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Soils, Land Use and Land Capability Impact Assessment

Prepared for:

Exxaro Coal (Pty) Ltd

Project Number:

EXX5725

December 2019 (updated August 2021)

Digby Wells and Associates (South Africa) (Pty) Ltd
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Report Type:	Soils, Land Use and Land Capability Impact Assessment
Project Name:	Environmental Impact Assessment/Environmental Management Plan and Water Use License Amendment for Dorstfontein East Mine, Mpumalanga
Project Code:	EXX5725

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DETAILS AND DECLARATION OF THE SPECIALIST

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Title/ Position:	Soil Scientist
Qualification(s):	B.Sc. Honours Soil Science
Experience (years):	5
Registration(s):	SACNASP: 117870

I, Willnerie Janse van Rensburg, declare that: –

- I act as the independent specialist in this application;
- I will perform the work relating to the application objectively, even if this results in views and findings that are not favourable to the applicant;
  - I declare that there are no circumstances that may compromise my objectivity in performing such work;
  - I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken concerning the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and

- I realise that a false declaration is an offense in terms of regulation 48 and is punishable in terms of section 24F of the Act.

August 2021

Signature of the Specialist *Date*

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EXECUTIVE SUMMARY

Digby Wells Environmental (Digby Wells) was appointed to compose an environmental regulatory process comprising of an amendment and consolidation of the Environmental Management Programme (EMPr) and Integrated Water Use License (IWUL) associated with the Dorstfontein East Mine located near Kriel, Mpumalanga. The aim is to extend the existing approved underground mining area (approved under the ownership of Total Coal South Africa (Pty) Ltd) and introduce supporting infrastructure to achieve this. Exxaro Coal (Pty) Ltd (Exxaro) aims to extend the underground mining area of the 2 Seam and 4 Seam associated with the Mining Right.

The Project Area is characterised by a climate that is typical of that of the Mpumalanga climatic zone characterized by warm, rainy summers and dry winters and falls within the Eastern Highveld Grassland vegetation. The Project Area falls within the Karoo Supergroup and consists of sediments from the Ecca Group. These sediments overlie the Dwyka Formations and include significant coal reserves, shales, and sandstones. Minor parts are underlain by massive porphyritic rhyolite and pyroclastic rocks. The channels and low-lying areas are filled by alluvium.

The proposed development area falls within land types **Bb4**, **Bb5** with a small area characterised by land type **Fa8**. These land types include soils of high value to the agricultural sector. Soil included Hutton, Clovelly, Glencoe, Kroonstad, Avalon, Pinedene, Longlands, Dresden/Wasbank, and Bainsvlei soil forms. The land capability is dominated by **Class II**, which indicates a high agricultural potential, and land capability with moderate conservation practices, **Class IV** indicating moderate agricultural potential, requiring careful management planning and **Class VI** occurring in smaller areas which are mainly used for pastures, rangelands, woodlands or wildlife.

The pH of the soil samples collected ranged from **4.18** to **5.98**, indicating that the soils are acidic. The Potassium and Calcium levels indicate that the levels are sufficient for agriculture, however, Phosphorus, Sodium, and Magnesium levels of some areas indicated to be low and require addition thereof for optimal crop production. The dominant soils had a sandy-loam texture, indicating well-drained, deep soils with high agricultural potential.

Land uses, including agropastoral and adjacent mining activities impact the soil resources changing the Physico-chemical properties thereof. The proposed underground mining activities will have minor additional impacts on the soils, however, associated surface infrastructure, during the Construction, Operational, and Decommissioning Phases will impact the soil, land use and land capability. Proposed impacts include:

- Geomorphological changes to the natural soils and landscape;
- Loss of habitat, vegetation and growth medium;
- Loss of wetland soils, wetlands, groundwater and water resources (boreholes, dams);
- Erosion, destruction of agricultural land, loss of topsoil and organic material;

- Sedimentation and pollution of watercourses (wetlands);
- Soil contamination through acid and sulphate, stockpiles sediment and erosion, mine impacted water (decant water), and heavy metals; and
- Potential subsidence, dewatering and decanting in the Project Area leading to loss of soil and land capability.

The impacts may, therefore, have a significant effect on the soil resources therefore impacting the land use and land capability of the Project Area. Contaminated soil will directly impact the water quality and quantity as well as vegetation of the area.

Recommendations are made for the Environmental Impact Assessment (EIA) phase to ensure that the rehabilitation plan, mitigation measures and continuous monitoring measures are in place and **encourage a concurrent rehabilitation and monitoring plan**. Based on the understanding of the Project while considering the results of the impact assessment, Digby Wells does not object to the Project; taken into consideration the provided EMPr, Monitoring Program, and Recommendations are adopted.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degree Celsius
AIPs	Alien Invasive Plants
AMD	Acid Mine Drainage
ARC	Agricultural Research Council
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CEC	Cation Exchange Capacity
cm	Centimetre
Cwb	Subtropical highland climate
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPr	Environmental Management Programme

EP	Environmental Practitioner
Exxaro	Exxaro Coal (Pty) Ltd
GPS	Global Positioning System
ha	Hectare
ISCW	Institute for Soil, Climate and Water
IWUL	Integrated Water Use License
IWWMP	Integrated Water and Waste Management Plan
km	Kilometres
L	Litre
LoM	Life of Mine
m	Metre
m.a.m.s.l.	Meters above mean sea level
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mm	Millimetre
MM	Mine Manager
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
NEM: WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act
OC	Organic Carbon
PM	Project Manager
PPP	Public Participation Process
ROM	Run of Mine
SANAS	South African National Accreditation System
SANBI	South African National Biodiversity Institute
SEP	Stakeholder Engagement Process
SCC	Species of Conservation Concern
SOC	Soil Organic Carbon
SOM	Soil Organic Matter
SSV	Soil Screening Values

WTP	Water Treatment Plant
WUL	Water Use License
WULA	Water Use License Application

Legal Requirement		**Section in Report**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 5
(b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Section III
(c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 2
c-A	And an indication of the quality and age of the base data used for the specialist report;	Section 6
c-B	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 1
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6
(e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Section 6
(f)	Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternative;	Section 1
(g)	An identification of any areas to be avoided, including buffers;	Section 1
(h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
(i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
(j)	A description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 6.2
(k)	Any mitigation measures for inclusion in the EMPr;	Section 10
(l)	Any conditions/aspects for inclusion in the environmental authorisation;	
(m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11
(n)	A reasoned opinion (Environmental Impact Statement) -	Section 14

Legal Requirement		Section in Report
	whether the proposed activity, activities or portions thereof should be authorised; and	
	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o)	A description of any consultation process that was undertaken during preparing the specialist report;	Section 12
(p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	Any other information requested by the competent authority.	N/A

1 Introduction

Exxaro Coal (Pty) Ltd (Exxaro) requested Digby Wells Environmental (Digby Wells) to compose an environmental regulatory process comprising of an amendment and consolidation of the Environmental Management Programme (EMPr) and Integrated Water Use License (IWUL) associated with the Dorstfontein East Mine located near Kriel, Mpumalanga (Figure 1-1). Exxaro holds an approved Mining Right with reference number **MP 30/5/1/2/3/2/1 (51) MR** for opencast and underground mining at the Dorstfontein East Coal Mine (DECM). The aim is to extend the existing approved underground mining area (approved under the ownership of Total Coal South Africa (Pty) Ltd) and introduce supporting infrastructure to achieve this. Exxaro aims to extend the underground mining area of the 2 Seam and 4 Seam associated with the Mining Right.

This application focuses on the inclusion of the extension of underground mining areas for both the 4 and 2 Seams. The goal of this process is therefore to include the extension areas and ultimately align the EMPrs associated with the DECM operations during the Environmental Impact Assessment (EIA) Phase.

The Soil, Land Use and Land Capability Impact Assessment Report has been compiled to fulfil the requirements of the EMPrs and IWULA processes. This report should be read in collaboration with the EMPr and IWULA as well as the other specialist reports (specifically wetlands, fauna & flora, and hydrology).

1.1 Terms of Reference

The proposed expansion of the underground mining operation and introduction of ancillary infrastructure triggers Listed Activities in terms of the EIA Regulations, 2014 (as amended) as promulgated under National Environmental Management Act, 1998 (Act No. 107 of 19998) (NEMA), requiring that an EIA Process be undertaken to obtain Environmental Authorisation. Furthermore, a Water Use Licence Application (WULA) in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) is required to lawfully undertake the proposed mining activities.

1.2 Project Locality

The Project Area is approximately 3,288.53 hectares (ha) in size and located in the Mpumalanga Province, approximately 16 km north-east of the town of Kriel. The Project Area falls within the Gert Sibande and the Nkangala District Municipalities and crosses over the Emalahleni as well as the Govan Mbeki Local district municipalities.

The proposed DECM underground expansion area is situated within the Olifants River Catchment (Primary Catchment B), within the B11B and B11D quaternary catchment, as indicated in Table 1-1 and Figure 1-1 and Figure 1-2).

Table 1-1: Property Description

Farm Name:	Farm Name	Farm Portion	Area (ha)
	Bosch Krans 53 IS	12/53	311,83
	Dorstfontein 71 IS	8/71	207,24
	Dorstfontein 71 IS	2/71	664,68
	Fentonia 54 IS	2/54	227,93
	Fentonia 54 IS	3/54	331,16
	Fentonia 54 IS	1/54	272,81
	Welstand 55 IS	4/55	359,58
	Welstand 55 IS	10/55	5,22
	Welstand 55 IS	11/55	83,22
	Welstand 55 IS	13/55	157,60
	Welstand 55 IS	5/55	231,99
Application Area (Ha):	3288,53 ha (surface area)		
Magisterial District:	Nkangala District Municipality		
Distance and direction from nearest town:	16 km north east of the town of Kriel.		
21-digit Surveyor General Code for each farm portion:	T0IS00000000005300012 T0IS00000000007100008 T0IS00000000007100002 T0IS00000000005400002 T0IS00000000005400003 T0IS00000000005400001 T0IS00000000005500004 T0IS00000000005500010 T0IS00000000005500011 T0IS00000000005500013 T0IS00000000005500005		

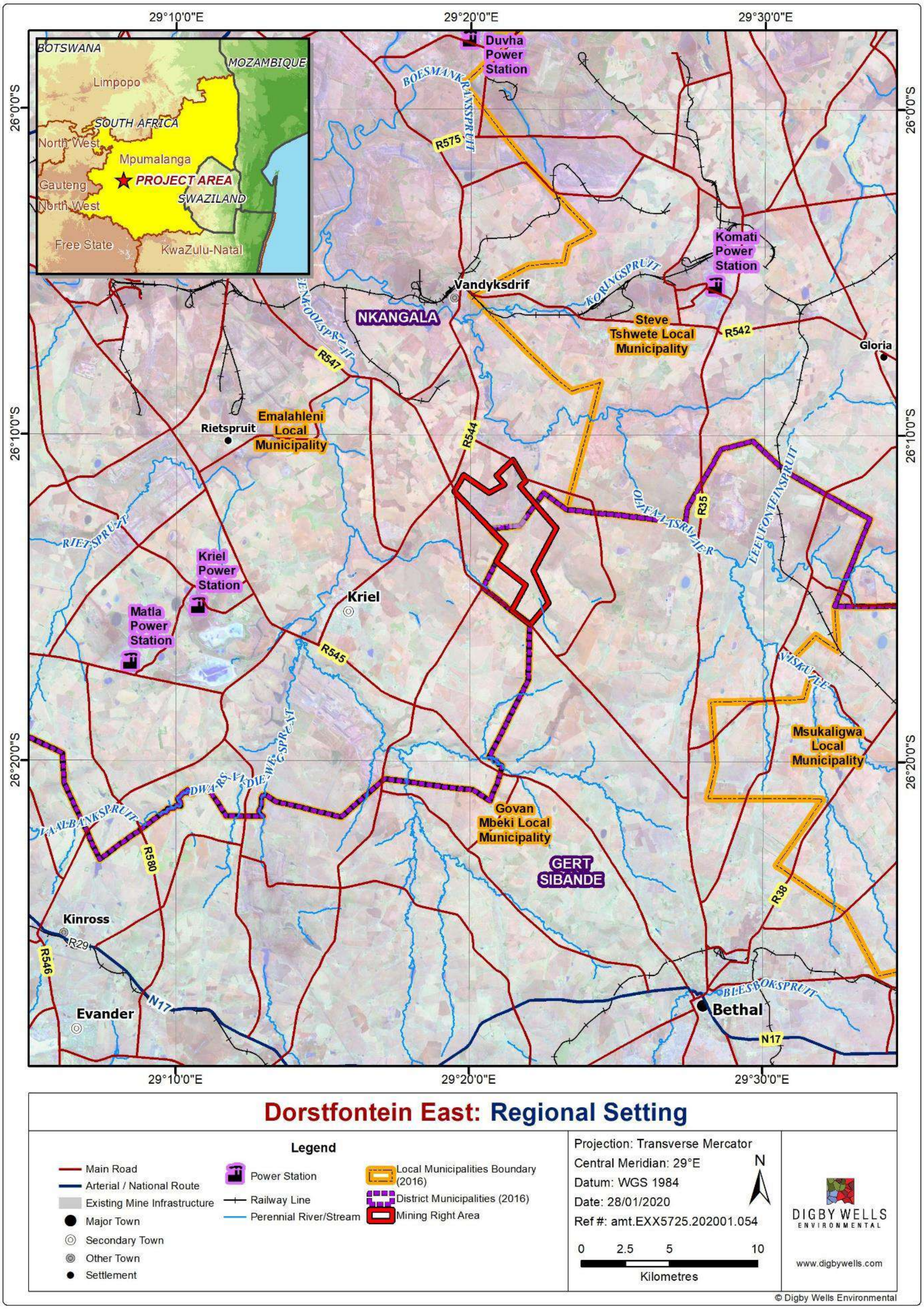


Figure 1-1: Regional Setting

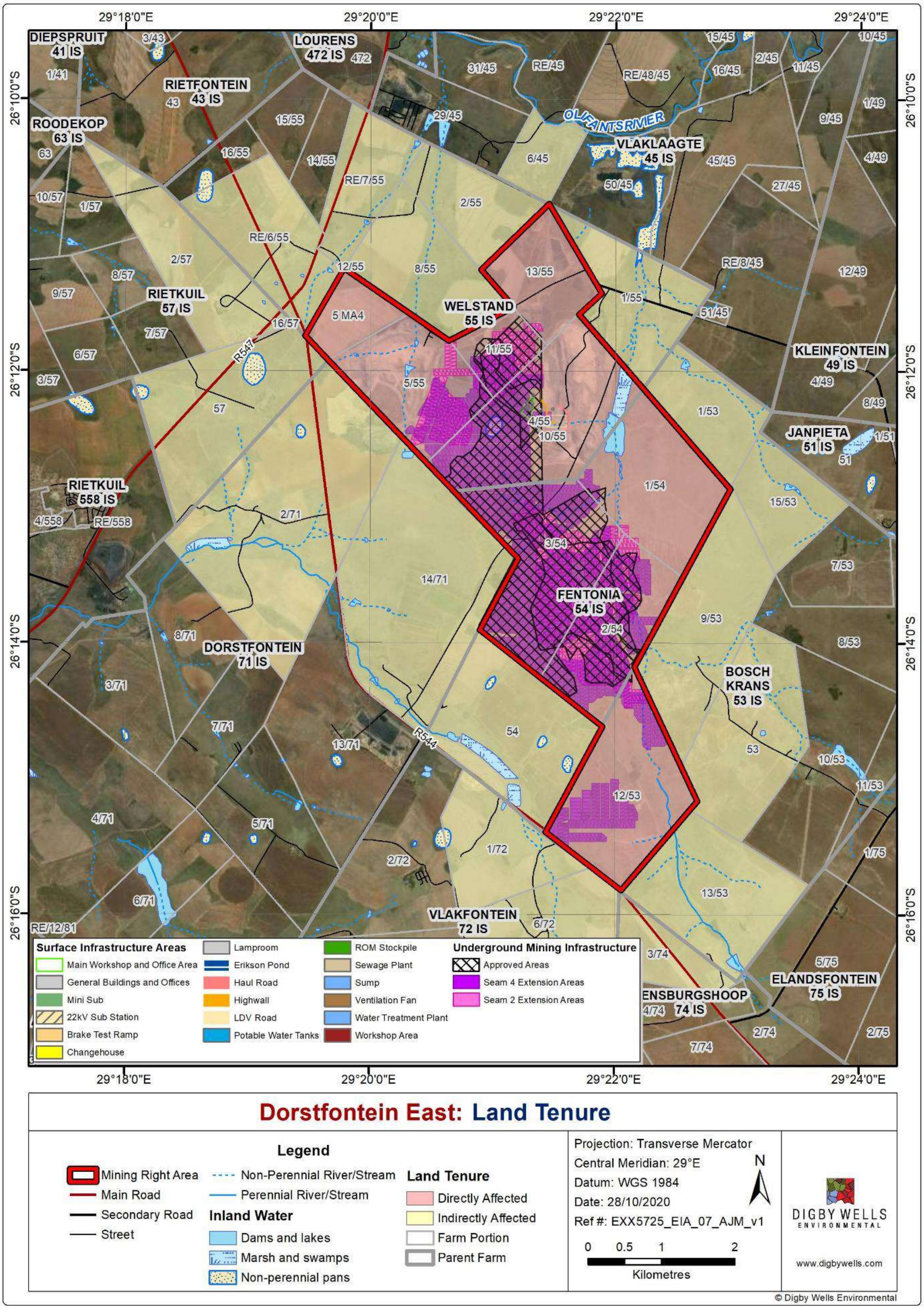


Figure 1-2: Land Tenure Map

1.3 Proposed Infrastructure and Activities

The underground mining operations will be accessed from the existing Pit 2 open cast and Dorstfontein West operations. The DECM intends to further extend the Life-of-Mine (LoM) through the exploitation of these identified additional coal reserves between 2021 until 2034 (14 years). A portion of the Seam 4 underground extension area situated in the `south west portion of the DECM Mining Right boundary will also be mined (Figure 1-4) as well as parts of Seam 2 in the north (Figure 1-5). This portion will be accessed from the Dorstfontein West operations. The required surface infrastructure proposed for the extension includes (Figure 1-3):

The required infrastructure proposed for the extension activities include:

- Sewage Treatment Plant;
- Water Treatment Plant;
- Potable water storage tank;
- Erikson Dam;
- A new 22 kV overhead powerline from the existing substation to a new kV substation;
- Run of Mine (RoM) Stockpile conveyor at portal;
- Portal ventilation fan;
- Sewer and water management;
- Change house;
- Lamp room;
- Office;
- Workshop area; and
- Stone dust silo.

The proposed infrastructure and activities to impact the Soil, Land Use and Land Capability of the Project Area are listed in Table 1-2 below. These activities are divided into the Construction, Operational, and Decommissioning Phases.

Table 1-2: Project Phases and Associated Activities

Project Phase	Project Activity
Construction Phase	• Site/vegetation clearance and site establishment (construction of surface infrastructure; and • In-pit RoM Stockpiling.

Project Phase	Project Activity
Operational Phase	• Blasting (only when dykes and other geological features are encountered); • In-pit RoM Stockpiling; • Transportation of coal from pit for further processing; • Underground Mining Machinery Maintenance; • Operation of water and sewer reticulation; and • Use of existing haul roads.
Decommissioning Phase	• Demolition and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation of the final land rehabilitation; • Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation; and • Post-closure monitoring and rehabilitation.

