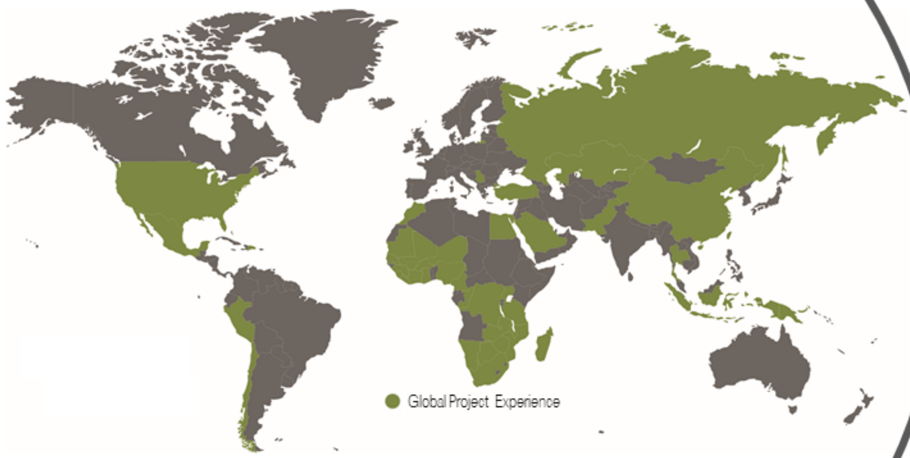

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Proposed Environmental Regulatory Process for the Middeldrift Resources Within the Existing New Clydesdale Colliery Mining Right, Situated in the Magisterial District of Nkangala, Mpumalanga Province

Soil, Land Use and Land Capability Impact Assessment

Prepared for:	**Project Number:**
Universal Coal Development IV (Pty) Ltd	UCD6587

May 2021

Digby Wells and Associates (South Africa) (Pty) Ltd
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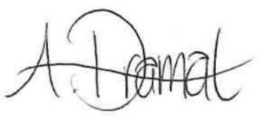
This document has been prepared by Digby Wells Environmental.

Report Type:	Soil, Land Use and Land Capability Impact Assessment
Project Name:	Proposed Environmental Regulatory Process for the Middeldrift Resources Within the Existing New Clydesdale Colliery Mining Right, Situated in the Magisterial District of Nkangala, Mpumalanga Province
Project Code:	UCD6587

Name	**Responsibility**	**Signature**	**Date**
Aamirah Dramat	Report Compiler		March 2021
Willnerie Janse van Rensburg	Site Survey and Report Compiler		May 2021
Arjan van 't Zelfde	Senior Reviewer		May 2021
Mia Smith	OpsCo Reviewer		June 2021

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DETAILS AND DECLARATION OF THE SPECIALIST

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Experience (years):	5
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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 in an objective manner, even if this results in views and findings that are not favourable to the applicant;
  - I declare that there are no circumstances that may compromise my objectivity in performing such work;
  - I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and

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

	May 2021
Signature of the Specialist	*Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

EXECUTIVE SUMMARY

Digby Wells has been appointed to undertake an Environmental Authorisation (EA) Application Process for the mining of the Middeldrift Resources within the existing New Clydesdale Colliery (NCC) operations. This report, therefore, includes inputs to the Environmental Impact Assessment (EIA) Report and Environmental Management Programme (EMPr) in support of the EA Application; and the application for an Integrated Water Use License (IWUL) supported by an Integrated Water and Waste Management Plan (IWWMP). This report focussed on the **Soil, Land Use and Land Capability Impact Assessment** in accordance with the following relevant legislation:

- EIA Regulations, 2014 (General Notice (GN) R982 of 04 December 2014, as amended) (the “EIA Regulations, 2014) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA); and
- Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).

The Project Area is located within the Kriel district of the Mpumalanga Province. The topography ranges from high elevations on the south-west side of the Project Area to low-lying areas in the north-west and south towards the Steenkoolspruit. The Project Area can be described as uneven slopes with moderate undulating plains running towards a low-lying valley (Steenkoolspruit) on the east and south of the Project Area. Three depressions/pans are scattered throughout the Study Area.

The land capability ranges from II and IV, with the land uses being predominantly cultivated land and grassland, with minor areas of wetlands, thicket/dense bush, plantation/woodlot, woodland/open bush and adjacent urban areas. Large areas of the Project Area have been rated as high sensitivity, due to the high land capability (intensive cultivation) (Figure 9-1).

The typical augured soil horizons were identified as Orthic A-horizons, overlying Yellow-brown to Red Apedal B-horizons with a Plinthic B-horizon. The soils were very sandy, deep fertile soils; and are generally used for commercial agriculture. Scattered pans were identified on-site, with typical soil horizons of Vertic-A overlying G-horizon and E-horizons overlying a G-horizon (Rensburg and Kroonstad soil forms).

The overall chemical and physical soil analysis indicated that the average soil fertility is low, with the exception of the large pan (refer to as HGM unit 4 in the Wetland Impact Assessment, 2021). The pan had elevated Potassium (K), Sodium (Na) and Magnesium (Mg). This can be attributed to the clayey nature of the soils in the pan, increasing the Cation Exchangeable Capacity (CEC), Electrical Conductivity (EC) and pH.

To summarise, the overall impacts of the Project were determined to be major and may lead to irreversible damage to the soil, land use and land capability as the entire Project Area are proposed to be mined out. Based on the impact assessment significance ratings, it is the opinion of the specialist that the Project will have major effects on the soil, land use and land capability as the area will completely be mined and will most certainly have impacts on the adjacent land uses and land capabilities.

The following is recommended:

- Mitigate and protect adjacent land, as well as include soil/land offset inputs, forming part of a biodiversity (wetland) offset to compensate for the land degradation and loss of agricultural land;
- Rehabilitation, mitigation and monitoring of the soil resources should be correctly implemented and managed. The Soil, Land Use and Land Capability management and monitoring requirements as set out in Section 12 and Section 13 of this report should form part of the conditions for EA; and
- Soils and land use should form part of the Biodiversity (Wetland) Offset Strategy to compensate for the degradation of land. In the opinion of the specialist, mining of the sensitive areas (specifically the large pan) might have major impacts on the biodiversity and soils (please refer to the Wetland Impact Assessment, 2021). Offsetting must be the last resort as ideally sensitive areas must be avoided and rehabilitated when impacted; however, an Offset Strategy must be implemented if these areas are going to be impacted, mined and removed.

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ACRONYMS, ABBREVIATIONS AND DEFINITIONS

°C	Degrees Celsius
ARC	Agricultural Research Council
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CEC	Cation Exchange Capacity
Digby Wells	Digby Wells Environmental
EA	Environmental Authorisation
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EP	Environmental Practitioner
GPS	Global Positioning System
ha	Hectare
I&APs	Interested and Affected Parties
IC	Intensive Cultivation
ISCW	Institute for Soil, Climate and Water
IWUL	Integrated Water Use License
IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
km	Kilometre
L	Litre
LG	Light Grazing
LoM	Life of Mine
m	Metre
m.a.m.s.l.	Metres above mean sea level
MC	Moderate Cultivation
MG	Moderate Grazing
mm	Millimetre
MM	Mine Manager
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
Mt	Million tonnes

NCC	New Clydesdale Colliery
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, 1998 (Act No. 36 of 1998)
PCD	Pollution Control Dam
PPP	Public Participation Process
ROM	Run of Mine
SANAS	South African National Accreditation System
SEP	Stakeholder Engagement Plan
SSV	Soil Screening Values
TMP	Topsoil Management Plan
WML	Water Management License

Legal Requirements

The Integrated Water and Waste Management Plan must provide the supporting documentation for the authorization of water uses in an Integrated Water Use Licence (IWUL). The table below shows each legal requirement and where in the report it can be found.

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;	xi
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	xi
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	2.2
cA	And indication of the quality and age of the base data used for the specialist report;	6
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	8
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	6

Legal Requirement		Section in Report
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	6
(f)	Details of an assessment of the specific 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 alternatives;	2.1
(g)	an identification of any areas to be avoided, including buffers;	9
(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;	
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	4
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	11
(k)	any mitigation measures for inclusion in the EMPr;	13
(l)	any conditions/aspects for inclusion in the environmental authorisation;	15
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	13
(n)	a reasoned opinion (Environmental Impact Statement) -	16
	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 Environmental Management Programme (EMPr), and where applicable, the closure plan;	12
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	14
(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

Universal Coal Development IV (Pty) Ltd (Universal Coal) operates the NCC mine, situated in the Nkangala Magisterial District of the Mpumalanga Province with Mining Right (MR) reference **MR Ref. No. MP30/5/1/2/2/492MR.** Universal Coal had identified coal resources north of the existing MR and as such is proposing to extend the proposed North Opencast Pit to the Middeldrift Resources (Middeldrift).

Digby Wells has been appointed by Universal Coal to undertake an EA Application Process for the mining of Middeldrift within the existing NCC operations (the "Project"). This report, therefore, includes the undertaking of an EIA and providing inputs into an EMPr; as well as supporting the application for an IWUL, supported by an IWWMP in accordance with the following relevant legislation:

- EIA Regulations, 2014 (GN R982 of 04 December 2014, as amended) (the "EIA Regulations, 2014) promulgated under the NEMA, 1998 (Act No. 107 of 1998); and
- Section 21 of the NWA, 1998 (Act No. 36 of 1998).

1.1. Terms of Reference

Digby Wells has been appointed by NCC to complete a comprehensive reconnaissance Soil, Land Use and Land Capability impact assessment for the proposed Opencast Coal Mine project in the Mpumalanga Province. A Soil, Land Use and Land Capability Impact Assessment of the mine impacted areas together with the listed activities are necessary as they assist in land and environmental management.

1.2. Project Background

The Project is located in the Kriel district of the Mpumalanga Province. The Middeldrift resources lie North of the Universal Coal Diepspruit Mining Area (an underground mining operation that forms part of the NCC) and Universal Coal is the holder of the MR. The Middeldrift area is a greenfield area. The intention is to exploit the resources through opencast mining methodologies.

The proposed new activities at the Middeldrift Resources to be authorised will entail:

- Opencast coal mining through wetlands;
- Diversion of the district road D1651;
- Construction of a new road (linked to the road diversion) (approximately 4 km long); and
- Construction of a bridge over the Steenkoolspruit to access the current NCC operation to make use of the surface infrastructure and facilities.

For the purpose of this report, the following applies:

- Mining Right Area (MRA) defines the farms included in the NCC MR boundary (red outlined area on the maps);
- Project Area defines farm portions directly associated with the Middeldrift Resources (black and orange, hatched areas on maps); and
- Study Area defines the zone of influence in terms of the potential impact the Project will have on the soil, land use and land capability. This includes the Project Area together with a 500 m buffer.

The current mining activities at the NCC consists of:

- Diepspruit Underground: Three board-and-pillar sections mining the No. 2 lower seam;
- Diepspruit West: Opencast truck and shovel mining operation; and
- Roodekop: Opencast truck and shovel mining operation.

