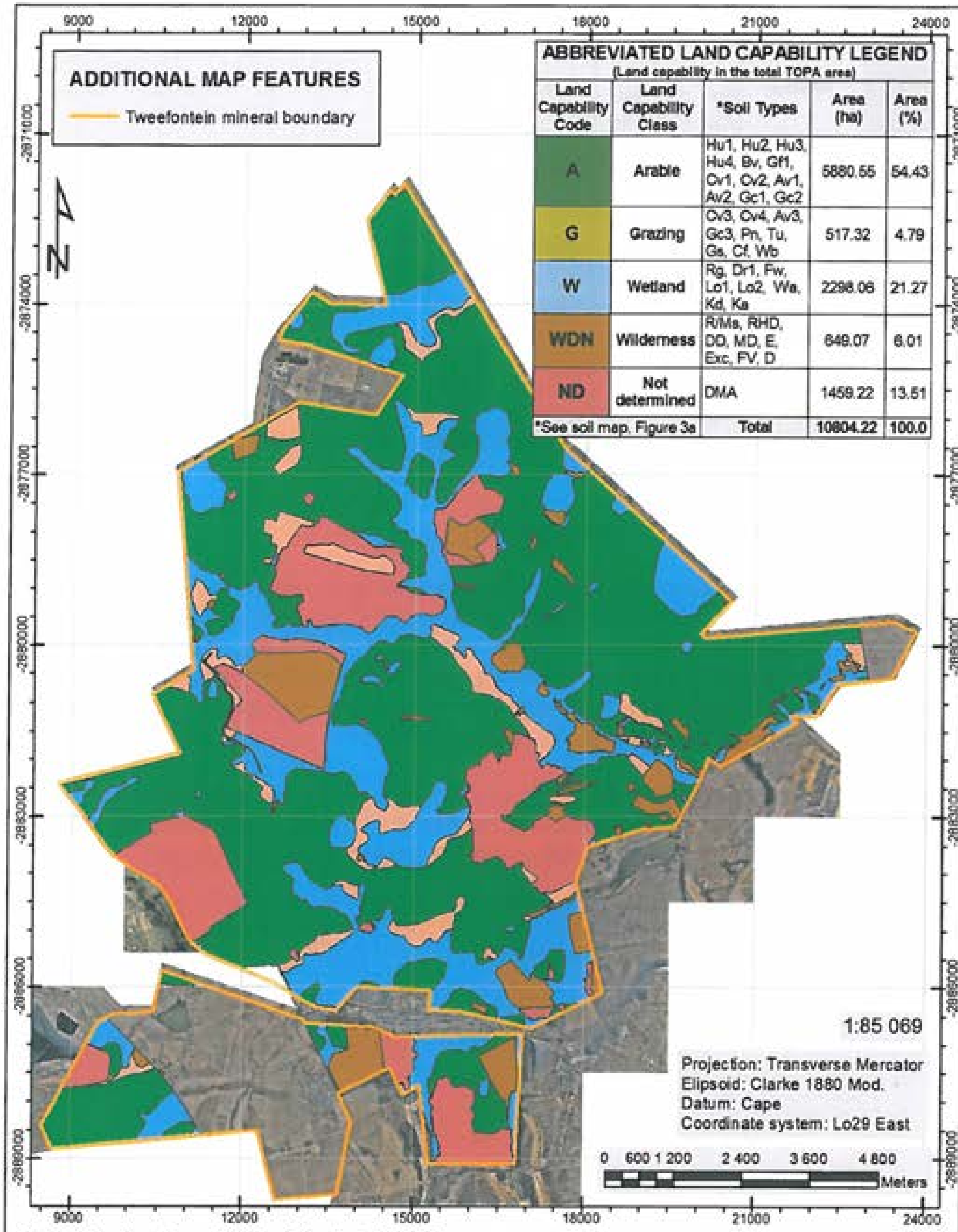


Figure 4g: Land capability of the total TOPA area

Table 6g: Land capability of the total TOPA area

ABBREVIATED LAND CAPABILITY LEGEND (Land capability in the total TOPA area)				
Land Capability Code	**Land Capability Class**	***Soil Types**	**Area (ha)**	**Area (%)**
A	**Arable**	Hu1, Hu2, Hu3, Hu4, Bv, Gf1, Cv1, Cv2, Av1, Av2, Gc1, Gc2	5880.55	54.43
G	**Grazing**	Cv3, Cv4, Av3, Gc3, Pn, Tu, Gs, Cf, Wb	517.32	4.79
W	**Wetland**	Rg, Dr1, Fw, Lo1, Lo2, Wa, Kd, Ka	2298.06	21.27
WDN	**Wilderness**	R/Ms, RHD, DD, MD, E, Exc, FV, D	649.07	6.01
ND	**Not determined**	DMA	1459.22	13.51
*See soil map, Figure 3a		**Total**	**10804.22**	**100.0**

5.5 Wetland and riparian delineation

Land capability was assessed in categories of arable land, grazing land, **wetlands** and wilderness land. Wetlands were therefore delineated as part of the land capability assessment based on soil properties by means of systematic auger observations towards wetland zones in order to locate the point where soil properties reflect signs of wetness within 500 mm from the surface or where soil, topography and vegetation combined, indicate the boundary of the riparian zone.

The soil types associated with wetlands and riparian zones are summarized in Tables 6a – 6e and the locality and extents are shown on the land capability maps Figures 4a – 4e. (See Appendix C for details on soil properties related to wetland zones).

5.6 Pre-mining land use

5.6.1 Pre-mining land uses within proposed opencast mining areas

The localities and extents of pre-mining and current land uses within the proposed opencast mining areas are shown in Figure 5a and are summarized in Table 7a.

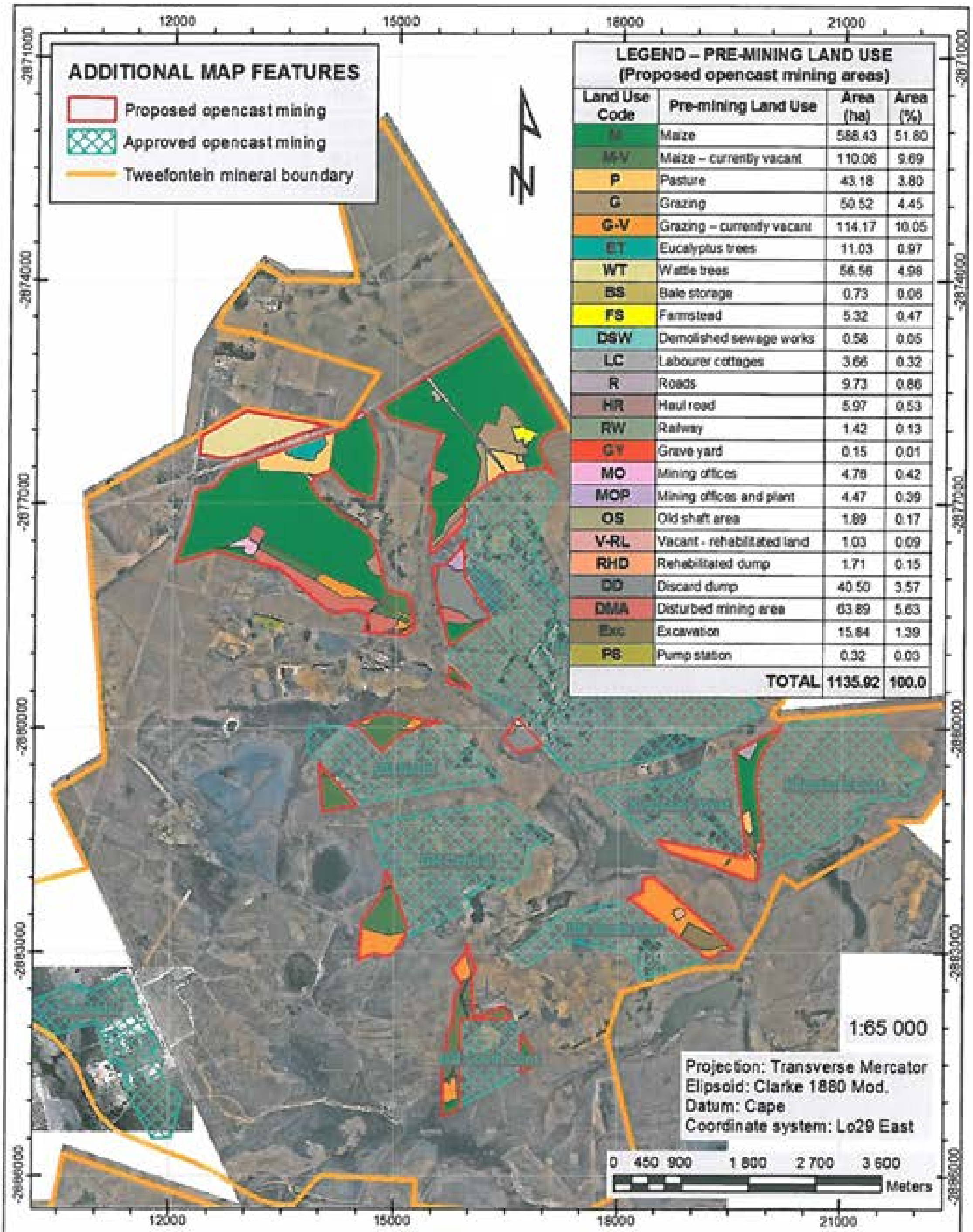


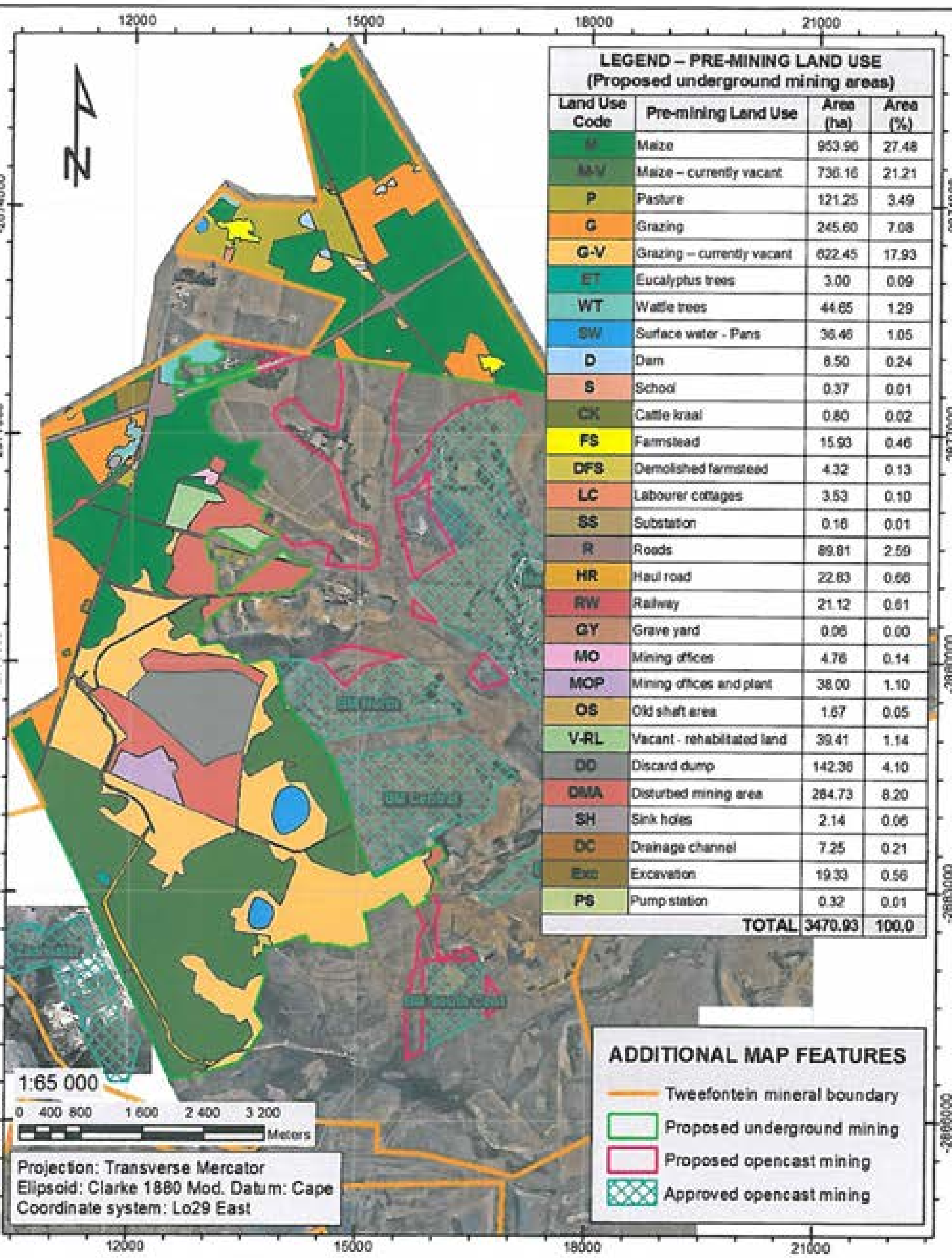
Figure 5a: Land uses within proposed opencast mining sections

Table 7a: Pre-mining land uses within the proposed opencast mining areas

LEGEND – PRE-MINING LAND USE (Proposed opencast mining areas)			
Land Use Code	Pre-mining Land Use	Area (ha)	Area (%)
M	Maize	588.43	51.80
M-V	Maize – currently vacant	110.06	9.69
P	Pasture	43.18	3.80
G	Grazing	50.52	4.45
G-V	Grazing – currently vacant	114.17	10.05
ET	Eucalyptus trees	11.03	0.97
WT	Wattle trees	56.56	4.98
BS	Bale storage	0.73	0.06
FS	Farmstead	5.32	0.47
DSW	Demolished sewage works	0.58	0.05
LC	Labourer cottages	3.66	0.32
R	Roads	9.73	0.86
HR	Haul road	5.97	0.53
RW	Railway	1.42	0.13
GY	Grave yard	0.15	0.01
MO	Mining offices	4.76	0.42
MOP	Mining offices and plant	4.47	0.39
OS	Old shaft area	1.89	0.17
V-RL	Vacant - rehabilitated land	1.03	0.09
RHD	Rehabilitated dump	1.71	0.15
DD	Discard dump	40.50	3.57
DMA	Disturbed mining area	63.89	5.63
Exc	Excavation	15.84	1.39
PS	Pump station	0.32	0.03
	TOTAL	**1135.92**	**100.0**

5.6.2 Pre-mining land uses within proposed underground mining areas

The localities and extents of current land uses within proposed underground mining areas are shown on Figure 5b and are summarized in Table 7b.



Land Use Code	Pre-mining Land Use	Area (ha)	Area (%)
M	Maize	953.96	27.48
M-V	Maize – currently vacant	736.16	21.21
P	Pasture	121.25	3.49
G	Grazing	245.60	7.08
G-V	Grazing – currently vacant	622.45	17.93
ET	Eucalyptus trees	3.00	0.09
WT	Wattle trees	44.65	1.29
SW	Surface water - Pans	36.46	1.05
D	Dam	8.50	0.24
S	School	0.37	0.01
CK	Cattle kraal	0.80	0.02
FS	Farmstead	15.93	0.46
DFS	Demolished farmstead	4.32	0.13
LC	Labourer cottages	3.53	0.10
SS	Substation	0.18	0.01
R	Roads	89.81	2.59
HR	Haul road	22.83	0.66
RW	Railway	21.12	0.61
GY	Grave yard	0.06	0.00
MO	Mining offices	4.76	0.14
MOP	Mining offices and plant	38.00	1.10
OS	Old shaft area	1.67	0.05
V-RL	Vacant - rehabilitated land	39.41	1.14
DD	Discard dump	142.36	4.10
DMA	Disturbed mining area	284.73	8.20
SH	Sink holes	2.14	0.06
DC	Drainage channel	7.25	0.21
Exc	Excavation	19.33	0.56
PS	Pump station	0.32	0.01
	TOTAL	3470.93	100.0

Figure 5b: Land uses within proposed underground mining sections

Table 7b: Pre-mining land uses within proposed underground mining areas

LEGEND – PRE-MINING LAND USE (Proposed underground mining areas)			
Land Use Code	Pre-mining Land Use	Area (ha)	Area (%)
M	Maize	953.96	27.48
M-V	Maize – currently vacant	736.16	21.21
P	Pasture	121.25	3.49
G	Grazing	245.60	7.08
G-V	Grazing – currently vacant	622.45	17.93
ET	Eucalyptus trees	3.00	0.09
WT	Wattle trees	44.65	1.29
SW	Surface water - Pans	36.46	1.05
D	Dam	8.50	0.24
S	School	0.37	0.01
CK	Cattle kraal	0.80	0.02
FS	Farmstead	15.93	0.46
DFS	Demolished farmstead	4.32	0.13
LC	Labourer cottages	3.53	0.10
SS	Substation	0.16	0.01
R	Roads	89.81	2.59
HR	Haul road	22.83	0.66
RW	Railway	21.12	0.61
GY	Grave yard	0.06	0.00
MO	Mining offices	4.76	0.14
MOP	Mining offices and plant	38.00	1.10
OS	Old shaft area	1.67	0.05
V-RL	Vacant - rehabilitated land	39.41	1.14
DD	Discard dump	142.36	4.10
DMA	Disturbed mining area	284.73	8.20
SH	Sink holes	2.14	0.06
DC	Drainage channel	7.25	0.21
Exc	Excavation	19.33	0.56
PS	Pump station	0.32	0.01
	TOTAL	3470.93	100.0

5.6.3 Pre-mining land uses within proposed borrow pit areas

The localities and extents of current land uses within proposed borrow pit areas are shown in Figure 5c and are summarized in Table 7c.

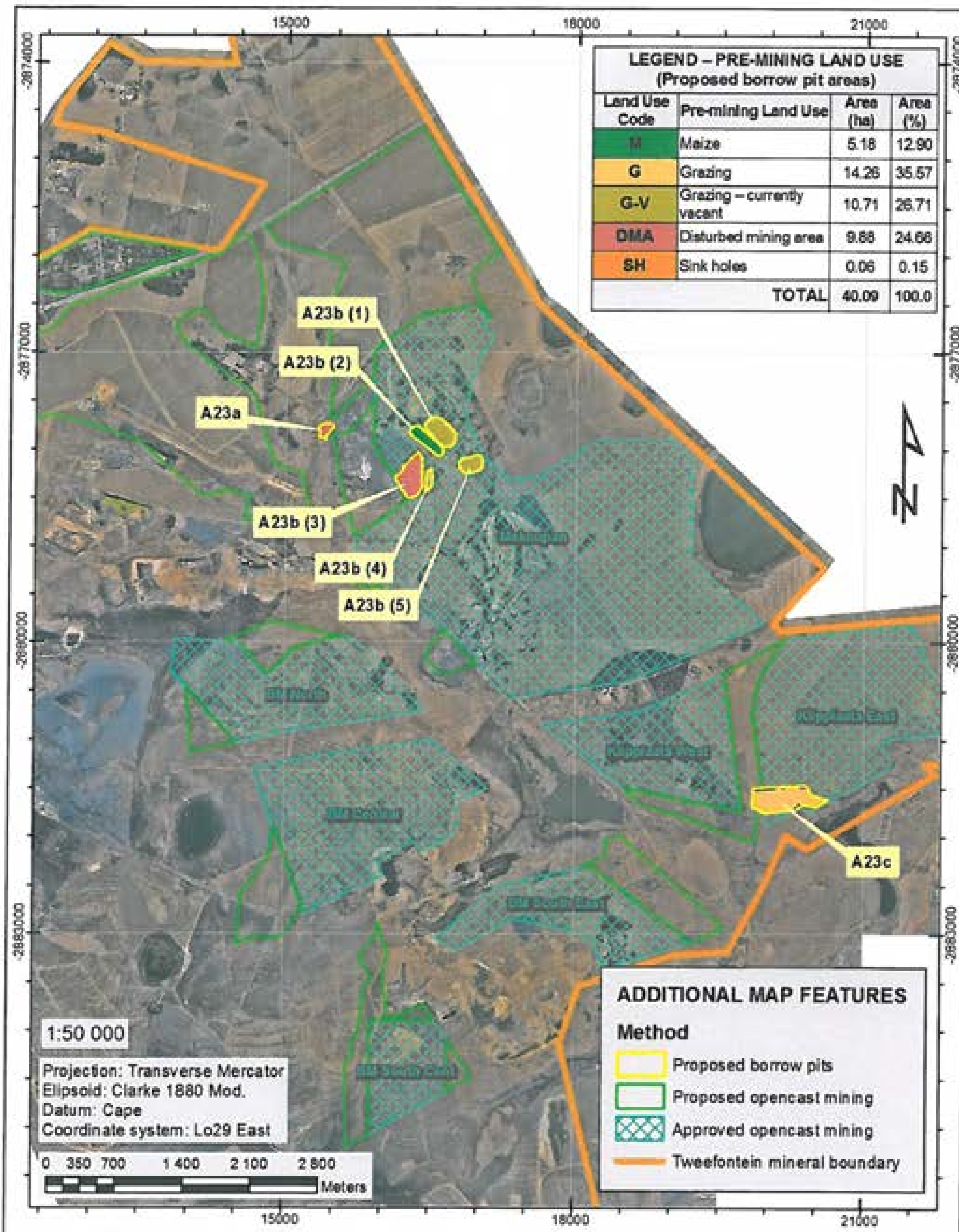


Figure 5c: Land uses within proposed borrow pit areas

Table 7c: Pre-mining land uses within proposed borrow pit areas

LEGEND – PRE-MINING LAND USE (Proposed borrow pit areas)			
Land Use Code	**Pre-mining Land Use**	**Area (ha)**	**Area (%)**
M	Maize	5.18	12.90
G	Grazing	14.26	35.57
G-V	Grazing – currently vacant	10.71	26.71
DMA	Disturbed mining area	9.88	24.66
SH	Sink holes	0.06	0.15
	TOTAL	**40.09**	**100.0**

5.6.4 Pre-mining land uses within the footprints of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course

The localities and extents of current land uses within the footprints of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course are shown in Figure 5d and are summarized in Table 7d.