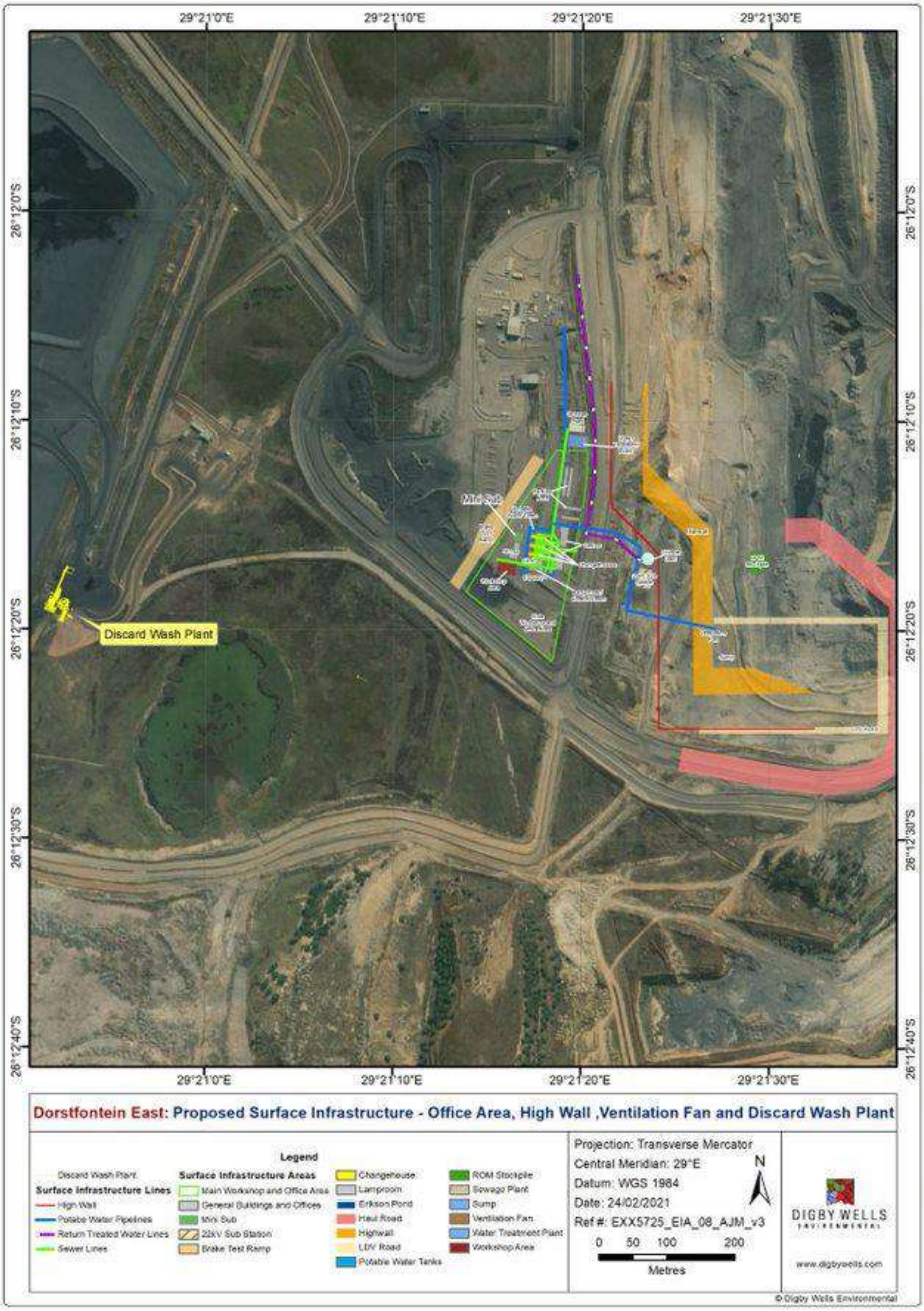


Figure 1-3: Surface Infrastructure Layout

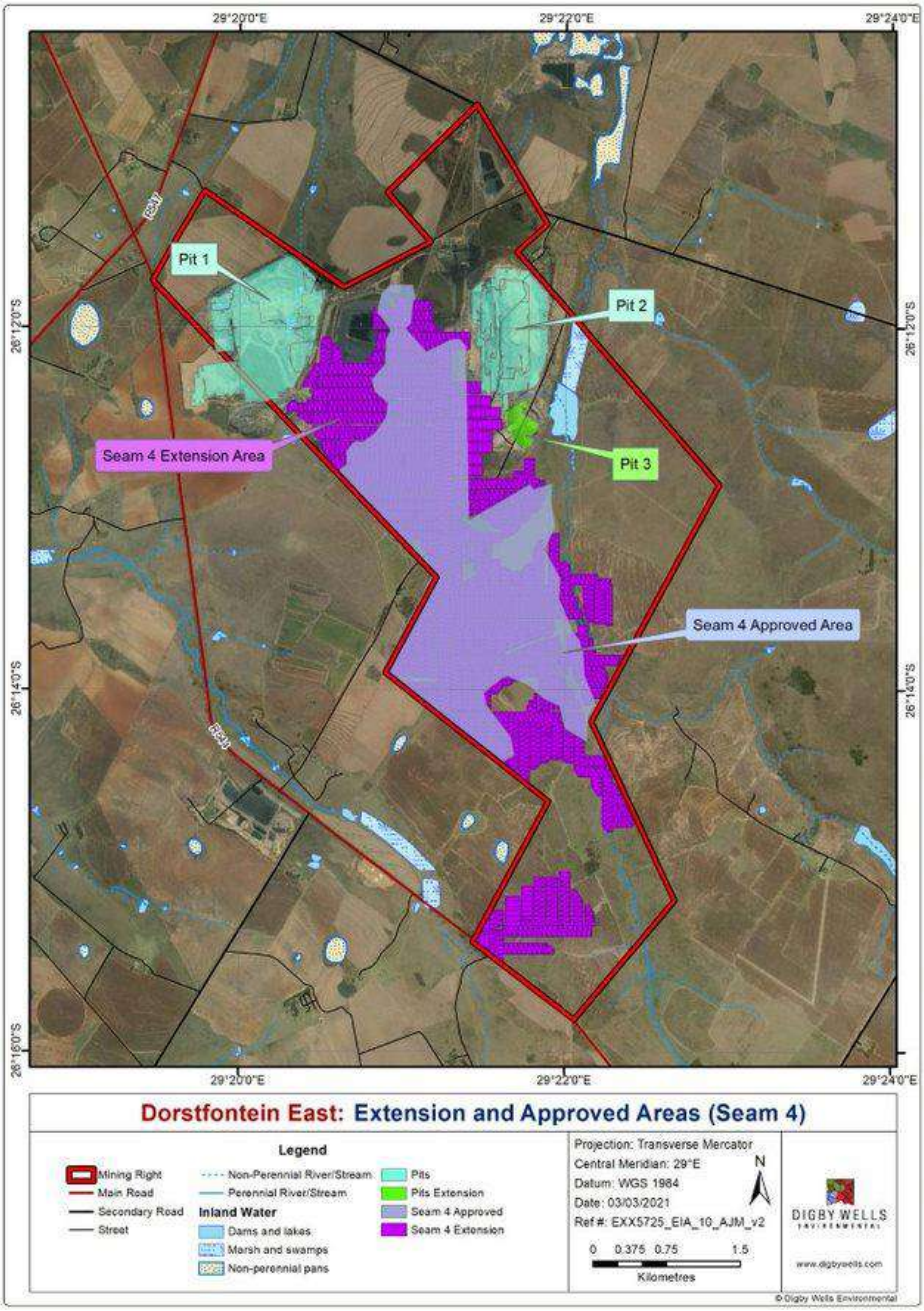


Figure 1-4: Seam 4 Extension and Approved Areas

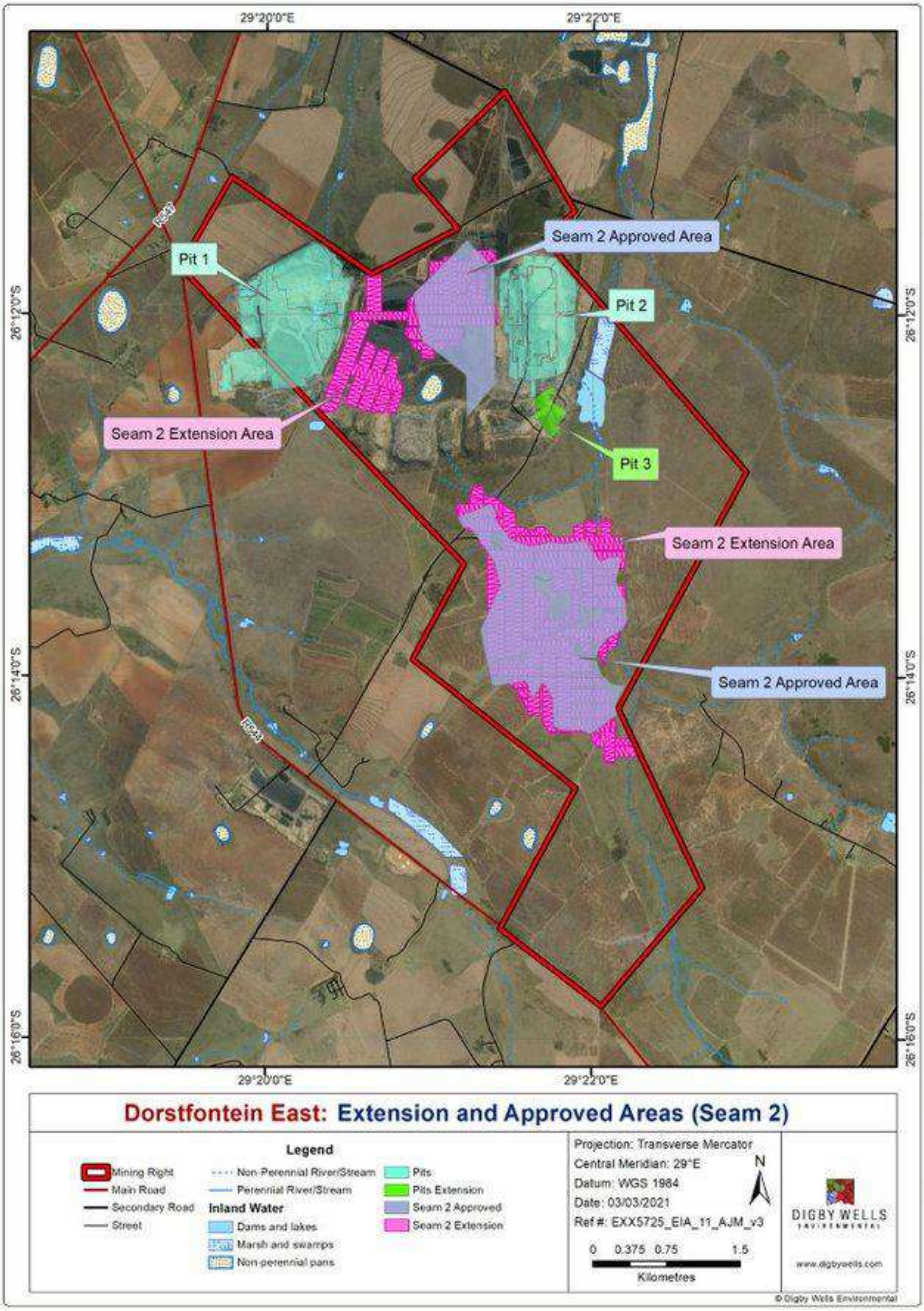


Figure 1-5: Seam 2 Extension and Approved Areas

1.4 Alternatives Considered

Alternatives to consider ensuring minimal impacts to the Soil, Land Use, and Land Capability include (Table 1-3):

Table 1-3: Alternatives to Consider

Alternative	Consequence
Reduce the amount of water and land for operations	This will entail to reduce the size of the pit
Clean wastewater and sewage before putting it back into the systems	This should be considered as this will reduce the impacts on the adjacent and downstream soils, wetlands and groundwater
Do site inspections regularly to ensure maintenance, concurrent rehabilitation is followed, and waste management plans are in place	This should be considered as it will assist in mine rehabilitaiton and closure
Reduce waste materials and waste outputs	This should be considered as this will reduce the impacts on the adjacent and downstream soils, wetlands and groundwater as well as assisting with rehabilitaiton and mine closure
Replenish native soils after decommissioning	This should be considered as this will assisting with rehabilitaiton and mine closure

2 Scope of Work

The Soil, Land Use, and Land Capability Impact Assessment comprised of the following activities:

- **Desktop Review**: Review all existing data for the collation of available information about the site and proposed work. Historical data of the Project Area was assessed with regards to operational history and identification of incidents (risks) that may have occurred and could have impacted the soil, land use, and capability. Review of existing data relating to soil form, soil depth, soil texture, laboratory analysis data and soil classification within the Project Area;
- **Soil Survey:** An initial soil desktop delineation was conducted before the site visit using historical data and Google Earth imagery. Thereafter, the soil verification was done during a one-day site visit. A hand soil auger was used to survey the soil depth and types present, with survey positions being recorded as waypoints. This included:
  - Description and categorization of soils using the South African Soil Classification System namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991); and

- Soil Sampling and Analysis: ten (10) soil samples were taken from 0 – 0.6 m depth and sent to a South African National Accreditation System (SANAS) accredited laboratory for soil physical and chemical analysis.

- **Land Use**: Existing land use data was verified during the site visit. This was mapped in conjunction with existing soil survey data and land uses/cover data;
- **Land Capability**: Land Capability was assessed by using the soil classification, soil form, depth, drainage, terrain, and climatic features. A map delineating the areas was produced for a visual representation of the most suitable areas for crop production;
- **Impact Assessment:** Identification of historical and current impacts on soils, land uses and land capabilities of the Project Area; and
- **Recommendations:** Mitigation recommendations regarding the soils, land use, and land capability of the Project Area to develop a rehabilitation and management plan for the Life of Mine (LoM).

3 Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the NEMA and the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). The additional guidelines directing the Soil. Land Use and Land Capability Impact Assessment are detailed in Table 3-1.

Table 3-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). NEMA (as amended) was set in place in accordance with Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment. Section 24(1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated.	Activities that will influence the Soil of the proposed Project Area are listed in Section 1.3 and has been identified as Listed Activities in the Listing Notices (as amended) and therefore require environmental authorisation prior to being undertaken. • The EIA process was undertaken to identify potential impacts to the soil, land use and land capability, including erosion, soil depth, soil form and areas dominated by Alien Invasive Plants (AIPs). • As part of the Assessment, applicable mitigation measures, monitoring plans and/or remediation were recommended to ensure that any potential impacts are managed to acceptable levels to support the

Legislation, Regulation, Guideline or By-Law	Applicability
	rights as enshrined in the Constitution.
<u>National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA).</u> The NEM: WA seeks to regulate waste management to protect health and environment by providing reasonable measures, including the provision of the remediation of contaminated land. Section 7(2)(d) of the NEM: WA sets the National Norms and Standards for the remediation of contaminated land and soil quality.	A Soil, Land Use and Land Capability Impact Assessment was undertaken as part of the EIA Phase. The Project activities were assessed to abide with the NEM: WA and the Soil Screening Values (SSV). The required mitigation measures are included in Section 13 to form part of the EMPr as part of the EIA.
<u>The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA).</u> The CARA is to provide control over the utilization of the natural agricultural resources to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants, and the matters connecting therewith. CARA defines the environmental conservation regulations as the protection of land against soil erosion, the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained.	A Soil, Land Use and Land Capability Impact Assessment was undertaken as part of the EIA Phase. The required mitigation measures are included in Section 13 to provide control over the natural agricultural resources to promote conservation of the soil, land use and land capability.

4 Assumptions and Limitations

The following assumptions and limitations have been made:

Table 4-1: Assumptions and Limitations

Assumptions and Limitations	Consequence
Soil characteristics and descriptions in the report for the Dorstfontein West area are supported by data obtained from the Soil Survey Report, 2017. A total of ten (10) soil samples were collected on the proposed infrastructure area of the Dorsfontein East area.	Soil delineations and characteristics of the Dorstfontein West area are based on historical information and desktop delineations and was not confirmed during a site visit; and No updated soil baseline analysis data to use for rehabilitation and soil remediation purposes for the Dorstfontein West area.
The area surveyed and confirmed during a one-day site visit is based on the initial layout presented by Exxaro.	The study does not include any confirmed data of the Dorstfontein West area and is solely based on a desktop assessment.

Assumptions and Limitations	Consequence
Land suited for crop production was assumed also to be suitable for other, less intensive uses such as pasture, natural grazing, forestry, and wildlife.	Land identified to be of Agricultural importance for crop production, are also suitable for lower land use classes.
Soils are contiguous hence differentiation is not abrupt, and the transition zone cannot be completely captured during any given soil survey.	The soil distribution map of the Project Area may not entirely be accurate.
The soils within the capability classes are similar only concerning the degree of limitations in soil used for agricultural purposes or concerning the impact on the soils when they are so used.	Not all soils have the same land use and are used according to their capabilities, each soil will react differently to the land use and impacts to the soils.

5 Details of the Specialist

The following is a list of Digby Wells' staff who were involved in the Soil, Land Use, and Capability Assessment:

- **Arjan van 't Zelfde** is a Senior Consultant with 13 years' experience in soil science and hydrogeology. Arjan received an M.Sc. degree in Soil Science (SAQA approved) as part of the B.Sc./M.Sc. program Soil, Water and Atmosphere, Wageningen University, The Netherlands. He specialises in soil capability assessments, soil contamination assessments and hydrogeological numerical groundwater flow modelling and has worked in multiple countries such as The Netherlands, Ireland, Senegal, and South Africa. Arjan is a registered Professional Natural Scientist (Pr.Sci.Nat) with the South African Council for Natural Scientific Professions (Registration Number: 115656).
- **Willnerie Janse van Rensburg** is a Soil Scientist in the Rehabilitation, Closure and Soils Division at Digby Wells. She received her Bachelor of Science in Environmental Geography as well as her Honours degree in Soil Science from the University of the Free State. She has five years' experience in the fields of Soil Science and Environmental Science. She has experience in completing soil surveys, land capability assessments, irrigation scheduling and provides recommendations on soil amelioration. Willnerie also completes wetland delineations and assessments. She has undertaken work in Lesotho, Botswana and throughout South Africa. Willnerie is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.
- **Aamirah Dramat** is an Assistant Rehabilitation Consultant in the Rehabilitation, Closure and Soils Department at Digby Wells. She received her Bachelor of Science Degree in Applied Biology and Environmental and Geographical Science (EGS) as well as her Honours Degree in Biological Sciences from the University of Cape Town. She joined Digby Wells in 2020 as a Rehabilitation Intern and has since gained experience in the environmental services sector with specialised focus in Soils, Wetlands and

Rehabilitation, both locally and internationally. She has been involved in the report compilation and undertaking of Baseline Assessments, Environmental Impact Assessments (EIAs), Rehabilitation and Closure Plans (RCPs), Rehabilitation Strategy and Implementation Plans (RSIPs), Alien Invasive Plant (AIP) Assessments, Re-vegetation Trial Studies and Monitoring Assessments. Aamirah is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.

6 Methodology

This section provides the methodology used in the compilation of the Soil, Land Use, and Land Capability Impact Assessment. To complete the proposed scope of work, several tasks needed to be completed, and these tasks are explained separately below.

6.1 Desktop Assessment and Literature Review

Digby Wells conducted a desktop review of the baseline data and findings related to the soil surveys and other relevant existing documentation, including:

- Baseline soil information was obtained from the South African land type data published with maps at a scale of 1:250 000 by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC) (ARC, 2006). These maps indicate delineated areas of relatively uniform terrain, soil pattern, and climate (Land Type Survey Staff, 1972 - 2006). These maps and their accompanying reports provide a statistical estimate of the different soils that can be expected in the area;
- Aerial imagery was analysed to determine areas that are most likely to be suitable for agriculture. The aerial imagery analysis focused on lower lying areas where suitable soils for agriculture are more likely to occur;
- Land use and land capability was described with specific reference to the interaction between water and land use through review of existing studies conducted in the area as well as publicly available information; and
- Rainfall, evaporation, and runoff data obtained was evaluated to determine the Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), and Mean Annual Evaporation (MAE) for the site. Understanding of the variables was useful in broadly determining soil characteristics that are influenced by incident rainfall, evaporation, and water movement through the soil matrix.

6.2 Soil Classification

A soil assessment on the proposed expansion areas was conducted during a field visit in February 2020.

The site was traversed by vehicle and on foot. A hand soil auger was used to determine the soil type and depth. Soils were investigated using a Bucket and Cradle auger to a maximum depth of 1.2 meters (m) or the first restricting layer. Survey positions were recorded as waypoints using a handheld Global Positioning System (GPS). Other features such as existing open trenches and diggings were helpful to determine soil form and depth. Mapping unit boundaries were determined by changes in topography with subsidiary indications from vegetation and parent material.

The soils were classified using the South African Soil Classification Taxonomic System (Soil Classification Working Group, 1991). The following attributes were included at each observation:

- Topography, aspect, and slope;
- Soil form and family;
- Soil depth;
- Estimated soil texture;
- Soil structure, coarse fragments, calcareousness;
- Underlying material; and
- Vegetation.

6.2.1 Soil Physical and Chemical Analysis

Ten (10) representative soil samples (0 to 300 mm depth) were collected from the Project Area for soil chemical and physical analysis. The soil samples were stored in plastic bags and sent for analysis at a South African National Accreditation System (SANAS) accredited laboratory. Following the methodology given in the Handbook of Standard Soil Testing Methods for Advisory Purposes (Soil Science Society of South Africa, 1990), the soil samples were tested for the following parameters:

- Cation Exchangeable Capacity (CEC);
- Electrical Conductivity (EC);
- pH (KCl);
- Exchangeable cations (Ca, Mg, K and Na);
- Phosphorus (Bray 1 extractant);
- Nitrogen ($NH_4 + NO_3$); and
- Soil particle distribution (Clay, Sand and Silt).