Opencast mining from the Diepspruit West and Roodekop Resources is on-going and will continue until the reserves are depleted; after which mining will progress into the Middeldrift Resources. The box cut for Middeldrift will be created simultaneously to coal resource depletion at Roodekop to prevent interruptions in production. The total Life of Mine (LoM) of Middeldrift is approximately ten years.

In the existing NCC area, the strip ratios are favourable for opencast mining. Middeldrift will be an opencast truck-and-shovel operation, focusing on the No. 4 upper and lower seams; No. 2 upper and lower seams; and the No. 1 and No. 1A seams. A total of 12.23 million tonnes (Mt) of coal have been identified. The target market for coal is Eskom's Kriel Power Station. This will ensure the minimum quality specifications for Eskom are achieved continuously. From the Middeldrift area, the coal will be transported to the NCC by truck via haul road. Run of Mine (RoM) coal will be washed at the NCC coal handling and processing plant. No new infrastructure is proposed to be constructed at Middeldrift.

Middeldrift is separated from the existing NCC opencast areas by a river, the Steenkoolspruit. To protect this water course, it is intended that Middeldrift be mined as a separate opencast operation once the existing NCC areas have been mined out. This will require the diversion of the district road around the north of the existing Roodekop opencast pit to continue with mining. A bridge over the Steenkoolspruit will be constructed to gain access to Middeldrift.

1.3. Project Locality

The Project Area is located within the Kriel district of the Mpumalanga Province under the jurisdiction of the Emalahleni Local Municipality and the Nkangala District Municipality (Table 1-1; Figure 1-1; Figure 1-2 and Figure 1-3). The site is located approximately 20 kilometres (km) north of Kriel and 27 km south-east of Ogies.

Table 1-1: Summary of the NCC Mine Project Location Details

Province	Mpumalanga	
District Municipality	Nkangala District Municipality	
Local Municipality	Emalahleni Local Municipality	
Nearest Town	Kriel (20 km), Ogies (27 km)	
Property Name and Number (Figure 1-3)	**Farm Name**	**21-digit Surveyor General Code**
	Portion 1 of Middeldrift 42 IS	T0IS00000000004200001
	Portion 2 of Middeldrift 42 IS	T0IS00000000004200002
	Portion 3 of Middeldrift 42 IS	T0IS00000000004200003
	Portion 4 of Middeldrift 42 IS	T0IS00000000004200004
	Portion 2 of Diepspruit 41 IS	T0IS00000000004100002
	Portion 9 of Diepspruit 41 IS	T0IS00000000004100009
	Portion 15 of Roodepoort 41 IS	T0IS00000000004000015
	Portion 21 of Roodepoort 41 IS	T0IS00000000004000021
	Portion 3 of Hartbeestfontein 39 IS	T0IS00000000003900003
	Portion 7 of Hartbeestfontein 39 IS	T0IS00000000003900007
	Portion 9 of Kromfontein 30 IS	T0IS00000000003000009
Application Area (Ha):	~150 ha	
Magisterial District:	Nkangala District Municipality	
Distance and direction from nearest town:	Approximately 9 km north of Kriel in the Mpumalanga Province	
GPS Co-ordinates (relative centre point of study area)	29°14’45.58’’E; 26°03’35.08’’S	