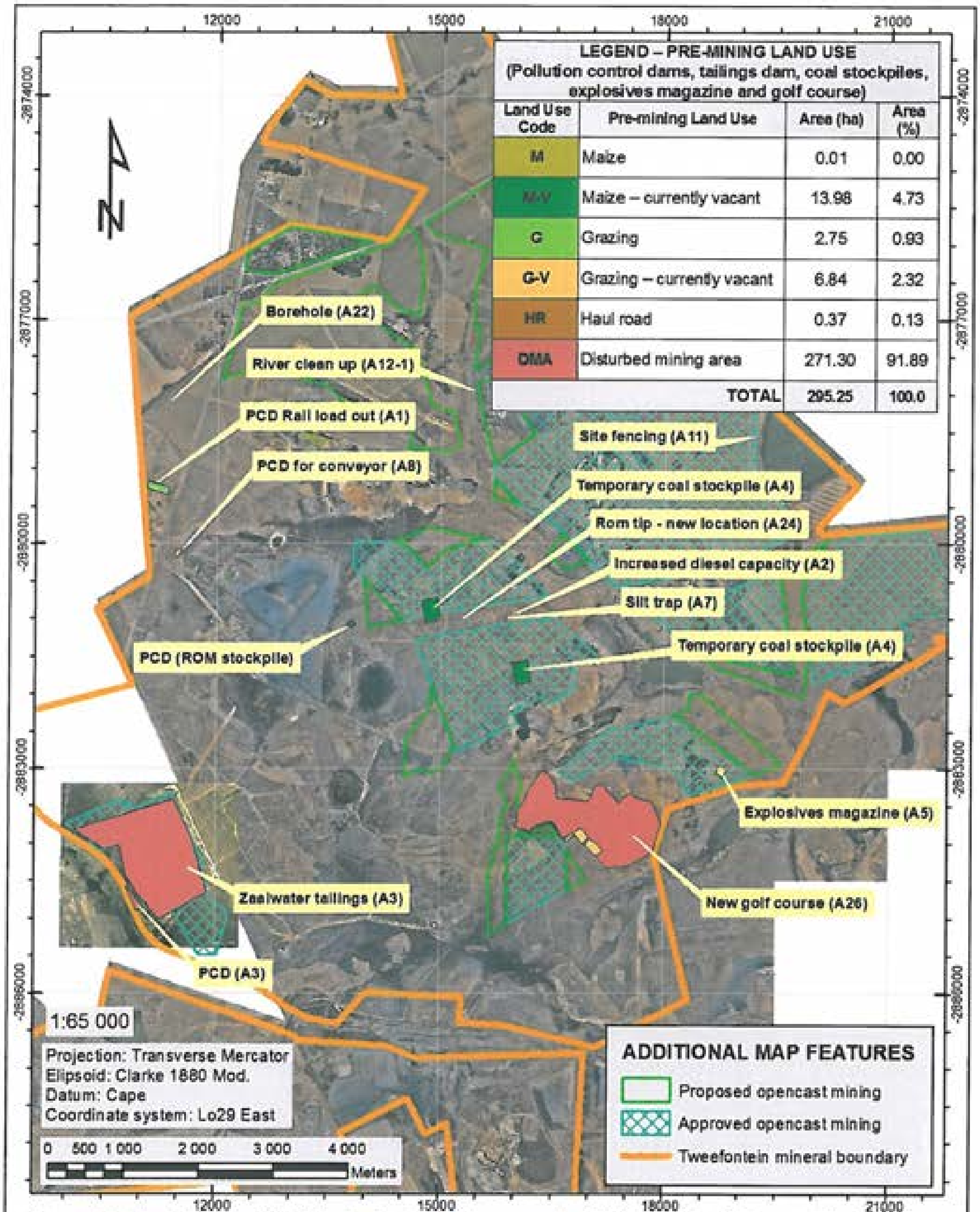


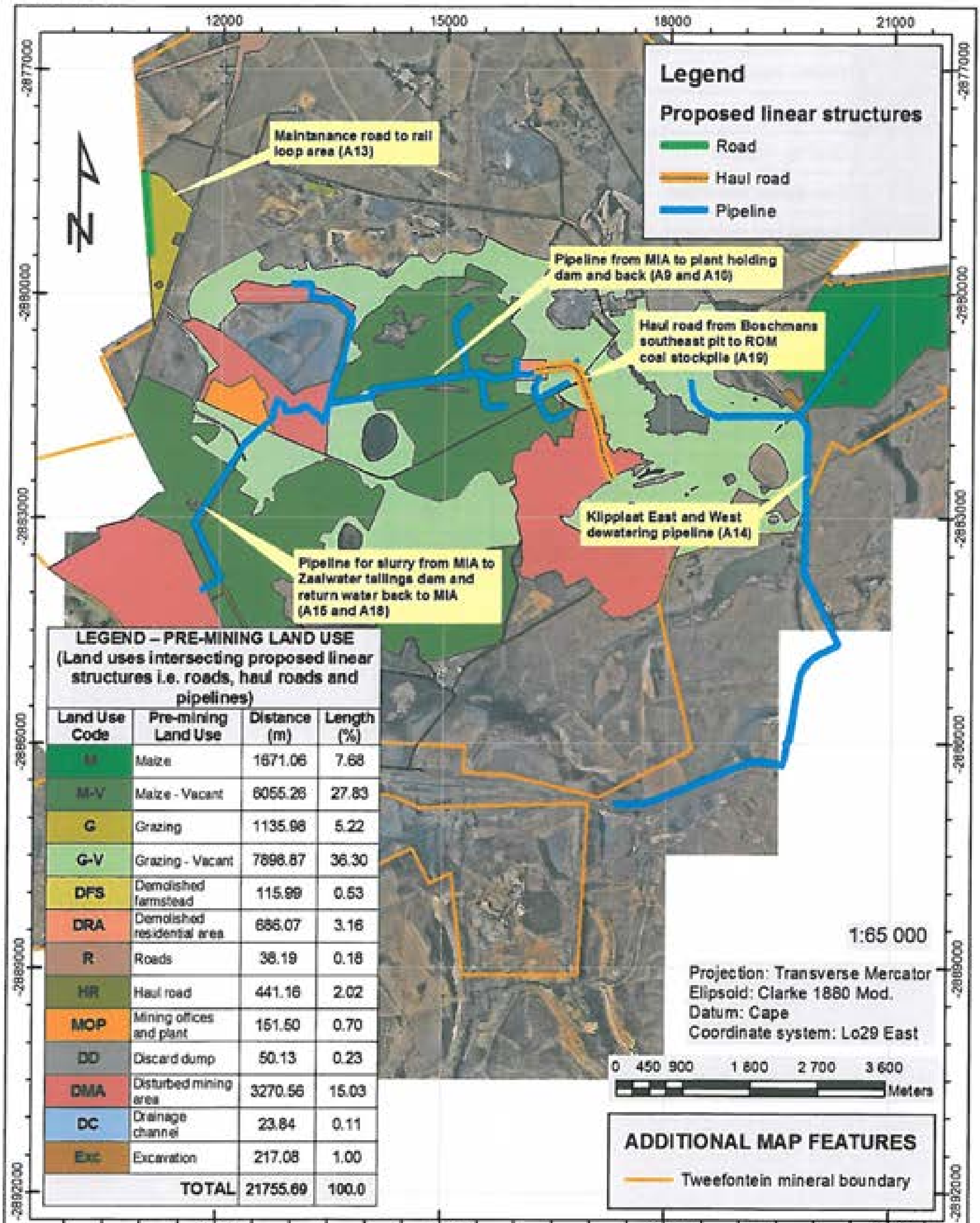
Figure 5d: Land uses within the footprints of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine, golf course and other as labeled.

Table 7d: Pre-mining land uses within the footprints of proposed pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course

LEGEND – PRE-MINING LAND USE (Pollution control dams, tailings dam, coal stockpiles, explosives magazine and golf course)			
Land Use Code	**Pre-mining Land Use**	**Area (ha)**	**Area (%)**
M	Maize	0.01	0.00
M-V	Maize – currently vacant	13.98	4.73
G	Grazing	2.75	0.93
G-V	Grazing – currently vacant	6.84	2.32
HR	Haul road	0.37	0.13
DMA	Disturbed mining area	271.30	91.89
	TOTAL	**295.25**	**100.0**

5.6.5 Pre-mining land uses intersected by proposed linear structures i.e. roads, haul roads and pipelines

The localities and extents of current land uses intersected by proposed linear structures i.e. roads, haul roads and pipelines are shown in Figure 5e and are summarized in Table 7e.



LEGEND – PRE-MINING LAND USE (Land uses intersecting proposed linear structures i.e. roads, haul roads and pipelines)

Land Use Code	Pre-mining Land Use	Distance (m)	Length (%)
M	Maize	1671.06	7.68
M-V	Maize - Vacant	6055.26	27.83
G	Grazing	1135.98	5.22
G-V	Grazing - Vacant	7896.87	36.30
DFS	Demolished farmstead	115.99	0.53
DRA	Demolished residential area	686.07	3.16
R	Roads	38.19	0.18
HR	Haul road	441.16	2.02
MOP	Mining offices and plant	151.60	0.70
DD	Discard dump	50.13	0.23
DMA	Disturbed mining area	3270.56	15.03
DC	Drainage channel	23.84	0.11
Exc	Excavation	217.08	1.00
	TOTAL	21755.69	100.0

Figure 5e: Land uses intersected by proposed linear structures i.e. roads, haul roads and pipelines

Table 7e: Pre-mining land uses intersected by proposed linear structures i.e. roads, haul roads and pipelines

LEGEND – PRE-MINING LAND USE (Land uses intersecting proposed linear structures i.e. roads, haul roads and pipelines)			
Land Use Code	Pre-mining Land Use	Distance (m)	Length (%)
M	Maize	1671.06	7.68
M-V	Maize - Vacant	6055.26	27.83
G	Grazing	1135.98	5.22
G-V	Grazing - Vacant	7898.87	36.30
DFS	Demolished farmstead	115.99	0.53
DRA	Demolished residential area	686.07	3.16
R	Roads	38.19	0.18
HR	Haul road	441.16	2.02
MOP	Mining offices and plant	151.50	0.70
DD	Discard dump	50.13	0.23
DMA	Disturbed mining area	3270.56	15.03
DC	Drainage channel	23.84	0.11
Exc	Excavation	217.08	1.00
	TOTAL	**21755.69**	**100.0**

5.6.6 Land uses within the combined proposed structure footprints of the TOPA area

Land uses of the combined structure footprints of the TOPA area are shown in Figure 5f and summarized in Table 7f.

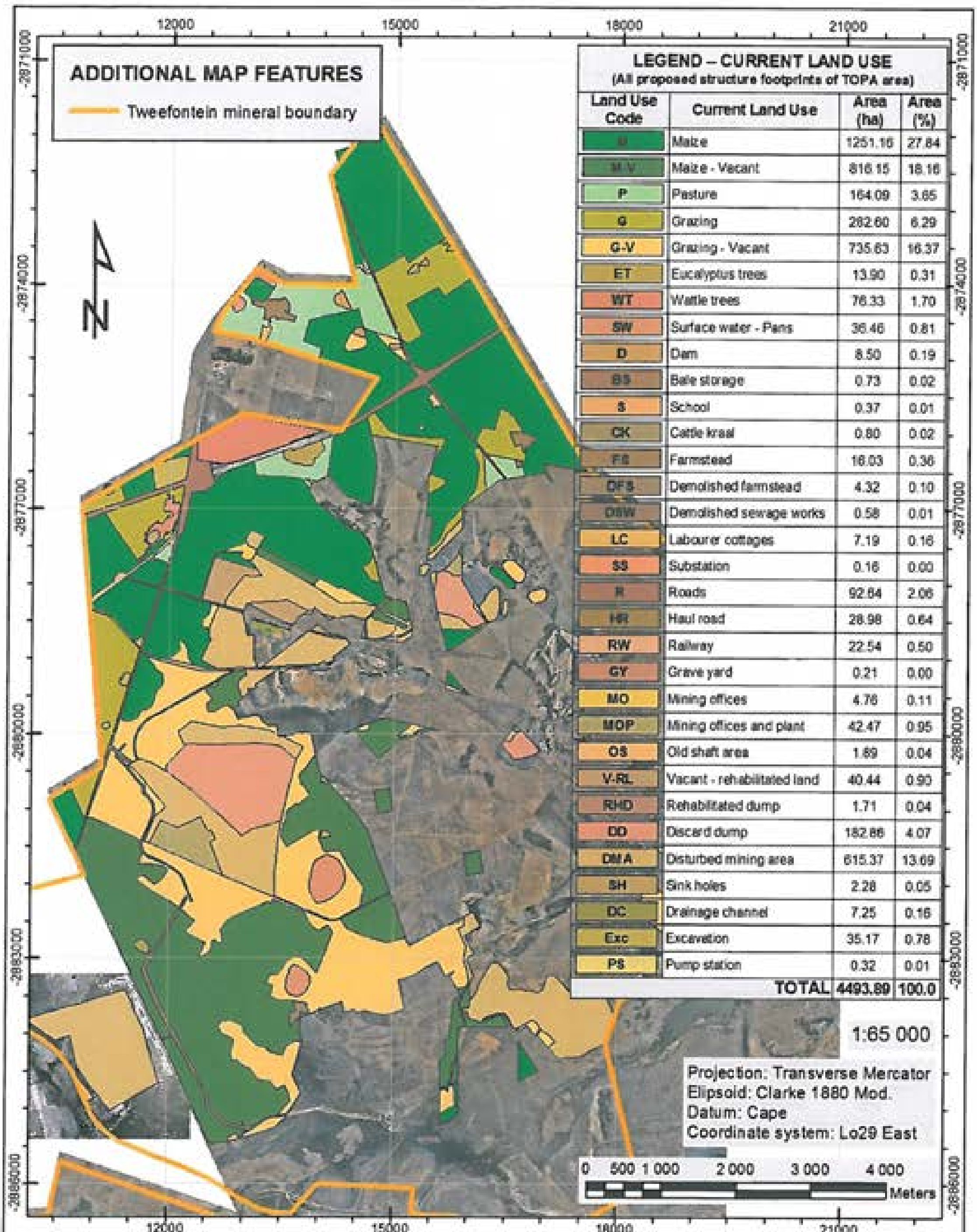


Figure 5f: Land uses within proposed structure footprints of the TOPA area

Table 7f: Land uses in combined proposed structure footprints of the TOPA area

LEGEND – CURRENT LAND USE (All proposed structure footprints of TOPA area)			
Land Use Code	Current Land Use	Area (ha)	Area (%)
M	Maize	1251.16	27.84
M-V	Maize - Vacant	816.15	18.16
P	Pasture	164.09	3.65
G	Grazing	282.60	6.29
G-V	Grazing - Vacant	735.63	16.37
ET	Eucalyptus trees	13.90	0.31
WT	Wattle trees	76.33	1.70
SW	Surface water - Pans	36.46	0.81
D	Dam	8.50	0.19
BS	Bale storage	0.73	0.02
S	School	0.37	0.01
CK	Cattle kraal	0.80	0.02
FS	Farmstead	16.03	0.36
DFS	Demolished farmstead	4.32	0.10
DSW	Demolished sewage works	0.58	0.01
LC	Labourer cottages	7.19	0.16
SS	Substation	0.16	0.00
R	Roads	92.64	2.06
HR	Haul road	28.98	0.64
RW	Railway	22.54	0.50
GY	Grave yard	0.21	0.00
MO	Mining offices	4.76	0.11
MOP	Mining offices and plant	42.47	0.95
OS	Old shaft area	1.89	0.04
V-RL	Vacant - rehabilitated land	40.44	0.90
RHD	Rehabilitated dump	1.71	0.04
DD	Discard dump	182.86	4.07
DMA	Disturbed mining area	615.37	13.69
SH	Sink holes	2.28	0.05
DC	Drainage channel	7.25	0.16
Exc	Excavation	35.17	0.78
PS	Pump station	0.32	0.01
	TOTAL	4493.89	100.0

5.6.7 Land uses of the total TOPA area

Land uses of the entire TOPA area, with the exception of a small potion to the south and east are shown in Figure 5g and are summarised in Table 7g.