Fertility analysis was used to provide recommendations for fertilization and liming that is mostly used for soil management and remediation.

Soil texture is defined as the particle distribution of the relative proportion of sand, silt, and clay particles in the soil. The relative proportions of the sand, silt, and clay, as illustrated in Figure 6-1 by the red arrows, determine 1 of 12 soil texture classes. The different texture class zones are demarcated by the thick black line in the diagram. The green zone can be used as a guideline for moderate to high agricultural potential but need to be evaluated together with other soil properties. Figure 6-1 illustrates an example of a sandy-loam soil texture class.

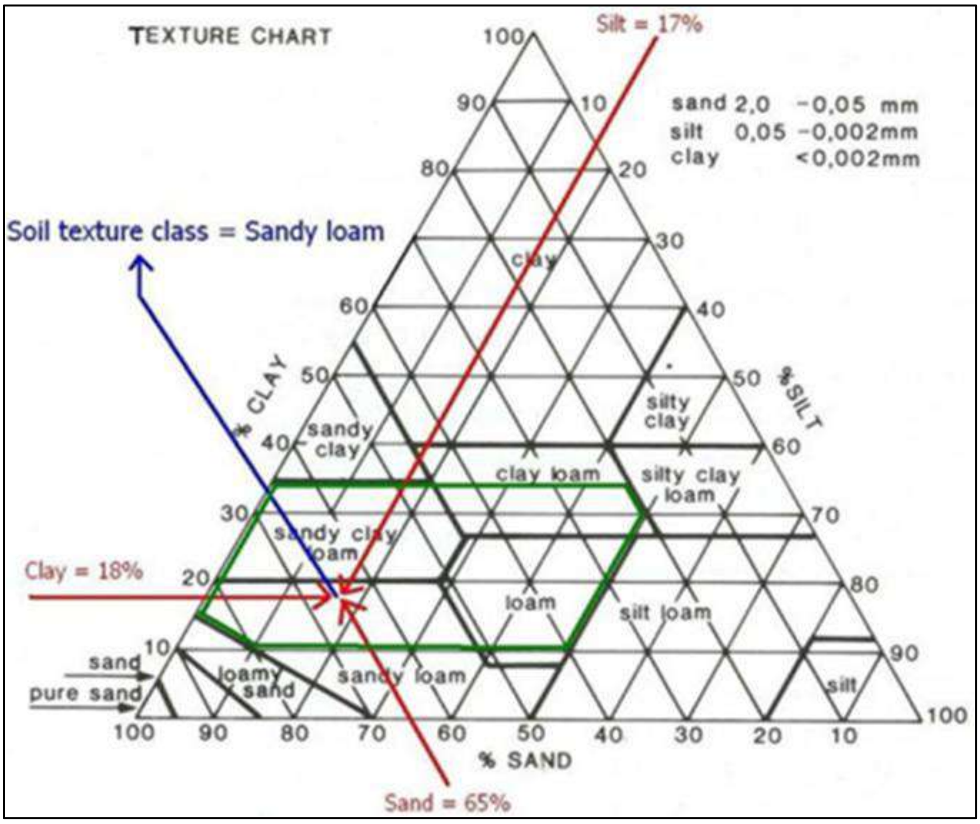


Figure 6-1: Soil Particle Size Distribution

(Source: (South African Sugar Association, 1999))

6.3 Land Capability

The land capability was determined by assessing a combination of soil, terrain, and climate features. Land capability is defined by the most suitable land use under rain-fed conditions. The approach by Schoeman *et al.*, (2000) was used to assess the land capability. The classification system is made up of land capability classes and land capability groups (Table 6-1). The land will be rated into eight classes which include a group of capability units or subgroups that have the same relative degree of limitation or potential. These classes range from I to VIII in order of decreasing agricultural potential based on limiting factors that include erosion hazard (e), excess water (w), soil root zone (s), and climatic (c) limitations. Classes I-IV represent arable land and Classes V-VIII represent non-arable land according to the guidelines (Schoeman, et al., 2000).

Table 6-1: Land Capability Classes

<table>
<tr><th>Class</th><th colspan="9">Increased Intensity of Use</th><th>Land Capability Groups</th><td rowspan="9">W - Wildlife
F - Forestry
LG - Light Grazing
MG - Moderate Grazing
IG - Intensive Grazing
LC - Light Cultivation
MC - Moderate Cultivation
IC - Intensive Cultivation
VIC - Very Intensive Cultivation</td></tr>
<tr><td>I</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>IC</td><td>VIC</td><td rowspan="4">Arable Land</td></tr>
<tr><td>II</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>IC</td><td>-</td></tr>
<tr><td>III</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>-</td><td>-</td></tr>
<tr><td>IV</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>V</td><td>W</td><td>-</td><td>LG</td><td>MG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Grazing Land</td></tr>
<tr><td>VI</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>VII</td><td>W</td><td>F</td><td>LG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Wildlife</td></tr>
<tr><td>VIII</td><td>W</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

6.4 Land Use

The current land use was identified by aerial imagery during the desktop assessment and by on-site inspection during the EIA phase. The maps indicate delineated areas of similar land use (Land Type Survey Staff, 1972 - 2006). Land use categories are split into:

- Plantations;
- Natural;
- Waterbodies;
- Mines;
- Urban built-up; and
- Agriculture.

6.5 Impact Assessment

The soil impacts were assessed based on the impact's magnitude as well as the receiving environment's sensitivity, resulting in an impact significance rating which identified the most important impacts that require management. Based on international guidelines and legislation, the following criteria were taken into consideration when potentially significant impacts were examined relating to Soil, Land Use, and Land Capability:

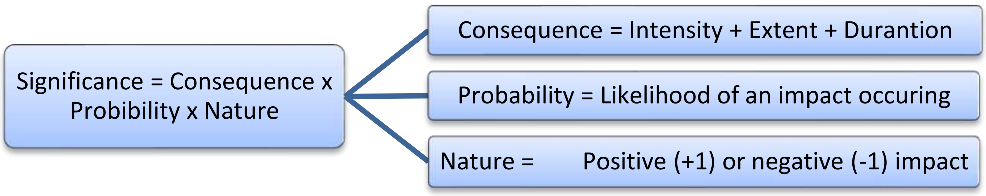
- Nature of impacts (direct/indirect, and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible), and frequent/seldom;
- Extent (geographical area, and size of affected population/species);
- Intensity (minimal, severe, replaceable / irreplaceable);
- Probability (high / medium / low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

6.5.1 Significance Rating

Impacts and risks have been identified based on the description of the activities to be undertaken. Once the impacts were identified, a numerical environmental significance rating process was undertaken that utilises the probability of an event occurring, and the severity of the impact as factors to determine the significance of a specific environmental impact.

The severity of an impact was determined by taking the spatial extent, the duration, and the severity of the impacts into consideration. The probability of an impact was then determined by the frequency at which the activity takes place or is likely to take place, and by how often the type of impact in question has taken place in similar circumstances.

Following the identification, and significance ratings of potential impacts, mitigation, and management measures were incorporated into the EMPr. Details of the impact assessment methodology used to determine the significance of physical, biophysical, and socio-economic impacts are provided below. The significance rating process follows the established impact/risk assessment formula:



Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts, and -1 for negative impacts

The matrix calculated the rating out of 147, whereby intensity, extent, duration, and probability were each rated out of seven as indicated in Table 6-3. The weight assigned to the various parameters was then multiplied by +1 for positive, and -1 for negative impacts.

6.5.2 Parameter Rating

Impacts are rated before mitigation, and again after consideration of the mitigation proposed in this report. The significance of an impact is then determined, and categorised into one of seven categories, as indicated in Table 6-2, which is extracted from Table 6-3. The description of the significance ratings is discussed in Table 6-4.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e., there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 6-2: Impact Assessment Parameter Ratings

Rating	Intensity/Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to high sensitivity.	A great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain/Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or moderately sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures/items of cultural significance.	Average to intense natural and/or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium-term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on the local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experienced by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare/improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate mitigation measures. <10% probability.
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and/or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely/None: Expected never to happen. <1% probability.

Table 6-3: Probability/Consequence Matrix

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

Table 6-4: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact may be sufficient by itself to justify the implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in a positive medium to long-term effect on the natural and/or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in a medium to short term effects on the natural and/or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development from being approved. These impacts will result in a negative medium to short term effects on the natural and/or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in a negative medium to long-term effect on the natural and/or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent the implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

7 Baseline Environment

A desktop baseline environmental assessment was conducted, and the results are presented in Table 7-1 below.

Table 7-1: Baseline Environment of the Dorstfontein East Mine Project Area

Characteristics of the Highveld Ecoregion (Kleynhans, Thirion, & Moolman, 2005)	
Terrain Morphology	Plains; Low Relief; Plains; Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to high Relief Closed Hills. Mountains; Moderate and High Relief.
Vegetation Types	Mixed Bushveld (limited); Rocky Highveld Grassland; Dry Sandy Highveld Grassland; Dry Clay Highveld Grassland; Moist Cool Highveld Grassland; Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).
Altitude (m.a.m.s.l.) (modifying)	1 100-2 100, 2 100-2 300 (very limited)
Mean Annual Precipitation (MAP) (mm) (Secondary)	400 to 1 000
Coefficient of Variation (% MAP)	<20 to 35
Rainfall Seasonality	Early to late summer
Climate	The climate is characterised by a temperate climate with hot summers and cold, dry winters. During the summer months (December, January and February), the average daily temperature is 27°C. In winter (June, July and August), the daily average temperature is 4°C. Most (65%) of the rainfall in the area occurs during the summer, largely as thunderstorms. The rainfall averages between 700 and 750 mm per annum.
Mean Annual Temp. (°C)	12 to 20
Mean Daily Summer Temp. (°C): February	10 to 32

Plant Species Characteristic of the Eastern Highveld Grasslands (Mucina & Rutherford, 2012) **(**Figure 7-1**)**	
Graminoid Species	*Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. capensis, E. curvula, E. gummiflua, E. patentissima, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata* subsp. *eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris* and *Urelytrum agropyroides.*
Herb Species	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides* subsp. *latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala* and *Wahlenbergia undulata.*
Geophytic Herb Species	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula* var. *pilosissima* and *Ledebouria ovatifolia.*
Succulent Herb Species	*Aloe ecklonis.*
Low Shrub Species	*Anthospermum rigidum* subsp. *Pumilum* and *Seriphium plumosum.*
Status	Vulnerable.
Topography and Slope (Figure 7-2 **and** Figure 7-3**)**	
The topography of the Project Area, as depicted in Figure 7-2, ranges from high elevations in the east and west and lowers towards the Olifants River tributary crossing the Project Area south to north. The Project Area can be described as uneven slopes with moderate undulating plains running towards a low-lying area. The elevation of the Project Area ranges from 1740-1 505 metres above mean sea level (m.a.m.s.l.) which equates to a range of 235 m between the lowest and highest points of elevation within the Project Area. The difference in elevation gives rise to a	

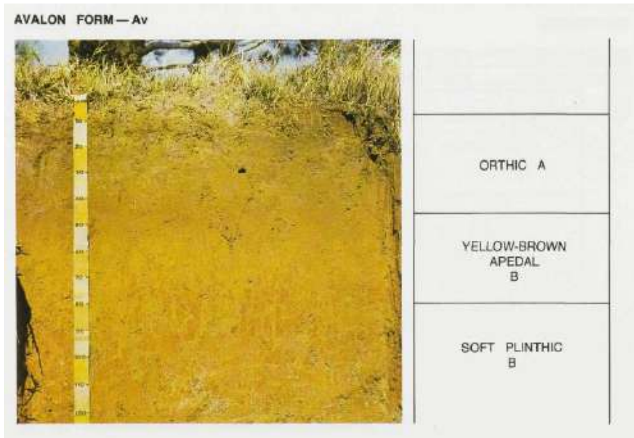
		slope of between 0 and 20 degrees (°) (Figure 7-3). The slope is high along the Olifants River tributary, indicating incisioning of the channel and steep riverbanks.
Mean Daily Winter Temp. (°C): July	-2 to 22	**Geology (**Figure 7-4**)**
Median Annual Simulated Runoff (mm)	5 to >250	The Witbank coalfield consists of the 1, 2, 4, and 5 seams with most mining occurring in the 2 and 4 seams. The thickness and distribution of the seams have been formed by paleo-topography, pre, and syndepositional events. Historically the Study Area has not been impacted by major fluvial events and simultaneous peat and organic material accumulation, therefore are the coal seam thicknesses minimal. Access to the coal seams in the Project Area is relatively easy due to the overlying formation and structure of the coal seams that have resulted in a gentle dipping in the south and sub-outcropping in the northern and western areas. However, the presence of the undulating dolerite dykes may affect the quality of the coal due to devolatilization during the emplacement of the dolerite dykes. This could result in poor roof conditions occurring during underground mining activities in some areas. Soils in the Project Area are derived from the lithologies an area. The lithologies associated with the geology of the area include: • Fine to coarse grained sandstone, shale and coal seams (dominant); • Massive porphyritic rhyolite (north and eastern corners); • Pyroclastic rocks; • Alluvium (dominant in the Olifants tributary); • Diabase (in the far western corner); and • Network of dolerite sills, sheets and dykes, mainly intrusive into the Karoo Supergroup (small section in the far southern corner). Soil is formed from dynamic geological processes. The type of parent material (geology) and the weathering thereof is one of the five soil-forming processes that influence the soil properties. Soils in the Project Area are therefore expected to be sandy with some sections, associated with the dolerite sills, as silty and clayey.

Land Types and Dominant Soil Forms (Figure 7-5**)**

Land Type	Soil Form	Geology	Characteristics
Bb4 (dominant)	• Avalon • Glencoe • Hutton • Kroonstad • Longlands • Mispah • Sterkspruit	• Shale, sandstone, clay and conglomerate of the Ecca Group, Karoo Sequence. Dolerite, occasional felsitic lava of the Rooiberg Group, Transvaal Sequence.	• Dominated by moderately deep to deep well drained red soils on the upper slopes with soils getting shallower down slope, increasing in clay content and lower in permeability; • The Hutton soil form usually indicates deep, fertile soils, good for agriculture, where Mispah soil forms are only slightly permeable due to the high clay content; and • Mispah has a low potential for agriculture due to shallow bedrock and low permeability with a high erosion hazard and a shallow rooting depth.
Bb5 (north-eastern section)	• Mispah • Hutton • Glencoe • Rensburg • Wasbank • Avalon	• Shale, sandstone, clay, conglomerate, marl and limestone of the Ecca Group. Dolerite, lava, sandstone, conglomerate, siltstone and rhyolite (Loskop Formation)	• These soils are commonly found in the lower parts of the terrain, with shallower soils, low drainage and high clay content due to the plinthic B-horizons; and • These soils are commonly associated with wetlands.

<table>
<tr><td></td><td>• Swartland
• Longlands
• Kroonstad</td><td></td><td></td></tr>
<tr><td>Fa8
(eastern section)</td><td>• Mispah
• Hutton
• Clovelly
• Estcourt</td><td>• Rhyolite of the Selonsriver Formation, Rooiberg Group. Bushveld Igneous Complex</td><td>• These soils are described as sandy-loam to sandy-loam-clay soils;
• These soils are common in the upper parts of the catchment as well as in the lower foot-slope; and
• Lower in the terrain/slope the clay content is mostly higher and therefore this soil type is associated with seepage and valley bottom wetlands.</td></tr>
<tr><th colspan="3">Land Capability (Figure 7-6)</th><th>Land Use (Figure 7-7)</th></tr>
<tr><th>Class</th><th>Classification</th><th>Dominant Limitation Influencing the Physical Suitability for Agricultural Use</th><td rowspan="4">The Land Type Survey Staff information (1972 - 2006) classified the Land Use for the Dorstfontein East Project Area as:
• Mine: extraction pits, quarries, tailings and resource dumps;
• Commercial annual crops rain-fed/ dryland;
• Fallow land & old fields (grassland);
• Fallow land & old fields (bare land);
• Natural grassland;
• Open & sparse plantation forest;
• Artificial dams (including canals);
• Natural pans;
• Natural rivers; and
• Forest/Woodland.
During the site survey, the land use was confirmed to be the aforementioned, as well as:
• Livestock farming;
• Infrastructure (buildings, roads, powerlines, fence lines);
• Dams; and
• Large stands of Eucalypts Sp. and AIPs.
The current Land Use of the Project Area is expected not to be largely impacted by the proposed underground mining activities.</td></tr>
<tr><td>II
(dominant)</td><td>Arable Land – Intensive Cultivation</td><td>Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.</td></tr>
<tr><td>IV
(north-eastern section)</td><td>Arable Land – Moderate Grazing</td><td>Soils have very severe limitations that restrict the choice of plants or require very careful management, or both.</td></tr>
<tr><td>VI
(eastern section)</td><td>Grazing – Moderate Grazing</td><td>Soils have severe limitations that make them generally unsuited to cultivation and that limit their use mainly to pasture, range, forestland, or wildlife food and cover.</td></tr>
</table>

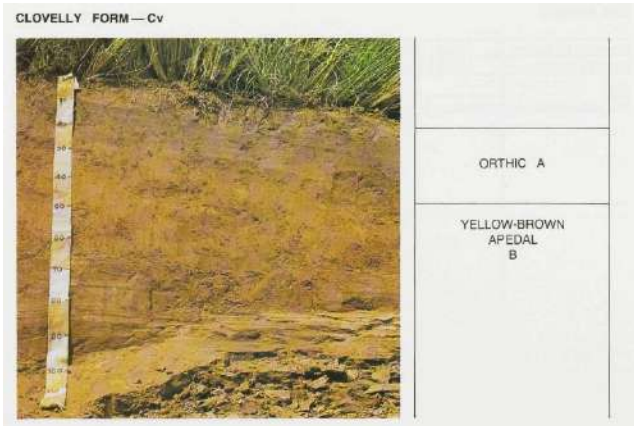
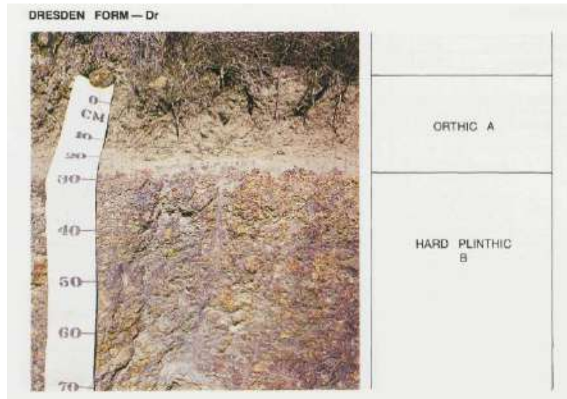
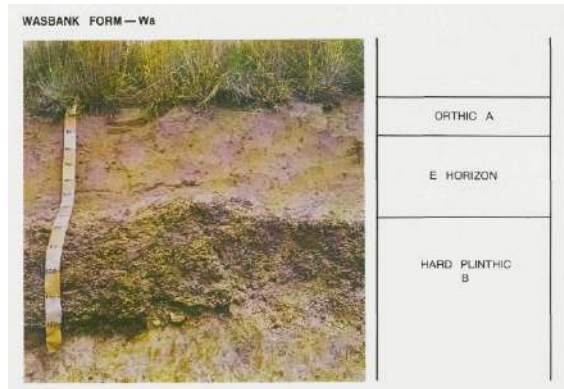
Table 7-2: Soil Forms

<table>
<tr><th colspan="9">Soil Forms (Soil Classification Working Group, 1991) (Figure 7-8)</th></tr>
<tr><th></th><th colspan="4">Avalon Soil Form</th><th colspan="4">Bainsvlei Soil Form</th></tr>
<tr><td>Soil Horizon</td><td>Orthic A-horizon</td><td>Yellow-brown Apedal B-horizon</td><td>Soft Plinthic B</td><td rowspan="4">

</td><td>Orthic A-horizon</td><td>Red Apedal B-horizon</td><td>Soft Plinthic B</td><td rowspan="4">

</td></tr>
<tr><td>Soil Horizon</td><td>A</td><td>B</td><td>B</td><td>A</td><td>B</td><td>B</td></tr>
<tr><td>Average Depth (mm)</td><td>0 – 200 mm</td><td>200 – 600 mm</td><td>>1 200 mm</td><td>0 – 100 mm</td><td>100 – 1 000 mm</td><td>>1 000 mm</td></tr>
<tr><td>General Characteristics</td><td>Light yellow-brown, coarse sandy, single grain, loose, many matrix pores, few roots, sandy-loam texture, and gradual smooth transition towards B1 horizon.</td><td>Reddish yellow, coarse sand single grain, loose, sandy-loam, many matrix pores, common roots, gradual smooth transition, interflow soils.</td><td>Accumulation and concretions of Fe and Mn oxides, loose crumbling structure, sandy-clay-loam, macro matrix pores, few roots.</td><td>Light brown, coarse sandy, single grain, loose, many matrix pores, high roots, sandy-loam texture, gradual smooth transition.</td><td>Red, coarse sandy loam, structureless, massive loose, many matrix pores, common roots, gradual transition.</td><td>Accumulation and concretions of Fe and Mn oxides, loose crumbling structure, light soil matrix, sandy-clay-loam, high clay content.</td></tr>
<tr><td>Comment</td><td colspan="4">Avalon soils are free draining and chemically active. Manganese and iron oxides accumulate under conditions of a fluctuating water table forming localised mottles or soft iron concretions of the soft plinthic B horizon.