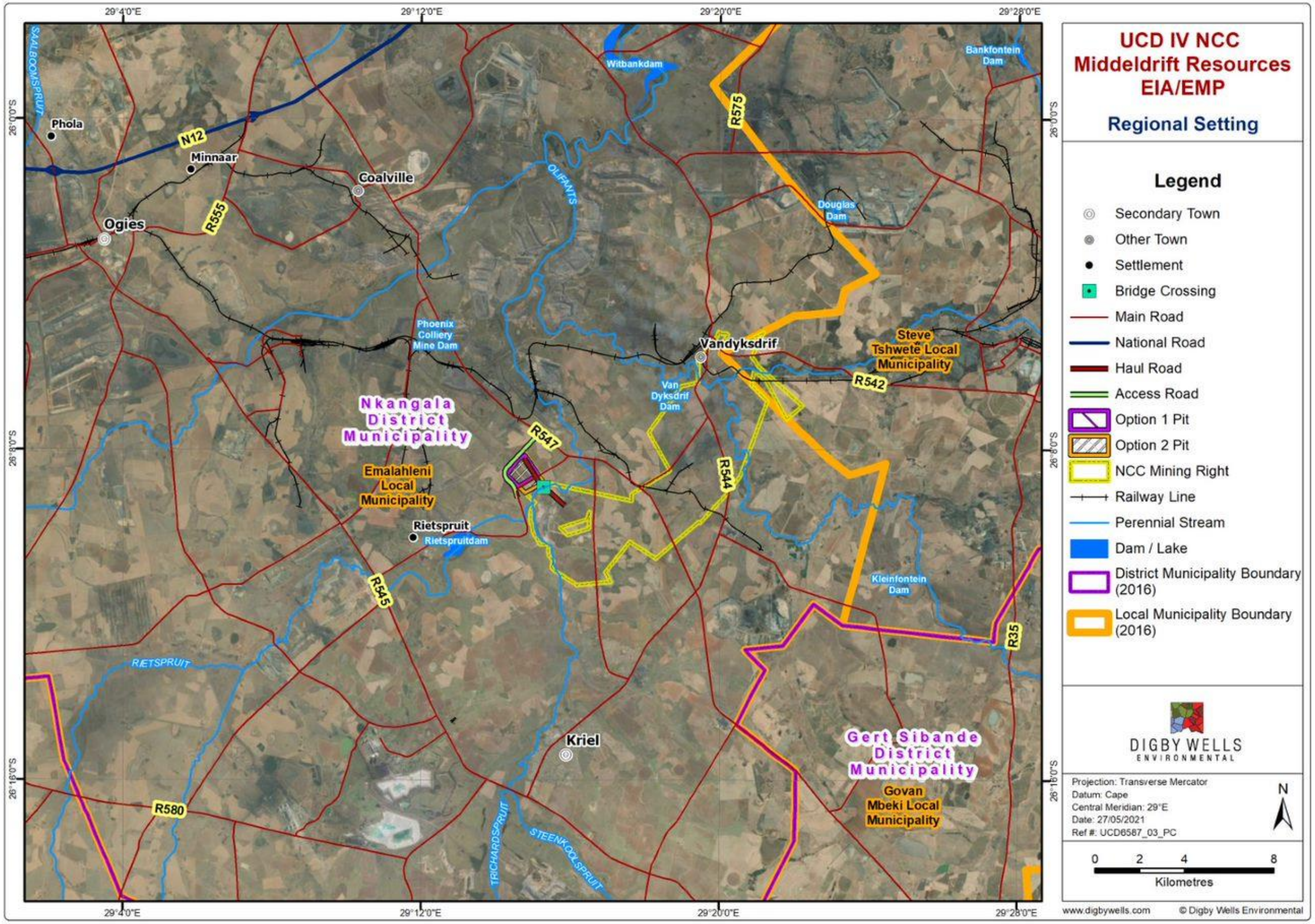


Figure 1-1: Regional Setting

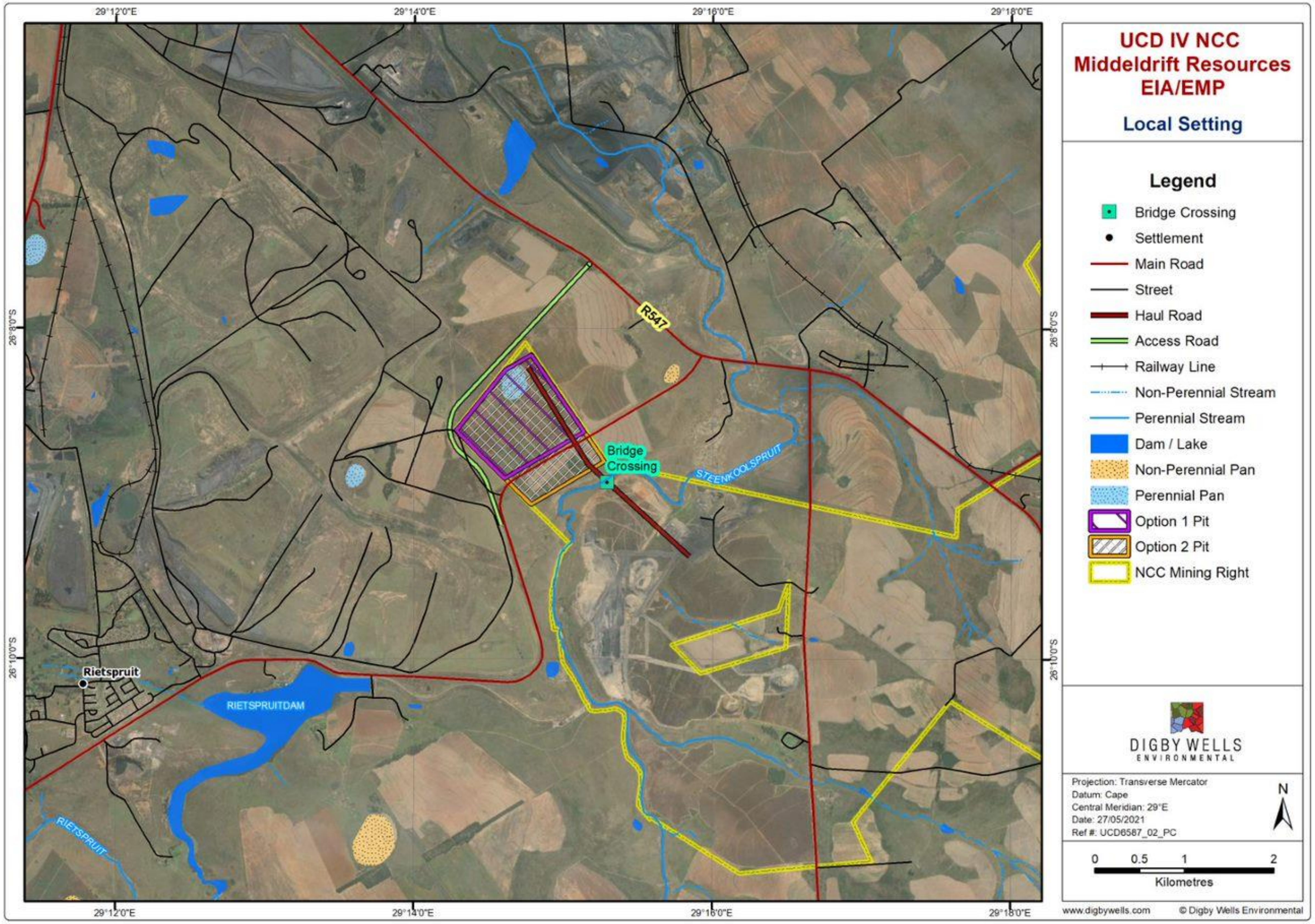


Figure 1-2: Local Setting

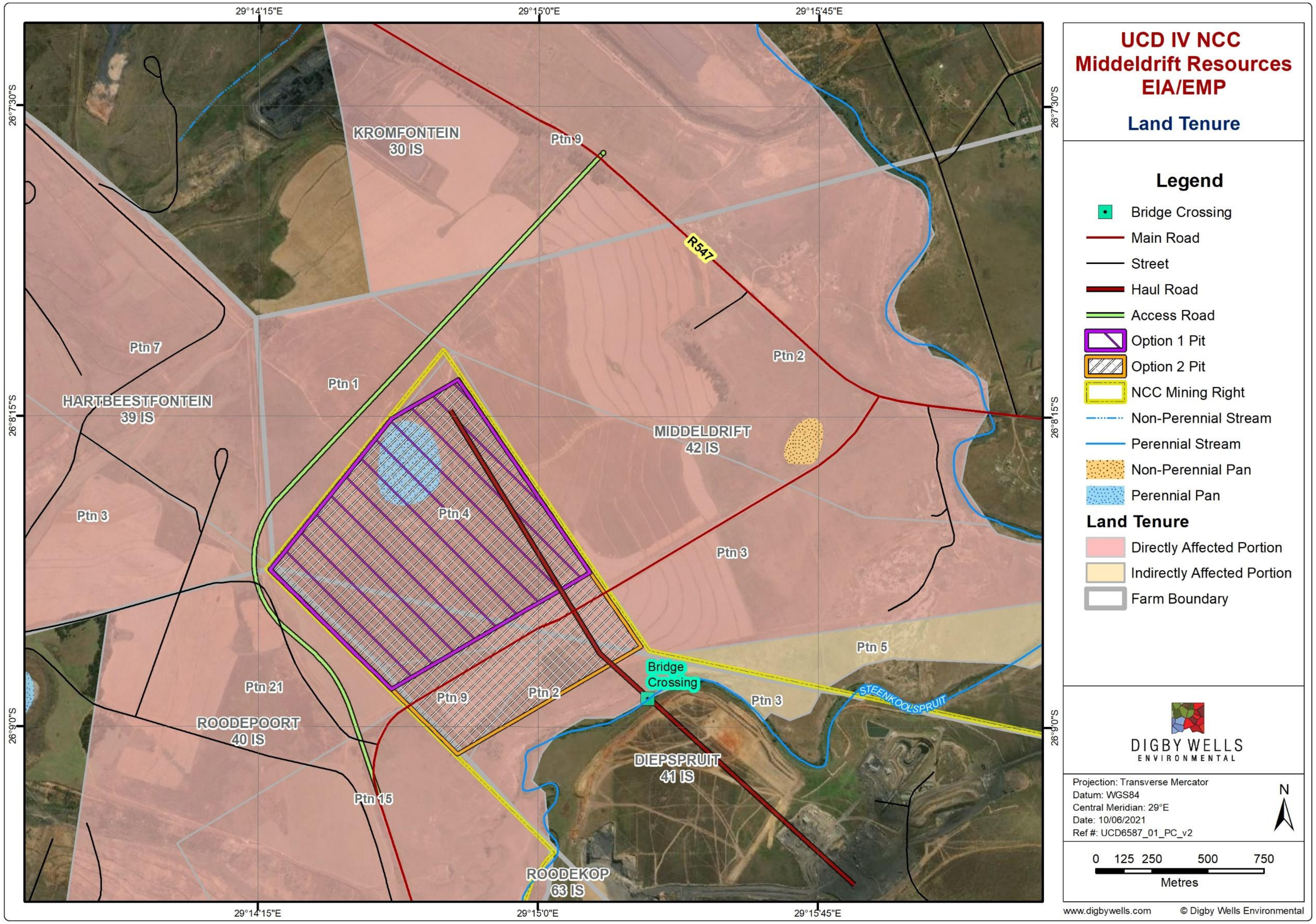


Figure 1-3: Land Tenure Map

2. Proposed Infrastructure and Activities

Activities applicable to the Project provides the identified Listed Activities as specified in Listing Notice 1 (GN R983 of 04 December 2014, as amended) and Listing Notice 2 (GN R984 of 04 December 2014, as amended). As indicated in Table 2-1 and illustrated Figure 2-1 below, activities listed under Listing Notice 1 and 2 will be triggered; and therefore, an EIA process must be undertaken, and approval received prior to the activities commencing. Table 2-1 details the Project activities for the duration of the Construction, Operational and Decommissioning Phases.

Table 2-1: Project Phases and Associated Activities

Project Phase	Project Activity
Construction Phase	Site/vegetation clearance
	Contractor laydown yard
	Access and haul road construction
	Topsoil stockpiling
Operational Phase	Open-pit establishment
	Removal of rock (blasting)
	Stockpiling (i.e., soils) establishment and operation
	Operation of the open pit workings
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation
	Post-closure monitoring and rehabilitation

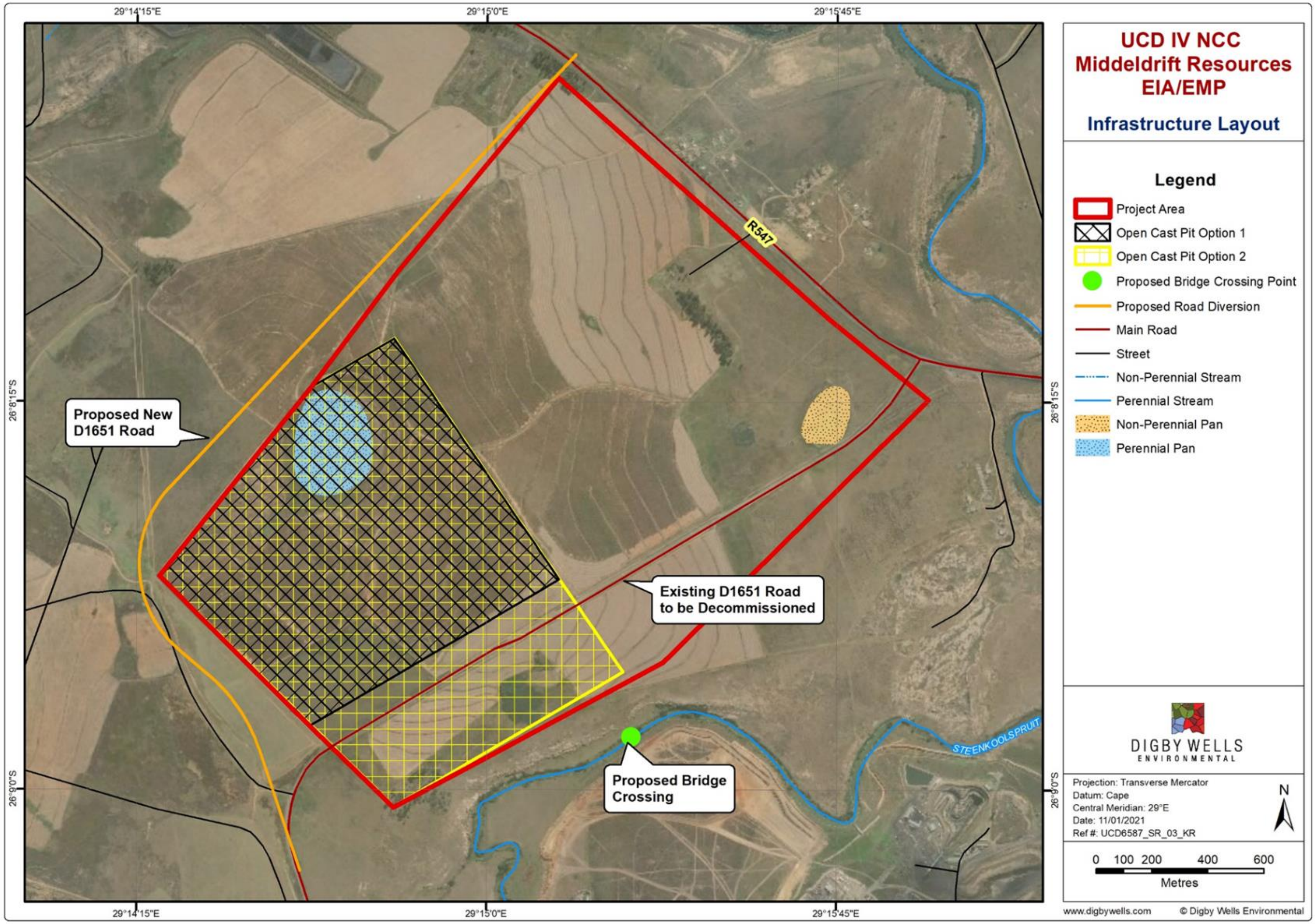


Figure 2-1 Preliminary Infrastructure Layout Plan

2.1. Alternatives Considered

Alternatives to be considered to ensure minimal impacts to the soil, land use and land capability include (Table 2-2):

Table 2-2 Alternatives and Consequences

Alternative	Consequence
Reduce the size of the pit (Option 1)	This will entail reducing the size of the pit therefore reducing the Life of Mine. Excluded soils has a medium sensitivity which will protect some soils, however areas with a high land capability will still be mined
Option 2	Complete loss of all soils within the Study Area as well as impacts to adjacent areas
Clean wastewater and sewage before putting it back into the systems	This will reduce the impacts on the adjacent and downstream soils, wetlands and groundwater
Do site inspections regularly to ensure maintenance and concurrent rehabilitation is followed, and waste management plans are being implemented	This will assist in the rehabilitation and closure phases