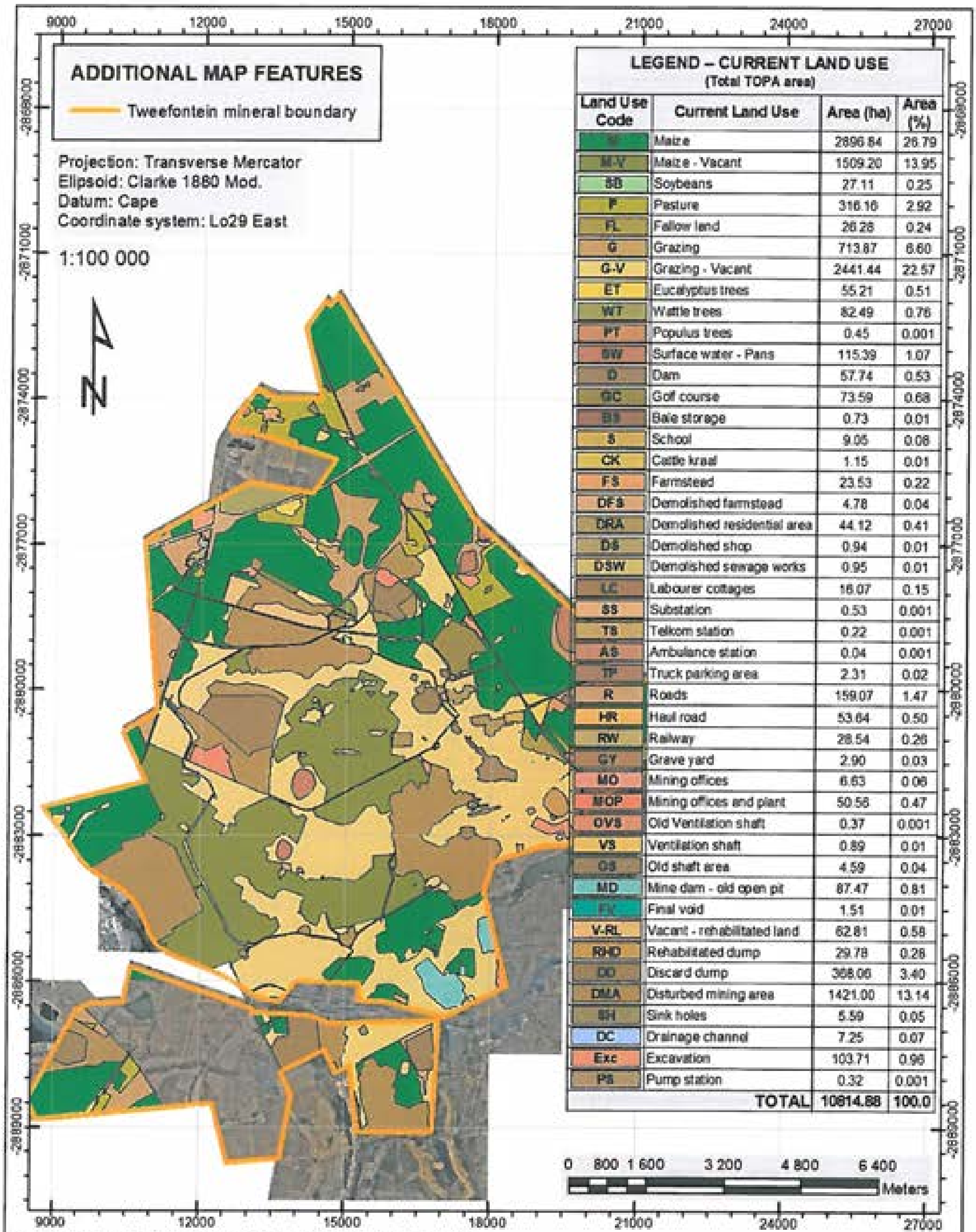


Figure 5g: Land uses within the total TOPA area

Table 7g: Land uses in total TOPA area

LEGEND – CURRENT LAND USE (Total TOPA area)			
Land Use Code	**Current Land Use**	**Area (ha)**	**Area (%)**
M	Maize	2896.84	26.79
M-V	Maize - Vacant	1509.20	13.95
SB	Soybeans	27.11	0.25
P	Pasture	316.16	2.92
FL	Fallow land	26.28	0.24
G	Grazing	713.87	6.60
G-V	Grazing - Vacant	2441.44	22.57
ET	Eucalyptus trees	55.21	0.51
WT	Wattle trees	82.49	0.76
PT	Populus trees	0.45	0.001
SW	Surface water - Pans	115.39	1.07
D	Dam	57.74	0.53
GC	Golf course	73.59	0.68
BS	Bale storage	0.73	0.01
S	School	9.05	0.08
CK	Cattle kraal	1.15	0.01
FS	Farmstead	23.53	0.22
DFS	Demolished farmstead	4.78	0.04
DRA	Demolished residential area	44.12	0.41
DS	Demolished shop	0.94	0.01
DSW	Demolished sewage works	0.95	0.01
LC	Labourer cottages	16.07	0.15
SS	Substation	0.53	0.001
TS	Telkom station	0.22	0.001
AS	Ambulance station	0.04	0.001
TP	Truck parking area	2.31	0.02
R	Roads	159.07	1.47
HR	Haul road	53.64	0.50
RW	Railway	28.54	0.26
GY	Grave yard	2.90	0.03
MO	Mining offices	6.63	0.06
MOP	Mining offices and plant	50.56	0.47
OVS	Old Ventilation shaft	0.37	0.001
VS	Ventilation shaft	0.89	0.01
OS	Old shaft area	4.59	0.04
MD	Mine dam - old open pit	87.47	0.81
FV	Final void	1.51	0.01
V-RL	Vacant - rehabilitated land	62.81	0.58
RHD	Rehabilitated dump	29.78	0.28
DD	Discard dump	368.06	3.40
DMA	Disturbed mining area	1421.00	13.14
SH	Sink holes	5.59	0.05
DC	Drainage channel	7.25	0.07
Exc	Excavation	103.71	0.96
PS	Pump station	0.32	0.001
	TOTAL	**10814.88**	**100.0**

5.7 Historical agricultural production

Crop yields vary from farm to farm and field to field due to various factors such as soil types and climatic conditions e.g. annual precipitation, temperature, day lengths, heat units etc. Potential crop yields were broadly assessed based on soil properties and estimates are provided in Table 8.

Table 8: Historical agricultural production

Product	*Soil Types	Derived soil potential	Potential Yield
Maize	Hu1, Hu2, Hu3, Gf1,	High	5-8 t/ha/a
	Hu4, Bv, Cv1, Cv2, Av1, Av2, Gc1, Gc2, Pn, Tu	Moderate to high	4-6 t/ha/a
	Cv3, Cv4, Av3, Av4, R/Ms, Wb	Low (shallow sandy and rehabilitated soils)	1-3
	Rg, Fw, Lo1, Lo2, Wa, Kd, Ka	Very low to none (wet soils)	Very low suitability
	RHD, DMA, DD, E, Exc	Very low to none (Disturbed areas and rehabilitated structures)	Very low to none
Grazing (Cattle)	All soil types	Very low to high	5 ha/lsu
* See soil maps Figure 3a – 3e			

5.8 Evidence of misuse

No evidence of misuse was observed.

6. ENVIRONMENTAL IMPACT ASSESSMENT

The environmental impact assessment in terms of soils, land capability and land use for the construction, operational and decommissioning phases including mitigation measures is compiled in a separate MS Excel spreadsheet.

7. REHABILITATION / MITIGATION

7.1 Principles for stripping and stockpiling of topsoil

Stripping and stockpiling is an impact on soil, land capability and land use, but it is important to realize that the way this action is performed is also the primary and one of the most important mitigation measures. The impact on soil, land capability and land use are mitigated by means of the rehabilitation process which commences with stripping and stockpiling of topsoil before mining takes place and is not a process that starts with replacing of topsoil after or during the mining operation. Rehabilitation and subsequent mitigation consists therefore of the following phases:

- Stripping and stockpiling of topsoil
- Backfill of open pits and leveling of spoil material to a free draining surface
- Replacing and leveling of topsoil and preparation of the surface
- Soil amelioration and re-vegetation

If the first phase of rehabilitation namely stripping and stockpiling of topsoil is not done with the aim to reinstate post-mining land capability similar to pre-mining land capability, then successful rehabilitation will not be achieved and it will result in a serious deterioration from pre-mining to post-mining land capability.

In practice, even with optimal rehabilitation procedures applied, deterioration from pre-mining to post-mining land capability is almost unavoidable. It is therefore crucial to follow the proposed rehabilitation procedures precisely in order to minimise degradation of soil characteristics and to re-establish the highest possible post-mining land capability.

The term topsoil refers to the A and B-horizons of the soil profile as defined in the Taxonomic Soil Classification system for South Africa. The A-horizon comprises the upper part (0-300 mm) of the soil profile and the B-horizon from 300 mm up to the stripping depth specified per soil type indicated in Figure 6a and 6b. The characteristics of soil horizons (A- and B-horizons) are further described in Appendix E in terms of soil stripping, stockpiling and replacing.

Stripping, stockpiling and replacing of topsoil has a very high impact on soil, land capability and land use and the procedures followed during execution of these actions directly influence the post-mining land capability and consequently determine the degree of deterioration from pre-mining to post-mining land capability. They also directly determine the possible post-mining land uses.

During stripping and stockpiling the following principles should be adhered to:

- ***Prevent mixing of high quality topsoil (A and B-horizons) with low quality underlying material to ensure sufficient volumes of high quality soil for rehabilitation.*** The quality of soil earmarked for rehabilitation purposes significantly deteriorates when the high quality topsoil is mixed with the underlying poorer quality material (clay layers, calcrete, plinthite, weathered rock etc). This results in significant deterioration in the quality of the soil's physical and chemical properties and a decline in the soil fertility necessary for re-vegetation. The deterioration in soil quality also significantly increases the susceptibility of rehabilitated soils for erosion and seal and crust formation.

- ***Separate stockpiling of different soil types to obtain the highest post-mining land capability.*** Topsoil quality or potential is not just limited to the grade of soil generally referred to as topsoil but can vary from very high to low due to various properties. Soil properties of different soil types can vary substantially e.g. high quality red and yellow well-drained soils and low quality grey poorly drained wetland soils can occur over very short distances in the same field. Mixing of different soil types results in rapid changes in soil properties and characteristics such as texture, infiltration rates and water holding capacity over short distances after replacement, which will definitely adversely affect the post-mining land capability.

- ***Separate stripping, stockpiling and replacing of soil horizons (A and B-horizon) in the original natural sequence to combat hardsetting and compaction, maintain soil fertility and conserve the natural seed source.*** The higher soil fertility of the A-horizon, especially phosphorus and carbon contents, declines significantly when it is mixed with the B-horizon, resulting in poorer re-vegetation success. It also increases the susceptibility to compaction and hard setting. The A-horizon also serves as a seed source which will enhance the re-establishing of natural species. The A and B-horizons should be stripped and stockpiled separately and replaced with the A-horizon overlying the B-horizon. Contrary to the general perception, separate stockpiling of different soil types and horizons does not have significant cost implications for the mine and mainly requires planning and continuing management.

The soil horizons and properties influencing stripping and stockpiling procedures are discussed in Appendix E.

7.2 Handling of topsoil from construction to decommissioning phase

Handling of topsoil from construction to decommissioning phase should be based on the following principles.

7.2.1 Structures to be demolished during the decommissioning phase

Procedures to follow for structures with a flat basis involving coalliferous material such as coal stockpiles, haul roads, sidings and plants:

- Topsoil (A-horizon) should be removed to a depth of 300 mm and stockpiled. For linear structures it can be stored as a berm along the structure.
- The footprint should be filled with soft overburden material which should serve as a sealing layer for salt and heavy metal pollution. For non-linear structures a soft overburden berm should be constructed around the structure.
- During the decommissioning phase the footprint should be thoroughly cleaned and all coalliferous and soft overburden material should be removed to a discard dump or suitable disposal facility.
- The footprint should be ripped to alleviate compaction before replacement of the topsoil.
- The topsoil should be replaced and ameliorated according to soil chemical analysis

of samples taken after replacement.

- The footprint should be re-vegetated with a grass seed mixture dominated by local climax species.

Procedures to follow for structures with a deeper concave basis involving coalliferous material such as pollution control dams and slurry ponds:

- The upper 300 mm of topsoil (A-horizon) should be removed and stockpiled for final rehabilitation.
- The B-horizon (300 up to subsoil material) can be used for the construction or elevation of wall embankments but may not be mixed with subsoil material.
- The entire footprint should be lined with a polyethylene membrane to prevent soil and groundwater pollution.
- During the decommissioning phase the footprint should be thoroughly cleaned and all polluted material should be removed to a discard dump or suitable disposal facility.
- Material used for wall embankments should be replaced at the bottom
- The stockpiled A-horizon should be replaced.
- The topsoil should be ameliorated according to soil chemical analysis of samples taken after replacement.
- The footprint should be re-vegetated with a grass seed mixture dominated by local climax species.

Procedures for structures not involving coalliferous material such as roads, explosives magazines, pipelines, buildings, parking areas:

- All excess topsoil which might be excavated for the foundations of these structures should be stored for later rehabilitation.
- During the decommissioning phase the footprint should be thoroughly cleaned.
- The footprint should be ripped to alleviate compaction
- Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface.
- The topsoil should be ameliorated according to soil chemical analysis.
- The footprint should be re-vegetated with a grass seed mixture dominated by local climax species.

7.2.2 Structures that will remain after the decommissioning phase

Procedures for structures involving coalliferous material such as discard dumps and tailings dams:

- Structures such as discard dumps mostly remain after the decommissioning phase and are usually responsible for serious salt and heavy metal pollution to soil and water resources on a continuing bases. It is therefore critical to ensure that sufficient soil material is removed and stored during the construction phase in order to properly rehabilitate (cap) the structure to prevent pollution as far as possible.
- The upper 1000 mm of topsoil should be removed and stockpiled.
- The entire footprint should be compacted and lined to prevent soil pollution.
- Leachates should be channeled to a pollution control dam via lined or concrete drains.
- The gradients of the dump edges should be designed to facilitate effective capping of the dump with topsoil.

- During the decommissioning phase the edges of the dump should be shaped to suitable gradients and covered with a lime layer before the topsoil are replaced.
- The soil should be ameliorated according to soil analysis and re-vegetated with a grass seed mixture dominated by a strong grower and stabilizing specie such as *Cynodon dactylon.*

7.2.3 Stripping and stockpiling of topsoil for opencast areas

Stripping and stockpiling of topsoil will takes place to a large extent during the operational phase, mainly at the footprint of open pits and the discard dump extension area. The soil types should be stripped and stockpiled together based on soil type and soil quality as shown in Figure 6. The figure should be read together with Table 8 which shows the stripping depths, the areas and percentages as well as the total soil volume per soil type, based on the stripping depth. It also shows the replacing depth (topsoil thickness) and post-mining land capability class. The replacing depth was determined by calculating the total soil volume per soil group (stockpile), divided by the original area which was stripped. This implies that if more than one soil type, which were stripped at different depths, are stockpiled together, it will be replaced at a single average depth.

The following guidelines for stripping and stockpiling procedures need to be executed:

- Figure 6a and 6b and Table 9a and 9b show the soil types to be stripped in the proposed opencast and borrow pit areas respectively.
- These Figures and tables show the combination (groups) of soil types that need to be stripped and stockpiled on 4 separate stockpiles. The A and B-horizon should be stripped and stockpiled separately and marked with a signboard as specified in the guidelines for the rehabilitation of mined land (Chamber of Mines of South Africa, 2007).
- The size of the stockpiles should be based on the soil volume per stockpile as indicated in Figures 6a and 6b and Tables 9a and 9b and will be determined by the timeframe before a roll-over mining method is initiated. No stockpile height restriction is proposed as long as the soil types as specified in Figures 6a and 6b are stockpiled together.
- The boundaries of the soil types that should be stripped at different depths and/or stockpiled separately should be surveyed and staked by the mine surveyor at 50 m intervals before any soil stripping commences.
- Soils to be stripped and stockpiled on stockpile 1 are shown in green and consist of well to moderately well-drained red soils.
- Soils to be stripped and stockpiled on stockpile 2 are shown in orange and consist of well to moderately well-drained brownish yellow soils.
- Soils to be stripped and stockpiled on stockpile 3 are shown in light blue and consist of grey, imperfectly drained, sandy soils in temporary wetland zones.
- Soils to be stripped and stockpiled on stockpile 4 are shown in dark blue and consist of black, poorly drained, clay soils in temporary and seasonal wetland zones.
- The stripping plans, Figures 6a and 6b, includes soil types in wetlands, shown in light and dark blue, but mining of these wetland areas is subject to authorization of the relevant government departments.
- The most suitable stockpile positions consisting each of a section for the A and B-horizon should be determined by the mine engineer based on the mining sequence plan and need to be surveyed and staked by the mine surveyor.

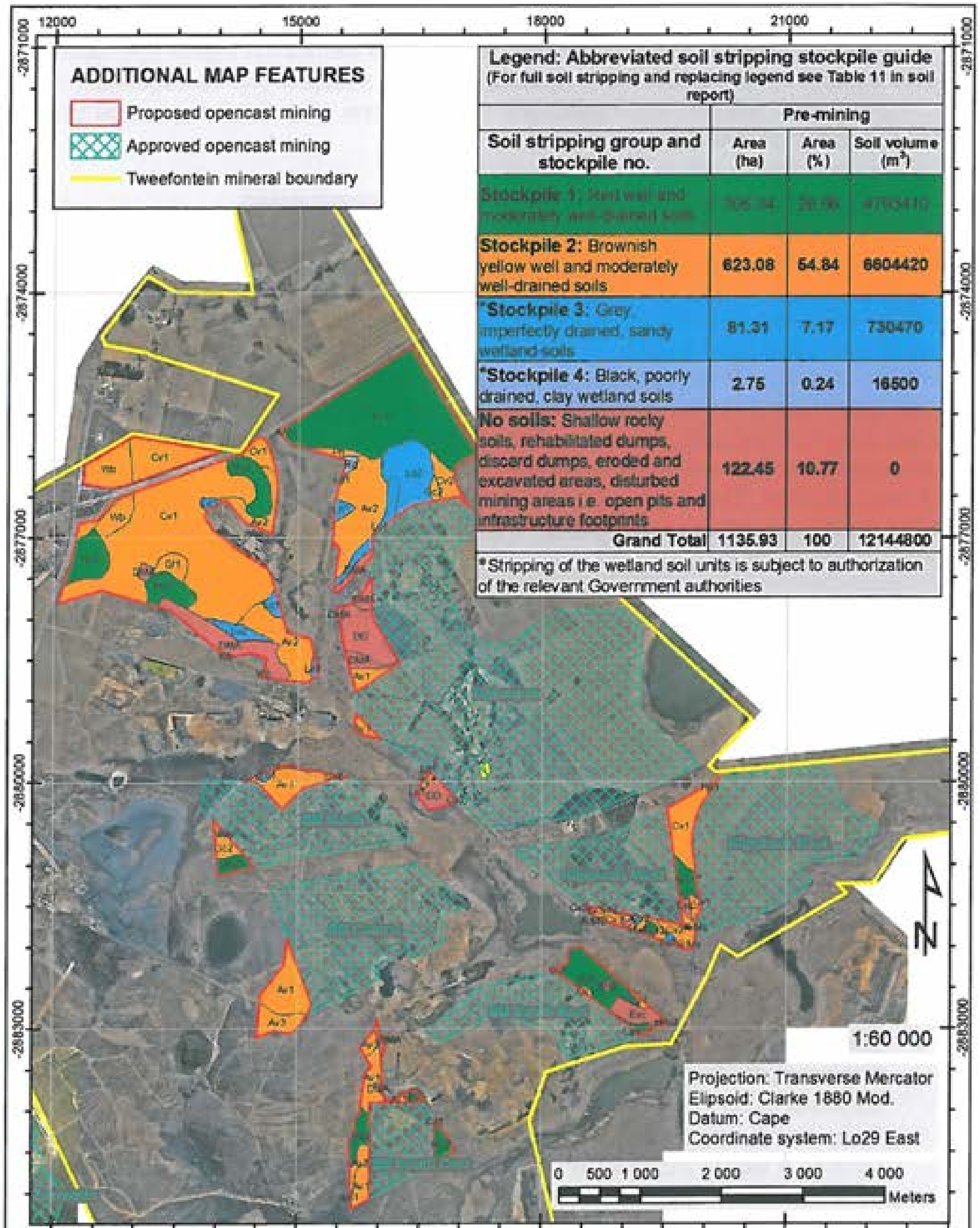
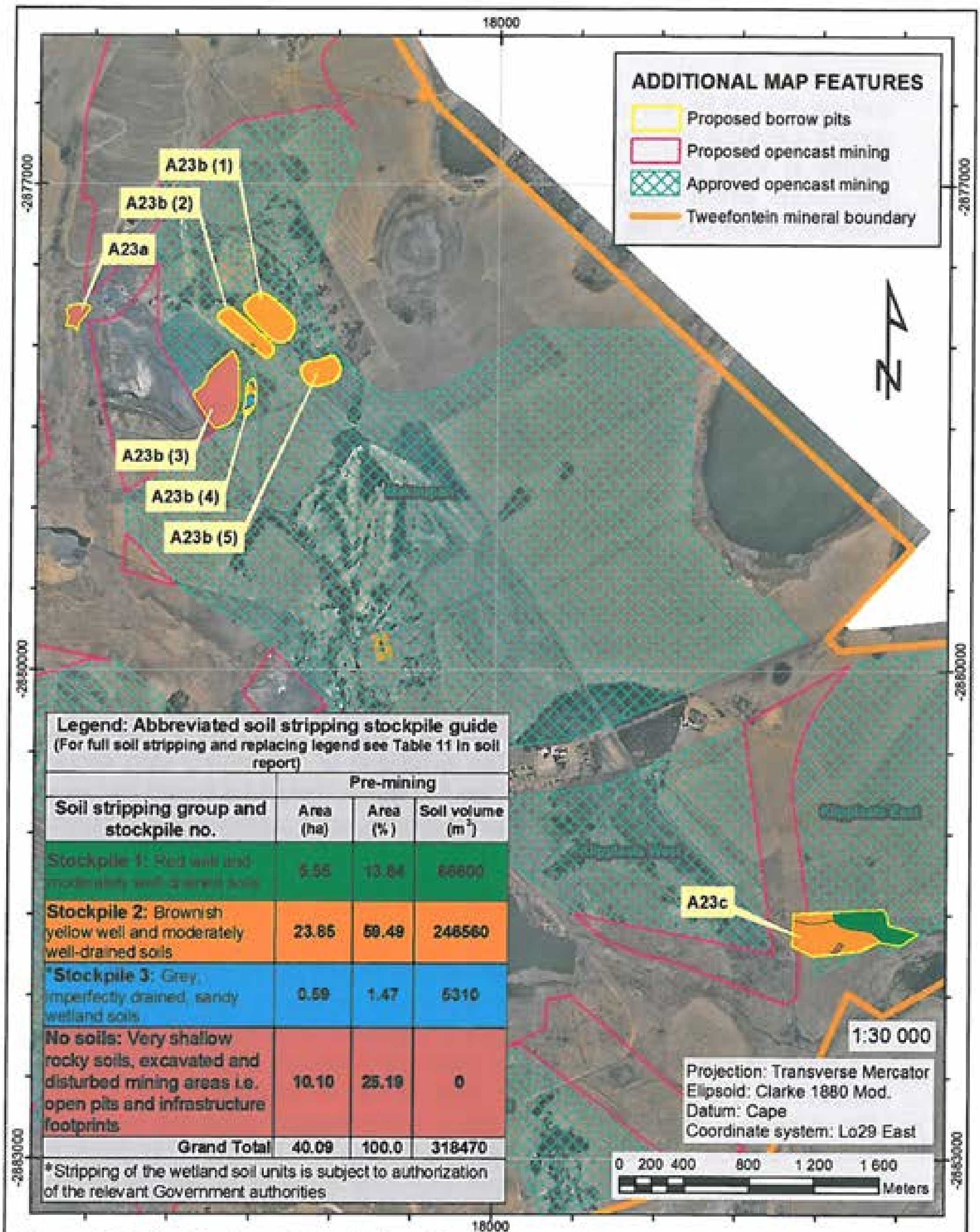