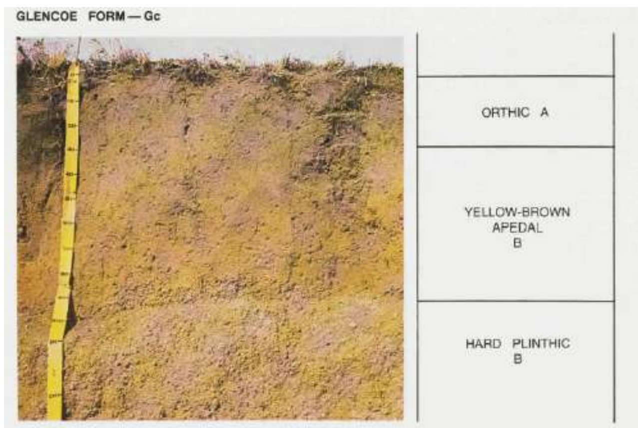
The Avalon soils within the Study Area were very deep, sandy soils with a light-yellow soil matrix. The soils are mainly cultivated and found in the upper slopes. Soil wetness increased with soil depth due to increasing clay content and the semi-permeable soft plinthic B2-horizon. Accumulation of iron and manganese were observed, forming mottles around 800 mm depth.</td><td colspan="4">Bainsvlei soils are dark, red soils, freely draining, and chemically active. Manganese and iron oxides accumulate under conditions of a fluctuating water table forming localised mottles or soft iron concretions of the soft plinthic B horizon.

The Bainsvlei soils were very deep, sandy soils with a dark, red soil matrix. The soils were mainly used for cultivation and found in the upper slopes. Soil wetness increased with soil depth due to increasing clay content and the semi-permeable soft plinthic B2-horizon. Accumulation of clay, iron, and manganese was observed within 800 mm depth.</td></tr>
</table>

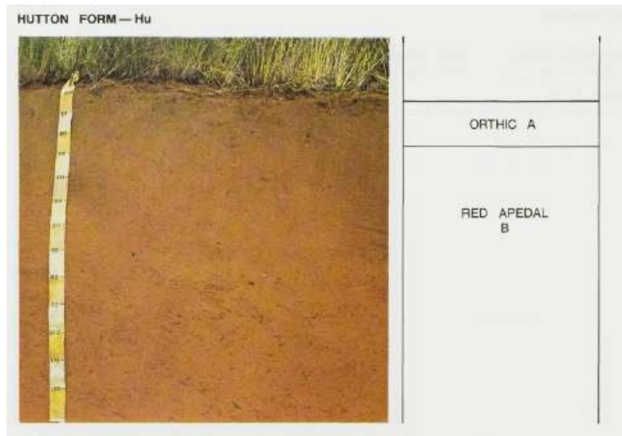
	Clovelly Soil Form				Dresden/Wasbank Soil Form			
Soil Horizon	Orthic A-horizon	Yellow-brown Apedal B-horizon	Yellow-brown Apedal B-horizon	  	Orthic A-horizon	(E-horizon)	Hard Plinthic B	  
Soil Horizon	A	B	B		A	(B)	B	
Average Depth (mm)	0 – 200 mm	200 – 1 200 mm	> 1 200 mm		0 – 80 mm	(>350mm)	>80 mm	
General Characteristics	Brown, coarse sandy, single grain, loose, many matrix pores, sandy-loam, common roots, gradual smooth transition.	Reddish yellow, coarse sand single grain, loose, sandy-loam, many matrix pores, common roots, gradual smooth transition.	Reddish yellow, fine sand, single grain, loose, many matrix pores, sandy-loam-clay, few roots		Shallow, light brown topsoil with few roots, sandy-loam, few roots, and abrupt transition towards B horizon. Iron and Manganese peds on the surface. Eroded.	(Light yellow to bleached (grey), coarse sandy soil, single grain, loose, many matrix pores, few roots, sandy-loam, gradual smooth transition.)	Hardened zone of accumulated iron and manganese oxides. Virtually no roots and water movement. Forms a restricted layer for hand-auger and agriculture.	

Comment	Clovelly soil forms are frequently confused with Hutton soil forms as they share the same characteristics. Clovelly soil forms have a Yellow-brown Apedal B-horizon, whereas Hutton soil has a Red-apedal B-horizon. Both these soil forms have deep, sandy, well-drained characteristics. Yellow-brown Apedal B-horizons are formed from leached Red Apedal B-horizons. Yellow- Brown Apedal B-horizons are thus usually in lower-lying areas, more leached, and has higher drainage than that of the red soils and are poorer in nutrients. The Clovelly Soil Forms within the Project Area were very deep, sandy soils mainly used for cattle grazing and perennial grassland. These soils are low in Soil Organic Material (SOM) and therefore not used for cultivation, but rather grassland. The Clovelly soils in the low-lying areas contained high clay content with soil depth and evidence of mottling due to a fluctuation water table indicating wetland soils.	**Dresden** soils typically consist of a shallow Orthic A horizon overlying a hard plinthic layer. These soils are limiting for agriculture production due to shallow soils and restricted water and air movement. The plinthic horizon consists of the accumulation of iron and manganese oxides with a strong developed structure. These horizons cannot be augured. **Wasbank** soils have the same characteristics as the Dresden soil form, however, if the E-horizon is deeper than 350 mm the soil form will be classified as a Wasbank. The Dresden and Wasbank soils within the Study Area were found in the upland landscapes used for manly cattle grazing as these soils have restrictions for cultivation due to soil depth. The A-horizons are highly susceptible to erosion due to a lack of vegetation cover and stability. Large Iron and Manganese peds were observed on the surface of the soil. The soil depth of the B-horizon, in the lower-lying areas, increased, exceeding 350 mm, thus qualifying as a Wasbank soil form.

	Glencoe Soil Form		
Soil Horizon	Orthic A-horizon	Yellow-brown Apedal B-horizon	Hard Plinthic B
Soil Horizon	A	B	B
Average Depth (mm)	0 – 100 mm	100 – 400 mm	>400 mm
General Characteristics	Brown, coarse sandy, single grain, loose, many matrix pores, common roots, gradual smooth transition, Fe and Mn peds on the soil surface.	Reddish-brown, coarse sand single grain, loose, many matrix pores, common roots, gradual smooth transition.	Dark red with mottles (wet), clayey fine grain, few matrix pores, few roots.



	Hutton Soil Form		
Soil Horizon	Orthic A-horizon	Red Apedal B-horizon	Red Apedal B-horizon
Soil Horizon	A	B	B
Average Depth (mm)	0 – 150 mm	150 – 1 200 mm	>1 200 mm
General Characteristics	Dark reddish-brown, medium sandy loam, structureless massive, loose, many matrix pores, many roots, gradual smooth transition.	Red, coarse sandy loam, structureless, massive loose, many matrix pores, common roots, gradual transition.	Red (moist), coarse sandy loam, structureless, massive, friable, many matrix pores, few roots, gradual transition.



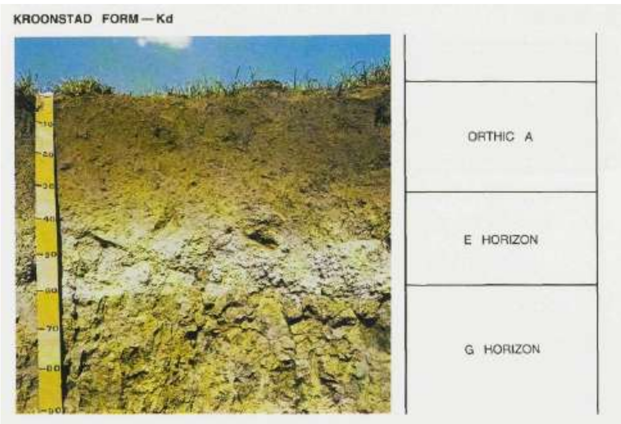
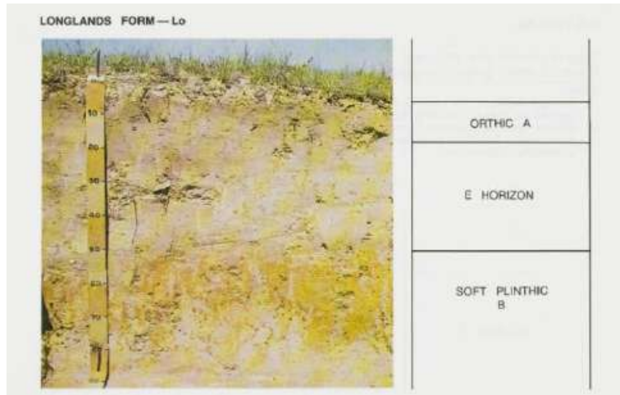
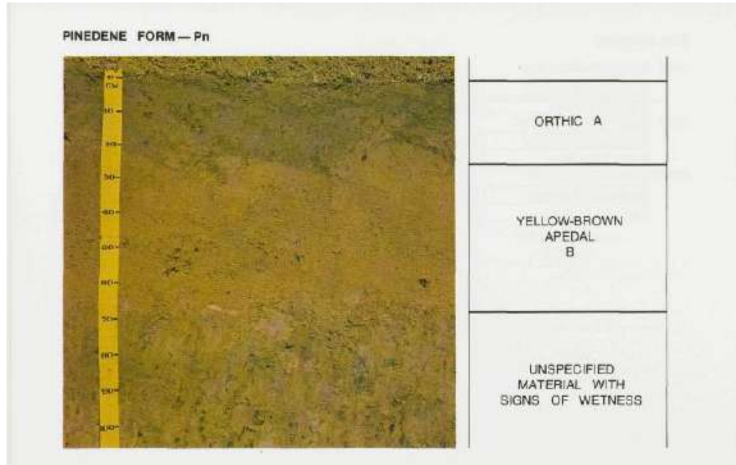
Comment	These soils comprise of a Yellow-brown Apedal B-horizon overlying a Hard Plinthic layer containing an accumulation of iron- and manganese oxides. These soils together with its high clay content and restricted rooting depth prevent free drainage and lower the agricultural potential of the soils. Glencoe soil forms within the Project Area were predominantly shallow and had a restricting layer at 400 mm where the auger hit the Hard-plinthic layer. Large peds of Fe and Mn were evident on the soil surface as well as occurring through the soil profile. These areas were mainly used for grassland and cattle grazing. These shallow soils are not ideal for cultivation due to root development restrictions and low drainage potential.				Hutton soil forms are usually deep, uniformly red, sandy (apedal) soils that are well-drained and have low organic carbon content and CEC due to the low clay content. These soils developed from basic parent material (example basalt) and are in an advanced state of weathering and leaching is indicative (Soil Classification Working Group, 1991). The Hutton soil forms within the Dorstfontein Project Area were deep, sandy recharge soils with a maize crop cover. The soil profile contained small Iron and Manganese peds, indicating Ferricrete underlying geology. The soils had an increased clay content with depth together with soil wetness.			
	Kroonstad Soil Form				**Longlands Soil Form**			
Soil Horizon	Orthic A-horizon	E-horizon	G-horizon	 	Orthic A-horizon	E-horizon	Soft Plinthic B	 
Soil Horizon	A	B	B		A	B	B	
Average Depth (mm)	0 – 100 mm	100 - 700 mm	>700 mm		0 – 100 mm	100 - 600 mm	>600 mm	
General Characteristics	Light yellow-brown, coarse sandy, single grain, loose, many matrix pores, few roots, sandy-loam texture, and gradual smooth transition towards B1 horizon.	Light yellow to bleached (grey), coarse sand single grain, loose, many matrix pores, few roots, sandy-loam, gradual smooth transition.	Light grey-brown with mottles (wet), sandy-clay-loam, macro matrix pores, few roots.		Dark brown sandy-loam topsoil with high organic material (many roots), single grain, loose, gradual smooth transition. Signs of wetness within 100 mm	Light yellow to bleached (grey), very light soil matrix, coarse sand single grain, loose, many matrix pores, many roots, sandy-loam, gradual smooth transition.	Light soil matrix with red (Fe) and black (Mn) mottles, sandy-clay-loam, high clay content.	
Comment	These soils are generally high in clay content with clear signs of mottles within the first 500 mm of the profile (indicating wetland soils). E-horizons are grey, leached, sandy soils with low structure development. They are grey and has a loose consistency. The G horizon has a higher				Longlands soils are typically characterised by eluvial horizons (E-horizons) overlying a soft plinthic B-horizon. Eluviation is defined as the down movement (leaching/washing) of suspended material, leaving the soil matrix with a light chroma. The E-horizons are typically very sandy, deep with high porosity. The leached material (consisting			

Figure text for image 2:

Figure text for image 4:

<table>
<tr><td></td><td colspan="3">clay content with an accumulation of iron and manganese oxides, known as mottles. These horizons are saturated for long periods, usually contain a fluctuating water table, and has noticeable clay accumulation within the G-horizon.
The Kroonstad soil forms within the Dorstfontein Project Area were widespread towards the wetlands and low-lying areas. The soils matrix of these soils was highly leached, low in SOM, and light in colour with clear indications of Fe and Mn mottles within the deeper horizons. The G-horizon contained high amounts of clay with clear signs of a fluctuating water table. The areas containing Kroonstad soil forms were mainly classified as wetlands and used for cattle grazing.</td><td>of clay, silt, and nutrients (Fe, Mn) leached/washes down the soil profile and accumulation of colloidal material (illuviation) in the plinthic-horizon. The plinthic-horizon is high in clay, low permeability, and contains high concentrations of nutrients (colloidal material).
The Longlands soils within the Study Area were deep, very sandy, and well-vegetated. Signs of wetness (mottles) were observed within the first 100 mm of the soil, indicating wetland soils. The soils were mostly found in the low-lying areas used for cattle grazing. The soils are susceptible to erosion and should be monitored.</td></tr>
<tr><th></th><th colspan="4">Pinedene Soil Form</th></tr>
<tr><th>Soil Horizon</th><td>Orthic A-horizon</td><td>Yellow-brown Apedal B-horizon</td><td>Unspecified material with signs of wetness</td><td rowspan="4"> </td></tr>
<tr><th>Soil Horizon</th><td>A</td><td>B</td><td>B</td></tr>
<tr><th>Average Depth (mm)</th><td>0 – 100 mm</td><td>100 - 500 mm</td><td>> 1 200 mm</td></tr>
<tr><th>General Characteristics</th><td>Light yellow-brown, coarse sandy-clay-loam, single grain, loose, many matrix pores, high root volume, sandy-loam texture, and gradual smooth transition towards B-horizon.</td><td>Light brown to yellow coarse sand single grain, loose, many matrix pores, few roots, sandy-clay-loam, gradual smooth transition to unspecified material.</td><td>Light grey-brown with mottles (wet), sandy-clay-loam, macro matrix pores, few roots.</td></tr>
<tr><th>Comment</th><td colspan="4">These soils are generally fairly deep (70 – 120 centimetre (cm)) and have a loamy-sand texture with up to 8% clay content. The soils are yellow-brown with minor drainage limitations in the upper horizons, however, usually contains very high clayey underlying material, limiting free drainage. Due to these high clay sub-horizons, drainage is limited causing waterlogging and potential for wetland formation.
The Pinedene soils of the Project Area were generally high in clay content with clear signs of mottles within the first 500 mm of the profile (indicating wetland soils). The soils were very wet with a high water-holding-capacity. The Yellow-brown Apedal B-horizon had clear indications of wetness with increasing clay content with depth. The soils in the B2 horizon were very wet and leached with a greyish soil matrix and red, yellow, and black mottles.</td></tr>
</table>