Reduce waste materials and waste outputs	This will reduce the impacts on the adjacent and downstream soils, wetlands and groundwater, as well as assisting with rehabilitation and mine closure
Replenish native soils after decommissioning	This should be considered as this will assist with rehabilitation and mine closure
Consider finding alternatives of the bridge crossing by using existing roads, bridges and entrance to the existing NCC min	This will prevent sedimentation and erosion of the downstream and adjacent wetlands and reduce the impacts on the high land capability soils
Consider upgrading and using existing and/or historical roads in the vicinity of the proposed road, for the diversion of the district road D1651. Historical roads exist in the same area and could be reused and upgraded instead of creating new roads	This will prevent increased impacts on the soil and land capability in the area

2.2. Scope of Work

The field assessment for the soil, land use and land capability impact assessment associated with the Project was carried out on the 24th and 25th of February 2021. The Scope of Work for the impact assessment included:

- **Desktop Review**: Review of all existing data for the collation of available information concerning the site and proposed work. Historical data of the Study Area was assessed regarding land use 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 Study Area;
- **Soil Survey:** An initial soil desktop delineation was conducted before the site visit using historical data and Google Earth imagery. The soil delineation was verified during a two-day site visit. A hand soil auger was used to survey the soil depth and types present, with survey positions being recorded as waypoints;
- **Land Use**: Existing land use data was verified during the site visit. This was mapped in conjunction with existing soil survey data and land use/cover data;
- **Land Capability**: Land Capability was assessed 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. The land was rated into eight classes which include subgroups that have the same relative degree of limitation or potential;
- **Impact Assessment:** Identification of historical and current impacts on soils, land use, and land capabilities of the Project; and
- **Recommendations:** Mitigation recommendations to develop a rehabilitation and management plan for the mine.

3. Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the national legislation, regulations, guidelines and by-laws. The 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.	Activities that will influence the soil of the proposed Project Area are listed in Section 2 and has been identified as Listed Activities in the Listing Notices (as amended) and therefore require EA prior to being undertaken.

Legislation, Regulation, Guideline or By-Law	Applicability
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.	• 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 Impact Assessment (IA), applicable mitigation measures, monitoring plans and/or remediation were recommended to ensure that any potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA) 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 (GN R331 of 2 May 2014).	A Soil, Land Use and Land Capability IA was undertaken as part of the EIA. The Project activities were assessed to abide by the NEM: WA and the Soil Screening Values (SSV). The required mitigation measures are included in Section 12 to form part of the EMPr.
The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) The CARA is to provide control over the utilisation 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 salinisation of soils by means of suitable soil conservation works to be constructed and maintained.	A Soil, Land Use and Land Capability AI was undertaken as part of the EIA. The required mitigation measures are included in Section 12 to provide control over the natural agricultural resources to promote conservation of the soil, land use and land capability.

4. Assumptions, Limitations and Exclusions

The compilation of this Report is based on the following assumptions and limitations in Table 4-1.

Table 4-1: Limitations and Assumptions with Resultant Consequences

Assumptions and Limitations	Consequences
The area surveyed was based on the layout presented by the NCC in January 2021.	The study does not include any other information other than the Study Area as shown in Figure 2-1.
Land suited for crop production was assumed also to be suitable for other, less intensive uses such as pasture, natural grazing, forestry and wildlife.	The land identified to be of high 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 be absolutely 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.
Due to historical and current land use activities (dominantly intensive cultivation) some areas have been highly impacted, specifically the naturally occurring vegetation and geomorphology.	Some discrepancies with the soil delineations may occur due to changing impacts on the land; for example, intensive vegetation clearing, sedimentation, water extraction, damming, excavations, stockpiling and cultivation.

5. Details of the Specialist

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

- **Mia Smith** is the Divisional Manager for Environmental Services and has an MSc in Geography, with associated studies in Environmental Management and Energy. She has experience within the environmental services field including but not limited to mining, energy, oil and gas, pulp and paper, and agriculture. Mia re-joined Digby Wells Environmental as Manager of the new Compliance Department in 2018. She previously worked for Sappi SA as the Risk Manager and has over 14 years' experience in project management, risk assessment, IFC compliance, auditing of ISO14001:2015 Environmental Management Systems, environmental legal compliance and ESG. Mia is a registered EAP with EAPASA (Reg. No. 2019/1282).
- **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. programme 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, 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, EIAs, Rehabilitation and Closure Plans (RCPs), Rehabilitation Strategy and Implementation Plans (RSIPs), Rehabilitation Audits, AIP Assessments, Re-vegetation Trial Studies and Monitoring Assessments.

6. Methodology

This section provides the methodology used in the compilation of the Soil, Land Use and Land Capability Impact Assessment. A detailed methodology is described in Appendix A and is summarised below.

The field assessment for the soil, land use and land capability were carried from the 24th to the 25th of February 2021.

Desktop Assessment and Literature Review

The following sources were used to obtain baseline soil information such as generalised soil patterns and terrain types for the Project site:

- South African land type data by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC) (ARC, 2006);
- Aerial imagery;
- Land use and land capability data;
- Existing Land Type data (Land Type Survey Staff, 1972 - 2006); and
- Existing studies conducted in the area.

Soil Classification

A hand soil auger was used to determine the soil properties to a maximum depth of 1.2 m or to the first restricting layer. Soils were classified using the Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991). Soil Properties included:

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

Soil Physical and Chemical Analysis

Representative soil samples were collected for analysis at a SANAS accredited laboratory. The analysis was done in accordance with the Handbook of Standard Soil Testing Methods for Advisory Purposes (Soil Science Society of South Africa, 1990).

Land Use

Land use was identified by aerial imagery during the desktop assessment and verified during the site-inspection. Land use maps indicate delineated areas of similar land use (Land Type Survey Staff, 1972 - 2006).

Land use categories are:

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

Land Capability

Land capability is defined by the most suitable land use under rain-fed conditions. Land capability was determined by assessing a combination of soil, terrain and climate features. The land was rated into 8 classes with subgroups that have the same relative degree of limitation or potential.

Land Suitability (Agricultural Potential)

Soil agricultural potential was determined by soil forms, land capability, soil analysis, hydrology and current land use. The process involved allocating terrain and soil factors to an area of land. The soil chemical analysis was considered in determining the final suitability of the soil. The suitability guidelines according to Schoeman et al., (2000) were used.

Figure 6-1: Soil, Land Use and Land Capability Assessment Methodology

7. Regional Baseline Environment and Desktop Review

Relevant literature was reviewed prior to the field assessment concerning the soil, land use and land capability associated with the Study Area. This includes the soil forms, depth, texture, structure and underlying geology. Baseline and background information was researched and used to understand the Study Area prior to undertaking the fieldwork component and is described in Table 7-1 below.

Table 7-1: Baseline Environment of the NCC Project Area

Characteristics of the Highveld Ecoregion (Kleynhans, Thirion, & Moolman, 2005)		**Plant Species Characteristic of the Eastern Highveld Grassland** (Mucina & Rutherford, 2012)	
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.	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, Urelytrum agropyroides.*
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).	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, Hilliardiella oligocephala, Wahlenbergia undulata.*
Altitude (m.a.m.s.l.) (modifying)	1 100-2 100, 2 100-2 300 (very limited)	Geophytic Herb Species	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia.*
Mean Annual Precipitation (MAP) (mm) (Secondary)	400 to 1 000	Succulent Herb Species	*Aloe ecklonis.*
Coefficient of Variation (% MAP)	<20 to 35	Low Shrub Species	*Anthospermum rigidum* subsp. *pumilum, Seriphium plumosum.*
Rainfall Seasonality	Early to late summer	Status	Endangered.
Mean Annual Temp. (°C)	12 to 20	**Topography and Slope**	
Mean Daily Summer Temp. (°C): February	10 to 32	The topography of the Project Area ranges from high elevations on the south-west side of the Project Area to low lying areas in the north-west and south towards the Steenkoolspruit. The Project Area can be described as uneven slopes with moderate undulating plains running towards a low-lying valley (Steenkoolspruit) on the east and south of the Project Area. Depressions/pans are scattered throughout the western and eastern side of the landscape. The elevation of the Project Area ranges from 1 509-1 628 metres above mean sea level (m.a.m.s.l.) which equates to a range of 119 m between the lowest and highest points of elevation within the Project Area. The elevation difference gives rise to a slope of between 0 and 23 degrees (°).	
Mean Daily Winter Temp. (°C): July	-2 to 22	**Geology**	
Median Annual Simulated Runoff (mm)	5 to >250	The NCC Project Area is situated within the Witbank Coal Field, forming part of the Karoo Basin. The Karoo Basin extensively covers the central areas of South Africa with an area of 700 000 km^2 and a basin fill of more than 5 000 m of siliciclastic rocks. The Project Area is located within the siliciclastic rock lithology and above the coal-bearing Vryheid Formation which is part of the Ecca Group. The	

<table>
<tr><td></td><td colspan="3"></td><td>Vryheid formation consists of various sequences of sandstones, shales and siltstones with various coal seams located within them. The Witbank Coal Field consists of five coals seems, namely 1, 2, 3, 4 and 5 Seam (numbered from the base up). Within the Project Area, only the upper most 2 Seam, 2A Seam and basal 1 Seam are present.

Siliciclastic rock can be described as clastic non-carbonations sedimentary rock that is high in silica, either from quartz or other silicate minerals. The soils forming from these lithologies are sandstone based and generally consists of high sand textures, such as Red and Yellow-Brown Apedal soils. These sedimentary rocks include conglomerates, sandstone, shale and siltstone.</td></tr>
<tr><td colspan="5">Land Types and Dominant Soil Forms</td></tr>
<tr><td>Land Type</td><td colspan="2">Soil Form</td><td>Geology</td><td>Characteristics</td></tr>
<tr><td>Bb4</td><td>• Arcadia
• Avalon
• Estcourt
• Glencoe
• Glenrosa
• Hutton
• Katspruit
• Kroonstad</td><td>• Longlands
• Mispah
• Rensburg
• Sterkspruit
• Swartland
• Westleigh
• Valsrivier</td><td>• Shale, sandstone, clay and conglomerate of the Ecca Group, Karoo Sequence; and
• Dolerite, occasional felsitic lava of the Rooiberg Group, Transvaal Sequence.</td><td>• Dominated by moderately deep to deep well-drained sandy soils on the upper slopes with soils becoming shallower down the slope, increasing in clay content and becoming lower in permeability;
• The Hutton and Avalon soil forms usually indicate deep, fertile soils, which are good for agriculture, whereas Mispah soil forms are only slightly permeable due to the high clay content;
• Mispah and Glenrosa have a low potential for agriculture due to shallow bedrock, low permeability with a high erosion hazard and a shallow rooting depth;
• Upland duplex and margalitic soils are rare; and
• Red soils (apedal) are not common in these areas.</td></tr>
<tr><td>Bb5</td><td>• Mispah
• Hutton
• Rensburg
• Wasbank
• Avalon</td><td>• Glencoe
• Swartland
• Kroonstad
• Longlands</td><td>• Shale, sandstone, clay, conglomerate, limestone and marl (Ecca Group);
• Dolerite; and
• Lava, sandstone, conglomerate, siltstone and rhyolite (Loskop Formation).</td><td>• Falls within the Plinthic Catena;
• Upland duplex and margalitic soils are rare;
• Red soils (apedal) are not common in these low-lying areas; and
• These soils are usually high in clay content, occur in low lying areas and associated with wetlands.</td></tr>
<tr><td colspan="4">Land Capability</td><td>Land Use</td></tr>
<tr><td>Class</td><td colspan="2">Classification</td><td>Dominant Limitation Influencing the Physical Suitability for Agricultural Use</td><td rowspan="3">Predominantly:
• Cultivated Land; and
• Grassland.
Minor Areas:
• Water Area and Wetland;
• Thicket/Dense Bush;
• Plantation/Woodlot;
• Woodland/Open Bush; and
• Adjacent Urban Areas.</td></tr>
<tr><td>II</td><td colspan="2">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</td><td colspan="2">Arable land – Moderate Grazing</td><td>Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.</td></tr>
</table>