Figure 6a: Soil stripping and stockpile guide for proposed opencast mining areas

7.2.4 Stripping and stockpiling of topsoil (Borrow pit areas)

The same stripping and stockpiling procedures described in section 7.2.3 are applicable to borrow pits.



Legend: Abbreviated soil stripping stockpile guide (For full soil stripping and replacing legend see Table 11 in soil report)			
	Pre-mining		
Soil stripping group and stockpile no.	Area (ha)	Area (%)	Soil volume (m^3)
Stockpile 1: Red well and moderately well-drained soils	5.55	13.84	66600
Stockpile 2: Brownish yellow well and moderately well-drained soils	23.85	59.49	246560
***Stockpile 3:** Grey, imperfectly drained, sandy wetland soils	0.59	1.47	5310
No soils: Very shallow rocky soils, excavated and disturbed mining areas i.e. open pits and infrastructure footprints	10.10	25.19	0
Grand Total	40.09	100.0	318470

*Stripping of the wetland soil units is subject to authorization of the relevant Government authorities

Figure 6b: Soil stripping and stockpile guide for proposed borrow pit areas

The following procedures might also take place during the operational phase if a rollover mining method is applied.

7.2.5 Backfilling of open pits and leveling of spoil material

- Before topsoil can be replaced, the open pit should be backfilled to an elevation similar to the pre-mining topography (except for the final void) in order to ensure a continuation of the pre-mining surface drainage pattern. The backfilled surface should be surveyed by a surveyor in order to ensure that it has the correct elevation and slopes to be free draining. A non free draining surface results in local depressions of periodically saturated zones and increased percolation which usually leads to localised subsidence of underlying spoil material. Slopes of the spoil surface should therefore be similar to the pre-mining surface and should change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation.

7.2.6 Replacing and leveling of topsoil and preparation of the surface

- The backfilled and levelled spoil surface should first be covered with soil of the B-horizons. Care should be taken to tip enough soil per square unit to reinstate the total required B-horizon thickness at once. Spreading of soil over far distances and repeated traversing should be minimised in order to prevent compaction in the lower profile which is difficult to alleviate afterwards. The dumped soil heaps should thus only be levelled on top to reach the required horizon/soil thickness. Caterpillar-type tracked equipment is preferred for levelling of the B-horizons due to the large quantities of soil that need to be handled and the tracks cause less compaction. Bowl scrapers cause enormous compaction and should not be used.
- When the roll-over mining system is initiated and the point is reached where soils are stripped and directly replaced, without stockpiling, the following method should be implemented. The A-horizon of one mining strip should be stored at the final mining strip and the B-horizon should be tipped and levelled on the area to be rehabilitated (properly levelled spoil surface). The A-horizon of the next mining strip should then be tipped and levelled on top of the replaced B-horizon and the roll-over system can continue like this. The stored A-horizon of the first mining strip should then be replaced on the B-horizon of the last mining strip.
- After the B-horizon is replaced, the surface should be loosened to a depth of approximately 300 mm with normal agricultural equipment, preferably a multiple tooth implement. This is very important to prevent a compacted layer between the A and B-horizons which will be similar to a plough sole which dramatically reduces the effective soil depth and restricts root development.
- The A-horizon should then be tipped systematically over the loosened B-horizon surface and spread evenly. Replacing the A-horizon involves much smaller quantities of soil and a combination of a lighter dozer and grader should be used. Graders have the ability to create a more even surface with less traversing than a dozer, without creating too much compaction.
- The replaced topsoil thickness should be progressively monitored during replacement to verify if it is similar to the replacing depth provided in Table 8 and to prevent encountering shortages of topsoil.

Table 9a and 9b provides the criteria for soil stripping and stockpiling and also provides the replacing soil depths and post-mining land capability for opencast mining areas and borrow pits respectively.

Table 9a: Criteria for stripping and replacing - proposed opencast areas

Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability									
	Pre-mining					Post-mining			
						Replacing			
Soil stripping group and stockpile no.	Soil Types	Strip depth (m)	Area (ha)	Area (%)	Soil volume (m^3)	Depth (m)	Area (ha)	Area (%)	Land capability
Stockpile 1 (Red well and moderately well-drained soils)	Hu1	1.6	224.71	19.78	3595360	1.5	306.34	26.98	Arable
	Hu2	1.5	77.23	6.80	1158450				
	Hu4	0.9	2.38	0.22	21420				
	Bv	0.9	2.02	0.18	18180				
		TOTAL	**306.34**	**26.98**	**4793410**				
Stockpile 2 (Brownish yellow well and moderately well-drained soils)	Gf1	1.5	9.21	0.81	138150	1.0	623.08	54.84	Arable
	Cv1	1.2	307.17	27.03	3686040				
	Cv2	0.9	25.34	2.23	228060				
	Cv3	0.5	7.38	0.65	36900				
	Cv4	1.2	0.70	0.06	8400				
	Av1	1.2	87.71	7.70	1052520				
	Av2	0.9	107.77	9.49	969930				
	Av3	0.7	22.88	2.02	160160				
	Gc2	0.9	11.34	1.00	102060				
	Pn	0.6	4.30	0.38	25800				
	Wb	0.5	39.28	3.47	196400				
		TOTAL	**623.08**	**54.84**	**6604420**				
***Stockpile 3** (Grey, imperfectly drained, sandy wetland soils)	Lo1	0.9	36.68	2.52	330120	0.9	81.31	7.17	Wetland/ Grazing
	Lo2	0.9	52.58	3.59	473220				
	Wa	0.6	0.44	0.03	2640				
		TOTAL	**81.31**	**7.17**	**730470**				
***Stockpile 4** (Black, poorly drained, clay wetland soils)	Rg	0.6	2.75	0.24	16500	0.6	2.75	0.24	Wetland/ Grazing
		TOTAL	**2.75**	**0.24**	**16500**				
No soil Shallow rocky soils, rehabilitated dumps, discard dumps, eroded and excavated areas, disturbed mining areas i.e. open pits and infrastructure footprints	R/Ms	0	2.35	0.21	0	0	122.45	10.77	Wilderness
	RHD	0	1.71	0.15	0				
	DMA	0	61.55	5.41	0				
	DD	0	40.50	3.56	0				
	E	0	0.56	0.05	0				
	Exc	0	15.78	1.39	0				
		TOTAL	**122.45**	**10.77**	**0**				
		Grand Total	**1135.93**	**100.00**	**12144800**		**1135.93**	**100.0**	
*Stripping of the wetland soil units is subject to authorization of the relevant Government authorities									

Table 9b: Criteria for stripping and replacing - proposed borrow pit areas

Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability									
	Pre-mining					Post-mining			
						Replacing			
Soil stripping group and stockpile no.	Soil Types	Strip depth (m)	Area (ha)	Area (%)	Soil volume (m^3)	Depth (m)	Area (ha)	Area (%)	Land capability
Stockpile 1 (Red well-drained soils)	Hu3	1.2	5.55	13.84	66600	1.2	5.55	13.84	Arable
		TOTAL	5.55	13.84	66600				
Stockpile 2 (Brownish yellow well and moderately well-drained soils)	Cv1	1.2	10.89	27.16	130680	1.0	**23.85**	**59.49**	Arable
	Cv2	0.9	8.22	20.50	73980				
	Av2	0.9	4.36	10.88	39240				
	Av3	0.7	0.38	0.95	2660				
		TOTAL	**23.85**	**59.49**	**246560**				
*Stockpile 3 (Grey, imperfectly drained, sandy wetland soils)	Lo1	0.9	0.59	1.47	5310	0.9	**0.59**	**1.47**	Wetland/grazing
		TOTAL	**0.59**	**1.47**	**5310**				
No soil Shallow rocky soils, excavated areas, disturbed mining areas i.e. open pits and infrastructure footprints	R/Ms	0	0.22	0.55	0	0	**10.10**	**25.19**	Wilderness
	DMA	0	9.88	24.64	0				
		TOTAL	**10.10**	**25.19**	**0**				
		Grand Total	**40.09**	**100.0**	**318470**		40.09	100.0	
*Stripping of the wetland soil units is subject to authorization of the relevant Government authorities									

7.2.7 Soil amelioration and re-vegetation

- The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation), and soil amelioration should be done accordingly as recommended by a soil specialist, in order to correct the pH and nutrition status before re-vegetation.
- The rehabilitated sections should be re-vegetated with a grass mixture dominated by local climax species in early summer to stabilize the soil.
- A short term fertilizer program should be based on the soil chemical status after the first year in order to maintain the fertility status for 2 to 3 years after rehabilitation until the area can be declared as self sustaining.

7.3 Post-mining land capability requirements

The post-mining land capability class will be determined mainly by the soil type and the thickness of the soil layer placed back on the spoil surface. Other factors and characteristics that might influence the post-mining land capability are slope, compaction and reduction of soil quality due to contamination of soils by subsoil, soft overburden or spoil material.

A post-mining land capability assessment needs to be done progressively (annually) during the operational phase by a soil specialist by means of auger observations at a grid spacing of 100 x 100 m. This is required to evaluate the rehabilitation procedures and to verify that the topsoil thickness is similar to the replacing depths provided in Table 9a and 9b. A final post-mining land capability map needs to be compiled and should be submitted for closure purposes.

8. CONCLUSIONS

The following conclusions are made from the study:

- Wetland sections occur within the proposed opencast mining areas as shown on the land capability map for proposed opencast mining areas, Figure 4a.

- Wetland sections occur within the proposed borrow pit areas as shown on the land capability map for proposed borrow pits, Figure 4c.

- Wetland sections are intersected by proposed linear structures as shown on the land capability map for proposed linear structures, Figure 4e.

The impacts on these wetlands need to be assessed by a wetland specialist and environmental authorization is required.

9. RECOMMENDATIONS

- The soil, land capability and land use information on Figures 3a-e, 4a-e, 5a-e and 6a-b should be used to refine the proposed mine plan.

- Stripping and mining of soils within the wetland zones will be subject to authorization by the relevant government divisions.

- The procedures and guidelines in Section 7 should be integrated with the mine specific rehabilitation plan.

- The mine specific rehabilitation plan must be integrated with the mine plan to ensure successful rehabilitation and prevent the unacceptable high deterioration from pre-mining to post-mining land capability.

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APPENDIX A
SOIL CLASSIFICATION SYSTEM

The classification system categorizes soil types in an upper soil Form level which is subdivided into a number of lower Family levels. Each soil Form (higher level) is defined by a unique vertical sequence of soil horizons with specific defined properties. The soil Families (lower level) are a subdivision of the soil Form (higher level), differentiated on the basis of specific characteristics such as leaching status, calcareousness, structure types and sizes etc.

In this way, standardised soil identification and communication is allowed by use of soil Form names and family numbers or names e.g. Hutton 2100 or Hutton Hayfield. The soil Form and soil Family together are referred to as soil types.

The soil Forms are indicated by the name and the Family by its appropriate number e.g. Hutton 2100. The soil Form and Family are then symbolized e.g. Hu and referred to as soil type Hu. The soil Form and Family are often further categorized based on effective soil depth, terrain unit and slope and a numerical number is added to the symbol e.g. Hu1. For example, where the Hutton 2100 soil Form and Family occurs at an effective depth of 900-1200 mm, it is symbolized and referred to as soil type Hu1, and where this soil Form and Family occurs at an effective depth of 600-900 mm it is symbolized and referred to as soil type Hu2.

APPENDIX B
SOIL PROPERTIES AND CHARACTERISTICS

Various terms in the soil legend are used to describe a series of soil properties and characteristics such as the dominant soil Form and Family, effective soil depth, internal drainage, and clay content per soil horizon and texture class.

1. Effective soil depth

Effective soil depth can be considered as the depth freely permeable to plant roots and water. Effective soil depth categories used in the soil legend are as follows:

Very shallow	< 300mm
Shallow	300-600 mm
Moderately deep	600-900 mm
Deep	900-1500 mm
Very deep	> 1500 mm

2. Internal drainage

Internal drainage is the flow of water (annual precipitation) through the soil profile. Soils with the ability to drain annual precipitation though the profile without waterlogged periods within certain parts of the profile are called **well-drained** soils. Soils which lack this ability will display properties indicating temporary to permanent water logged conditions in parts of the soil profile in the form of mottling, leaching or gleying.

Moderately well-drained soils mostly display impeded internal drainage in the lower profile e.g. soft plinthic horizons, which is the result of periodically fluctuating water tables which are characterized by mottling and accumulation of iron and manganese oxides.

Imperfectly drained soils mostly display impeded internal drainage in the upper and lower parts of the profile e.g. E and plinthic horizons, which is the result of periodic lateral flow of water in the profile and fluctuating water tables. Such soils are characterized by grey, leached, sandy horizons and mottled plinthic horizons.

Poorly drained soils mostly display impeded internal drainage in the upper and lower parts of the soil profile e.g. E, plinthic and G-horizons and are the result of long term to permanent wetness in the soil profile, which is characterized by grey, leached, sandy horizons, mottled plinthic horizons and gleyed clay horizons.

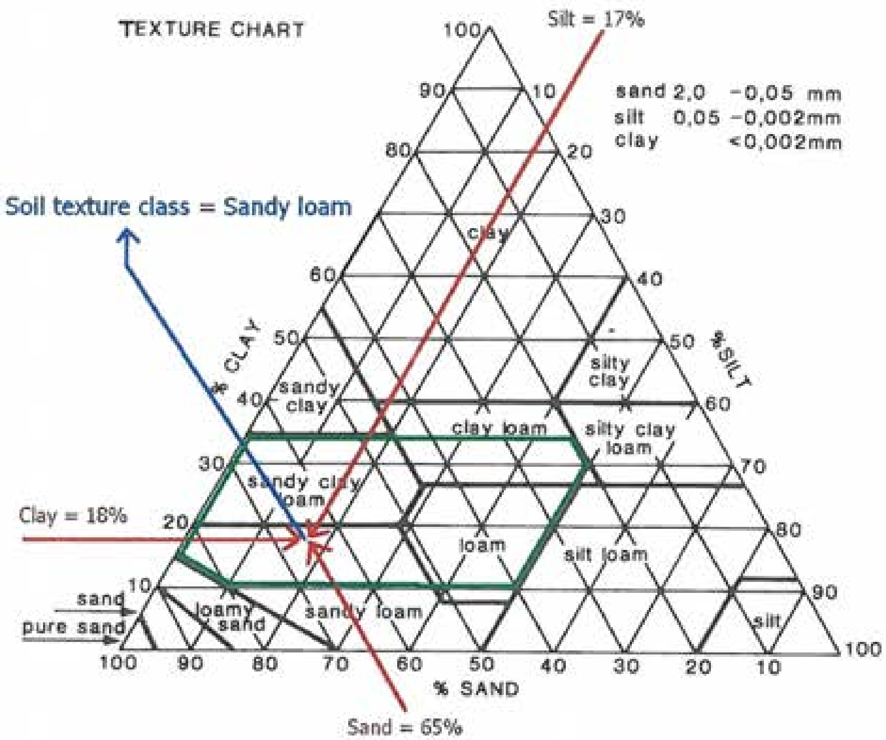
3. Texture class

Soil texture refers to the relative proportions of the various particle size separates in the soil. Particle sizes are defined in the following **fractions**.

Sand – (2.0 – 0.05 mm)
Silt – (0.05 – 0.002 mm)
Clay – (< 0.002 mm)

The relative proportions of these 3 fractions (as illustrated by the red arrows in Figure B1) determines 1 of 12 soil texture classes e.g. sandy loam, loam, sandy clay loam etc. The different texture class zones are demarcated by the thick black lines in the diagram. The green zone can be used as a guideline for moderate to high agricultural potential, but needs to be evaluated together with other soil properties.

Figure B1: Soil texture chart



APPENDIX C
WETLAND DELINEATION

1. Legal framework

In order to determine the existence and extent of a wetland in the proposed mining area the legal framework on what classifies as a wetland should be applied. The National Water Act, 1998 (Act 36 of 1998), (NWA), includes a wetland in the definition of a watercourse. A watercourse is:

- *"a river or spring;*
- *a natural channel in which water flows regularly or intermittently;*
- *a wetland, lake or dam into which, or from which, water flows, and*
- *any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse."*

A wetland is then further defined by the NWA as *"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".*

Based on the above definition, the Department of Water Affairs and Forestry (DWAF), now the Department of Water Affairs (DWA), published a set of guidelines describing field indicators and methods for determining whether an area is a wetland or riparian area, and for finding its boundaries (DWAF, 2005). These guidelines state that wetlands must have one or more of the following attributes:

- *Wetland (Hydromorphic) soils* that display characteristics resulting from prolonged saturation;
- The presence, at least occasionally, of *water loving plants (hydrophytes)*; and
- A *high water table* that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

Based on the NWA definition of a wetland, four indicators were identified within the DWAF (2005) guidelines to assist in identifying wetland areas:

- *Terrain Unit Indicator.* The topography of the area is usually used to determine where in the landscape the wetland is likely to occur.
- *Soil Form Indicator.* Certain soil forms, as defined by the Soil Classification Working Group (1991), are associated with prolonged and frequent saturation.
- *Soil Wetness Indicator.* The soil wetness indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- *Vegetation Indicator.* The vegetation indicator identifies hydrophilic vegetation associated with frequently saturated soils.