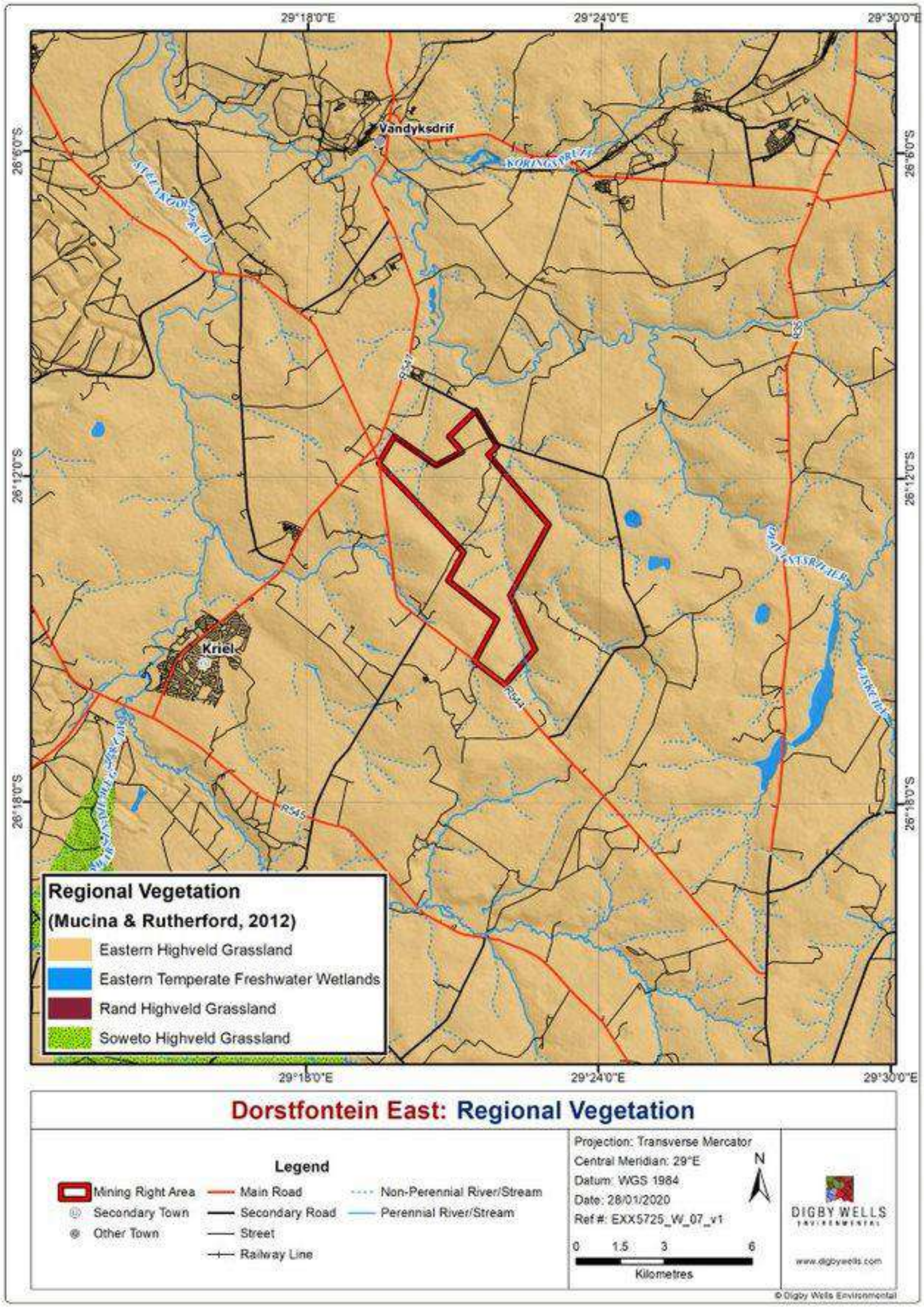


Figure 7-1: Regional Vegetation

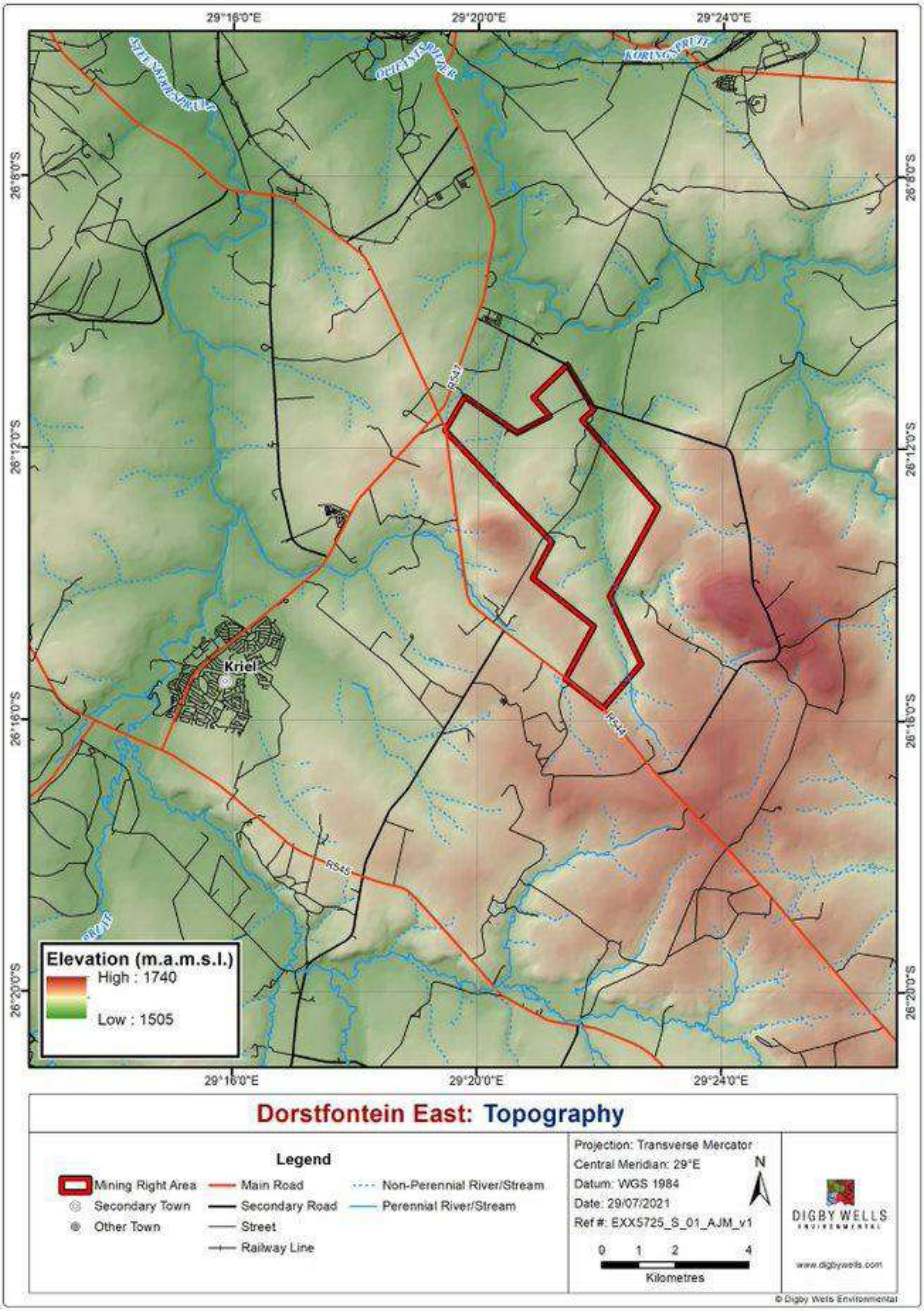


Figure 7-2: Regional Topography

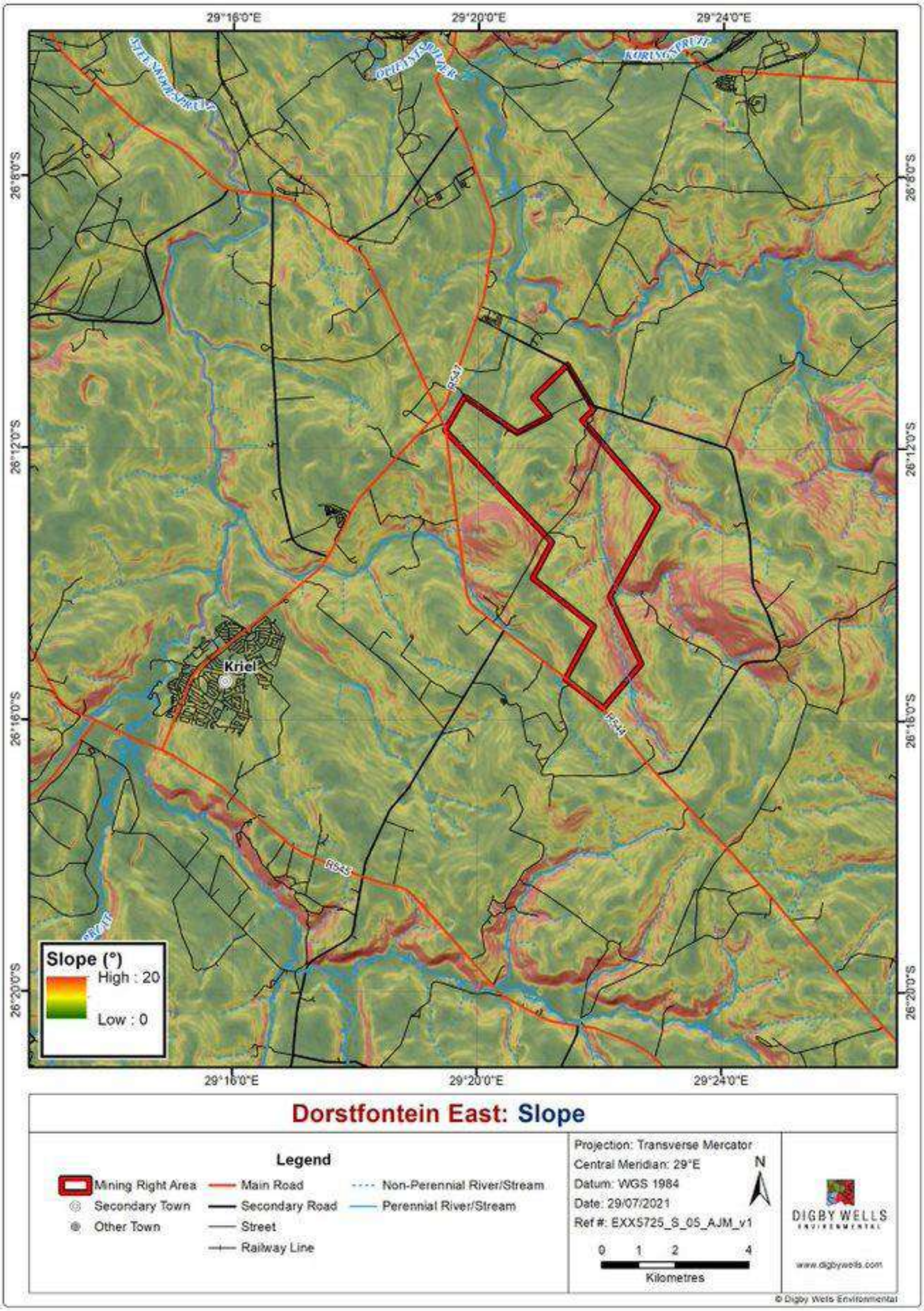


Figure 7-3: Regional Slope

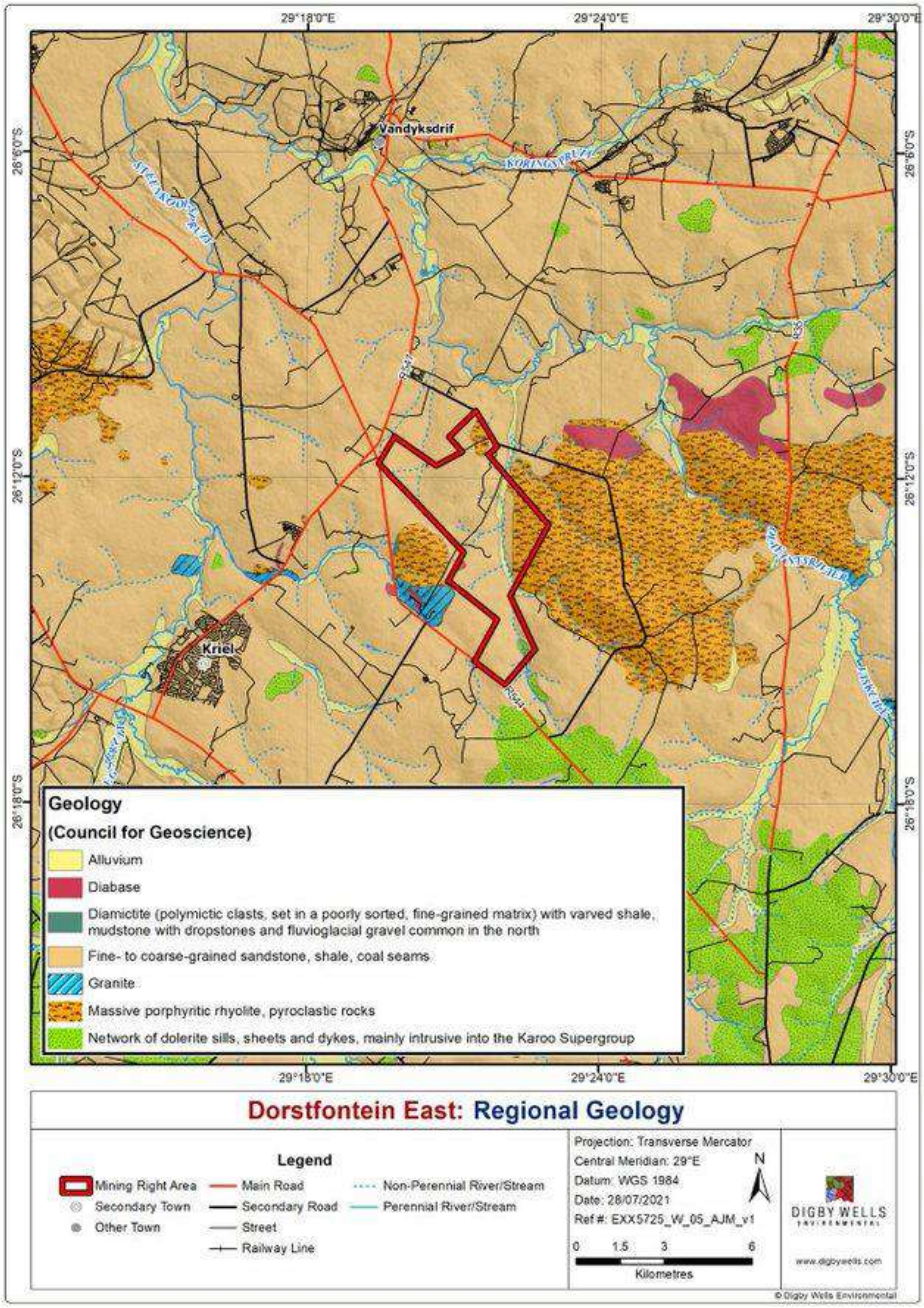


Figure 7-4: Regional Geology

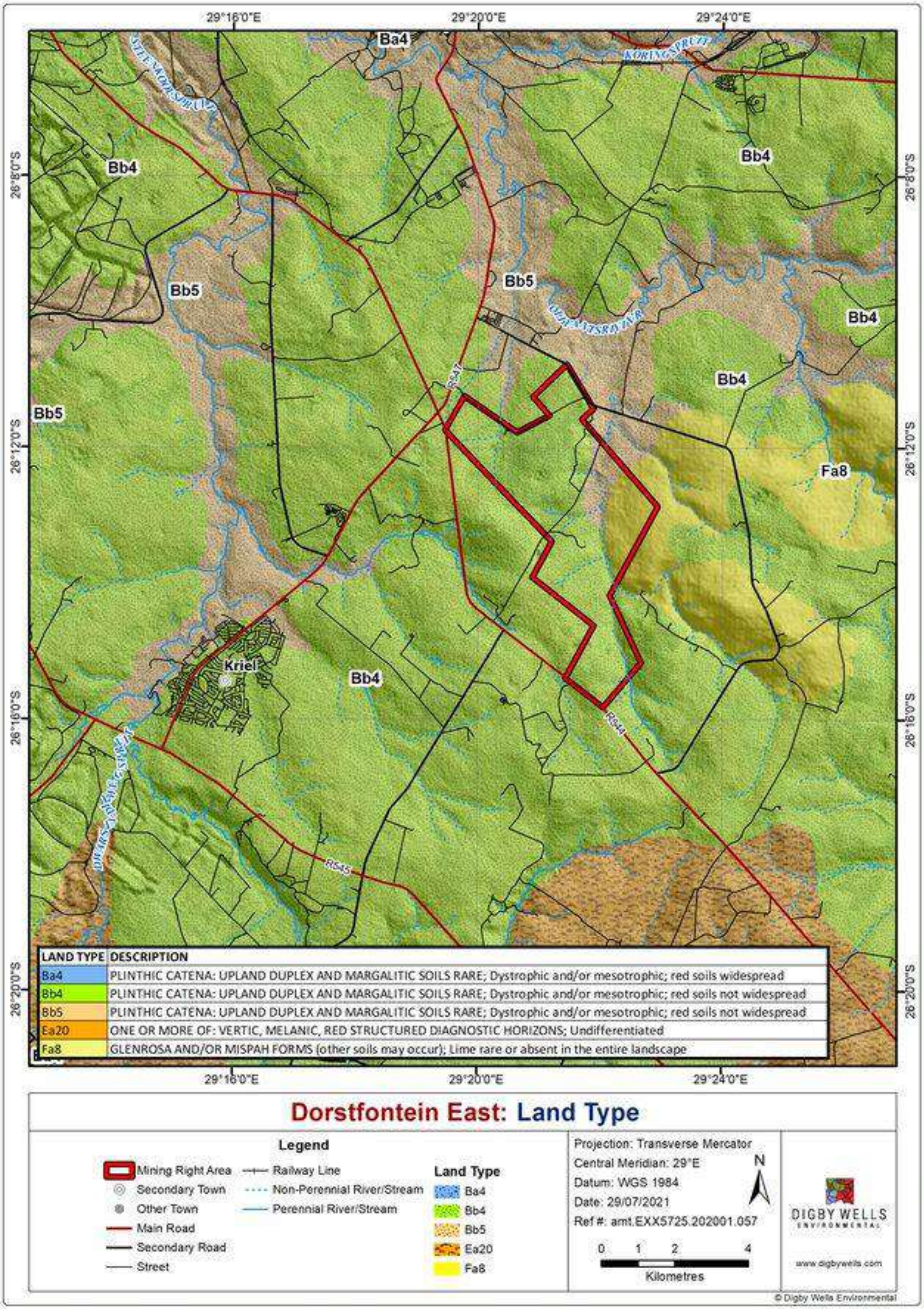


Figure 7-5: Land Type

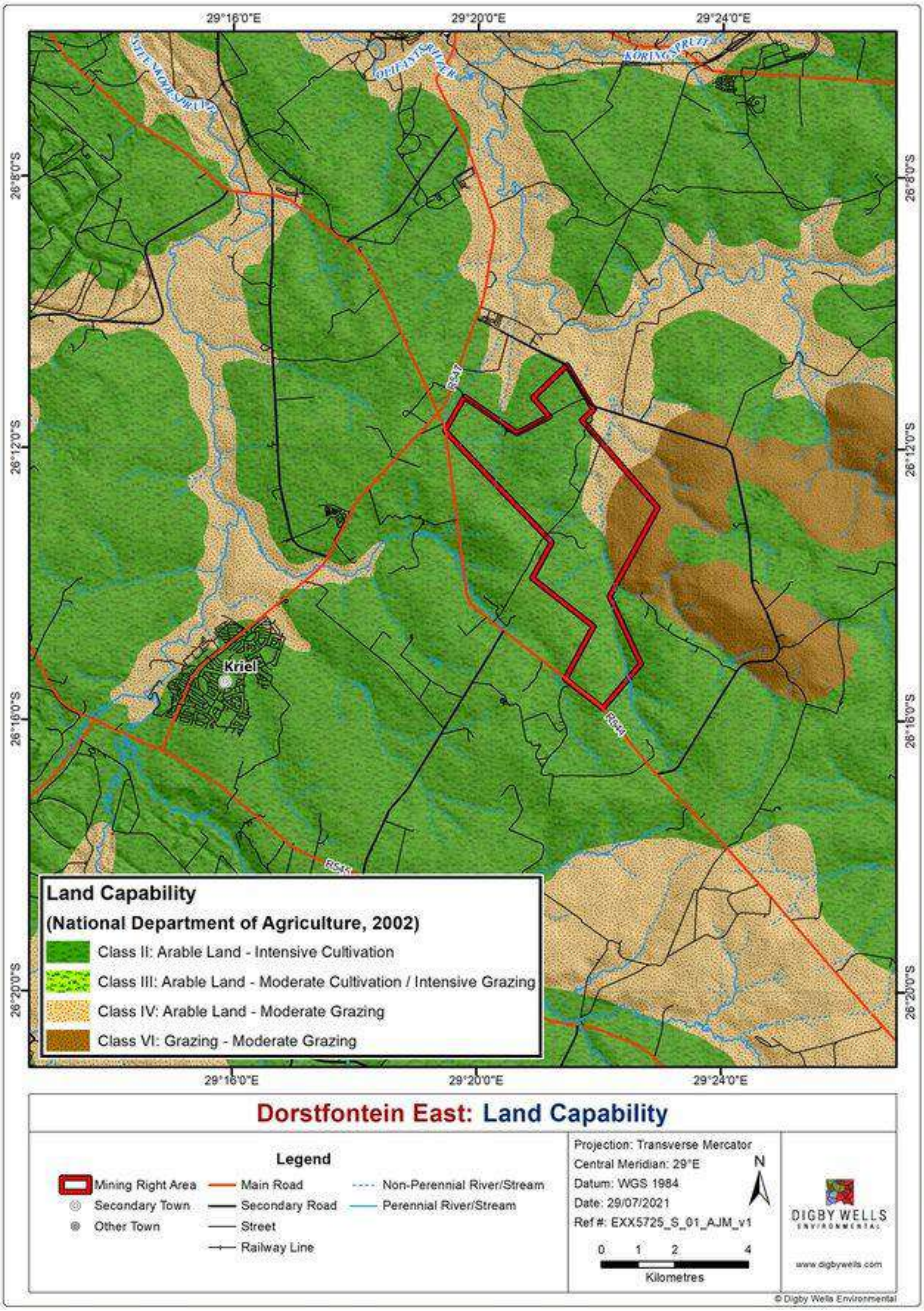


Figure 7-6: Land Capability

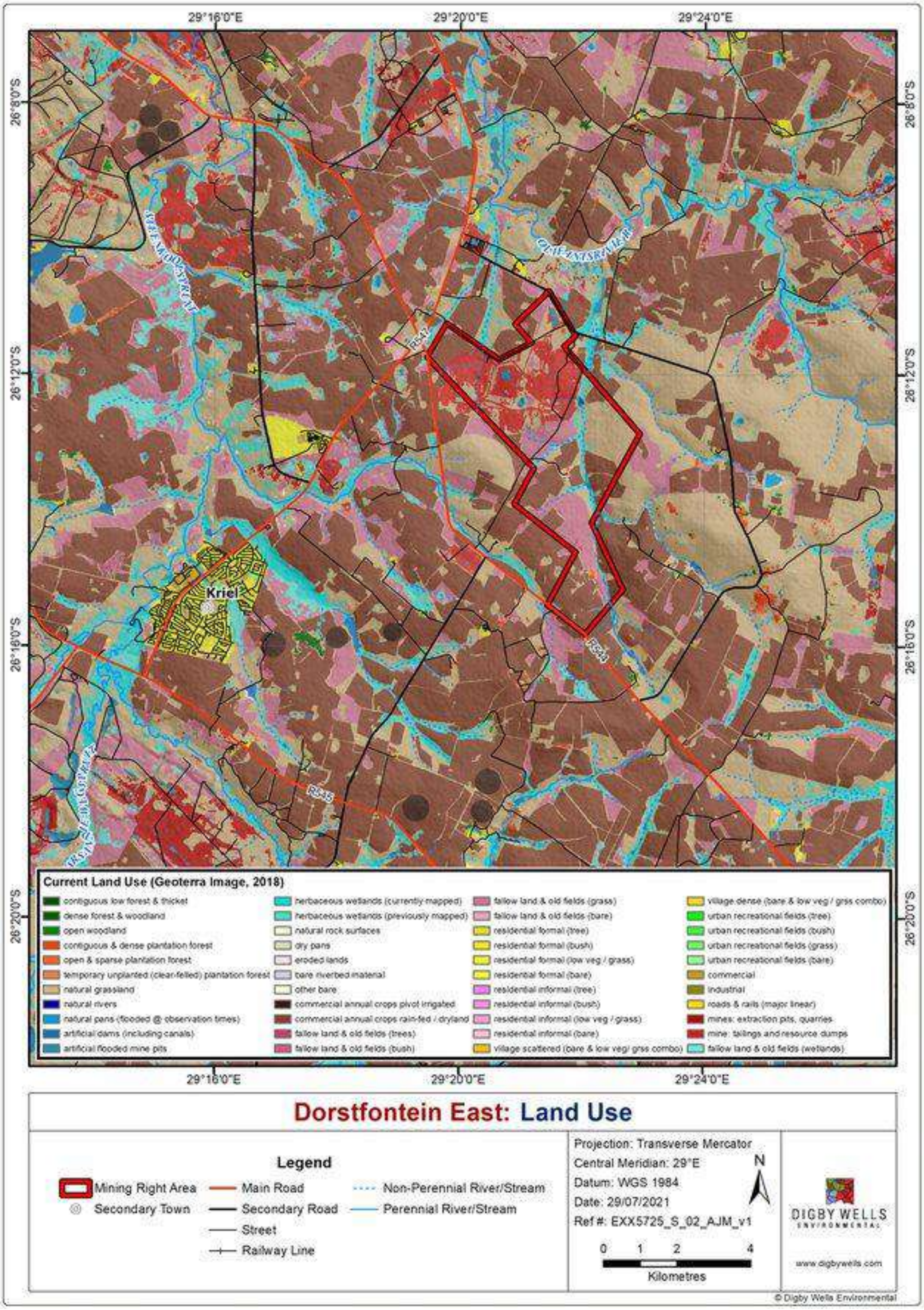


Figure 7-7: Land Use

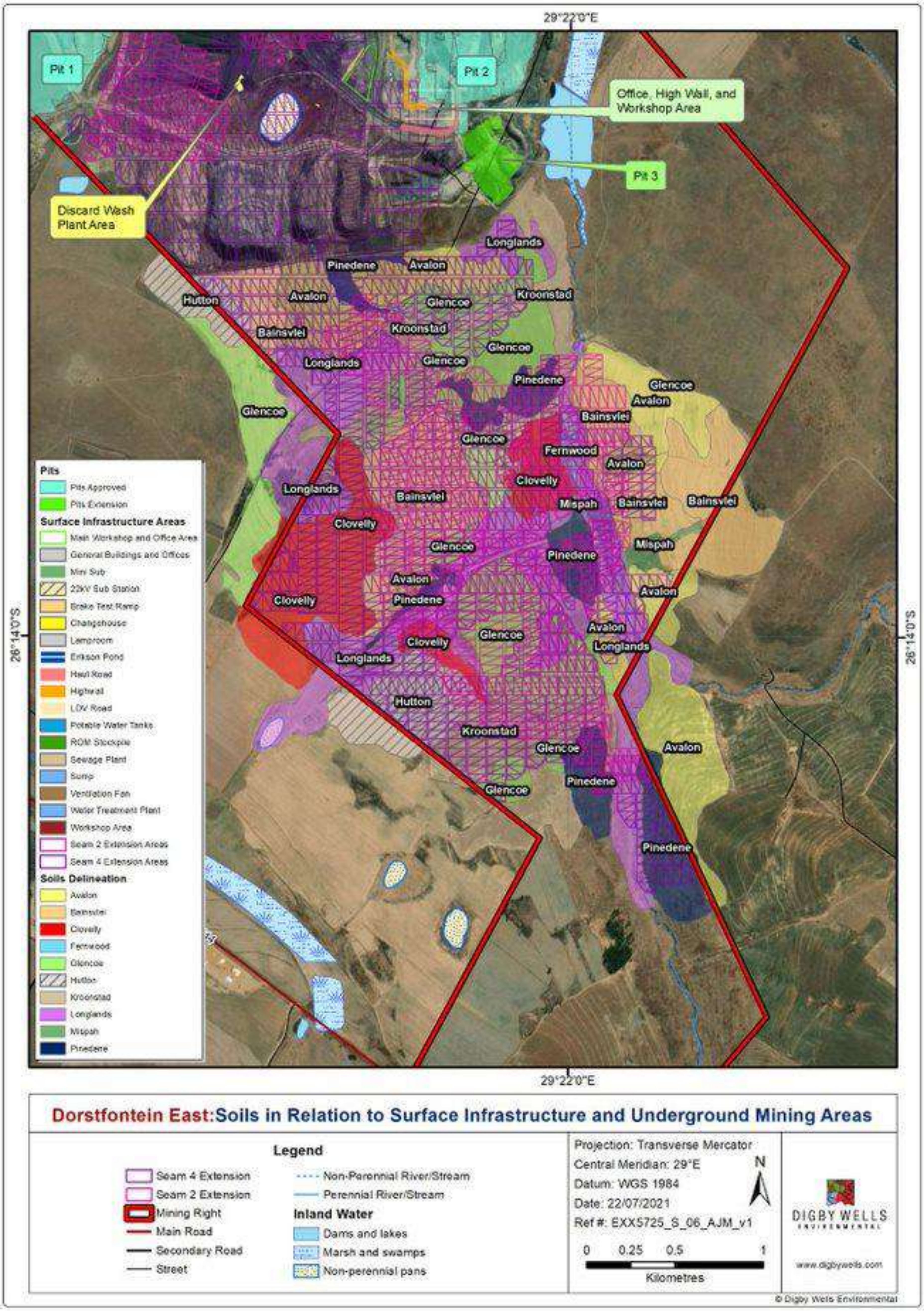


Figure 7-8: Soil Delineations in relation to the Surface Infrastructure and Underground Mining Areas

8 Findings and Discussion

A site visit was conducted in February 2020 to assess the soils, current land use and land capabilities. This report includes the potential impacts the proposed Dorstfontein East Expansion Project will have on the soils, land use and land capability associated with the Project Area.

8.1 Soil Chemical and Physical Characteristics

A total of ten representative soil samples were collected over the Project Area to establish the baseline conditions of the soils before mining activities as well as to provide support for recommendations regarding soil and rehabilitation management. The results of the soil analysis for the samples taken during the February 2020 survey are presented in Table 8-2. As a basis for interpreting the data, Soil Screening Values (SSV) and local soil fertility guidelines are presented in Table 8-1 together with the pH guidelines.

Table 8-1: Soil Fertility Guidelines

Guidelines (mg per kg)					
Macro Nutrient			Low	High	
Phosphorus (P)			<5	>35	
Potassium (K)			<40	>250	
Sodium (Na)			<50	>200	
Calcium (Ca)			<200	>3000	
Magnesium (Mg)			<50	>300	
pH (KCl)					
Very Acid	Acid	Slightly Acid	Neutral	Slightly Alkaline	Alkaline
<4	4.1-5.9	6-6.7	6.8-7.2	7.3-8	>8

Table 8-2: Soil Physic-Chemical Properties

	pH KCl	P Bray1	K AmAc	Na AmAc	Ca AmAc	Mg AmAc	CLAY	SILT	SAND	Texture Class	C WB	SOM
	-	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%					
SSV	Table 8-1	5 - 35	40 - 250	50 - 200	200 - 3000	50 - 300						
S1	4.18	4	105	17	182	49	18	8	74	Sandy Loam	0.59	1.02
S2	5.6	7	107	14	338	49	16	6	78	Sandy Loam	0.23	0.4
S3	4.54	10	64	26	239	37	18	5	77	Sandy Loam	0.33	0.56
S4	5.08	2	223	16	464	113	20	8	72	Sandy Clay Loam	1.06	1.82
S5	4.33	2	97	29	400	91	12	17	71	Sandy Loam	1.98	3.4
S6	5.98	12	67	17	479	58	18	7	75	Sandy Loam	0.46	0.79
S7	4.57	3	174	21	298	78	28	13	59	Sandy Clay Loam	1.21	2.08
S8	5.47	2	112	76	341	125	14	8	78	Sandy Loam	0.73	1.26
S9	5.33	2	54	60	351	472	28	16	56	Sandy Clay Loam	0.16	0.28
S10	5.28	7	57	15	263	78	20	7	73	Sandy Clay Loam	0.28	0.49

8.1.1 Soil pH

The pH of the soil samples collected ranged from **4.18** to **5.98**, indicating that the soils are acidic. The acidic soils may be due to the acidic nature of the parent material where more alkaline soils can be attributed to the high levels of cations such as calcium (Ca^{+2}), magnesium (Mg^{+2}), potassium (K^{+}) and ammonium (HN^{+4}) in the soil.

For optimal crop production, the pH should range between 5.8 and 7.5. In soils with low pH, Aluminium (Al) becomes soluble, and crops may suffer from toxic levels of Al. In the soluble form, Al retards root growth, restrict nutrient and water uptake and produce smaller grain size and less yield. The pH of the soil can be improved by lime or gypsum additions.

The soil pH is determined in the supernatant liquid of an aqueous suspension of soil after having allowed the sand fraction to settle out of suspension. Soil pH influences plant growth in the following manner:

- Through the direct effect of the hydrogen ion concentration on nutrient uptake;
- The mobilisation of toxic ions such as aluminium which restrict plant growth; and
- Indirect impacts include the effect on trace nutrient availability.

8.1.2 Exchangeable Cations

The levels of the basic cations (Sodium (Na), potassium (K), calcium (Ca), magnesium (Mg)) are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend Ca>Mg>K>Na, Ca being the most reactive and Na less reactive.

In soil, dispersion and flocculation of soil particles are a chemical phenomenon that is driven by the balance of the exchangeable cations. Excess Na and K cause dispersion (soil is broken down in very fine particles which are particularly sensitive to erosion), whereas high levels of Ca rather cause flocculation (soil particles adhere to each other to form clusters/flakes or clumps). Dispersion and flocculation have several impacts on soil development and responses which in return affects root development and plant growth (Chibowski, 2011).

The levels of the basic cations for the ten samples are indicated in Table 8-3. The results marked as green indicate that the value is below the SSV, whereas the results in red indicate that the value is above the SSV. The Potassium and Calcium levels indicate that the levels are sufficient for agriculture, however, the Sodium levels of most of the samples indicated to be low and would require the addition of Na to the soil for optimal crop production. The Magnesium levels of Samples 1 to 3 indicate insufficient levels and requires the addition of Mg to the soils, nevertheless, Sample 9 indicates levels above the SSV. However, small amounts of Mg will not particularly be harmful to crops.

Table 8-3: Exchangeable Cations

Sample	K	Na	Ca	Mg
SSV	40 - 250	50 - 200	200 - 3000	50 - 300
S1	105	17	182	49
S2	107	14	338	49
S3	64	26	239	37
S4	223	16	464	113
S5	97	29	400	91
S6	67	17	479	58
S7	174	21	298	78
S8	112	76	341	125
S9	54	60	351	472
S10	57	15	263	78

8.1.3 Phosphorus

The soil Phosphorous (P) levels were low (less than 5 mg/kg) for most of the samples when compared to the soil fertility guidelines (Table 8-4). Low levels of P in soil may limit plant growth and cause weak, shortened stems with dark, bluish-green leaves. P is required in plants for root development and promote plant sugars for more efficient ripening of fruits and promote larger flowers. Fertilization is required to establish a good plant stand and growth. An excellent, natural source of phosphorus is cattle manure. Other sources of P include fertilizers such as NPK (a Nitrogen (N), P, and Potassium (K) commercial fertilizer blend) and superphosphate.

Depending on the clay content of the soil should phosphorus be applied to amend the P level of the soil. P levels in the soil are dependent on soil pH and depth as P is immobile in soil and will be higher at a depth where there is a free flow of water.

Table 8-4: Phosphorus Levels

Sample	P
SSV	5 - 35
S1	4
S2	7
S3	10
S4	2
S5	2

Sample	P
SSV	5 - 35
S6	12
S7	3
S8	2
S9	2
S10	7

8.1.4 Soil Organic Carbon

Soil Organic Carbon (SOC) and SOM indicate organic matter content in the soil, therefore the soil fertility. Levels above 2-3% SOC are considered moderate to high according to du Preez *et al.* (2010).

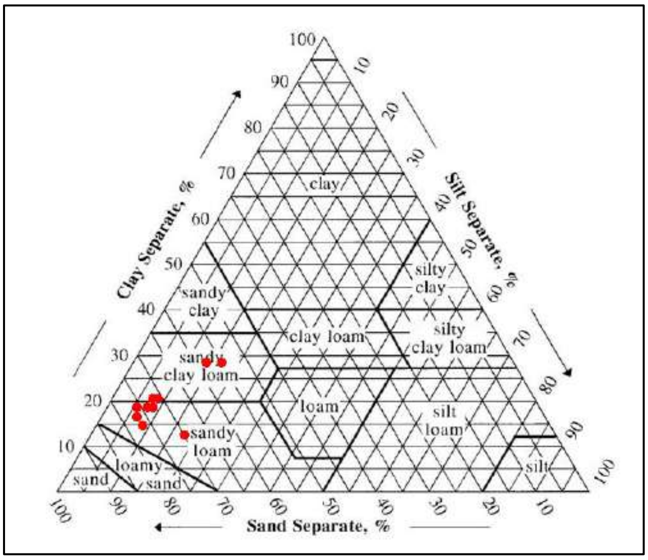
Table 8-5: Soil Organic Carbon

Sample	SOC	SOM
SSV	**%**	**%**
S1	0.59	1.02
S2	0.23	0.4
S3	0.33	0.56
S4	1.06	1.82
S5	1.98	3.4
S6	0.46	0.79
S7	1.21	2.08
S8	0.73	1.26
S9	0.16	0.28
S10	0.28	0.49

8.1.5 Soil Particle Size Distribution

The soil particle size distribution sampled were grouped into the percentages of sand, silt, and clay present. The textural classes were obtained from plotting the three fractions on the particle size distribution triangle indicated in Table 8-6.

Table 8-6: Soil Particle Size Distribution

Sample	Texture Class	
S1	Sandy Loam	
S2	Sandy Loam	
S3	Sandy Loam	
S4	Sandy Clay Loam	
S5	Sandy Loam	
S6	Sandy Loam	
S7	Sandy Clay Loam	
S8	Sandy Loam	
S9	Sandy Clay Loam	
S10	Sandy Clay Loam	

Soil water retention characteristics are strongly affected by soil texture. Higher clay content results in greater water retention. Similarly, the higher the sand fraction, the less water is retained by the soil (Gebregiorgis, 2003). Soil macropores allow a greater volume of water to drain more rapidly than would be expected from a soil that is dominated by clay fractions. Generally, the ideal pore space is between 40 – 60% (NRCS-USDA, 2013).