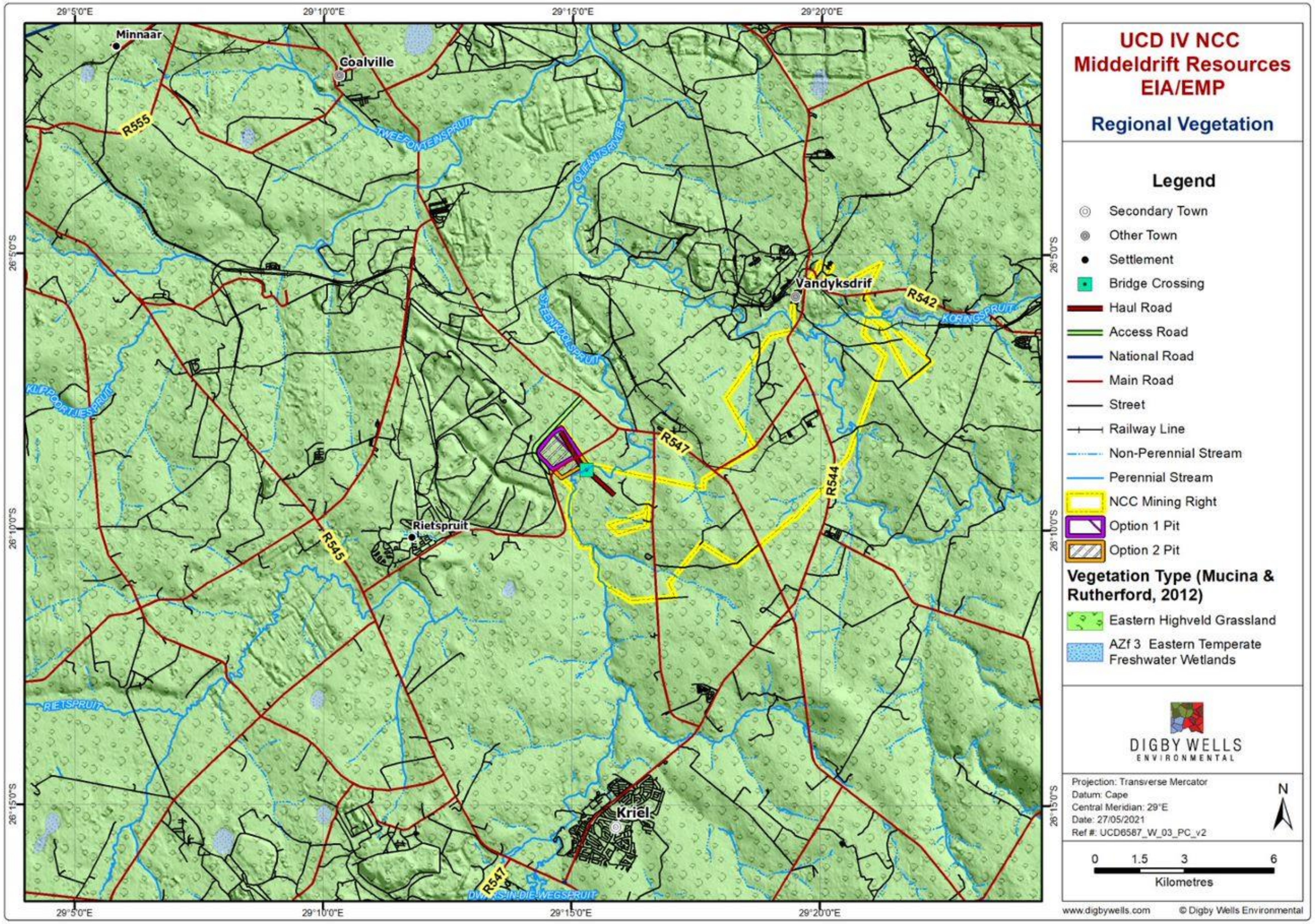


Figure 7-1: Regional Vegetation

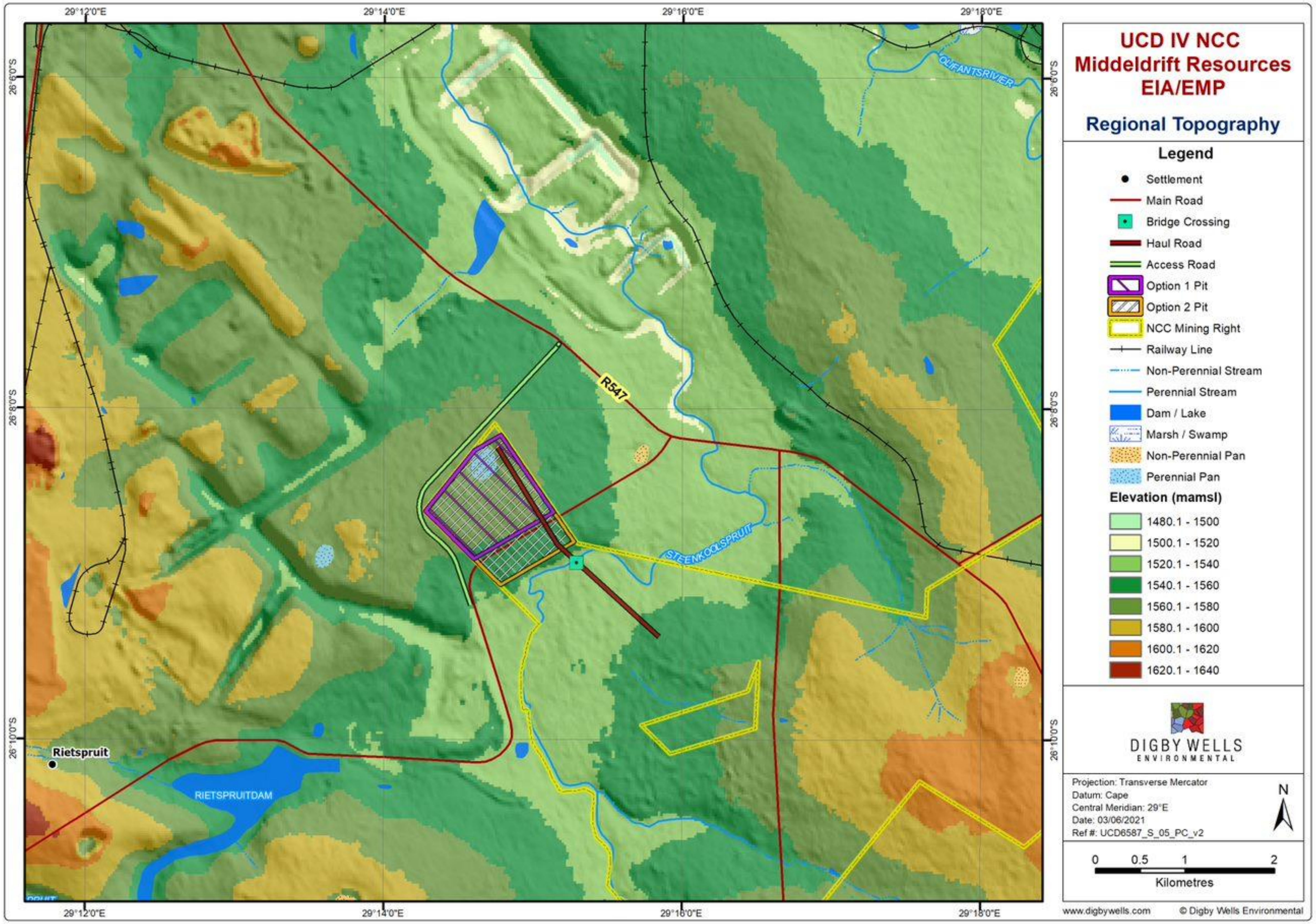


Figure 7-2: Regional Topography

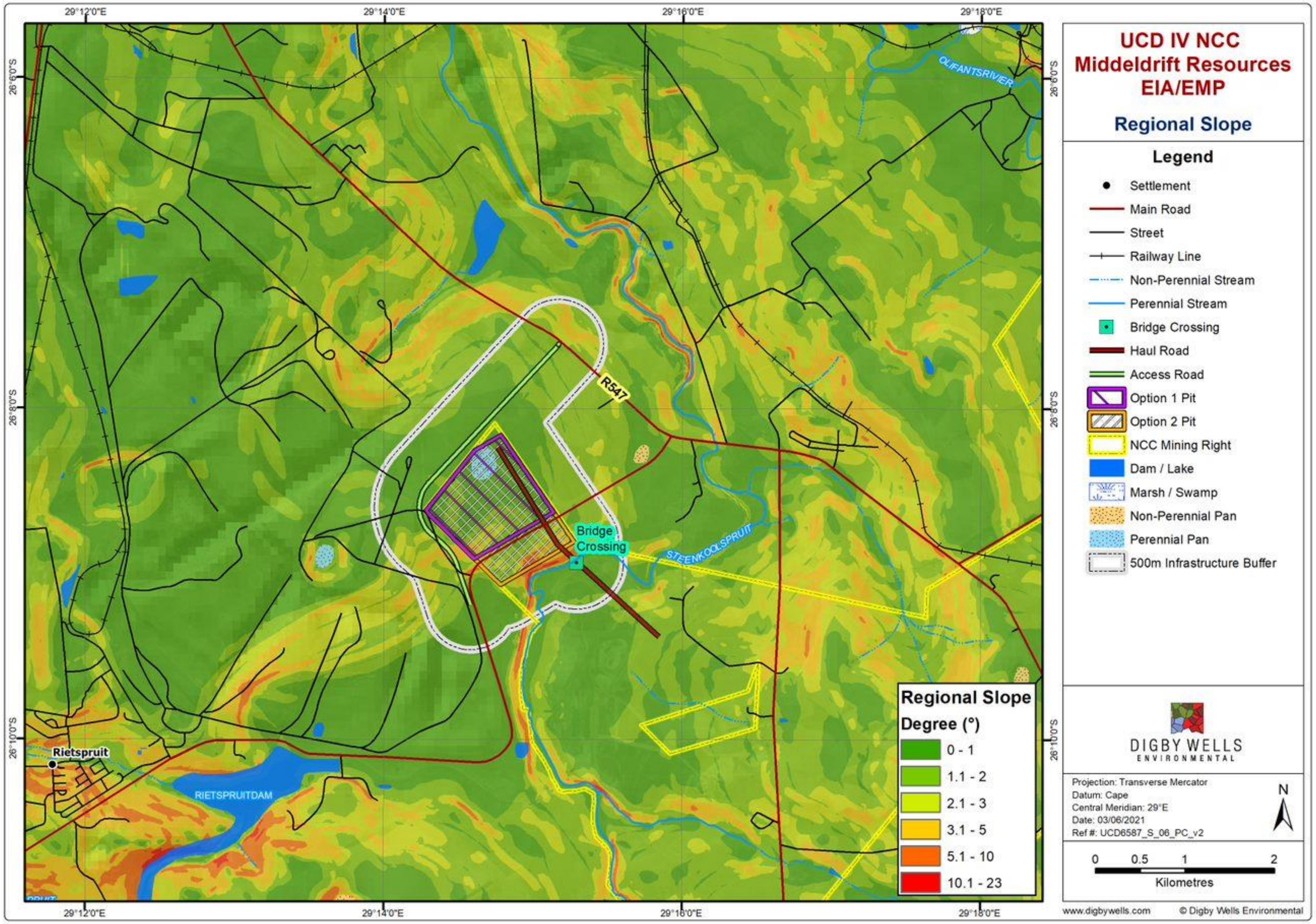


Figure 7-3: Slope of the NCC Project Area

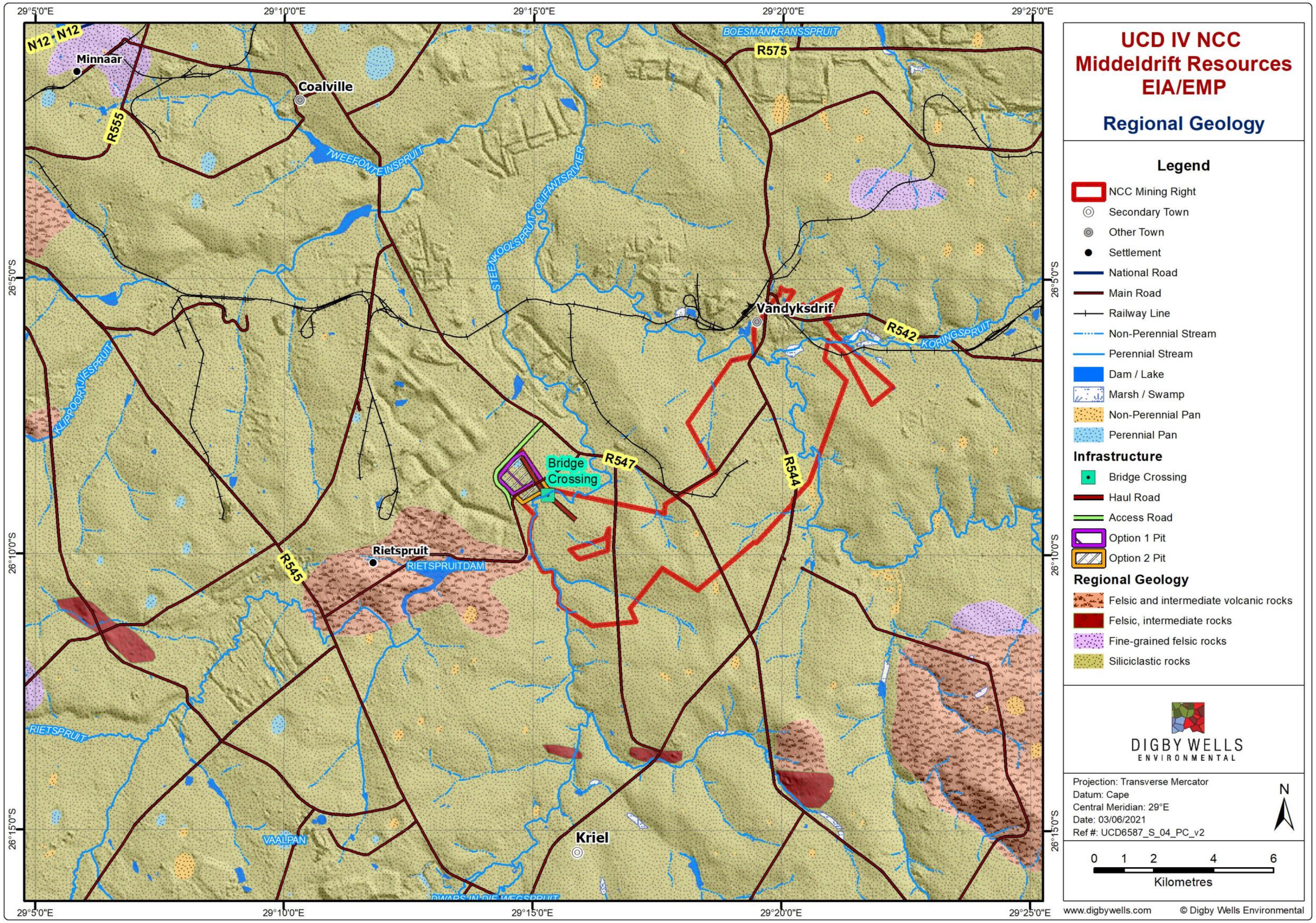


Figure 7-4: Regional Geology

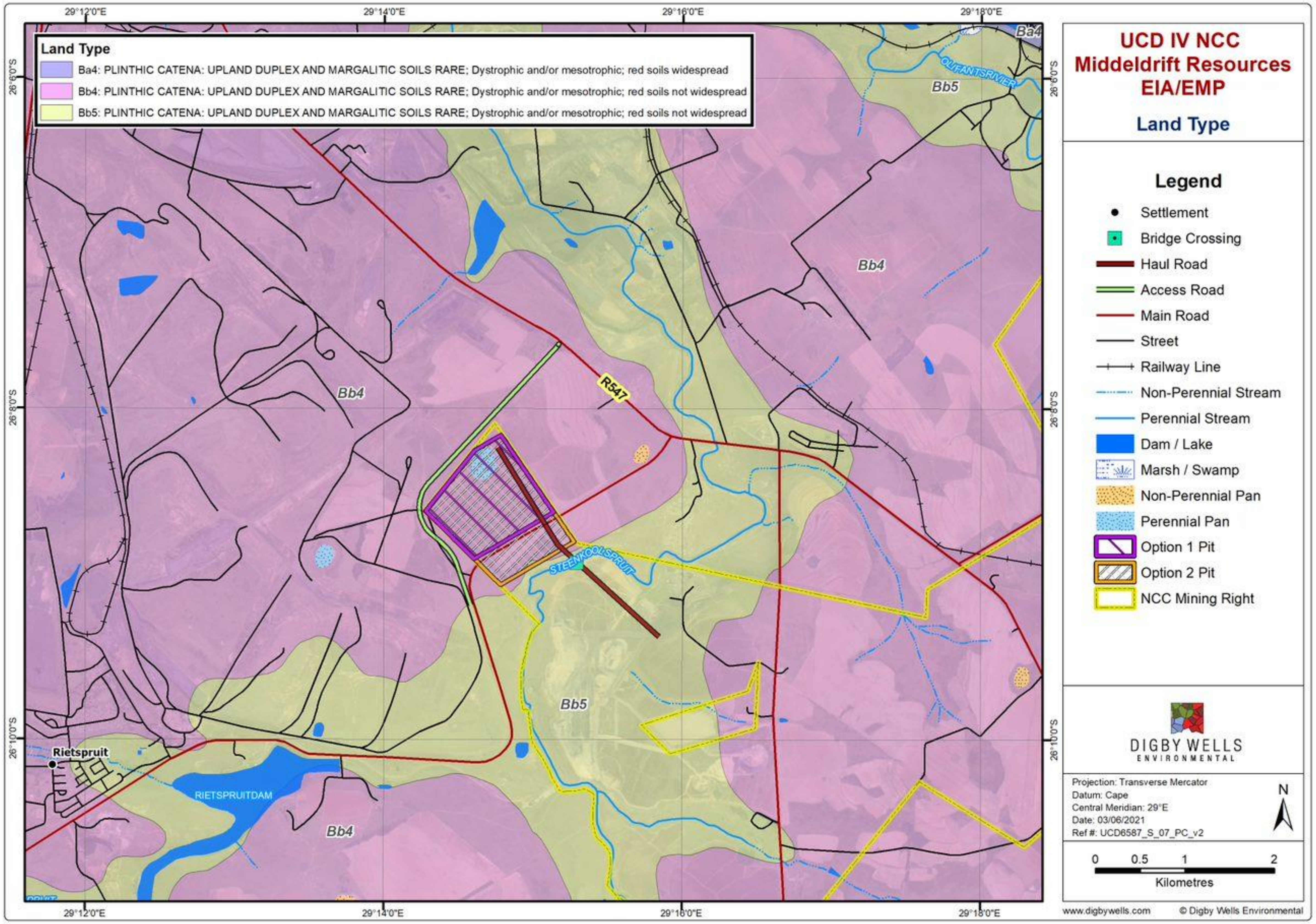


Figure 7-5: Land Types

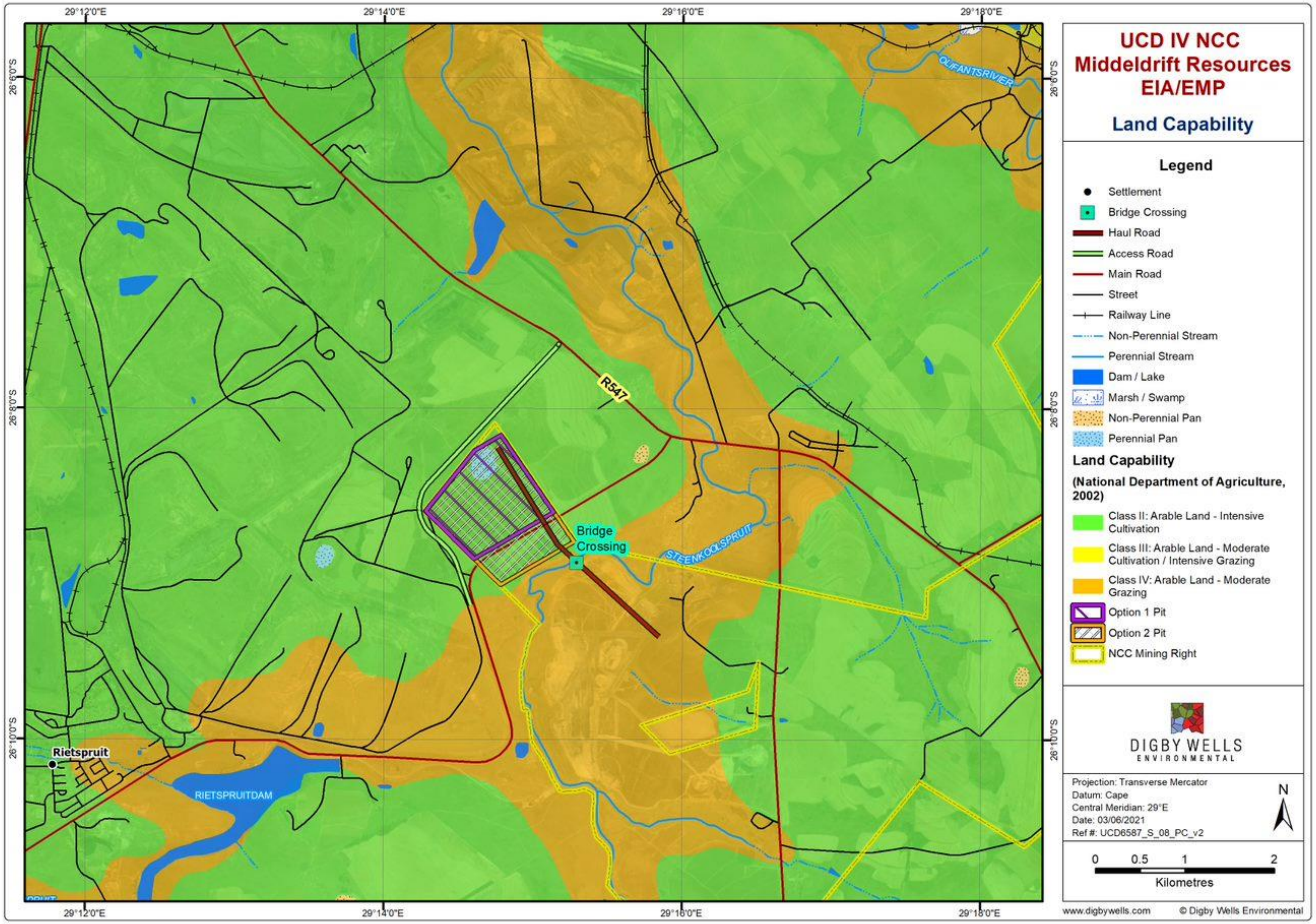


Figure 7-6: Land Capability

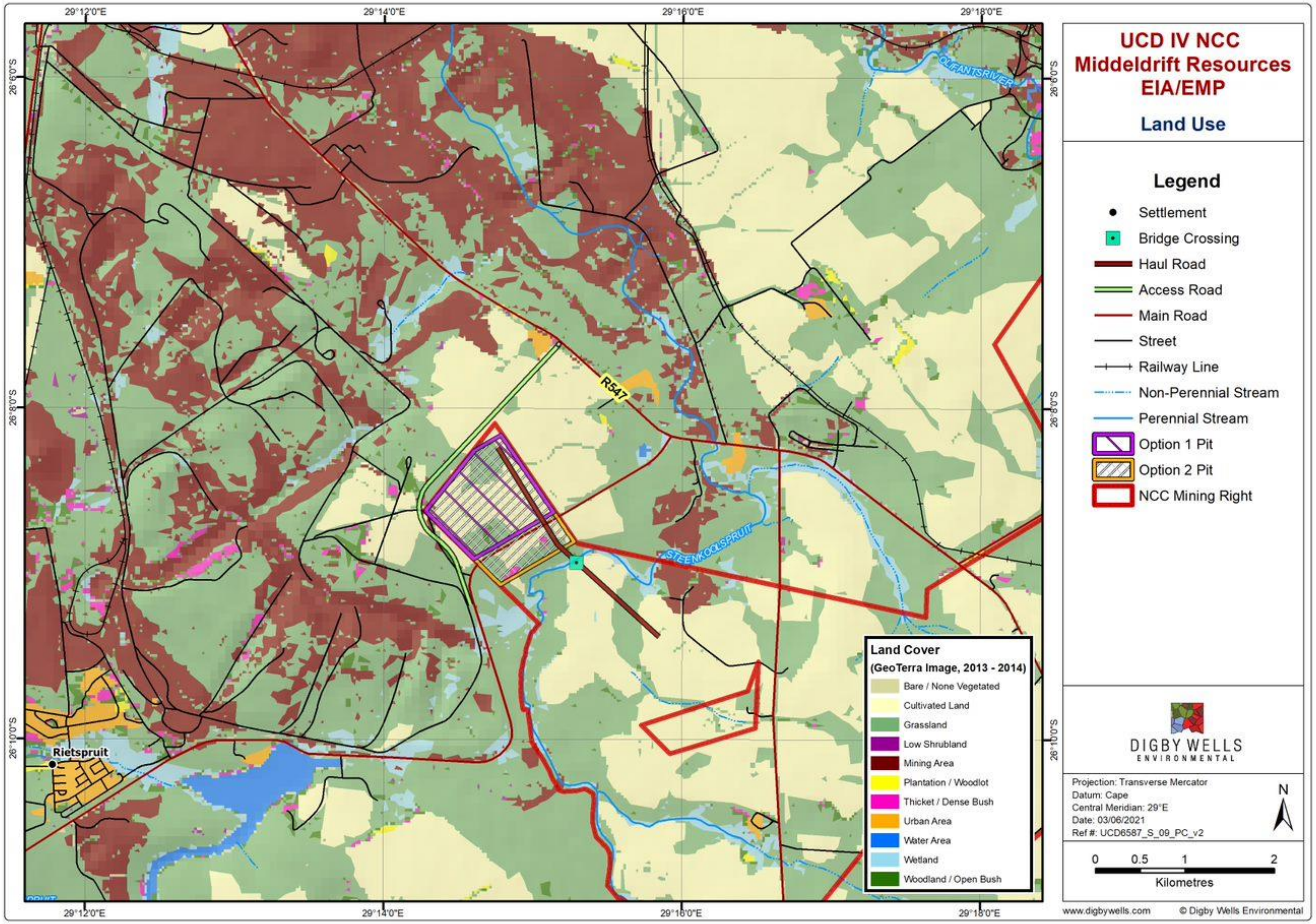


Figure 7-7: Land Use

8. Findings and Discussion

The soil, land use and land capability of the Study Area have been assessed at a desktop level using detailed aerial imagery and standard spatial data. These were confirmed during a rapid site survey. The site survey was used to refine the soil, land use and land capability and to determine the impacts the proposed activities might have on the soil, land use and land capability.

8.1. Soil Forms

Guidance Notes

Soil forms are conceptual generalisations based on specific soil properties. Each soil form consists of soil horizons, uniquely combined and integrated. The soils were classified using the Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991).

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 m or to the first restricting layer. 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.

Avalon, Pinedene, Hutton, and Clovelly soils are typically deep soils, dominated by a red to Yellow-brown apedal (non-structure), sandy B-horizons with a clayey underlying material such as Soft-Plinthic. The clayey horizon increases the water holding capacity, organic material and Cation Exchange Capacity (CEC) of the soil therefore increasing the agricultural potential.