2. Processes in wetland soils and associated properties

The following processes normally take place under anaerobic/saturated or so-called wetland conditions:

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

These processes usually result in soil properties which provide undisputable evidence of temporary to permanent wetness such as:

Dark grey coloured A-horizons

The A-horizon is the upper 200-300 mm of the soil profile and is usually defined by a slightly darker colour due to a greater or lesser amount of humified organic matter. The dark grey A-horizon is common to almost all the soils found in permanent and seasonal zones. The dark grey colour usually appears only in the moist state and rapidly fades in to a plain grey colour when it dries out. The dark appearance is due to higher organic carbon content which builds up under the long term moist conditions in a wetland system. The carbon and also fine organic matter loses its dark colour in the dry state and the grey colour of the soil particles becomes prominent. The grey soil colour is the result of the removal of soluble constituents (iron oxides, silicate clay) by percolating water. The dark grey A-horizon is common in permanent, seasonal and temporary wetland zones.

Grey to pale grey E-horizons

The E-horizon underlies the A-horizon, having a lower content of colloidal matter (clay, sesquioxides, organic matter) usually reflected by a pale colour and a relative accumulation of quartz and/or other resistant minerals of sand or silt sizes. The E-horizon develops under high lateral flow (permanent or periodic) of water in the soil profile, which removes some colloidal matter to the lower soil profile and some further down the wetland system. The E-horizon is thus the flow path for shallow groundwater in the wetland zone. The grey and pale grey E-horizon is common in permanent and seasonal wetland zones and less common in temporary zones.

Yellowish grey E-horizons

The colour of the E-horizon reflects the intensity of removal of colloidal matter from the horizon. This results in the phenomenon that some E-horizons have a yellowish colour in the moist state but become grey in the dry state. The yellowish colour in the moist state is due to an incomplete covering of the mineral soil particle by ferric oxides and indicates a less leached state and less anaerobic (saturated conditions) conditions. The yellowish E-horizons are therefore strongly related to temporary wetland zones and occur less in seasonal or permanent wetland zones.

Plinthic horizons

Plinthic horizons are characterised by localization and accumulation of iron and manganese oxides under conditions of a fluctuating water table, resulting in distinct reddish brown, yellowish brown and/or black mottles, with or without hardening to form sesquioxide concretions. Plinthic horizons are the result of fluctuating water tables which implies wetter and dryer phases and are therefore found commonly in seasonal and temporary wetland zones and less in permanent wetland zones.

G-horizons

Gleying is the process of reduction of ferric oxides and hydrated oxides under anaerobic conditions, resulting in grey, low chroma matrix colours. This usually goes along with clay illuviation from the upper horizon which results in a grey clay horizon and is called a G-horizon. G-horizons are commonly found in permanent wetland zones, occasionally in seasonal zones and rarely in temporary wetland zones.

APPENDIX D
COORDINATES OF SOIL SAMPLING POINTS AND STAKE POINTS

Table D1: Coordinates of soil sampling points

Coordinates of Soil Sampling Points				
Soil sampling point	Projected Coordinate System Ellipsoid: Clarke 1880 Mod Coordinate system: LO29 Datum: Cape		Geographic Coordinate System Datum: Cape Units: Decimal degrees	
	X (m)	Y (m)	X/Lat (dd)	Y/Long (dd)
DS92	2884652.228	-14756.739	-26.072608	29.147480
DS98	2884652.228	-15656.742	-26.072599	29.156475
DT105	2884502.227	-16706.745	-26.071233	29.166967
EG73	2882552.221	-11906.730	-26.053678	29.118978
EH93	2882402.221	-14906.739	-26.052297	29.148954
EQ86	2881052.217	-13856.736	-26.040121	29.138448
EQ126	2881052.217	-19856.754	-26.040051	29.198396
EQ138	2881052.217	-21656.760	-26.040025	29.216380
ER88	2880902.216	-14156.737	-26.038764	29.141443
EV70	2880302.215	-11456.729	-26.033372	29.114462
EV72	2880302.215	-11756.730	-26.033369	29.117459
EW92	2880152.214	-14756.739	-26.031988	29.147430
EZ103	2879702.213	-16406.744	-26.027908	29.163909
FC68	2879252.211	-11156.728	-26.023896	29.111455
FG99	2878652.210	-15806.742	-26.018437	29.157902
FJ106	2878202.208	-16856.745	-26.014363	29.168385
FK104	2878052.208	-16556.744	-26.013012	29.165386
FM104	2877752.207	-16556.744	-26.010304	29.165382
FY81	2875952.201	-13106.734	-25.994091	29.130903

APPENDIX E
SOIL HORIZON PROPERTIES INFLUENCING STRIPPING AND STOCKPILING PROCEDURES

The stripping procedures aim, with consideration of practical limitations, to reconstruct the original horizon sequences. This is the only way to re-establish 70% or more of the pre-mining land capability. It is important to bear in mind that the natural soil horizons developed over thousands of years in a specific sequence and is the result of soil genesis (weathering) of the parent rock driven by climatic conditions (temperature and moisture) within a specific topography. Stripping and replacing of soil will always result in a moderate to severe disturbance of the natural balances in the soil's physical and chemical properties. This implies that, even with precise execution of well defined rehabilitation procedures, a degradation from pre-mining to post-mining land capability is unavoidable. This implies that, without precise stripping and replacing of topsoil, substantial degradation from pre-mining to post-mining land capability will probably take place.

The term topsoil in these guidelines refers to the A, B, E and G-horizons of the soil profile as defined in the Taxonomic Soil Classification system for South Africa. The A-horizon comprises the upper part (0-300 mm) of the soil profile and the B1 and B2-horizon from 300 mm up to the stripping depth specified per soil type as shown on Figure 6 and Table 10.

The A-horizon is characterised by a darker colour due to a higher organic carbon content, caused by decomposition of organic matter and roots of crops or natural vegetation. The organic carbon provides higher fertility and water holding capacity. It also improves infiltration and provides a natural buffer against compaction and hard setting. It also serves as a seed source of natural species which can re-establish after rehabilitation. It is therefore crucial to strip the A-horizon separately and replace it in the same position.

Well-drained, red and yellow brown B-horizons usually contain significantly lower organic carbon and have a higher clay content which gradually increases lower in the soil profile. The increasing clay content plays a significant role in soil potential and the soil's ability to sustain crops and plants, because it provides higher water storage capacity and prevents groundwater from rapidly leaching out of the rooting zones of plants. Red and yellow brown B-horizon materials which are placed on the surface (in the natural A-horizon position) tend to seal and compact severely, which leads to lower germination rates of seeds, restricted root development and higher runoff which triggers soil erosion.

Imperfectly to poorly drained plinthic B-horizons commonly have significantly higher clay contents than the well-drained horizons above them. They are characterised by prominent mottling and sesquioxide concretions which indicate impeded internal drainage. These materials are prone to severe compaction and sealing which result in low infiltration, higher runoff and consequent erosion when placed on the surface (in the natural A-horizon position).

Poorly drained G-horizons are clayey, very slowly permeable horizons. Placing this horizon on the surface will result in high runoff, very low infiltration and poor plant growth.

TABLE 7.3.1: ACTIVITY / GROUP OF ACTIVITIES

No.	Environmental Component	Potential Impact	Issue of Concern with I&APs Yes / No	Rating: Status	Rating: Magnitude	Rating: Extent	Rating: Duration	Rating: Probability	Rating: Significance	Rating: Reversibility	Rating: Irreplaceable loss of resources	Rating: Potential of impacts to be mitigated	Mitigation management objectives and principles	Mitigation by design	Proposed Mitigation measures	Responsible person	Timeframe of mitigation	Financial Plan: Concurrent (Annual Cost)	Financial Plan: Final (Rehabilitation)	Residual Impacts after mitigation Rating: Magnitude	Residual Impacts after mitigation Rating: Extent	Residual Impacts after mitigation Rating: Duration	Residual Impacts after mitigation Rating: Probability
1. CONSTRUCTION PHASE (approx. 6 months - 1 year)																							
1.1 Opening of initial box cut for coal mining																							
1.1.1	**Soil**	**Stripping of topsoil at initial box cut footprint and storage thereof on stockpiles.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			**1. S**oils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil. **2.** Topsoil will be stripped and stockpiled based on soil type groups (red soils, yellow brown soils and grey wetland soils) in order to preserve pre-mining soil potential and land capability as far as possible as indicated by Figure 6a and Table 9a in soil report. **3.** The topsoil stockpiles will be removed as soon as possible. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Progressively during the construction, operational and decommissioning phases			10	1	4	5
1.1.2	**Land capability**	The land capability at the footprint of the box cut will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.1.3	**Land use**	The land use at the footprint of the box cut will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.2. Preparation for the underground mining of coal																							
1.2.1	**Soil**	No impact on soil		**Neutral**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			**None**					2	1	1	1
1.2.2	**Land capability**	No impact on land capability		**Neutral**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			**None**					2	1	1	1
1.2.3	**Land use**	Will probably or already has led to withdrawal of land uses such as cultivation and grazing due to mining operation		**-**	**6**	**2**	**4**	**4**	**48**	**1**	**1**	**1**	The mine should make the area available for local farmers to utilize it		The mine should make the area available to be utilized by local farmers.	The mine's environmental officer	Construction, operational and decommissioning phases			2	1	1	1
1.3. Stripping and stockpiling of topsoil at the footprint of gravel and sand borrow pits for construction purposes																							

1.3.1	**Soil**	**Stripping of topsoil at borrow pit footprints and storage thereof on stockpiles.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			**1. S**oils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil. **2.** Topsoil will be stripped and stockpiled based on soil type groups (red soils, yellow brown soils and grey wetland soils) in order to preserve pre-mining soil potential and land capability as far as possible as indicated by Figure 6a and Table 9a in soil report. **3.** The topsoil stockpiles will be removed as soon as possible. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Progressively during the construction, operational and decommissioning phases			10	1	4	5
1.3.2	**Land capability**	The land capability at the footprint of the borrow pit will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.3.3	**Land use**	The land use at the footprint of the box cut will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.4a Construction of water management infrastructure (Pollution control dams, silt traps and drainage canal)																							
1.4.1	**Soil**	**Stripping of topsoil at the footprint of pollution control dams, silt traps and drainage canal where the upper 300 mm will be stockpiled and the remainder used for construction of the wall embankments.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			**1.** The upper 300 mm of topsoil (A-horizon) will be removed and stockpiled for final rehabilitation. **2.** The dam floor and embankments will be lined with a polyethylene membrane to prevent soil pollution by low quality mine water. **3.** Dirty water channels will be lined with concrete or a polyethylene membrane. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer and mine engineer	Contruction phase			10	1	4	5
1.4.2	**Land capability**	The land capability at the footprint of the structures will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above	As for soils above			10	1	4	5
1.4.3	**Land use**	The land use at the footprint of the structures will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above	As for soils above			10	1	4	5
1.4b Construction of water management infrastructure (underground pipelines for water)																							

1.4.1	**Soil**	**Digging of trenches for the construction of low quality water pipelines.** 1. The digging of trenches will result in mixing of the A and B soil horizons and possible mixing with low quality subsoil horizons with subsequent reduction in soil quality, fertility, water holding capacity and buffer capacity against compaction. 3. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. 5. Possible contamination of soils by spillages of fuel or oil.		**-**	**4**	**1**	**2**	**5**	**35**	**1**	**1**	**1**			1. The upper 300 mm of topsoil (A-horizon) will be excavated and placed further away from the trench. 2. The remainder of the soils up to the preferred depth should be placed in-between the trench and soils of the upper 300 mm in order to prevent mixing of the A and B-horizons. 3. The soils should be backfilled in the original sequence. 4. The footprint will be loosened with a multiple tooth implement to a depth of 300 mm in order to alleviate soil compaction. 5. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			4	1	2	5
1.4.2	**Land capability**	The land capability will reduce from arable, grazing and wetland to none because the open trences will have no land capability. The original land capability will be reinstated to a large extend when the topsoil are backfilled according to mitigation measures.		**-**	**4**	**1**	**2**	**5**	**35**	**1**	**1**	**1**			All mitigation measures applied on soils will mitigate and improve post-mining land capability	As for soils above.	As for soils above.			4	1	2	5
1.4.3	**Land use**	The land use will change from crop production and grazing to none because the open treches will have no possible land use potential. The original land uses can be reinstated when the topsoil are backfilled according to mitigation measures.		**-**	**4**	**1**	**2**	**5**	**35**	**1**	**1**	**1**			All mitigation measures applied on soils will affect post-mining land uses.	As for soils above.	As for soils above.			4	1	2	5
1.4c Construction of water management infrastructure (borehole at RLO)																							
1.4.1	**Soil**	**Drilling of a borehole usually result in destroying of the soils A and B horizons at the footprint of the borehole, approximately 200 mm in diametre, which is very small (less than 0.000004 ha).** 1. Destroying of the soils A and B-horizons at the diameter of the hole. 2. Possible pollution of soils in close vacinity of the hole with sludge and low quality water. 3. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**4**	**5**	**75**	**2**	**2**	**2**			1. There are probably no practical solution to preseve the soil's A and B horizons due to the very small size of the impact footprint. 2. Soil pollution with sludge and low quality water should be prevented with polyethylene membranes. 3. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			10	1	4	5
1.4.2	**Land capability**	The land capability will reduce from arable and grazing to none because the open borehole will have no land capability.		**-**	**10**	**1**	**4**	**5**	**75**	**2**	**2**	**2**			All mitigation measures applied on soils will mitigate and improve land capability	As for soils above.	As for soils above.			10	1	4	5
1.4.3	**Land use**	The land use will change from crop production and grazing to none because the open borehole will have no possible land use potential.		**-**	**10**	**1**	**4**	**5**	**75**	**2**	**2**	**2**			All mitigation measures applied on soils will affect post-mining land uses.	As for soils above.	As for soils above.			10	1	4	5
1.5 Construction of diesel storage tanks (above ground)																							
1.5.1	**Soil**	**Construction of diesel tanks above ground** **1**. Possible contamination of soils by spillages of fuel or oil.		**-**	**2**	**1**	**4**	**2**	**14**	**1**	**1**	**1**			1. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			2	1	1	1
1.5.2	**Land capability**	The current arable and grazing land capability will cease completely until the structure is removed.		**-**	**8**	**1**	**4**	**5**	**65**	**1**	**1**	**1**			As for soil above	As for soils above.	As for soils above.			8	1	4	1
1.5.3	**Land use**	The current land uses will cease completely until the structure is removed.		**-**	**8**	**1**	**4**	**5**	**65**	**1**	**1**	**1**			Contain the footprint as far as possible.	As for soils above.	As for soils above.			8	1	4	5
1.6a Construction of waste management infrastructure (Zaaiwater tailings dam)																							
1.6.1	**Soil**	**Construction of the Zaaiwater tailings dam on the existing backfilled opencast footprint. 1.**The topsoil was removed during the opencast mining prosess. The construction phase of the tailings dam will therefore have no additional impack on soils.		**Neutral**	**0**	**0**	**0**	**0**	**0**					Lining of drains vir concrete to prevent soil pollution in surrounding area	Lining of footprint drains to prevent soil pollution in surrounding area					10	1	5	5
1.6.2	**Land capability**	No additional impact on land capabiity during construction phase		**Neutral**	**0**	**0**	**0**	**0**	**0**						As for soils above					10	1	5	5
1.6.3	**Land use**	No additional impact on land use during construction phase		**Neutral**	**0**	**0**	**0**	**0**	**0**						As for soils above					10	1	5	5
1.6b Construction of waste management infrastructure (Pipelines for slurry)																							

1.6.1	**Soil**	**Slurry pipelines are usually above ground and will then have minor impacts on soil. If the slurry pipes are buried it will have similar impacts as water pipelines above.** 1. Possible contamination of soils by spillages of fuel or oil during consturction.		-	2	1	1	1	4	1	1	1			All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			2	1	4	1
1.6.2	**Land capability**	Minor impacts		-	2	1	1	1	4	1	1	1			As for soils above	As for soils above.	As for soils above.			2	1	4	1
1.6.3	**Land use**	The current crop production and grazing land uses will cease.		-	4	1	1	1	6	1	1	1			Contain the footprint as far as possible.	As for soils above.	As for soils above.			2	1	4	5
1.7 Construction of temporary coal stockpiles																							
1.7.1	**Soil**	**Construction of temporary coal stockpiles.** 1. Covering the soil surface with the base layer (probably soft overburden material) will cause natural soil functions (growth and nutrient medium and habitat) at the stockpile footprint to cease completely. 2. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively.		-	10	1	2	5	65	1	1	1			1. The soil surface will be covered with a soft overburden layer which will serve as a sealing layer for salt and heavy metal pollution. 2. A soft overburden berm will be constructed around the structure to manage storm water and pollution of surrounding area.	The mine's environmental officer and mine engineer	Contruction phase			8	1	4	5
1.7.2	**Land capability**	The current arable and grazing land capability will cease completely until the footprint is rehabilitated.		-	10	1	2	5	65	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.7.3	**Land use**	All current land uses will cease completely until the footprint is rehabilitated.		-	10	1	2	5	65	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.8 Construction of an explosive magazine																							
1.8.1	**Soil**	**The construction of an expolosive magazine with a concrete or gravel foundation. 1.**Covering the soil surface at the footprint of the magazine with concrete or gravel will cause natural soil functions (growth and nutrient medium and habitat) to cease completely. **2.** Compaction of foudation footprint will alter soil physical properties negatively. **3.** Possible contamination of soils by spillages of fuel or oil.		-	10	1	4	5	75	1	1	1			Contain the footprint as far as possible. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility	The mine's environmental officer	Contruction phase			8	1	4	5
1.8.2	**Land capability**	The current arable and grazing land capability will cease completely until the structure is removed.		-	10	1	4	5	75	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.8.3	**Land use**	The current land uses will cease completely until the structure is removed.		-	10	1	4	5	75	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.9 Construction of general fencing																							
1.9.1	**Soil**	**Digging or drilling of holes for fence poles and filling with concrete usually result in destroying of the soils A and B horizons at the footprint of the hole, approximately 250 mm in diametre, which is very small (less than 0.000004 ha).** 1. Destroying of the soils A and B-horizons at the diameter of the hole. 2. Possible contamination of soils by spillages of fuel or oil during construction.		-	10	1	4	5	75	1	1	1			1. There are probably no practical solution to preseve the soil's A and B horizons due to the very small size of the impact footprint. 2. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			10	1	4	5
1.9.2	**Land capability**	The land capability will reduce from arable and grazing to none because the concrete pole footprints will have no land capability.		-	10	1	4	5	75	1	1	1			All mitigation measures applied on soils will mitigate and improve land capability	As for soils above.	As for soils above.			10	1	4	5
1.9.3	**Land use**	The land use will change from crop production and grazing to none because the concrete pole footprints will have no possible land use potential.		-	10	1	4	5	75	1	1	1			All mitigation measures applied on soils will affect post-mining land uses.	As for soils above.	As for soils above.			10	1	4	5
1.10 Construction of haul roads																							