The bulk density of soil is dependent on the sand-clay-silt ration. The higher the clay content the higher the bulk density. Bulk density represents the mass of dry soil (mass of solids) per unit volume of soil (White, 2003). A low bulk density implies a favourable soil structure for root penetration as it is not compacted (Karuku, et al., 2012). Generally, soils with bulk densities greater than 1.6 g/cm^{-3} are considered as compacted soils (Twum & Nii-Annang, 2015).

9 Impact Assessment

The main impacts associated with underground mining activities and accompanying surface infrastructure at Dorstfontein East are a disturbance to the natural soil sequence and vegetation. However, the impacts on the soils will be LOW due to underground mining not impacting the surface (soils). Impacts on the soils will only be focused on areas of surface infrastructure. These areas have an impact of MEDIUM due to topsoil removal, change to the geomorphology, soil contamination, compaction, loss of vegetation cover, and potential of erosion that are likely to occur during the construction and operational phases. However, it can be argued that by applying several Mitigation Strategies and implementing a Monitoring Plan the impacts will be LOW.

The Soil, Land Use, and Land Capability impacts were assessed for the three phases of the project life, including the Construction, Operational, and Decommissioning phases. The impacts were assessed based on the impact's magnitude as well as the receiver's sensitivity, concluding an impact significance rating which identifies the most important impacts that require management.

The impacts identified in this section are a result of both the environment in which the proposed project activities will take place, as well as the actual activities. The impacts that possibly will affect the soil and land capability are:

- Loss of the soil resource due to change in land use and removal of the soil. The construction of mine associated facilities will change land utilization potential (land capability) resulting in loss of the soils resource for the life of the activity;
- Underground mines may result in subsidence of the surface topography which presents different challenges for farming. Subsidence of the soil surface may cause changes in drainage lines, waterlogging and a change in land capability influencing land use. This impact must be quantified through expert consultation with the relevant engineers/geotechnical specialists;
- Loss of the soil resource due to wind and water erosion of unprotected soils;
- Change in soil characteristics (geomorphology) due to compaction of areas during construction and operation (associated with mine infrastructure such as dirt roads, conveyor belts, access roads);
- Contamination of the soil resource due to:
  - Hydrocarbons spillages from the workshop and access roads (heavy machinery);
  - Coal residue and sedimentation from the ROM Stockpile conveyor; and
  - Coal wash plant water, sewage and wastewater spillages.
- Changes to the land use, from commercial agriculture to mining which can permanently change the land capability.

9.1 Summarised Impact Ratings

Table 9-1 summarizes the impacts to the Soil, Land Use and Land Capability as well as the impact score before and after mitigation. Appendix A contains the detailed Impact Assessment ratings for each Phase separately.

Table 9-1: Summarized Impact Ratings

Phase	Activity	Impact Rating before Mitigation	Impact Rating after Mitigation
Construction	Access road construction, movement of vehicles, and heavy machinery.	Moderate (negative) - 60	Negligible (negative) - 32
	Site clearing and preparation by the removal of vegetation and topsoil, leading to the exposure of soils for site establishment.	Moderate (negative) - 82	Negligible (negative) - 30
	Construction of surface infrastructure	Moderate (negative) - 82	Negligible (negative) - 30
	Waste management activities, including: • In-pit RoM Stockpiling; • Handling of hydrocarbon chemicals; • Hauling and transportation of waste material; • Transportation of product coal; and • Disposal of waste material.	Minor (negative) - 64	Negligible (negative) - 29
Operational	Blasting (only when dikes and other geological features are encountered).	Moderate (negative) - 60	Negligible (negative) - 32
	Underground mining machinery maintenance.	Minor (negative) - 66	Negligible (negative) - 28
	Use of existing haul roads and vehicle movement.	Moderate (negative) - 65	Negligible (negative) - 32
	In-pit ROM Stockpiling.	Moderate (negative) - 66	Minor (negative) - 36
	Operation of water and sewer reticulation. Waste management activities.	Moderate (negative)	Negligible (negative)

Phase	Activity	Impact Rating before Mitigation	Impact Rating after Mitigation
		- 66	- 32
	Operation of the coal discard processing plant	Moderate (negative) - 78	Minor (negative) - 36
Decommissioning	Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land, and re-vegetation.	Minor (negative) - 50	Negligible (negative) - 32
	Demolition of infrastructure and rehabilitation of affected areas.	Minor (negative) - 65	Negligible (negative) - 24
	Post-closure monitoring and rehabilitation.	Minor (negative) - 55	Moderate (Positive) 91

9.2 Construction Phase

Activities during the Construction Phase that may have potential impacts on the soil, land use, and land capability are described in Table 9-2 below.

9.2.1 Management Objectives and Actions

The mitigation hierarchy starts with the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction Phase, the next step is or to minimize the impact and thereafter rectify or reduce the impact. When it is not possible to rectify or reduce the impact, offset need to be implemented.

The aim during the construction phase is to minimize the impact footprint on the soils as it is not possible to avoid the impacts. The impact size should be kept minimal with as little changes to the natural state of the Project Area as far as possible.

The management actions are proposed in the EMPr in Section 10.

Table 9-2: Construction Phase Interactions, Impacts and Description

Interaction	Impact	Description
Access road construction, movement of vehicles, and heavy machinery.	• Compaction of soil; • Increased runoff potential; and • Increased erosion and consequently sedimentation potential.	Vehicles will drive on the soil surface during the construction phase, thereby causing compaction of the soils and loss of vegetation cover. This reduces infiltration rates and the ability for plant roots to penetrate the compacted soil. The soil will be exposed to erosion where vegetation has been removed during the construction phase. The loss of vegetation cover will exacerbate runoff potential that will lead to increased erosion as well as the loss of organic material. Once the soil is eroded it reduces the overall soil depth, soil fertility, and as a result, the land capability.
Site clearing and preparation by the removal of vegetation and topsoil, leading to the exposure of soils for site establishment.	• Compaction of soil; • Increased runoff potential; • Increased wind and water erosion and consequently sedimentation potential; • Removal of vegetation and basal cover resulting in loss of topsoil, organic material and increased erosion potential; and • Compaction, ponding, and changing the natural landscape of the area.	During the construction phase, site clearing is necessary for the preparation of surface infrastructure development, where vegetation will be removed along with topsoil. When soils are removed, the physical and chemical properties are changed, and the soils will deteriorate unless properly managed. When the organic matter has been removed either by the clearing of an area for development of infrastructure or by erosion; the soil fertility status is reduced and may result in soil acidification. The natural topography will be altered that could lead to ponding of water, increased runoff, and trapping of sediment that will lead to reduced vegetation cover and changes to the natural hydrology.