Rensburg, Arcadia, Katspruit, Kroonstad and Longlands are often associated with low-lying areas and wetlands and are referred to as hydromorphic soils. These soils are saturated for long periods, has a fluctuating water table and very specific characteristics, including mottles, gleying and leaching.

The soil forms within the Study Area were delineated and are illustrated in Figure 8-1 below. Each soil form together with site photos and a short description area presented in Table 8-1 below.

The following soils were identified within the Project Area:

- Avalon;
- Cartref/Glenrosa;
- Clovelly;
- Glencoe;
- Glenrosa;
- Katspruit;
- Kroonstad;
- Mispah;

- Pinedene;
- Rensburg; and
- Witbank.

The typical augured soil horizons were identified as Orthic A-horizons, overlying Yellow-brown to Red Apedal B-horizons with a Plinthic B-horizon. The soils were very sandy, deep fertile soils and are generally used for commercial agriculture. Scattered pans were identified on site, with typical soil horizons of Vertic-A overlying G-horizon and E-horizons overlying a G-horizon (Rensburg and Kroonstad soil forms).

The dominant land use of the area is commercial cultivation, indicating the high agricultural potential and land capability of the soils. These deep, sandy soils are generally easily manageable, preferred by farmers and excellent agricultural soils. The low-lying and depressions within the Project Area showed increased clay content and soil wetness. These soils were identified as wetland soils and are saturated for long periods with a fluctuating water table. The land use in these areas were generally wetlands and used for cattle grazing and perennial grasslands. These soils are somewhat limited for cultivation and highly mobile (high erosion probability).