1.10.1	**Soil**	**Construction of haul roads. The soil surface will be graded, compacted and covered with base materials. 1.**Covering the soil surface with base materials will cause natural soil functions (growth and nitrient medium and habitat) at the road footprint to cease completely. **2.** Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. **3**. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			10	1	4	5
1.10.2	**Land capability**	The current arable and grazing land capability will cease completely until the structure is removed.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.10.3	**Land use**	The current land uses will cease completely until the structure is removed.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.11 Construction of ROM tip																							
1.11.1	**Soil**	**Construction of ROM tip.** 1. Covering the soil surface with the base layer (probably soft overburden material) will cause natural soil functions (growth and nutrient medium and habitat) at the stockpile footprint to cease completely. 2. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. 3. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			1. The soil surface will be covered with a soft overburden layer which will serve as a sealing layer for salt and heavy metal pollution. 2. A soft overburden berm will be constructed around the structure to manage storm water and pollution of surrounding area. 3. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer and mine engineer	Contruction phase			10	1	4	5
1.11.2	**Land capability**	The current arable and grazing land capability will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.11.3	**Land use**	The current arable and grazing land uses will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.12 Construction of raw coal stockpile																							
1.12.1	**Soil**	**Construction of raw coal stockpile.** 1. Covering the soil surface with the base layer (probably soft overburden material) will cause natural soil functions (growth and nutrient medium and habitat) at the stockpile footprint to cease completely. 2. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. 3. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			1. The soil surface will be covered with a soft overburden layer which will serve as a sealing layer for salt and heavy metal pollution. 2. A soft overburden berm will be constructed around the structure to manage storm water and pollution of surrounding area. 3. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer and mine engineer	Contruction phase			10	1	4	5
1.12.2	**Land capability**	The current arable and grazing land capability will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.12.3	**Land use**	The current arable and grazing land uses will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
2. Operational Phase (approx. years)																							
2.13 Opencast mining of coal (progressive stripping of topsoil)																							
2.13.1	**Soil**	**Progressive stripping of topsoil at the opencast footprint and direct replacing on backfilled opencast areas.** **1.** Stripping and replacing result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. **2.** Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. **3.** Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			**1.** Soils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil (Figure 6a and Table 9a in soil report). **2.** Open pits will be backfilled and spoil surfaces will be levelled and shaped to a free draining topography similar to the pre-mining surface. **3.** Topsoil will be dumped in sufficient quantities on levelled spoil surfaces to render a soil depth similar to the stripping depth after levelling (Table 9a). **4.** Soil amelioration and re-vegetation will be done as described in section 7.2.3 to 7.2.7 in the soil report. **5.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer with consultation of a soil specialist from time to time	Progressively during the, operational and decommissioning phases			6	1	2	5

2.13.2	**Land capability**	The impacts on soils as described above will cause a reduction in land capability. However, the post-mining land capability will remain arable if the mitigation measures are followed.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will mitigate and improve post-mining land capability	As for soils above	As for soils above			6	1	2	5
2.13.3	**Land use**	A reduction in land capability will reduce crop production potential and subsequent crop yields. However, the pre-mining land uses which are mainly crop farming and grazing can be reinstated after rehabilitation.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will directly affect post-mining land capability which will determine possible post mining land uses.	As for soils above	As for soils above			6	1	2	5
2.14 Concurrent rehabilitation of opencast voids																							
2.14.1	**Soil**	**Progressive stripping of topsoil at the opencast footprint and direct replacing on backfilled opencast areas.** **1.** Stripping and replacing result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. **2.** Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. **3.** Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			**1.** Soils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil (Figure 6a and Table 9a in soil report). **2.** Open pits will be backfilled and spoil surfaces will be levelled and shaped to a free draining topography similar to the pre-mining surface. **3.** Topsoil will be dumped in sufficient quantities on levelled spoil surfaces to render a soil depth similar to the stripping depth after levelling (Table 9a). **4.** Soil amelioration and re-vegetation will be done as described in section 7.2.3 to 7.2.7 in the soil report. **5.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer with consultation of a soil specialist from time to time	Progressively during the, operational and decommissioning phases			6	1	2	5
2.14.2	**Land capability**	The impacts on soils as described above will cause a reduction in land capability. However, the post-mining land capability will remain arable if the mitigation measures are followed.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will mitigate and improve post-mining land capability	As for soils above	As for soils above			6	1	2	5
2.14.3	**Land use**	A reduction in land capability will reduce crop production potential and subsequent crop yields. However, the pre-mining land uses which are mainly crop farming and grazing can be reinstated after rehabilitation.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will directly affect post-mining land capability which will determine possible post mining land uses.	As for soils above	As for soils above			6	1	2	5
2.15 Underground mining of coal																							
2.15.1	**Soil**	1. Possible subsidence with minor impact on soil physical and chemical properties		**-**	**4**	**1**	**5**	**3**	**30**	**1**	**1**	**1**			**None**					2	1	1	1
2.15.2	**Land capability**	Arable and grazing land capability wil be affected negatively		**-**	**6**	**1**	**5**	**3**	**36**	**1**	**1**	**1**			**None**					2	1	1	1
2.15.3	**Land use**	Will probably led to at least partial withdrawal of land uses such as cultivation and grazing.		**-**	**8**	**1**	**4**	**4**	**52**	**1**	**1**	**1**			Inspect all occurences of subsidence frequently and take remedial action where dangerous cracks or sinkholes occurs.	The mine's environmental officer	Construction, operational and decommis			2	1	1	1
2.16 Stripping and stockpiling of topsoil at the footprint of gravel and sand borrow pits for construction purposes																							
2.16.1	**Soil**	**Progressive stripping of topsoil at borrow pit footprints and storage thereof on stockpiles.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			**1. S**oils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil. **2.** Topsoil will be stripped and stockpiled based on soil type groups (red soils, yellow brown soils and grey wetland soils) in order to preserve pre-mining soil potential and land capability as far as possible as indicated by Figure 6a and Table 9a in soil report. **3.** The topsoil stockpiles will be removed as soon as possible. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Progressively during the construction, operational and decommissioning phases			10	1	4	5

2.16.2	**Land capability**	The land capability at the footprint of the borrow pit will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above.	As for soils above.			10	1	4	5
2.16.3	**Land use**	The land use at the footprint of the box cut will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above.	As for soils above.			10	1	4	5
2.17a Maintanance of water management infrastructure - Pollution control dams and silt traps																							
2.17.1	**Soil**	**Maintenance and use of pollution control dams and silt traps.** **1.** All impacts on soil during the construction phase will remain throughout the operational phase (natural soil functions will remain ceased). **2.** Possible contamination of soils (salts) by leaking dams or overspills of pollution control dams during the rainy season will alter soil chemical status negatively.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			1. Continuous monitoring of pollution control dam levels in order to prevent overspills. 2. Frequent inspections to identify leaks and immediate reparation thereof. 3. Immediate removal of sludge after overspills.	The mine's environmental officer	Progressively during the, operational phase			10	1	4	5
2.17.2	**Land capability**	The pre-mining land capability will remain ceased. Altered soil chemical status due to leaks or overspils might hamper land capability to some extent.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
2.17.3	**Land use**	The pre-mining land uses will remain ceased. Altered soil chemical stauts might hamper land uses to some extent.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
2.17b Use and maintanance of waste management infrastructure (Zaaiwater tailings dam)																							
2.17.1	**Soil**	Dumping of discard material on the Zaaiwater tailings dam. **1.** The dam prevent replacing of topsoil and all natural soil functions will remain ceased. **2. P**ossible leachates from the dam can cause salt pollution and acidification of soils in the surroundings area.		**-**	**10**	**2**	**5**	**5**	**85**	**3**	**3**	**3**			1. Progressive shaping of the dam edges to gradients suitable for re-vegetation. 2. Progressively covering dam edges with a topsoil layer and re-vegetation thereof with grass mixture with strong stabilizing abilities. 3. Frequent maintanance and cleaning of concrete drains. 4. Frequent inspections to identify zones contaminated by leachates seeping from the dam.	The mine's environmental officer	Progressively during the operational phase			10	1	5	5
2.17.1	**Land capability**	Land capability at the dam footprint will remain ceased.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above.	As for soils above.	As for soils above.			10	1	5	5
2.17.1	**Land use**	All land uses at the dam footprint will remain ceased.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above.	As for soils above.	As for soils above.			10	1	5	5
2.17C Use and maintanance of waste management infrastructure (Pipelines for slurry)																							
2.17.1	**Soil**	**Conveyance of low quality water and sludge via slurry pipelines.** **1.** Possible salt and sludge pollution by leaking pipes will alter soil chemical status negatively.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			Frequent inspections to identify leaks. Immediate reparation of leaks and removal of spilled sludge to a suitable disposal facility.	The mine's environmental officer	Progressively during the operational phase			4	1	1	1
2.17.2	**Land capability**	Altered soil chemical stauts might hamper land capability to some extent.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above.	As for soils above.			4	1	1	1
2.17.3	**Land use**	Altered soil chemical stauts might hamper land uses to some extent.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above.	As for soils above.			4	1	1	1
2.17d Use and maintanance of waste management infrastructure (Borehole)																							

2.17.1	**Soil**	**Extraction of water** **1.** The soil's A and B horizons remains destroyed; No additional impact.		-	4	1	1	2	12	1	1	1			No mitigation required	The mine's environmental officer	Progressively during the operational phase			2	1	1	1
2.17.2	**Land capability**	No additional impact.		-	4	1	1	2	12	1	1	1			As for soils above.	As for soils above.	As for soils above.			2	1	1	1
2.17.3	**Land use**	No additional impact.		-	4	1	1	2	12	1	1	1			As for soils above.	As for soils above.	As for soils above.			2	1	1	1
2.18 Use and maintanance of linear structures (roads and haul roads)																							
2.18.1	**Soil**	**Use of roads and haul roads.** **1.** All impacts on soils during the construction phase will remain during the operational phase. 2. Coal and coal dust pollution from haul trucks along haul road will cause salt pollution which will alter soil chemical status negatively.		-	10	1	4	5	75	1	1	1			Frequent dust sepression by water trucks. Implementation of an effective storm water management system along haul roads.	The mine's environmental officer and mine engineer	Progressively during the operational phase			10	1	4	5
2.18.2	**Land capability**	Land capability at roads and haul road footprints will remain ceased. Altered soil chemical stauts might hamper land capability to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.18.3	**Land use**	All land uses at roads and haul road footprints will remain ceased. Altered soil chemical status might hamper land uses to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.19a Use and maintanance of diesel stotage tanks																							
2.19.1	**Soil**	**Use of diesel tanks** **1**. All impacts of construction phase will remain. 2. Possible contamination of soils by spillages of diesel		-	10	1	4	5	75	1	1	1			1. All accidental fuel spillages will be cleaned up immediately.					10	1	4	5
2.19.2	**Land capability**	The pre-mining arable and grazing land capability will remain ceased until the structure is removed.		-	10	1	4	5	75	1	1	1			As for soil above					10	1	4	5
2.19.3	**Land use**	The pre-mining land uses will remain ceased until the structure is removed.		-	10	1	4	5	75	1	1	1			Contain the footprint as far as possible.					10	1	4	5
2.19b Use and maintanance coal stockpiles and ROM tip																							
2.19.1	**Soil**	**Dumping and storage of coal on coal stockpiles and ROM tip.** **1.** All impacts of the construction phase will remain during the operational phase until the site is rehabilitated. **2.** Possible salt pollution of surface runoff and leachates from the stockpile may alter soil chemical status negatively in the immediate surrounding.		-	10	1	4	5	75	1	1	1			Implementation of an efficient storm water management system	The mine's environmental officer and mine engineer	Progressively during the operational phase			10	1	4	5
2.19.2	**Land capability**	Altered soil chemical stauts might hamper land capability to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.19.3	**Land use**	Altered soil chemical stauts might hamper land uses to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.19c Use and maintanance of an explosive magazine																							
2.19.1	**Soil**	**Use and maintenance of the explosives magazine.** **1.** All impacts of the construction phase will remain during the operational phase and no additional impacts is anticipated.		-	10	1	4	5	75	1	1	1			None					10	1	4	5
2.19.2	**Land capability**	Land capability at the magazine footprint will remain ceased.		-	10	1	4	5	75	1	1	1			None					10	1	4	5
2.19.3	**Land use**	All land uses at the magazine footprint will remain ceased.		-	10	1	4	5	75	1	1	1			None					10	1	4	5
3. Decommissioning Phase (after operational phase until closure goals are reached)																							
3.20a Rehabilitation of remaining surface areas (Backfilling and rehabilitation remaining final voids)																							

3.20.1	**Soil**	**Replacing of remaining coal discard and overburden back in final voids. Back filling of final voids with overburden. Replacement of stockpiled topsoil.** **1.** Above mentioned activities are mitigtion procedures and not impacts. 2**.** Possible contamination of soils by spillages of fuel and oil.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			**1.** Stockpiled topsoil will be replaced at all remaining voids unless required to stay open. 2. Replaced topsoil will be loosened with a muliple tooth implement, ameliorated according to soil analysis and re-vegetated with a grass mixture dominated by local climax species. 3**.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer with consultation of a soil specialist from time to time	Decomisioning phase			6	1	2	5
3.20.2	**Land capability**	Spillages might affect land capabioity negatively		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20.3	**Land use**	Spillages might affect land capabioity negatively		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20b Rehabilitation of remaining surface areas (Demolishing of water management infrastructure - Pollution control dams)																							
3.20.1	**Soil**	**Demolishing of pollution control dams.** **1.** Compaction of soil by heavy mechanical equipment during replacement of soil. **2.** Possible contamination of soils by spillages of fuel or oil.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			**1.** The dam floor will be thoroughly cleaned and all polluted material will be be removed to a discard dump or suitable disposal facility. **2.** Soil material used for wall embankments will be replaced at the floor of the borrow pit. **3.** The stockpiled topsoil will be replaced on the surface. **4.** Compaction will be alleviated by ripping. **5.** Soil amelioration will be done according to analises of soil samples taken afer replacment of the stored topsoil. **6.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental or rehab officer	Decomisioning phase			6	1	2	5
3.20.2	**Land capability**	The post-mining land capability will be arable and grazing if mitigation measures are followed.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20.3	**Land use**	The post-mining land uses will be cultivation and grazing if mitigation measures are followed.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20c Rehabilitation of remaining surface areas (Rehabilitation of waste management infrastructure - Zaaiwater tailings dam)																							
3.20.1	**Soil**	**Final rehabilitation of the tailings dam.** **1.**Substantial loss of soil potential in terms of production potential and topoghaphy. Very high eriosion susceptability of soils replaced on steep edges of the dam. **2.** Possible leaking drains or leachates from the dam polluting soils in the surrounding area.		**-**	**10**	**2**	**5**	**5**	**85**	**3**	**3**	**3**			1. Shaping of the remaining dam edges to gradients suitable for re-vegetation. 2. Covering dam edges with a topsoil layer and re-vegetation with grass mixture with strong stabilizing abilities. 3. Regular inspections to identify leaking or blocked drains causing soil pollution in the surrounding area. 3. Immediate rectification of any causes that my lead to soil pollution.	The mine's environmental officer	Decomisioning phase			10	1	5	5
3.20.2	**Land capability**	Substantial reduction from pre-mining to post-mining land capability. Pre-mining land capability at the footprint of the dam remain permanently ceased. The post-mining land capabilty will be wilderness.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above. The post-mining land capability will be wilderness	As for soils above.	As for soils above.			10	1	5	5
3.20.2	**Land use**	Substantial reduction from pre-mining to post-mining land use potential. Pre-mining land uses at the footprint of the dam remain permanently ceased. No possible post-mining land uses.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above. Due to steep slopes and erosion susceptibility of rehabilitated edges no other post-mining land uses will be viable.	As for soils above.	As for soils above.			10	1	5	5
3.20d Rehabilitation of remaining surface areas (Salvation of pipes - Pipelines for slurry and water)																							

3.20.1	**Soil**	**Recovery of water and slurry pipes.** Trenches will be dug to revover water and slurry pipes. All impacts related to the constructuion phase will basically be repeated.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			1. The initial trench will be re-opened to remove pipes. 2. The upper 300 mm op topsoil should be excavated and placed further away from the trench. 3. The remainder of the soils up to the depth of the pipe should be placed in-between the trench and soils of the upper 300 mm in order to prevent mixing of the A and B-horizons. 4. The soils should be backfilled in the original sequence with the high quality soils on top after the pipes had been removed. 5. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Decomisioning phase			4	1	2	5
3.20.2	**Land capability**	Little reduction of land capability will take place if mitigtion measures are followed. The post-mining land capability will be arable and grazing and wetland.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			4	1	2	5
3.20.3	**Land use**	Little reduction of land use potential will take place if mitigtion measures are followed. The post-mining land use will be cultivation and grazing.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			4	1	2	5
3.20e Rehabilitation of remaining surface areas (Demolishing and rehabilitation of termporary and raw coal stockpiles)																							
3.20.1	**Soil**	**Removal of all coal and the basis layer at the footprint of coal stockpiles.** **1.** Possible contamination of soils by spillages of fuel and oil.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			**1.** The footprint will be thoroughly cleaned and all coalliferous and soft overburden material will be removed to a discard dump or suitable disposal facility. **2.** The footprint will be loosened with a multiple tooth impement to a depth of at least 300 mm to alleviate compaction. **3.** The topsoil will be replaced and ameliorated according to soil chemical analysis. **4.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	Decomisioning phase			2	1	1	1
3.20.2	**Land capability**	Little reduction of land capability will take place if mitigtion measures are followed. The post-mining land capability will be arable and grazing.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above. The post-mining land capability will be arable	As for soils above.	As for soils above.			2	1	1	1
3.20.3	**Land use**	Little reduction of land use potential will take place if mitigtion measures are followed. The post-mining land use will be cultivation and grazing.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above. The post-mning land uses will be grazing or cultivation.	As for soils above.	As for soils above.			2	1	1	1
3.20f Rehabilitation of remaining surface areas (Demolishing of the explosive magazine and rehabilitation of the footprint)																							
3.20.1	**Soil**	**Complete removal of the structure and its foundations.** **1.** Possible spillages of oil or fuel by mechanical equipment used during the demolishing process. **2.** Compaction of soil by mechanical equipment.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			**1.** During the decommissioning phase the footprint should be thoroughly cleaned. **2.** Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface. **3.** The footprint should be ripped to alleviate compaction. **4.** The topsoil should be ameliorated according to soil chemical analysis. **5.** The footprint should be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	The decommissioning phase			2	1	1	1
3.20.2	**Land capability**	**Complete removal of the structure and its foundations.** Spillages of oil and fuel and compaction of soil will have minor impacts on land capability.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land capability will be arable or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.20.3	**Land use**	**Complete removal of the structure and its foundations.** Spillages of oil and fuel and compaction of soil will have minor impacts on land use.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land use can be cultivation or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.20g Rehabilitation of remaining surface areas (Demolishing of roads and haul roads)																							
3.20.1	**Soil**	**Complete removal of all roads building material. 1.** Possible spillages of oil or fuel by mechanical equipment used during the demolishing process. **2.** Compaction of soil by mechanical equipment.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			**1.** The footprint should be thoroughly cleaned and all road building matrial will be removed to a discard dump or suitable disposal facility. **2.** The footprint will be ripped to alleviate soil compaction and graded to a smooth surface. **3.** The topsoil will be ameliorated according to soil chemical analysis of samples taken after ripping. **4.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	The decommissioning phase			2	1	1	1