Construction of infrastructure, such as: • Powerline • ROM Stockpile conveyor; • Ventilation shafts and fan; • Sewer and water management; • Office, Change house and Workshop; • Lamproom; • Potable Water storage tank; • Clinic; • Stores; • Erikson Pond; • Coal discard processing plant; and • Stone dust silo.	• Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Increased hardened surfaces resulting in increased hydrological functioning; • Diggings, removal, and shifting of soil; • Potential spillage of sewage wastewater and hydrocarbons such as oils, fuels and grease, thus contamination of the soils; and • Increased dust, erosion, and sedimentation.	Construction of infrastructure may lead to increased compaction of the soils, loss of soil by erosion, decrease in soil fertility, and decrease in land capability. The land use will also change from Agriculture to infrastructure. Construction involves digging, moving, and removing soil, changing the natural geomorphology and soil strata. This may lead to changes in soil properties and land capability. During the construction of infrastructure, there is a possibility of spillage from the machinery used to construct, such as oil and diesel spillage. These machines and vehicles cause soil compaction and increased runoff. Infrastructure, if not maintained have the possibility of causing erosion and sedimentation.
Waste management activities, including: • In-put ROM Stockpiling; • Handling of hydrocarbon chemicals; • Hauling and transportation of waste material; • Transportation of product coal; and • Disposal of waste material.	• Soil contamination from Hydrocarbon waste (lubricants, oils explosives, and fuels); • Soil contamination from sewage and wastewater; and • Soil compaction resulting from the movement of heavy machinery within the Project Area.	RoM Stockpiling may lead to soil contamination when stockpiles are spilled, eroding, and leached of chemicals. These chemicals have the potential to leach into the groundwater and contaminate the natural water systems. Contaminated soil has a very low agricultural potential and will decrease the Land Capability significantly. There are chances for contamination by hydrocarbons (oils, fuels, grease) from vehicles or other machinery during construction, which could contaminate soils.

9.3 Operational Phase

Activities during the Operational Phase that may have a potential impact on the Soil, Land Use and Land capability are described in Table 9-3 below.

9.3.1 Management Objectives and Actions

The objectives during the Operational Phase are to minimize impacts to the Soil, Land Use, and Land Capability by undertaking concurrent rehabilitation.

Impacts during the Operational Phase are unavoidable and are therefore proposed to attempt to minimize the risks as far as possible. Impacts that are not able to be minimized should be rectified and reduced. The impact size should be kept minimal with as little changes to the natural state of the Project Area as far as possible.

The management actions are proposed in the Environmental Management EMPr in Section 10.

Table 9-3: Operational Phase Interactions and Impacts of Activity

Interaction	Impact	Description
Blasting (only when dikes and other geological features are encountered).	• Movement of the soil strata; and • Potential subsistence, causing ponding and undulating topographies.	Blasting has the potential for changing the soil strata and causing changes to the natural topography. This could lead to areas of water ponding, waterlogging, and changes to the natural water table thus impacting the soils, land uses, and land capability.
Underground mining machinery maintenance.	• Soil Contamination; and • Soil compaction.	Possible contamination due to heavy mining machinery containing large volumes of oils and diesel that could spill into the soils and water. Vehicle movement during the machinery maintenance will cause compaction of the soil, increased runoff, and potential to erosion.
Use of existing haul roads and vehicle movement.	• Compaction of soil; • Increased runoff potential; • Head cut erosion and channel forming from the roads (culverts); and • Increased erosion and consequently sedimentation potential.	The vehicle movement during the operational phase will increase rapidly. This will have various impacts on the soil. Compaction of the soil leads to hardened surfaces and loss of vegetation cover which may result in erosion and loss of sediment. When roads cross watercourses, culverts are installed, however, if not maintained it could lead to head-cut erosion and channel forming. Hydrocarbon spills can contaminate the soil. This includes the storage of fuel, lubricants, oil, diesel, and wastewater.
In-pit RoM Stockpiling.	• Potential runoff from stockpiles causing imbalances to the soil chemical and physical state;	RoM Stockpiling may lead to soil contamination when stockpiles are eroding and leaching of chemicals. These chemicals have the potential to leach into the groundwater and contaminate the natural water systems and affect soil fertility. Contaminated soil has a very low agricultural potential and will decrease the Land Capability significantly. Contaminated soil will impact the groundwater, vegetation growth, agricultural potential, grazing potential and may lead to sedimentation into the wetlands.

	• Erosion and sedimentation of contaminants into the wetland areas.	
Operation of water and sewer reticulation. Waste management activities.	• Soil contamination from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels); and • Soil contamination from sewage and wastewater.	• There are chances for contamination by hydrocarbons (oils, fuels, grease) from vehicles and machinery which could lead to soil and water pollution. • Potential sewage and wastewater spillage into the soils and watercourses, causing pollution and changes to the natural habitat. • Soil contamination and pollutants lead to decreased land capability and change land use.
Operation of the coal discard processing plant	• Contamination of soil; • Increased runoff; and • Increased erosion and consequently sedimentation potential.	• During the operation of the coal washing and discard processing plant, spillage may occur and contaminate the adjacent soils and end up polluting the groundwater. The plume of contaminants should be determined to determine the area of impact, however, the quicker the impacts/ spill has been cleaned up, the less the impact to the environment.

9.4 Decommissioning Phase

Activities during the Decommissioning Phase that may have a potential impact are described in Table 9-4 below.

9.4.1 Management Objectives and Actions

The objectives during the decommissioning phase are to rectify, reduce, and rehabilitate the impacts to the Soil, Land Use, and Land Capability of the Project Area. The aim will be to change the Land Capability from mining, back to agricultural pre-mining activities, including grazing and wildlife.

Impacts on the Project Area that cannot be rectified and reduces will lead to additional areas to be offset. Impacts during decommissioning are very low, however should be avoided if possible. Mitigation and rehabilitation of the soils' environment will have a positive consequence of the impact assessment.

The management actions are proposed in the Environmental Management EMPr in Section 10.

Table 9-4: Decommissioning Phase Interactions and Impacts of Activity

<table>
<tr><th>Interaction</th><th>Impact</th><th>Description</th></tr>
<tr><td>Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land, and re-vegetation.</td><td>• Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology; and
• The proliferation of AIPs, changing the soil biodiversity, and potential.</td><td rowspan="3">Impacts during mine decommissioning are somewhat positive as soil remediation and rehabilitation will be implemented. However, some impacts to consider are the loss of topsoil through erosion and compaction due to exposed areas and soil contamination by hydrocarbon and sewage waste.
During the removal of infrastructure, large machinery is used that will lead to soil compaction, reduce infiltration, and increased runoff. Soil compaction restricts vegetation growth and may lead to increased AIPs.
Due to the Concurrent Rehabilitation, it will only be necessary for the infrastructure areas to be rehabilitated during the decommissioning phase. As a result, the impact may be reduced if mitigation measures are implemented early enough. After infrastructure removal and rehabilitation, the areas must be assessed for compaction and possible erosion risk and corrected immediately if necessary. Additionally, subsidence and cracking of soils must be monitored closely.
The rehabilitation and mitigation during the Decommissioning Phase will have a positive impact on the environment.</td></tr>
<tr><td>Demolition of infrastructure and rehabilitation of affected areas.</td><td>• Exposure of soils and subsequent erosion by wind and water, changing soil depth;
• Increased vehicle movement in the area, increasing soil compaction and runoff potential; and
• Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils.</td></tr>
<tr><td>Post-closure monitoring and rehabilitation.</td><td>• Minimal negative impacts on the environment;
• AIPs Monitoring Plan; and
• Soil compaction and increased runoff potential due to vehicle movement during rehabilitation programs.</td></tr>
</table>

9.5 Cumulative Impacts

Cumulative impacts on soil resources were viewed in the light of similar mining or related operations within the catchment that contribute similar or related pollutants to soil resources within or downstream of the Project Area.

Mining and associated activities impacting the soil resources include changes to the Physico-chemical properties of the soil. Impacts include:

- Geomorphological changes to the natural soils and landscape;
- Loss of habitat, vegetation and growth medium;
- Loss of wetland soils, wetlands, groundwater and water resources (boreholes, dams);
- Erosion, destruction of agricultural land, loss of topsoil and organic material;
- Sedimentation and pollution of watercourses (wetlands); and
- Soil contamination through acid and sulphate, stockpiles sediment and erosion, mine impacted water (decant water), and heavy metals.

The cumulative impacts may, therefore, have a significant effect on the soil resources and therefore impacting the land use and land capability of the Project Area. Contaminated soil will directly impact the water quality and quantity as well as vegetation of the area.

9.6 Unplanned and Low-Risk Events

Contamination is the result of accidental leakage of oils and hydrocarbons from equipment used and it must be ensured that the requirements of South African legislation are met for minimisation of pollution. There is a risk of accidental spillages of hazardous substances, for example, hydrocarbons or oils from vehicles or other construction machinery and waste storage facilities during construction.

Table 9-5: Unplanned and Low-Risk Events

Unplanned Risk	Mitigation Measures
Coal spillage from RoM Stockpile conveyor or moving machinery.	• RoM Stockpile conveyor and machines must be services and maintained regularly; • Access road and conveyor must be maintained; • Ensure emergency response plans are in place; • Contractors must ensure that all employees are aware of the procedure for dealing with spills and undergo training on-site; and • Contaminated soils must be disposed of in a registered and licensed Waste Land Facility.

Unplanned Risk	Mitigation Measures
Hydrocarbon leaks from vehicles and machinery or hazardous materials.	• Place drip trays where the leak is occurring if vehicles are leaking; • All vehicles are to be serviced in a correctly concrete area or at an off-site location; and • Machines must be parked within hard park areas and must be checked daily for fluid leaks.
Hazardous substance spillage from pipelines or waste storage.	• Prevent any spills from occurring; • If a spill occurs it is to be cleaned up (Drizit spill kit/ Zupazorbtype spill kit, oil or chemical spill kit) immediately and reported to the appropriate authorities; • The conveyor must be maintained and checked regularly for leaks; • Ensure emergency response plans are in place; • Contractors must ensure that all employees are aware of the procedure for dealing with spills and leaks and undergo training on-site; • Ensure that emergency spill equipment is available; • All machines are to be serviced and refuelled in demarcated bunded areas, workshops or at appropriate off-site locations; • If a significant (> 5L) spill occurs, it is to be cleaned up immediately, reported to the appropriate authorities and recorded; and • Contaminated soils must be disposed of in a registered and licensed Waste Land Facility.

10 Environmental Management Programme

The EMPr is described in Table 10-1 below.

Table 10-1: Environmental Management Programme

Phase	Aspects Affected	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	Period for Implementation
Construction	Soil, Land Use, and Land Capability	• Clearing of vegetation and/or soil for site establishment; • In-pit RoM Stockpiling; and • Access road construction.	• Exposure of soil, increasing erosion potential and topsoil loss; • Compaction of soil; • Increased runoff potential; • Increased wind and water erosion and consequently sedimentation potential; • Removal of vegetation, basal cover and thus increasing the potential of loss of topsoil, organic material and increased erosion potential; and • Compaction, ponding, and landscaping of the area.	• Control site clearing to a minimal and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • In-pit ROM Stockpiling should be allocated to areas with low agricultural potential areas and outside of wetland areas; • Make use of existing roads to encourage minimal impacts/footprint to the Project Area. It is advised that existing roads be updated before new roads are constructed; • During soil stripping, topsoil should be stockpiled separate from the subsoil to enhance the rehabilitation process; • While soils are being stockpiled, the soils should be revegetated to limit erosion and loss of organic material; • Establishment of effective vegetation around constructed infrastructure for adequate soil protection from wind and water erosion; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place at regular intervals or after high rainfall events; • Runoff must be controlled and managed by the use of proper stormwater management measures; • Vehicles should regularly be surveyed and checked that oils spills and other contaminants are not exposed to the soils; • Re-fuelling must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil; • All vehicles and machines must be parked within hard park areas and must be checked daily for fluid leaks; and • Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (> 5L), if soils are contaminated, they must be stripped and disposed of at a licensed waste disposal site.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine, where applicable	Life of Construction Phase

Phase	Aspects Affected	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	Period for Implementation
Operational	Soil, Land Use, and Land Capability	• Blasting (only when dikes and other geological features are encountered); • In-pit RoM Stockpiling; • Underground Mining Machinery Maintenance; • Operation of water and sewer reticulation; • Use of existing haul roads; and • Operation of the coal discard processing plant.	• Movement of the soil strata; • Potential subsistence, causing ponding and undulating topographies; • Soil Contamination; • Soil compaction; • Increased runoff potential; • Increased erosion and consequently sedimentation potential; • Potential runoff from stockpiles causing imbalances to the soil chemical and physical state; • Erosion and sedimentation within the wetland areas; • Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Unexpected changes in the depth and the nature of the soil; • Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); and • Soil contamination from sewage.	• Keep site clearing to a minimal and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • It is advised that concurrent rehabilitation, where possible, be done to minimize the impacts of the soils; • Soil pollution monitoring should be conducted at selected locations on the project site to detect any extreme levels of pollutants; • Any spillages of sewage effluent from the treatment plant or ablution facilities should be cleaned up immediately and the removed contaminated soils should be disposed of at accredited disposal sites; • Long term stockpiles should be revegetated to minimise loss of soil quality. This will minimise AIPs, maintain soil organic matter levels, maintain soil structure and microbial activity; • Topsoil stripping should be scheduled for the dry season, where possible; and • All long-term topsoil material stockpiles should be located outside the active mine path and away from drainage lines.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine	Life of Operational Phase

Phase	Aspects Affected	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	Period for Implementation
Decommissioning	Soil, Land Use, and Land Capability	• Demolition and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation. • Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land, and re-vegetation. • Post-closure monitoring and rehabilitation	• Compaction of soil; • Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology; • The proliferation of AIPs, changing the soil biodiversity and potential; • Disturbance of soils and subsequent erosion by wind and water; • Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Unexpected changes in the depth and the nature of the soil; and • Ponding of water and creation of drainage channels; • Minimal negative impacts on the environment; • AIPs Monitoring Plan; and • Soil compaction and increased runoff potential due to vehicle movement during rehabilitation programs.	• Continue with Concurrent Rehabilitation and implement land rehabilitation measures; • Address compacted areas by deep ripping to loosen the soil and revegetate the area as soon as possible; • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions; • Seal the shafts by placing concrete plugs as well as implement a monitoring plan to ensure no decant; • Inventory of hazardous waste materials that may be expected from the Project Area must be classified and should be disposed of in an appropriate landfill facility; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; • Implement a soil monitoring plan to monitor any changes to the soil and its environments, such as contamination, erosion, subsidence, surface cracking, AIPs, and soil health; • Monitor decant from the underground workings and implement management measures which include reverse osmosis or neutralization and electrolytic treatment using a Water Treatment Plant (WTP) to get purified water for discharge to the natural environment or for other beneficial uses; and • A rehabilitation and monitoring plan should be implemented for at least three (3) years after decommissioning to ensure no unexpected and undulated impacts on the environment, Soil, Land Use, and Land Capability.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine	Life of Decommissioning and beyond

11 Monitoring Programme

A monitoring program is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring the effectiveness of the management measures in place. Table 11-1 describes the monitoring plan which should be followed from the construction phase through to the Decommissioning and Monitoring phase. The table below includes each element of monitoring together with the frequency of monitoring and the person responsible thereof.

The monitoring program is based on the following points:

- Monitoring should be done in terms of:
  - Appendix 6 of the NEMA EIA Regulations, 2014, (as amended);
  - National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
  - National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA);
  - The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA); and
  - Results of chemical analyses of soils obtained must be compared against the SSV listed in Section 8.1 and the baseline results as shown in this report to determine if the soil fertility has decreased and or potential harmful elements has increased over time during the LoM.

Table 11-1: Monitoring Plan

Monitoring Element	Comment	Requirements	Frequency	Responsibility
Soils • Erosion status; • Compaction; • Runoff; • Contamination; and • Vegetation Cover.	• Soil analysis parameters should include but not limited to pH; Electrical Conductivity; Sulphate; major cations (K, Ca, Mg & Na); trace metals (Al, Fe, Zn, Cu, Mn, Co, Se, Mo, Cd, Ni, Cr (VI), Pb, Hg & As); Anions (NO_3, NO_2, NH_4, Cl, F, PO_4); • The environmental officer is responsible to determine the effectiveness of the erosion control structures; and • The contractor is responsible to undertake the clearing of vegetation and rehabilitation of impacted areas.	• If soil is polluted, treat the soil using in-situ bioremediation; • If in-situ treatment is not possible then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification, and Disposal of Hazardous Material and disposed at an appropriate, permitted or licensed disposal facility; • Repair any damage caused by erosion; • Traffic should be limited where possible while the vegetation is establishing; and • The area must be fenced, and animals should be kept off the area until the vegetation is self-sustaining.	• Annual monitoring of soils and vegetation during the construction phase; • Annual monitoring of soils and vegetation during operational and decommissioning phases; and • Annual monitoring for soils and vegetation for at least three (3) years post-closure, or until rehabilitation has reached a sustainable state with no further changes.	• The Mine Manager and the EP should ensure soil contamination monitoring on-site, especially where hydrocarbons are stored and applied; • EP to give training to sub-contractors and all workers on the operational procedures and mitigation measures; and • The MM and the EP should be responsible to determine the effectiveness of erosion control structures.

12 Stakeholder Engagement Comments Received

Notes

The consultation process affords Interested and Affected Parties (I&APs) opportunities to engage in the EIA process. The objectives of the Stakeholder Engagement Process (SEP) include the following:

- To ensure that I&APs are informed about the Project;
- To provide I&APs with an opportunity to engage and provide comment on the Project;
- To draw on local knowledge by identifying environmental and social concerns associated with the Project;
- To involve I&APs in identifying methods in which concerns can be addressed;
- To verify that stakeholder comments have been accurately recorded; and
- To comply with the legal requirements.

The Public Participation Process (PPP) has been partially completed, as a process separate to the Wetland Impact Assessment. No formal consultation was undertaken as part of this assessment. Should any I&AP comments be submitted in relevance to soil resources during the SEP, these will be considered in the final EIA report.

13 Recommendations

The following actions are recommended to reduce adverse effects on the soil resources of the Project Area (Table 13-1):

Table 13-1: Recommendations

Possible Impacts	Recommendations
Soil erosion and loss of biodiversity/vegetation cover resulting in increased sedimentation, loss of topsoil and decreased land capability.	• Reduce the risk of erosion, compaction, and the creation of preferential flow paths by re-vegetating exposed areas, maintaining linear infrastructure and culverts and installing sediment traps and erosion berms; • Rehabilitated areas must be fenced, and animals should be kept off the area until the vegetation is self-sustaining; and • Runoff must be controlled and managed using proper stormwater management measures.
Change in soil characteristics (i.e., soil structure, depth, fertility) due to compaction of areas and associated infrastructure.	• Restriction of vehicle movement over sensitive areas to reduce compaction; • Only the designated access routes are to be used to reduce any unnecessary compaction; and • Deep rip compacted areas, cover with at least 300 mm of topsoil and revegetate.

Possible Impacts	Recommendations

Contamination of the soil resource due to hydrocarbons spillages and decanting.	• If soil is polluted, treat the soil using in-situ bioremediation;
	• If in-situ treatment is not possible then the polluted soil must be classified according to the minimum requirements for the handling, classification, and disposal of hazardous material, and disposed at an appropriate, permitted or licensed disposal facility;
	• All vehicles and machines must be parked within hard park areas, and must be checked daily for fluid leaks;
	• Refuelling must take place on a sealed surface area away from soils to prevent seepage of hydrocarbons into the soil;
	• Place drip trays where vehicles or machinery leaks are occurring;
	• Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits;
	• Any contractors on site must ensure that all employees are aware of the procedure for dealing with spills, and leaks, and undergo training on-site; and
	• Soil pollution monitoring after spills should be conducted at selected locations on the project site to detect any extreme levels of pollutants, including:
	    • pH;
	    • Cation Exchange Capacity (CEC);
	    • Exchangeable acidity (cations);
	    • Micronutrients;
	    • Anions and Nitrates (NH4 + NO3);
	    • Phosphorus (P) (Bray 1);
	    • Electrical Conductivity (EC);
	    • Carbon (Walkley Black);
	    • Soil particle size distribution (Clay, Silt & Sand); and
	    • Potential Harmful Elements and heavy metals, including: Cadmium (Cd), Chromium (Cr), Nickel (Ni), Lead (Pb), Copper (Cu), Mercury (Hg), Zinc (Zn), Arsenic (As) and Selenium (Se).