3.20.2	**Land capability**	**Complete removal of all roads building material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land capability.		-	4	1	1	1	6	1	1	1			As for soils above. The post-mining land capability will be arable or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.20.3	**Land use**	**Complete removal of all roads building material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land use.		-	4	1	1	1	6	1	1	1			As for soils above. The post-mining land use can be cultivation or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.21 Legacy rehabilitation - Cleaning up of polluted areas at Tweefontein Spruit, Waterpan dump, Tweefontein Dam, Witcons dump																							
3.21.1	**Soil**	**Removal of all coalliferous and mining waste material. These activities is mitigation procuderes and not impacts. 1.** Possible spillages of oil or fuel by mechanical equipment used during the rehabilitation process. **2.** Compaction of soil by mechanical equipment.		-	4	1	1	1	6	1	1	1			**1.** The footprint should be thoroughly cleaned of all mine waste matrial. **2.** The footprint will be ripped (accept for in rivers) to alleviate soil compaction and graded to a smooth surface. **3.** The topsoil will be ameliorated according to soil chemical analysis of samples taken after ripping. **4.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	The decommissioning phase			2	1	2	2
3.21.2	**Land capability**	**Complete removal of all mine waste material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land capability.		-	4	1	1	1	6	1	1	1			As for soils above. The post-mining land capability will be arable or grazing.	As for soils above.	As for soils above.			2	1	2	2
3.21.3	**Land use**	**Complete removal of all mine waste material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land use.		-	4	1	1	1	6	1	1	1			As for soils above. The post-mining land use can be cultivation or grazing.	As for soils above.	As for soils above.			2	1	2	2
3.22 Construction of a golf course on backfilled opencast areas																							
	Soil	The construction of a golf course on backfilled opencast areas will involve shaping of backfilled spoil material according to the landscape design of the golf course and replacement of topsoil which were **probably stripped and stockpiled during the opencast mining process.** The impacts on soils, land capability and land use **therefore already took place**. **(NB The impacts on soils, land capability and land use are formulated comparing the construction of the golf course to the pre-mining environment).** Impacts are: **1.** Soils were not stripped and stockpiled based on soil types which result in a reduction of soil potential by mixing different soil types and horizons with varying textural classes with subsequent reduction in fertility and water holding capacity as well as buffer capacity against compaction. **2.** A reduction of effective soil		-	10	1	5	5	80	2	2	2			**1.** The available soil volume for rehabilitation will be determined in order to calculate the average depth at which topsoil can be replaced on the shaped spoil footprint of the golf course. **2.** The topsoil will be spread evenly over the golf course footprint at the calculated depth, avoiding compaction by mechanical equipment as far as possible. **3.** The topsoil surface will be loosened with a multiple tooth implement to a depth of 300 mm to alleviate compaction and then graded with a grader to a smooth surface. **3.** The topsoil will be ameliorated according to soil chemical analysis. **4.** The footprint will be re-vegetated with a grass type suitable for the golf course.	The mine's environmental officer	The decommissioning phase			6	1	2	5
	Land capability	A reduction in land capability due impacts on soil as described above. The pre-mining land capability which was mainly arable land will probably reduce to post-mining grazing, wetland and wilderness.		-	10	1	5	5	80	2	2	2			As for soils above. The post-mining land capability will be grazing, wetland and wilderness.	As for soils above.	As for soils above.			6	1	2	5
	Land use	The possible pre-mining land uses which were mainly crop production and grazing will reduce to being used as a golf course with subsequent loss of productive food producing land.		-	10	1	5	5	80	2	2	2			As for soils above. The post-mining land use will be a golf course.	As for soils above.	As for soils above.			6	1	2	5

TABLE 7.3.1: ACTIVITY / GROUP OF ACTIVITIES

No.	Environmental Component	Potential Impact	Issue of Concern with I&APs	Rating									Mitigation management objectives and principles	Mitigation by design	Proposed Mitigation measures	Responsible person	Timeframe of mitigation	Financial Plan		Residual Impacts after mitigation: Rating			
			Yes / No	Status	Magnitude	Extent	Duration	Probability	Significance	Reversibility	Irreplaceable loss of resources	Potential of impacts to be mitigated						Concurrent (Annual Cost)	Final (Rehabilitation)	Magnitude	Extent	Duration	Probability
1. CONSTRUCTION PHASE (approx. 6 months - 1 year)																							
1.1 Opening of initial box cut for coal mining																							
1.1.1	**Soil**	**Stripping of topsoil at initial box cut footprint and storage thereof on stockpiles.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		-	10	2	4	5	80	2	2	2			**1. S**oils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil. **2.** Topsoil will be stripped and stockpiled based on soil type groups (red soils, yellow brown soils and grey wetland soils) in order to preserve pre-mining soil potential and land capability as far as possible as indicated by Figure 6a and Table 9a in soil report. **3.** The topsoil stockpiles will be removed as soon as possible. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Progressively during the construction, operational and decommissioning phases			10	1	4	5
1.1.2	**Land capability**	The land capability at the footprint of the box cut will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		-	10	2	4	5	80	2	2	2			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.1.3	**Land use**	The land use at the footprint of the box cut will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		-	10	2	4	5	80	2	2	2			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.2. Preparation for the underground mining of coal																							
1.2.1	**Soil**	No impact on soil		**Neutral**	2	1	1	1	4	1	1	1			**None**					2	1	1	1
1.2.2	**Land capability**	No impact on land capability		**Neutral**	2	1	1	1	4	1	1	1			**None**					2	1	1	1
1.2.3	**Land use**	Will probably or already has led to withdrawal of land uses such as cultivation and grazing due to mining operation		-	6	2	4	4	48	1	1	1	The mine should make the area available for local farmers to utilize it		The mine should make the area available to be utilized by local farmers.	The mine's environmental officer	Construction, operational and decommissioning phases			2	1	1	1
1.3. Stripping and stockpiling of topsoil at the footprint of gravel and sand borrow pits for construction purposes																							

1.3.1	**Soil**	**Stripping of topsoil at borrow pit footprints and storage thereof on stockpiles.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			**1. S**oils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil. **2.** Topsoil will be stripped and stockpiled based on soil type groups (red soils, yellow brown soils and grey wetland soils) in order to preserve pre-mining soil potential and land capability as far as possible as indicated by Figure 6a and Table 9a in soil report. **3.** The topsoil stockpiles will be removed as soon as possible. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Progressively during the construction, operational and decommissioning phases			10	1	4	5
1.3.2	**Land capability**	The land capability at the footprint of the borrow pit will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.3.3	**Land use**	The land use at the footprint of the box cut will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above.	As for soils above.			10	1	4	5
1.4a Construction of water management infrastructure (Pollution control dams, silt traps and drainage canal)																							
1.4.1	**Soil**	**Stripping of topsoil at the footprint of pollution control dams, silt traps and drainage canal where the upper 300 mm will be stockpiled and the remainder used for construction of the wall embankments.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			**1.** The upper 300 mm of topsoil (A-horizon) will be removed and stockpiled for final rehabilitation. **2.** The dam floor and embankments will be lined with a polyethylene membrane to prevent soil pollution by low quality mine water. **3.** Dirty water channels will be lined with concrete or a polyethylene membrane. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer and mine engineer	Contruction phase			10	1	4	5
1.4.2	**Land capability**	The land capability at the footprint of the structures will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above	As for soils above			10	1	4	5
1.4.3	**Land use**	The land use at the footprint of the structures will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above	As for soils above			10	1	4	5
1.4b Construction of water management infrastructure (underground pipelines for water)																							

1.4.1	**Soil**	**Digging of trenches for the construction of low quality water pipelines.** 1. The digging of trenches will result in mixing of the A and B soil horizons and possible mixing with low quality subsoil horizons with subsequent reduction in soil quality, fertility, water holding capacity and buffer capacity against compaction. 3. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. 5. Possible contamination of soils by spillages of fuel or oil.		**-**	**4**	**1**	**2**	**5**	**35**	**1**	**1**	**1**			1. The upper 300 mm of topsoil (A-horizon) will be excavated and placed further away from the trench. 2. The remainder of the soils up to the preferred depth should be placed in-between the trench and soils of the upper 300 mm in order to prevent mixing of the A and B-horizons. 3. The soils should be backfilled in the original sequence. 4. The footprint will be loosened with a multiple tooth implement to a depth of 300 mm in order to alleviate soil compaction. 5. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			4	1	2	5
1.4.2	**Land capability**	The land capability will reduce from arable, grazing and wetland to none because the open trences will have no land capability. The original land capability will be reinstated to a large extend when the topsoil are backfilled according to mitigation measures.		**-**	**4**	**1**	**2**	**5**	**35**	**1**	**1**	**1**			All mitigation measures applied on soils will mitigate and improve post-mining land capability	As for soils above.	As for soils above.			4	1	2	5
1.4.3	**Land use**	The land use will change from crop production and grazing to none because the open treches will have no possible land use potential. The original land uses can be reinstated when the topsoil are backfilled according to mitigation measures.		**-**	**4**	**1**	**2**	**5**	**35**	**1**	**1**	**1**			All mitigation measures applied on soils will affect post-mining land uses.	As for soils above.	As for soils above.			4	1	2	5
1.4c Construction of water management infrastructure (borehole at RLO)																							
1.4.1	**Soil**	**Drilling of a borehole usually result in destroying of the soils A and B horizons at the footprint of the borehole, approximately 200 mm in diametre, which is very small (less than 0.000004 ha).** 1. Destroying of the soils A and B-horizons at the diameter of the hole. 2. Possible pollution of soils in close vacinity of the hole with sludge and low quality water. 3. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**4**	**5**	**75**	**2**	**2**	**2**			1. There are probably no practical solution to preseve the soil's A and B horizons due to the very small size of the impact footprint. 2. Soil pollution with sludge and low quality water should be prevented with polyethylene membranes. 3. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			10	1	4	5
1.4.2	**Land capability**	The land capability will reduce from arable and grazing to none because the open borehole will have no land capability.		**-**	**10**	**1**	**4**	**5**	**75**	**2**	**2**	**2**			All mitigation measures applied on soils will mitigate and improve land capability	As for soils above.	As for soils above.			10	1	4	5
1.4.3	**Land use**	The land use will change from crop production and grazing to none because the open borehole will have no possible land use potential.		**-**	**10**	**1**	**4**	**5**	**75**	**2**	**2**	**2**			All mitigation measures applied on soils will affect post-mining land uses.	As for soils above.	As for soils above.			10	1	4	5
1.5 Construction of diesel storage tanks (above ground)																							
1.5.1	**Soil**	**Construction of diesel tanks above ground** **1**. Possible contamination of soils by spillages of fuel or oil.		**-**	**2**	**1**	**4**	**2**	**14**	**1**	**1**	**1**			1. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			2	1	1	1
1.5.2	**Land capability**	The current arable and grazing land capability will cease completely until the structure is removed.		**-**	**8**	**1**	**4**	**5**	**65**	**1**	**1**	**1**			As for soil above	As for soils above.	As for soils above.			8	1	4	1
1.5.3	**Land use**	The current land uses will cease completely until the structure is removed.		**-**	**8**	**1**	**4**	**5**	**65**	**1**	**1**	**1**			Contain the footprint as far as possible.	As for soils above.	As for soils above.			8	1	4	5
1.6a Construction of waste management infrastructure (Zaaiwater tailings dam)																							
1.6.1	**Soil**	**Construction of the Zaaiwater tailings dam on the existing backfilled opencast footprint. 1**.The topsoil was removed during the opencast mining prosess. The construction phase of the tailings dam will therefore have no additional impack on soils.		**Neutral**	**0**	**0**	**0**	**0**	**0**					Lining of drains vir concrete to prevent soil pollution in surrounding area	Lining of footprint drains to prevent soil pollution in surrounding area					10	1	5	5
1.6.2	**Land capability**	No additional impact on land capabiity during construction phase		**Neutral**	**0**	**0**	**0**	**0**	**0**						As for soils above					10	1	5	5
1.6.3	**Land use**	No additional impact on land use during construction phase		**Neutral**	**0**	**0**	**0**	**0**	**0**						As for soils above					10	1	5	5
1.6b Construction of waste management infrastructure (Pipelines for slurry)																							

1.6.1	Soil	**Slurry pipelines are usually above ground and will then have minor impacts on soil. If the slurry pipes are buried it will have similar impacts as water pipelines above.** 1. Possible contamination of soils by spillages of fuel or oil during consturction.		-	2	1	1	1	4	1	1	1			All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			2	1	4	1
1.6.2	Land capability	Minor impacts		-	2	1	1	1	4	1	1	1			As for soils above	As for soils above.	As for soils above.			2	1	4	1
1.6.3	Land use	The current crop production and grazing land uses will cease.		-	4	1	1	1	6	1	1	1			Contain the footprint as far as possible.	As for soils above.	As for soils above.			2	1	4	5
1.7 Construction of temporary coal stockpiles																							
1.7.1	Soil	**Construction of temporary coal stockpiles.** 1. Covering the soil surface with the base layer (probably soft overburden material) will cause natural soil functions (growth and nutrient medium and habitat) at the stockpile footprint to cease completely. 2. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively.		-	10	1	2	5	65	1	1	1			1. The soil surface will be covered with a soft overburden layer which will serve as a sealing layer for salt and heavy metal pollution. 2. A soft overburden berm will be constructed around the structure to manage storm water and pollution of surrounding area.	The mine's environmental officer and mine engineer	Contruction phase			8	1	4	5
1.7.2	Land capability	The current arable and grazing land capability will cease completely until the footprint is rehabilitated.		-	10	1	2	5	65	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.7.3	Land use	All current land uses will cease completely until the footprint is rehabilitated.		-	10	1	2	5	65	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.8 Construction of an explosive magazine																							
1.8.1	Soil	**The construction of an expolosive magazine with a concrete or gravel foundation. 1.**Covering the soil surface at the footprint of the magazine with concrete or gravel will cause natural soil functions (growth and nutrient medium and habitat) to cease completely. **2.** Compaction of foudation footprint will alter soil physical properties negatively. **3.** Possible contamination of soils by spillages of fuel or oil.		-	10	1	4	5	75	1	1	1			Contain the footprint as far as possible. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility	The mine's environmental officer	Contruction phase			8	1	4	5
1.8.2	Land capability	The current arable and grazing land capability will cease completely until the structure is removed.		-	10	1	4	5	75	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.8.3	Land use	The current land uses will cease completely until the structure is removed.		-	10	1	4	5	75	1	1	1			As for soils above	As for soils above	As for soils above			8	1	4	5
1.9 Construction of general fencing																							
1.9.1	Soil	**Digging or drilling of holes for fence poles and filling with concrete usually result in destroying of the soils A and B horizons at the footprint of the hole, approximately 250 mm in diametre, which is very small (less than 0.000004 ha).** 1. Destroying of the soils A and B-horizons at the diameter of the hole. 2. Possible contamination of soils by spillages of fuel or oil during construction.		-	10	1	4	5	75	1	1	1			1. There are probably no practical solution to preseve the soil's A and B horizons due to the very small size of the impact footprint. 2. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			10	1	4	5
1.9.2	Land capability	The land capability will reduce from arable and grazing to none because the concrete pole footprints will have no land capability.		-	10	1	4	5	75	1	1	1			All mitigation measures applied on soils will mitigate and improve land capability	As for soils above.	As for soils above.			10	1	4	5
1.9.3	Land use	The land use will change from crop production and grazing to none because the concrete pole footprints will have no possible land use potential.		-	10	1	4	5	75	1	1	1			All mitigation measures applied on soils will affect post-mining land uses.	As for soils above.	As for soils above.			10	1	4	5
1.10 Construction of haul roads																							

1.10.1	**Soil**	**Construction of haul roads. The soil surface will be graded, compacted and covered with base materials. 1.**Covering the soil surface with base materials will cause natural soil functions (growth and nitrient medium and habitat) at the road footprint to cease completely. **2.** Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. **3**. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Contruction phase			10	1	4	5
1.10.2	**Land capability**	The current arable and grazing land capability will cease completely until the structure is removed.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.10.3	**Land use**	The current land uses will cease completely until the structure is removed.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.11 Construction of ROM tip																							
1.11.1	**Soil**	**Construction of ROM tip.** 1. Covering the soil surface with the base layer (probably soft overburden material) will cause natural soil functions (growth and nutrient medium and habitat) at the stockpile footprint to cease completely. 2. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. 3. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			1. The soil surface will be covered with a soft overburden layer which will serve as a sealing layer for salt and heavy metal pollution. 2. A soft overburden berm will be constructed around the structure to manage storm water and pollution of surrounding area. 3. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer and mine engineer	Contruction phase			10	1	4	5
1.11.2	**Land capability**	The current arable and grazing land capability will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.11.3	**Land use**	The current arable and grazing land uses will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.12 Construction of raw coal stockpile																							
1.12.1	**Soil**	**Construction of raw coal stockpile.** 1. Covering the soil surface with the base layer (probably soft overburden material) will cause natural soil functions (growth and nutrient medium and habitat) at the stockpile footprint to cease completely. 2. Compaction of soil by heavy mechanical equipment will alter soil physical properties negatively. 3. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			1. The soil surface will be covered with a soft overburden layer which will serve as a sealing layer for salt and heavy metal pollution. 2. A soft overburden berm will be constructed around the structure to manage storm water and pollution of surrounding area. 3. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer and mine engineer	Contruction phase			10	1	4	5
1.12.2	**Land capability**	The current arable and grazing land capability will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
1.12.3	**Land use**	The current arable and grazing land uses will cease completely for the lifespan of the structure.		**-**	**10**	**1**	**2**	**5**	**65**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
2. Operational Phase (approx. years)																							
2.13 Opencast mining of coal (progressive stripping of topsoil)																							
2.13.1	**Soil**	**Progressive stripping of topsoil at the opencast footprint and direct replacing on backfilled opencast areas.** **1.** Stripping and replacing result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. **2.** Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. **3.** Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			**1.** Soils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil (Figure 6a and Table 9a in soil report). **2.** Open pits will be backfilled and spoil surfaces will be levelled and shaped to a free draining topography similar to the pre-mining surface. **3.** Topsoil will be dumped in sufficient quantities on levelled spoil surfaces to render a soil depth similar to the stripping depth after levelling (Table 9a). **4.** Soil amelioration and re-vegetation will be done as described in section 7.2.3 to 7.2.7 in the soil report. **5.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer with consultation of a soil specialist from time to time	Progressively during the, operational and decommissioning phases			6	1	2	5

2.13.2	**Land capability**	The impacts on soils as described above will cause a reduction in land capability. However, the post-mining land capability will remain arable if the mitigation measures are followed.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will mitigate and improve post-mining land capability	As for soils above	As for soils above			6	1	2	5
2.13.3	**Land use**	A reduction in land capability will reduce crop production potential and subsequent crop yields. However, the pre-mining land uses which are mainly crop farming and grazing can be reinstated after rehabilitation.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will directly affect post-mining land capability which will determine possible post mining land uses.	As for soils above	As for soils above			6	1	2	5
2.14 Concurrent rehabilitation of opencast voids																							
2.14.1	**Soil**	**Progressive stripping of topsoil at the opencast footprint and direct replacing on backfilled opencast areas.** **1.** Stripping and replacing result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. **2.** Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. **3.** Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			**1.** Soils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil (Figure 6a and Table 9a in soil report). **2.** Open pits will be backfilled and spoil surfaces will be levelled and shaped to a free draining topography similar to the pre-mining surface. **3.** Topsoil will be dumped in sufficient quantities on levelled spoil surfaces to render a soil depth similar to the stripping depth after levelling (Table 9a). **4.** Soil amelioration and re-vegetation will be done as described in section 7.2.3 to 7.2.7 in the soil report. **5.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer with consultation of a soil specialist from time to time	Progressively during the, operational and decommissioning phases			6	1	2	5
2.14.2	**Land capability**	The impacts on soils as described above will cause a reduction in land capability. However, the post-mining land capability will remain arable if the mitigation measures are followed.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will mitigate and improve post-mining land capability	As for soils above	As for soils above			6	1	2	5
2.14.3	**Land use**	A reduction in land capability will reduce crop production potential and subsequent crop yields. However, the pre-mining land uses which are mainly crop farming and grazing can be reinstated after rehabilitation.		**-**	**10**	**1**	**2**	**5**	**65**	**2**	**2**	**2**			All mitigation measures applied on soils will directly affect post-mining land capability which will determine possible post mining land uses.	As for soils above	As for soils above			6	1	2	5
2.15 Underground mining of coal																							
2.15.1	**Soil**	1. Possible subsidence with minor impact on soil physical and chemical properties		**-**	**4**	**1**	**5**	**3**	**30**	**1**	**1**	**1**			**None**					2	1	1	1
2.15.2	**Land capability**	Arable and grazing land capability wil be affected negatively		**-**	**6**	**1**	**5**	**3**	**36**	**1**	**1**	**1**			**None**					2	1	1	1
2.15.3	**Land use**	Will probably led to at least partial withdrawal of land uses such as cultivation and grazing.		**-**	**8**	**1**	**4**	**4**	**52**	**1**	**1**	**1**			Inspect all occurences of subsidence frequently and take remedial action where dangerous cracks or sinkholes occurs.	The mine's environmental officer	Construction, operational and decommis			2	1	1	1
2.16 Stripping and stockpiling of topsoil at the footprint of gravel and sand borrow pits for construction purposes																							
2.16.1	**Soil**	**Progressive stripping of topsoil at borrow pit footprints and storage thereof on stockpiles.** 1. Stripping and stockpiling result in mixing of the soil's A and B-horizons with different textural classes with subsequent reduction in fertility, water holding capacity and buffer capacity against compaction. 2. Stripping of lower quality subsoil together with high quality topsoil result in a reduction of soil quality and subsequent land capability. 3. The topsoil stockpiles will cover the natural soil surface and cause the majority of soil functions (growth and nutrient medium and habitat) to cease completely. 4. Possible contamination of soils by spillages of fuel or oil.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			**1. S**oils will be stripped at specified depths in order to prevent stripping of lower quality subsoil together with topsoil. **2.** Topsoil will be stripped and stockpiled based on soil type groups (red soils, yellow brown soils and grey wetland soils) in order to preserve pre-mining soil potential and land capability as far as possible as indicated by Figure 6a and Table 9a in soil report. **3.** The topsoil stockpiles will be removed as soon as possible. **4.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Progressively during the construction, operational and decommissioning phases			10	1	4	5

2.16.2	**Land capability**	The land capability at the footprint of the borrow pit will reduce from arable land and grazing to none because there will be no topsoil. The land capability at the footprint where topsoil are stockpiled will reduce from arable and grazng to none becuase the topsoil stockpile will cover the productive soil surface. The soil quality of the stockpiled topsoil will decreas due to compaction and mixing of soil horizons and subsequent deterioration of soil properties such as water holding capacity and fertility status.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land capability as far as possible	As for soils above.	As for soils above.			10	1	4	5
2.16.3	**Land use**	The land use at the footprint of the box cut will reduce from cultivation and grazing to none because there will be no topsoil. The land use at the footprint where topsoil are stockpiled will reduce from cultivation and grazng to none becuase the topsoil stockpile will cover the productive soil surface.		**-**	**10**	**2**	**4**	**5**	**80**	**2**	**2**	**2**			All mitigation measures applied on soils will directly contribute to reinsate pre-mining land uses as far as possible	As for soils above.	As for soils above.			10	1	4	5
2.17a Maintanance of water management infrastructure - Pollution control dams and silt traps																							
2.17.1	**Soil**	**Maintenance and use of pollution control dams and silt traps.** **1.** All impacts on soil during the construction phase will remain throughout the operational phase (natural soil functions will remain ceased). **2.** Possible contamination of soils (salts) by leaking dams or overspills of pollution control dams during the rainy season will alter soil chemical status negatively.		**-**	**10**	**2**	**4**	**5**	**80**	**1**	**1**	**1**			1. Continuous monitoring of pollution control dam levels in order to prevent overspills. 2. Frequent inspections to identify leaks and immediate reparation thereof. 3. Immediate removal of sludge after overspills.	The mine's environmental officer	Progressively during the, operational phase			10	1	4	5
2.17.2	**Land capability**	The pre-mining land capability will remain ceased. Altered soil chemical status due to leaks or overspils might hamper land capability to some extent.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
2.17.3	**Land use**	The pre-mining land uses will remain ceased. Altered soil chemical stauts might hamper land uses to some extent.		**-**	**10**	**1**	**4**	**5**	**75**	**1**	**1**	**1**			As for soils above	As for soils above	As for soils above			10	1	4	5
2.17b Use and maintanance of waste management infrastructure (Zaaiwater tailings dam)																							
2.17.1	**Soil**	Dumping of discard material on the Zaaiwater tailings dam. **1.** The dam prevent replacing of topsoil and all natural soil functions will remain ceased. **2. P**ossible leachates from the dam can cause salt pollution and acidification of soils in the surroundings area.		**-**	**10**	**2**	**5**	**5**	**85**	**3**	**3**	**3**			1. Progressive shaping of the dam edges to gradients suitable for re-vegetation. 2. Progressively covering dam edges with a topsoil layer and re-vegetation thereof with grass mixture with strong stabilizing abilities. 3. Frequent maintanance and cleaning of concrete drains. 4. Frequent inspections to identify zones contaminated by leachates seeping from the dam.	The mine's environmental officer	Progressively during the operational phase			10	1	5	5
2.17.1	**Land capability**	Land capability at the dam footprint will remain ceased.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above.	As for soils above.	As for soils above.			10	1	5	5
2.17.1	**Land use**	All land uses at the dam footprint will remain ceased.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above.	As for soils above.	As for soils above.			10	1	5	5
2.17C Use and maintanance of waste management infrastructure (Pipelines for slurry)																							
2.17.1	**Soil**	**Conveyance of low quality water and sludge via slurry pipelines.** **1.** Possible salt and sludge pollution by leaking pipes will alter soil chemical status negatively.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			Frequent inspections to identify leaks. Immediate reparation of leaks and removal of spilled sludge to a suitable disposal facility.	The mine's environmental officer	Progressively during the operational phase			4	1	1	1
2.17.2	**Land capability**	Altered soil chemical stauts might hamper land capability to some extent.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above.	As for soils above.			4	1	1	1
2.17.3	**Land use**	Altered soil chemical stauts might hamper land uses to some extent.		**-**	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above.	As for soils above.			4	1	1	1
2.17d Use and maintanance of waste management infrastructure (Borehole)																							

2.17.1	**Soil**	**Extraction of water** **1.** The soil's A and B horizons remains destroyed; No additional impact.		-	4	1	1	2	12	1	1	1			No mitigation required	The mine's environmental officer	Progressively during the operational phase			2	1	1	1
2.17.2	**Land capability**	No additional impact.		-	4	1	1	2	12	1	1	1			As for soils above.	As for soils above.	As for soils above.			2	1	1	1
2.17.3	**Land use**	No additional impact.		-	4	1	1	2	12	1	1	1			As for soils above.	As for soils above.	As for soils above.			2	1	1	1
2.18 Use and maintanance of linear structures (roads and haul roads)																							
2.18.1	**Soil**	**Use of roads and haul roads.** **1.** All impacts on soils during the construction phase will remain during the operational phase. 2. Coal and coal dust pollution from haul trucks along haul road will cause salt pollution which will alter soil chemical status negatively.		-	10	1	4	5	75	1	1	1			Frequent dust sepression by water trucks. Implementation of an effective storm water management system along haul roads.	The mine's environmental officer and mine engineer	Progressively during the operational phase			10	1	4	5
2.18.2	**Land capability**	Land capability at roads and haul road footprints will remain ceased. Altered soil chemical stauts might hamper land capability to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.18.3	**Land use**	All land uses at roads and haul road footprints will remain ceased. Altered soil chemical status might hamper land uses to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.19a Use and maintanance of diesel stotage tanks																							
2.19.1	**Soil**	**Use of diesel tanks** **1**. All impacts of construction phase will remain. 2. Possible contamination of soils by spillages of diesel		-	10	1	4	5	75	1	1	1			1. All accidental fuel spillages will be cleaned up immediately.					10	1	4	5
2.19.2	**Land capability**	The pre-mining arable and grazing land capability will remain ceased until the structure is removed.		-	10	1	4	5	75	1	1	1			As for soil above					10	1	4	5
2.19.3	**Land use**	The pre-mining land uses will remain ceased until the structure is removed.		-	10	1	4	5	75	1	1	1			Contain the footprint as far as possible.					10	1	4	5
2.19b Use and maintanance coal stockpiles and ROM tip																							
2.19.1	**Soil**	**Dumping and storage of coal on coal stockpiles and ROM tip.** **1.** All impacts of the construction phase will remain during the operational phase until the site is rehabilitated. **2.** Possible salt pollution of surface runoff and leachates from the stockpile may alter soil chemical status negatively in the immediate surrounding.		-	10	1	4	5	75	1	1	1			Implementation of an efficient storm water management system	The mine's environmental officer and mine engineer	Progressively during the operational phase			10	1	4	5
2.19.2	**Land capability**	Altered soil chemical stauts might hamper land capability to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.19.3	**Land use**	Altered soil chemical stauts might hamper land uses to some extent.		-	10	1	4	5	75	1	1	1			As for soils above.	As for soils above.	As for soils above.			10	1	4	5
2.19c Use and maintanance of an explosive magazine																							
2.19.1	**Soil**	**Use and maintenance of the explosives magazine.** **1.** All impacts of the construction phase will remain during the operational phase and no additional impacts is anticipated.		-	10	1	4	5	75	1	1	1			None					10	1	4	5
2.19.2	**Land capability**	Land capability at the magazine footprint will remain ceased.		-	10	1	4	5	75	1	1	1			None					10	1	4	5
2.19.3	**Land use**	All land uses at the magazine footprint will remain ceased.		-	10	1	4	5	75	1	1	1			None					10	1	4	5
3. Decommissioning Phase (after operational phase until closure goals are reached)																							
3.20a Rehabilitation of remaining surface areas (Backfilling and rehabilitation remaining final voids)																							

3.20.1	**Soil**	**Replacing of remaining coal discard and overburden back in final voids. Back filling of final voids with overburden. Replacement of stockpiled topsoil.** **1.** Above mentioned activities are mitigtion procedures and not impacts. 2**.** Possible contamination of soils by spillages of fuel and oil.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			**1.** Stockpiled topsoil will be replaced at all remaining voids unless required to stay open. 2. Replaced topsoil will be loosened with a muliple tooth implement, ameliorated according to soil analysis and re-vegetated with a grass mixture dominated by local climax species. 3**.** All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer with consultation of a soil specialist from time to time	Decomisioning phase			6	1	2	5
3.20.2	**Land capability**	Spillages might affect land capabioity negatively		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20.3	**Land use**	Spillages might affect land capabioity negatively		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20b Rehabilitation of remaining surface areas (Demolishing of water management infrastructure - Pollution control dams)																							
3.20.1	**Soil**	**Demolishing of pollution control dams.** **1.** Compaction of soil by heavy mechanical equipment during replacement of soil. **2.** Possible contamination of soils by spillages of fuel or oil.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			**1.** The dam floor will be thoroughly cleaned and all polluted material will be be removed to a discard dump or suitable disposal facility. **2.** Soil material used for wall embankments will be replaced at the floor of the borrow pit. **3.** The stockpiled topsoil will be replaced on the surface. **4.** Compaction will be alleviated by ripping. **5.** Soil amelioration will be done according to analises of soil samples taken afer replacment of the stored topsoil. **6.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental or rehab officer	Decomisioning phase			6	1	2	5
3.20.2	**Land capability**	The post-mining land capability will be arable and grazing if mitigation measures are followed.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20.3	**Land use**	The post-mining land uses will be cultivation and grazing if mitigation measures are followed.		**-**	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			6	1	2	5
3.20c Rehabilitation of remaining surface areas (Rehabilitation of waste management infrastructure - Zaaiwater tailings dam)																							
3.20.1	**Soil**	**Final rehabilitation of the tailings dam.** **1.**Substantial loss of soil potential in terms of production potential and topoghaphy. Very high eriosion susceptability of soils replaced on steep edges of the dam. **2.** Possible leaking drains or leachates from the dam polluting soils in the surrounding area.		**-**	**10**	**2**	**5**	**5**	**85**	**3**	**3**	**3**			1. Shaping of the remaining dam edges to gradients suitable for re-vegetation. 2. Covering dam edges with a topsoil layer and re-vegetation with grass mixture with strong stabilizing abilities. 3. Regular inspections to identify leaking or blocked drains causing soil pollution in the surrounding area. 3. Immediate rectification of any causes that my lead to soil pollution.	The mine's environmental officer	Decomisioning phase			10	1	5	5
3.20.2	**Land capability**	Substantial reduction from pre-mining to post-mining land capability. Pre-mining land capability at the footprint of the dam remain permanently ceased. The post-mining land capabilty will be wilderness.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above. The post-mining land capability will be wilderness	As for soils above.	As for soils above.			10	1	5	5
3.20.2	**Land use**	Substantial reduction from pre-mining to post-mining land use potential. Pre-mining land uses at the footprint of the dam remain permanently ceased. No possible post-mining land uses.		**-**	**10**	**1**	**5**	**5**	**80**	**3**	**3**	**3**			As for soils above. Due to steep slopes and erosion susceptibility of rehabilitated edges no other post-mining land uses will be viable.	As for soils above.	As for soils above.			10	1	5	5
3.20d Rehabilitation of remaining surface areas (Salvation of pipes - Pipelines for slurry and water)																							

3.20.1	**Soil**	**Recovery of water and slurry pipes.** Trenches will be dug to revover water and slurry pipes. All impacts related to the constructuion phase will basically be repeated.		-	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			1. The initial trench will be re-opened to remove pipes. 2. The upper 300 mm op topsoil should be excavated and placed further away from the trench. 3. The remainder of the soils up to the depth of the pipe should be placed in-between the trench and soils of the upper 300 mm in order to prevent mixing of the A and B-horizons. 4. The soils should be backfilled in the original sequence with the high quality soils on top after the pipes had been removed. 5. All accidental fuel and oil spillages will be cleaned up immediately and all mechanical equipment will be serviced at a suitable facility.	The mine's environmental officer	Decomisioning phase			4	1	2	5
3.20.2	**Land capability**	Little reduction of land capability will take place if mitigtion measures are followed. The post-mining land capability will be arable and grazing and wetland.		-	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			4	1	2	5
3.20.3	**Land use**	Little reduction of land use potential will take place if mitigtion measures are followed. The post-mining land use will be cultivation and grazing.		-	**4**	**1**	**1**	**2**	**12**	**1**	**1**	**1**			As for soils above.	As for soils above	As for soils above			4	1	2	5
3.20e Rehabilitation of remaining surface areas (Demolishing and rehabilitation of termporary and raw coal stockpiles)																							
3.20.1	**Soil**	**Removal of all coal and the basis layer at the footprint of coal stockpiles.** **1.** Possible contamination of soils by spillages of fuel and oil.		-	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			**1.** The footprint will be thoroughly cleaned and all coalliferous and soft overburden material will be removed to a discard dump or suitable disposal facility. **2.** The footprint will be loosened with a multiple tooth impement to a depth of at least 300 mm to alleviate compaction. **3.** The topsoil will be replaced and ameliorated according to soil chemical analysis. **4.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	Decomisioning phase			2	1	1	1
3.20.2	**Land capability**	Little reduction of land capability will take place if mitigtion measures are followed. The post-mining land capability will be arable and grazing.		-	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above. The post-mining land capability will be arable	As for soils above.	As for soils above.			2	1	1	1
3.20.3	**Land use**	Little reduction of land use potential will take place if mitigtion measures are followed. The post-mining land use will be cultivation and grazing.		-	**2**	**1**	**1**	**1**	**4**	**1**	**1**	**1**			As for soils above. The post-mning land uses will be grazing or cultivation.	As for soils above.	As for soils above.			2	1	1	1
3.20f Rehabilitation of remaining surface areas (Demolishing of the explosive magazine and rehabilitation of the footprint)																							
3.20.1	**Soil**	**Complete removal of the structure and its foundations. 1.** Possible spillages of oil or fuel by mechanical equipment used during the demolishing process. **2.** Compaction of soil by mechanical equipment.		-	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			**1.** During the decommissioning phase the footprint should be thoroughly cleaned. **2.** Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface. **3.** The footprint should be ripped to alleviate compaction. **4.** The topsoil should be ameliorated according to soil chemical analysis. **5.** The footprint should be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	The decommissioning phase			2	1	1	1
3.20.2	**Land capability**	**Complete removal of the structure and its foundations.** Spillages of oil and fuel and compaction of soil will have minor impacts on land capability.		-	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land capability will be arable or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.20.3	**Land use**	**Complete removal of the structure and its foundations.** Spillages of oil and fuel and compaction of soil will have minor impacts on land use.		-	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land use can be cultivation or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.20g Rehabilitation of remaining surface areas (Demolishing of roads and haul roads)																							
3.20.1	**Soil**	**Complete removal of all roads building material. 1.** Possible spillages of oil or fuel by mechanical equipment used during the demolishing process. **2.** Compaction of soil by mechanical equipment.		-	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			**1.** The footprint should be thoroughly cleaned and all road building matrial will be removed to a discard dump or suitable disposal facility. **2.** The footprint will be ripped to alleviate soil compaction and graded to a smooth surface. **3.** The topsoil will be ameliorated according to soil chemical analysis of samples taken after ripping. **4.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	The decommissioning phase			2	1	1	1

3.20.2	**Land capability**	**Complete removal of all roads building material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land capability.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land capability will be arable or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.20.3	**Land use**	**Complete removal of all roads building material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land use.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land use can be cultivation or grazing.	As for soils above.	As for soils above.			2	1	1	1
3.21 Legacy rehabilitation - Cleaning up of polluted areas at Tweefontein Spruit, Waterpan dump, Tweefontein Dam, Witcons dump																							
3.21.1	**Soil**	**Removal of all coalliferous and mining waste material. These activities is mitigation procuderes and not impacts. 1.** Possible spillages of oil or fuel by mechanical equipment used during the rehabilitation process. **2.** Compaction of soil by mechanical equipment.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			**1.** The footprint should be thoroughly cleaned of all mine waste matrial. **2.** The footprint will be ripped (accept for in rivers) to alleviate soil compaction and graded to a smooth surface. **3.** The topsoil will be ameliorated according to soil chemical analysis of samples taken after ripping. **4.** The footprint will be re-vegetated with a grass seed mixture dominated by local climax species.	The mine's environmental officer	The decommissioning phase			2	1	2	2
3.21.2	**Land capability**	**Complete removal of all mine waste material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land capability.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land capability will be arable or grazing.	As for soils above.	As for soils above.			2	1	2	2
3.21.3	**Land use**	**Complete removal of all mine waste material.** Spillages of oil and fuel and compaction of soil will have minor impacts on land use.		**-**	**4**	**1**	**1**	**1**	**6**	**1**	**1**	**1**			As for soils above. The post-mining land use can be cultivation or grazing.	As for soils above.	As for soils above.			2	1	2	2
3.22 Construction of a golf course on backfilled opencast areas																							
	Soil	The construction of a golf course on backfilled opencast areas will involve shaping of backfilled spoil material according to the landscape design of the golf course and replacement of topsoil which were **probably stripped and stockpiled during the opencast mining process.** The impacts on soils, land capability and land use **therefore already took place**. **(NB The impacts on soils, land capability and land use are formulated comparing the construction of the golf course to the pre-mining environment).** Impacts are: **1.** Soils were not stripped and stockpiled based on soil types which result in a reduction of soil potential by mixing different soil types and horizons with varying textural classes with subsequent reduction in fertility and water holding capacity as well as buffer capacity against compaction. **2.** A reduction of effective soil		**-**	**10**	**1**	**5**	**5**	**80**	**2**	**2**	**2**			**1.** The available soil volume for rehabilitation will be determined in order to calculate the average depth at which topsoil can be replaced on the shaped spoil footprint of the golf course. **2.** The topsoil will be spread evenly over the golf course footprint at the calculated depth, avoiding compaction by mechanical equipment as far as possible. **3.** The topsoil surface will be loosened with a multiple tooth implement to a depth of 300 mm to alleviate compaction and then graded with a grader to a smooth surface. **3.** The topsoil will be ameliorated according to soil chemical analysis. **4.** The footprint will be re-vegetated with a grass type suitable for the golf course.	The mine's environmental officer	The decommissioning phase			6	1	2	5
	Land capability	A reduction in land capability due impacts on soil as described above. The pre-mining land capability which was mainly arable land will probably reduce to post-mining grazing, wetland and wilderness.		**-**	**10**	**1**	**5**	**5**	**80**	**2**	**2**	**2**			As for soils above. The post-mining land capability will be grazing, wetland and wilderness.	As for soils above.	As for soils above.			6	1	2	5
	Land use	The possible pre-mining land uses which were mainly crop production and grazing will reduce to being used as a golf course with subsequent loss of productive food producing land.		**-**	**10**	**1**	**5**	**5**	**80**	**2**	**2**	**2**			As for soils above. The post-mining land use will be a golf course.	As for soils above.	As for soils above.			6	1	2	5