Soil contamination from decanting.	• Monitor the decant of Acid Mine Drainage (AMD), contamination and dewatering and implement management measures which include for example, an abstraction borehole placed down gradient of the decant point and reverse osmosis or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment, 2021).

Possible Impacts	Recommendations
Livestock impacts.	• Fence off rehabilitated areas from livestock until vegetation has established. Follow a grazing plan to prevent overgrazing, trampling and erosion. This will lead to improved soil fertility land capability.
Complete loss of soils	• Soil/Land Offset should form part of a biodiversity (wetland) Offset plan if one will be developed and implemented after the residual impacts have been determined.
Underground related impacts (i.e., decanting, dewatering, subsidence and contamination)	• Monitor the area for related impacts and report to authorities as soon as possible. If areas are unstable and hold a risk to animals and humans, the area should be fenced off.

14 Reasoned Opinion Whether Project Should Proceed

Based on the baseline information and impact assessment significance ratings, it is the opinion of the specialist that this Project is feasible and should be considered. The proposed underground mining activities will not have a significant impact on the soils and their environment as most of the activities will be underground. Only solitary sections of the soils will be impacted due to infrastructure related to underground workings, such as sewage and wastewater areas, access roads, and office buildings. Land Use will predominantly stay agropastoral activities and therefore not impact the overall Land Capability.

However, it is highly recommended that concurrent rehabilitation (where possible), management, and mitigation measures are correctly implemented to minimise potential impacts on soils (as set out in Section 1) to maintain the land capability for future land use. Soil management measures and monitoring requirements as set out in Section 10 should form part of the conditions for environmental authorisation. It is highly recommended that wetland areas and dams are not impacted on by keeping at least a 500 m zone of regulation buffer to any construction and infrastructure. Soil management measures and monitoring requirements as set out in this report should form part of the conditions of environmental authorisation and be included in the EMPr.

15 Conclusion

The proposed development area falls within land types **Bb4**, **Bb5** with a small area characterised by land type **Fa8**. These land types include soils of high value to the agricultural sector. The land capability is dominated by **Class II**, which indicates a high agricultural potential, and land capability with moderate conservation practices, **Class IV** indicating moderate agricultural potential, requiring careful management planning and **Class VI** occurring in smaller areas which are mainly used for pastures, rangelands, woodlands or wildlife.

The potential impact due to the underground mining activities on the soil, land use, and land capability is low to moderate if mismanaged. These impacts include:

- Natural wetlands and water resources may be impacted, changing the use of water in the area, water contamination, and loss of water quality and quantity. Contaminated water will affect the soils, potential of land use and water use;
- Soil erosion caused by wind and water movement over the soil surface, increasing sedimentation within the lower areas;
- Disturbance to the functionality and productivity of the soil and may also result in a loss of topsoil, erosion, losing organic material from the topsoil;
- Chemical soil pollution, loss of vegetation, organic material, and soil fertility;
- Acidification of soil, loss of organic matter, soil contamination and loss of soil use;
- Soil compaction, low vegetation growth, high runoff potential, increased erosion;
- The land capability will change from Class II, IV, and VI to industrial and infrastructure. Should the area not be rehabilitated to pre-mining land capability after mining operations, the land capability may be reduced; and
- Potential for subsidence, decanting and dewatering that will impact the soil and their functionality (land capability).

Recommendations are made for the EIA phase to ensure that the rehabilitation plan, mitigation measures and continuous monitoring measures are in place. It is highly recommended that if any impacts to the soils, land use and land capability are observed, such as decanting, spills and erosion, the impacts must be mitigated as soon as possible.

In conclusion, based on the understanding of the Project while considering the results of the impact assessment, Digby Wells does not object to the Project; taken into consideration the provided EMPr, Monitoring Program, and Recommendations are adopted.

16 References

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Appendix A: Impact Assessment Ratings

Impact Ratings

Construction Phase Impact Ratings

The construction phase impacts are rated below.

Construction Phase Impact Rating Table

<table>
<tr><td colspan="4">1. Activity and Interaction:
Access road construction and Movement of vehicles and heavy machinery.</td></tr>
<tr><td colspan="4">Impact Description:
• Compaction of soil;
• Increased runoff potential; and
• Increased erosion and consequently sedimentation potential.</td></tr>
<tr><td colspan="4">Prior Mitigation</td></tr>
<tr><td>Dimension</td><td>Rating</td><td>Motivation</td><td>Significance</td></tr>
<tr><td>Duration</td><td>5</td><td>The impact of soil compaction will occur during the life of the project, although reduced during the decommissioning phase.</td><td rowspan="5">Moderate (negative) - 60</td></tr>
<tr><td>Extent</td><td>3</td><td>Soil compaction will occur within the Project Area</td></tr>
<tr><td>Intensity</td><td>4</td><td>Increased erosion and loss of organic material due to increased runoff from compacted areas.</td></tr>
<tr><td>Probability</td><td>5</td><td>Site clearance and the movement of vehicles and heavy mine machinery will result in soil compaction.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation measures</td></tr>
<tr><td colspan="4">• Keep site clearing to a minimal and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans);
• Make use of existing roads to encourage minimal impacts/footprint to the Project Area; and
• Runoff must be controlled and managed by the use of proper stormwater management measures.</td></tr>
<tr><td colspan="4">Post-Mitigation</td></tr>
</table>

Dimension	Rating	Motivation	Significance
Duration	4	The impact will occur on a long-term basis, specifically during the construction and Operational Phases.	Negligible (negative) - 32
Extent	2	Soil compaction is limited only to limited areas, provided that soil management measures are implemented.	
Intensity	2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

2. Activity and Interaction:
Site clearing and preparation by the removal of vegetation and topsoil, leading to the exposure of soils for site establishment.

Impact Description:

- Soil loss by wind and water erosion from cleared land surfaces;
- Compaction of soil;
- Increased runoff potential;
- Increased wind and water erosion and consequently sedimentation potential;
- Removal of vegetation, basal cover and thus increasing the potential of loss of topsoil, organic material and increased erosion potential; and
- Compaction, ponding, and landscaping of the area.

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	5	The impact of soil erosion will occur during the life of the Project.	Moderate (negative) - 84
Extent	4	Loss of soil will only occur within the impacted area and its near surroundings.	
Intensity	5	Loss of soil and organic material to erosion. Once the resource has been lost from the landscape it cannot be recovered.	

Probability	6	Site clearance has to take place for construction of the various infrastructures which will expose the soil.	
Nature	Negative		
Mitigation measures			
• Keep site clearing to a minimal • While soils are being stockpiled, the soils should be revegetated to limit erosion and loss of organic material; • Establishment of effective vegetation around constructed infrastructure for adequate soil protection from wind and water erosion; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place at regular intervals or after high rainfall events; and • Runoff must be controlled and managed by the use of proper stormwater management measures.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will occur during the life of the project	Negligible (negative) - 32
Extent	2	Loss of soil is limited only to exposed areas due to soil management measures being implemented, such as limit vehicle movement and restrict movement to specific sites.	
Intensity	2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will continue to occur.	
Nature	Negative		
1. **Activity and Interaction:** Construction of infrastructure: A new 22 kV overhead powerline from the existing substation to a new 11kV substation, ROM Stockpile conveyor at the portal, Ventilation shaft, Portal ventilation fan, Sewer and water management, Change house, Lamproom, Office, Workshop area and Stone dust silo.			

Impact Description:			
• Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Increased hardened surfaces resulting in increased hydrological functioning; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Increased dust, erosion and sedimentation; and • Removal of natural vegetation and loss of basal cover.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact of soil erosion will occur during the life of the project.	Moderate (negative) - 84
Extent	4	Loss of soil will only occur within the impacted area and its near surroundings.	
Intensity	5	Loss of soil and organic material to erosion. Once the resource has been lost from the landscape it cannot be recovered.	
Probability	6	Site clearance has to take place for construction of the various infrastructures which will expose the soil.	
Nature	Negative		
Mitigation measures			
• Increased vehicle movement in the area, increasing soil compaction and runoff potential; • Increased hardened surfaces resulting in increased hydrological functioning; • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the soils; and • Increased dust, erosion, and sedimentation.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will occur during the life of the Project.	Negligible (negative)

Extent	2	Loss of soil is limited only to exposed areas due to soil management measures being implemented, such as limit vehicle movement and restrict movement to specific sites.	- 32
Intensity	2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will continue to occur.	
Nature	Negative		
1. Activity and Interaction: Waste management activities, including In-put ROM Stockpiling; Handling of hydrocarbon chemicals; Hauling and transportation of waste material; Transportation of product coal; and Disposal of waste material.			
Impact Description: • Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); • Erosion and sedimentation from ROM Stockpiling areas; and • Soil compaction resulting from the movement of heavy machinery within the Project Area.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact on soils will occur during the life of the Project.	Minor (negative) - 66
Extent	3	The impact may extend across the Project Area as well as to nearby environments.	
Intensity	3	Loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function.	
Probability	6	It is highly probable that oil, grease, or fuel spillages will occur during Project life.	
Nature	Negative		
Mitigation measures			

- Runoff must be controlled and managed by the use of proper stormwater management measures;
- Vehicles should regularly be surveyed and checked that oils spills and other contaminants are not exposed to the soils;
- Re-fuelling must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil;
- All vehicles and machines must be parked within hard park areas and must be checked daily for fluid leaks; and
- Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5 L), if soils are contaminated, they must be stripped and disposed of at a licensed waste disposal site.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	4	The impact should only occur during the construction and operational phase. The impact can be reversed with proper management and mitigation.	Negligible (negative) - 28
Extent	2	Localised to the incident area, although it can extend to a larger area if not managed	
Intensity	1	Minimal loss and/or effect to biological or physical resources, not affecting ecosystem functioning.	
Probability	4	The impact on soil resources will likely occur if not managed.	
Nature	Negative		

Operational Phase Impact Ratings

The operational phase impacts are rated below.

Operational Phase Interactions and Impacts of Activity Rating

1. Activity and Interaction:
Blasting (only when dikes and other geological features are encountered).

Impacts:

- Movement of the soil strata; and
- Potential subsistence, causing ponding and undulating topographies.

Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	Blasting will only take place when dikes and other geological features are encountered. The impact on the soil will occur during the Operational Phase.	Moderate (negative) - 60
Extent	3	Soil mixing/movement of naturally occurring soil strata (topsoil and subsoil) will occur within the Project Area.	
Intensity	4	Increased erosion and loss of organic material due to increased runoff from compacted areas. Water ponding, slope changes.	
Probability	5	Blasting will only take place when dikes and other geological features are encountered and would therefore occur.	
Nature	Negative		
Mitigation measures			
• Do not blast in sensitive areas (wetland areas) where there is a possibility of ponding and subsidence; and • Limit the use of blasting.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will occur on a long-term basis, specifically during the construction and operational phases.	Negligible (negative) - 32
Extent	2	Soil compaction is limited only to limited areas, provided that soil management measures are implemented.	
Intensity	2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	

Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
2. **Activity and Interaction:** Underground mining machinery maintenance.			
Impacts: • Soil Contamination; and • Soil compaction.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact on soils will occur during the life of the Project.	Minor (negative) - 66
Extent	3	The impact may extend across the site and to nearby environments.	
Intensity	3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function.	
Probability	6	It is highly probable that oil, grease, or fuel spillages will occur during Project life.	
Nature	Negative		
Mitigation measures			
• Soil pollution monitoring should be conducted at selected locations on the project site to detect any extreme levels of pollutants; and • Any spillage effluent should be cleaned up immediately and the removed contaminated soils should be disposed of at accredited disposal sites.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	Long term: 6-15 years and impact can be reversed with proper management.	Negligible (negative)

Extent	2	Impact on soils will occur through accidental spillages localized to the incident area.	- 28
Intensity	1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning.	
Probability	4	The impact on soil resources can occur.	
Nature	Negative		
3. **Activity and Interaction:** In-put ROM Stockpiling.			
Impact Description: • Soil Contamination from ROM stockpiles, leaching, erosion, sedimentation of contaminants; • Loss of vegetation and habitat due to high contaminates in soils; and • Erosion and sedimentation from ROM Stockpiling areas.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact on soils will occur during the life of the Project.	Moderate (negative) - 66
Extent	3	The impact may extend across the Project Area as well as to nearby environments.	
Intensity	3	Loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function.	
Probability	6	It is highly probable that oil, grease, or fuel spillages will occur during Project life.	
Nature	Negative		
Mitigation measures			
• Runoff must be controlled and managed by the use of proper stormwater management measures; • Stockpiles should be engineered to prevent excessive runoff and erosion; • Construct a trench around the stockpiles to prevent runoff, contaminants, and sediments to enter the natural systems; and • ROM-stockpiles not to be constructed in high land capability areas and wetland areas.			

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact should only occur during the construction and operational phase. The impact can be reversed with proper management and mitigation.	Minor (negative) - 36
Extent	2	Localised to the incident area, although it can extend to a larger area if not managed to increase the extent, intensity of contamination	
Intensity	3	Loss and/or damage to biological or physical resources of moderately sensitive environments and, limiting ecosystem function.	
Probability	4	The impact on soil resources will likely occur if not managed.	
Nature	Negative		

4. **Activity and Interaction:** Use of existing haul roads and vehicle movement.

Impacts:

- Compaction of soil;
- Increased runoff potential; and
- Increased erosion and consequently sedimentation potential.

Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact will occur during the life of the project, although reduced during the decommissioning phase.	Moderate (negative) - 65
Extent	4	Soil stripping and stockpiling will occur within the Project Area.	
Intensity	4	Serious medium-term environmental effects. Environmental damage can be reversed in less than a year.	
Probability	5	The probability is very high.	

Nature	Negative		
Mitigation measures			
• Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • Keep to designated areas for vehicle movement to prevent further compaction and potential erosion; and • Maintain road culverts and monitor soil erosion and sedimentation.			
Post-Mitigation			
Duration	4	The impact will occur on a long-term basis, specifically during the Construction and Operational Phases.	Negligible (negative) - 32
Extent	2	Soil stripping and stockpiling is limited only to current mine areas, provided that soil management measures are implemented.	
Intensity	2	Amelioration of topsoil before rehabilitation will restore soil fertility hence impact intensity will be low after mitigation.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
5. **Activity and Interaction:** Operation of water and sewer reticulation. Waste management activities.			
Impacts: • Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); and • Soil contamination from sewage.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The impact on soils will occur during the life of the Project.	Moderate (negative) - 66
Extent	3	The impact may extend across the site and to nearby environments.	

Intensity	3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function.	
Probability	6	It is highly probable that oil, grease, or fuel spillages will occur during Project life.	
Nature	Negative		
Mitigation measures			
• Soil pollution monitoring should be conducted at selected locations on the Project site to detect any extreme levels of pollutants; and • Any spillages of sewage effluent from the treatment plant or ablution facilities should be cleaned up immediately and the removed contaminated soils should be disposed of at accredited disposal sites.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	Long term: 6-15 years and impact can be reversed with proper management.	Negligible (negative) - 32
Extent	2	Impact on soils will occur through accidental spillages localised to the incident area.	
Intensity	2	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning.	
Probability	4	The impact on soil resources can occur.	
Nature	Negative		
6. **Activity and Interaction:** Operation of the coal discard processing plant.			
Impacts: • Contamination of soil; • Increased runoff; and • Increased erosion and consequently sedimentation potential.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

<table>
<tr><td>Duration</td><td>5</td><td>The impact will occur during the life of the project, although reduced during the decommissioning phase.</td><td rowspan="5">Moderate (negative) - 78</td></tr>
<tr><td>Extent</td><td>4</td><td>Impacts my extent to a municipal area if not managed and mitigation (soil and water contamination).</td></tr>
<tr><td>Intensity</td><td>4</td><td>Serious medium-term environmental effects due to contamination of the soil and groundwater</td></tr>
<tr><td>Probability</td><td>6</td><td>It is almost certain that impacts may occur due to the activity</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation measures</td></tr>
<tr><td colspan="4">Soil pollution monitoring should be conducted at selected locations on the project site to detect any extreme levels of pollutants;
Discard from the coal wash plant must be contained and treated before released into the environment; and
Any spillages from the coal wash plant should be cleaned up immediately and the removed contaminated soils should be disposed of at accredited disposal sites.</td></tr>
<tr><td colspan="4">Post-Mitigation</td></tr>
<tr><td>Duration</td><td>4</td><td>Even after mitigation, the impacts could last for up to 15 year after the impact</td><td rowspan="5">Minor (negative) - 36</td></tr>
<tr><td>Extent</td><td>2</td><td>Impacts may only be at a limited area if mitigation is done soon after the impact</td></tr>
<tr><td>Intensity</td><td>3</td><td>Moderate environmental effects due to contamination of the soil and groundwater</td></tr>
<tr><td>Probability</td><td>4</td><td>There is still a possibility that an impact may occur even when mitigation is followed.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
</table>

Decommissioning Phase Impact Ratings

The rehabilitation impacts described are rated below.

Decommissioning Phase Impact Rating

1. Activity and Interaction: Rehabilitation – rehabilitation mainly consists of spreading and landscaping of the preserved subsoil and topsoil, profiling of the land, and re-vegetation.			
Impact Description: • Compaction of soil; • Uneven surfaces and topographies, causing water ponding and changes to the hydrogeomorphology; and • The proliferation of AIPs, changing the soil biodiversity, and potential.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	3	Reduces soil compaction during the Decommissioning Phase.	Minor (negative) - 50
Extent	3	Soil compaction and uneven landscapes may occur if the rehabilitation plan is not followed.	
Intensity	4	Minimal effect on biological or physical resources affecting soil system functioning.	
Probability	5	The impact on soil resources can occur.	
Nature	Negative		
Mitigation measures			
• Continue with Concurrent Rehabilitation and implement land rehabilitation measures; • Address compacted areas by deep ripping to loosen the soil and revegetate the area as soon as possible; • Re-vegetate exposed soil areas to promote organic carbon and soil health; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; • Only designated access routes are to be used to reduce any unnecessary compaction; and • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions.			

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact will occur on a small scale, specifically during rehabilitation and monitoring.	Negligible (negative) - 32
Extent	2	The impact is limited only to specific areas, provided that soil management measures are implemented.	
Intensity	2	Minor loss and/or effects to biological or physical resources not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

2. Activity and Interaction:
Demolition and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation.

Impact Description:

- Disturbance of soils and subsequent erosion by wind and water;
- Increased vehicle movement in the area, increasing soil compaction and runoff potential;
- Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils;
- Unexpected changes in the depth and the nature of the soil; and
- Ponding of water and creation of drainage channels.

Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	The impact will remain for some time after the life of a Project.	Minor (negative) - 65
Extent	3	The impact is limited only to specific areas, provided that soil management measures are implemented.	

Intensity	4	Serious medium-term environmental effects.	
Probability	5	The impact may likely occur.	
Nature	Negative		

Mitigation measures

- Continue with Concurrent Rehabilitation and implement land rehabilitation measures;
- Address compacted areas by deep ripping to loosen the soil and revegetate the area as soon as possible;
- Inventory of hazardous waste materials stored on-site should be compiled and arrange complete removal;
- Monitor decant of Acid Mine Drainage (AMD) and implement management measures which include in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses;
- Seal the shaft by placing concrete plugs as well as implement a monitoring plan to ensure no decant;
- Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs;
- Only designated access routes are to be used to reduce any unnecessary compaction; and
- The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	2	The impact will be less than a year if rehabilitation measures are implemented correctly.	Negligible (negative) - 24
Extent	2	The impact will be limited to the site due to the implementation of mitigation measures.	
Intensity	2	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	4	The impact can occur.	
Nature	Negative		

3. **Activity and Interaction:** Post-closure monitoring and rehabilitation.

Impact Description:

- Minimal negative impacts on the environment;
- AIPs Monitoring Plan; and
- Soil compaction and increased runoff potential due to vehicle movement during rehabilitation programs.

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	5	The impact will remain beyond Project life.	Minor (negative) -55
Extent	4	Will affect the whole municipal area.	
Intensity	2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	5	Likely: The impact may occur. <65% probability.	
Nature	Negative		

Mitigation measures

- The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions;
- Continue with Concurrent Rehabilitation and implement land rehabilitation measures; and
- Rehabilitation and Monitoring Plan.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	6	Beyond Project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Moderate (Positive) 91
Extent	4	Municipal Area: Will affect the whole municipal area.	

Intensity	+3	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	
Probability	7	Definite: There are sound scientific reasons to expect that the impact will occur. >80% probability.	
Nature	Positive		