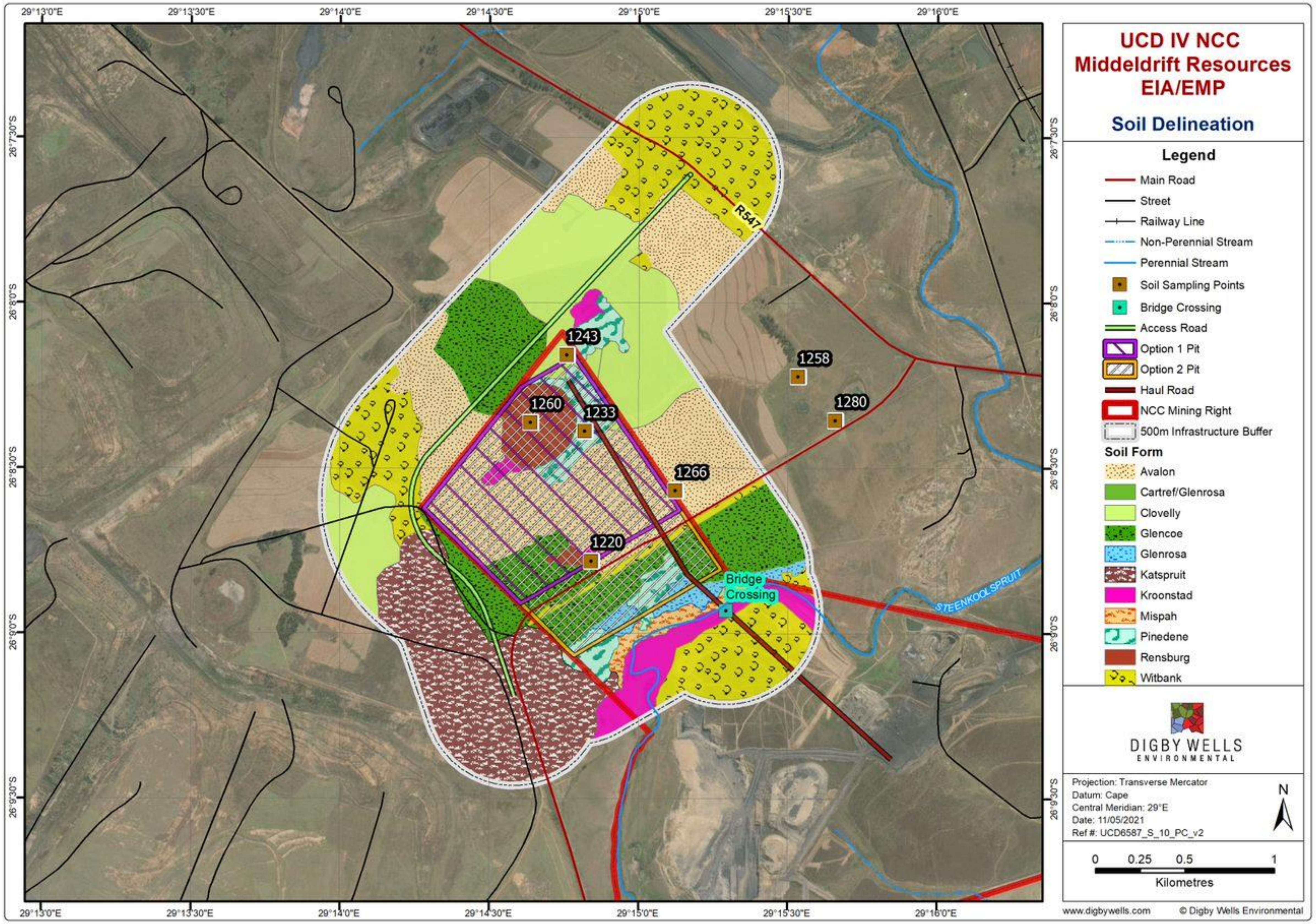


Figure 8-1: Soil Form Delineation and Sample Points

Table 8-1: Soil Forms of the Study Area

Soil Form	Description ((Soil Classification Working Group, 1991))	Observations in the Study Area	
Avalon → Orthic A → Yellow-brown Apedal → Soft Plinthic	Avalon soils are free draining and chemically active soils with high permeability and leaching potential. Clay, Manganese and iron oxides accumulate with depth under conditions of a fluctuating water table forming localised mottles or soft iron concretions in the soft plinthic B horizon.	Avalon soils in the Study Area covered large areas, dominantly associated with hillslope seep wetlands and intensively cultivated land. The soils are deep, yellow-brown sandy soils overlying a clayey Plinthic layer. The soil depth varies from 500mm to >1200 mm. Avalon soils are often more fertile than Clovelly soils due to the higher clay contents, absorbing more nutrients and organic material.	
Cartref/Glenrosa → Orthic A → E-horizon → Lithocutanic → Lithocutanic	Cartref soils consist of leached, sandy E-horizons, overlying a weathered hard Lithocutanic layer containing cutans and signs of wetness (mottles). The soils usually overlie a hard, impermeable sandstone layer.	A very small section of the Study Area consists of Cartref soil form in the east of the Project Area. The soils are shallow, leached and overly a hard sandstone layer, restricting hand auguring, water movement and root development. Due to the shallow depths, these soils are not cultivated and used for cattle grazing.	
Clovelly → Orthic A → Yellow-brown Apedal → Unspecified	Clovelly soil forms are frequently confused with Hutton soil forms as they share the same characteristics. Clovelly soils have a yellow-brown chroma B-horizon, whereas Hutton soil has a red B-horizon. Both these soil forms have deep, sandy, well-drained characteristics. Yellow-brown Apedal B-horizons form from leached Red Apedal B-horizons and are therefore typically in lower-lying areas, are wetter, have higher permeability potential and lower fertility than red soils. These soils have a high land capability potential and are often intensively cultivated.	Clovelly soils in the Study Area were dominantly used for intensive cultivation. The soils were deep, sandy, freely drained soils with an unspecified B2 horizon (>1200 mm). The soils formed from the weathering of Sandstone parent material and red-apedal soils in the upper catchment. The soils were deep (>1200 mm), sandy, high permeability and well suited for cultivation. The soils are less susceptible to erosion (when vegetated), drain easily and have a high leachability. The soil has a low capacity to supply nutrients to plants and retain nutrients (CEC). These soils were dominantly cultivated and associated with crests, scarps, and mid-slopes.	
Glencoe → Orthic A → Yellow-brown Apedal → Hard Plinthic	These soils comprise a Yellow-brown Apedal B-horizon overlying a Hard Plinthic layer containing an accumulation of iron-, and manganese oxides. These soils together with their high clay content and restricted rooting depth (usually shallow soils) prevent free drainage and lower the agricultural potential of the soils.	Glencoe soils within the Project Area were predominantly shallow and had a restricting water, root and auger layer at 600 mm. The Glencoe soils were historically cultivated, had large areas of AIPs, smaller sections of current cultivation and evidence of alterations to the natural hydrology and geomorphology. The topsoil is sandy, freely drained and low in nutrients, overlying a restricted layer, therefore limiting intensive cultivation.	

Soil Form	Description ((Soil Classification Working Group, 1991))	Observations in the Study Area	
Glenrosa → Orthic A → Lithocutanic	Glenrosa soils are shallow sandy soils overlying a Lithocutanic B-horizon containing cutans and signs of wetness (mottles). Glenrosa soils are often confused with Cartref soils. The Lithocutanic horizon merges into the underlying weathering rock (sandstone) with the same general organisation in respect to the colour, structure and consistency.	The Glenrosa soils were associated with shallow soils adjacent to the large floodplain system in the scarp terrain. The soils had some signs of temporary wetness due to springs and water accumulation due to shallow, rocky sandstone outcrops. The soils were dominantly used for cattle grazing and less disturbed by anthropological activities due to the shallow soil depths (~400 mm).	
Katspruit → Orthic A → G-horizon	Katspruit soils are high in clay leading to water accumulation. The restricted water permeability leads to a fluctuating water table and soil wetness for long periods, expressed in the soils as signs of wetness (mottles, clay, gleying). The G-horizon has an accumulation of iron, and manganese oxides, forming mottles. These horizons are saturated for long periods and have noticeable clay accumulation and are often referred to as hydromorphic soils (wetland soils).	Katspruit soils were identified within the Channelled Valley Bottoms and low-lying areas. The soils are high in clay with mottles and gleying within the first 100 mm. The dominant land use for these soils is wetland and used for cattle grazing and cattle watering/dams. These soils have cultivation restrictions due to the low draining potential causing waterlogging conditions, however, are high in organic material and soil fertility.	
Kroonstad → Orthic A → E-horizon → G-horizon	Kroonstad soils are referred to as hydromorphic soils due to waterlogging conditions and permanent wetness. These soils consist of a sandy, leached E-horizon overlying a G-horizon with high clay content and clear signs of wetness (mottles/leaching). The soils are saturated for long periods, has a fluctuating water table and have noticeable clay accumulation in the deeper profile. Kroonstad soils have a perched water table resulting in reducing conditions such as mottling, gleying and leaching. These soils are often sandy loams with high permeability in the upper horizon overlying an impermeable/low-permeable B-horizon.	Kroonstad soils in the Project Area are associated with hillslope seep wetlands connected to the pans and floodplain system. The soils are seasonal to temporary wet and were often impacted by adjacent cultivation practices. The soils were leached, very sandy in the A-horizon, overlying a very clayey B-horizon with Fe and Mn accumulation. The soils contribute to subsurface water/ interflow into the pans and Channel Valley Bottoms (CVBs). The soil depth varied, however often deeper than 1200 mm.	 

Soil Form	Description ((Soil Classification Working Group, 1991))	Observations in the Study Area	
Mispah → Orthic A → Hard rock	Mispah soils are dominantly shallow with restricting water and rooting depth. The soils often have a shallow water table, high surface runoff and associated with sheetrock wetlands. The A-horizon are highly susceptible to erosion when overgrazed, disturbed and low vegetation cover.	Mispah soils in the Project Area are very shallow soils overlying hard rock. The soils can easily be confused with Glenrosa soil forms; however, these soils had no B-horizon overlying the hard rock. The soils were delineated in the scarp, adjacent to the floodplain/CVB system. The soil depth did not exceed 150 mm, therefore restricts cultivation and often had low vegetation cover. These areas were less impacted by anthropological activities.	
Pinedene → Orthic A → Yellow-brown Apedal → Unspecified material with signs of wetness	Pinedene soils are generally fairly deep (700 – 1200 mm) 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, the potential for wetland formation and accumulation of nutrients, increasing the soil fertility. These soils are often cultivated and have a high land capability.	Pinedene soils on site were deep (>1200 mm) soils with an unspecified, clayey B-horizon. The soils were sandy, well-drained, and often cultivated due to their high agricultural potential (soil fertility) and easy management rating. Clay increased with depth and often had signs of wetness (mottles) in the deeper horizons, however, were deeper than 500 mm and thus not classified as wetland soils.	
Rensburg → Vertic A → G-horizon	Rensburg soils consist of a Vertic-A horizon with high clay, dark colour and high in organic material. The G-horizon subsoil has a grey or gleyic colour pattern (leached) which at times can be hints of green due to the reduction of iron under permanent or periodic anaerobic conditions and has a firmer consistence than the overlying topsoil and is classified as a wetland soil. These soils are often associated with wetlands and classified as hydrogeomorphic soil.	These soils were augured in the pans and valley bottom wetlands within the Project Area. The soils had a dark, black, clayey A-horizon (vertic) overlying a sandy-clay-loam, light coloured G-horizon. These soils were permanently saturated with water, well-vegetated and used for cattle grazing. The soils are high in Organic Material (OM) and soil fertility, however restrictions to cultivation due to saturation and waterlogging.	
Witbank → Man-made material	Witbank soils are anthropologically impacted soils. These soils are combined and mixed soils with various properties and pedogenesis. These soils are altered from their natural state and include intensively cultivated land.	Witbank soils were dominant in the Study Area due to adjacent historical mining and historical and current agropastoral activities. The natural geomorphology of these soils was altered by excavations, compaction, dam building, stockpiling, cultivation and historical infrastructure. Some of these soils were associated with artificial wetness due to compaction, mixing of subsoil and topsoil causing water ponding.	

8.2. Soil Chemical and Physical Characteristics

The results of the soil analysis for the seven (7) representative samples taken during the site survey are presented in Table 8-3. As a basis for interpreting the data, SSV and local soil fertility guidelines are presented in Table 8-2, together with the pH guidelines.

The results highlighted in yellow present values below the SSV and red above the SSV. The pH colours are presented in Table 8-2 below.

Table 8-2: Soil Fertility Guidelines

Guidelines (mg per kg)			Source
Macro Nutrient	**Low**	**High**	
Aluminium (Al)	<10	>50	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)
Boron (B)	<0.5	>1.5	USA Guidelines, (Allison, et al., 1954)
Calcium (Ca)	<200	>3000	South Africa Guidelines, (NEM:WA 2008)
Chlorides (Cl)	-	>12000	South Africa Guidelines, (NEM:WA 2008)
Copper (Cu)	<36.0	>190	Dutch Guidelines, (Dutch VROM, 2000)
F (Fluoride)	-	>200	Canadian Guidelines, (CCME, 2007)
Magnesium (Mg)	<50	>300	South Africa Guidelines, (NEM:WA 2008)
Nickel (Ni)	-	>45	Canadian Guidelines, (CCME, 2007)
Organic Carbon (OC)	< 2 %	>3 %	South Africa Guidelines, (du Preez, Mnkeni, & van Huyssteen, 2010)
Phosphorus (P)	<5	>35	South Africa Guidelines, (NEM:WA 2008)
Potassium (K)	<40	>250	South Africa Guidelines, (NEM:WA 2008)
Sodium (Na)	<50	>200	South Africa Guidelines, (NEM:WA 2008)
Zinc (Zn)	<140	>720	Dutch Guidelines, (Dutch VROM, 2000)
EC	110 (mS/m)	570 (mS/m)	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)
CEC	5%	25%	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)

pH					
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 8-3: Soil Physico-Chemical Properties

Sample ID	pH (KCl)	Electrical Conductivity (EC)	Organic Carbon	Cation Exchange Capacity (CEC)	P (Bray1)	K	Na	Ca	Mg	Fe	Mn	Cu	Zn	Ni	F	Cl	NO_2	NO_3	NH_4	Clay	Sand	Silt	Texture
		mS/m	%	Cmol(+)/kg	mg/kg					mg/l										%			
1	4.28	100	0.59	3.24	7.4	24.7	26.0	109.7	35.3	69.03	0.65	0.60	0.30	0.09	0.24	27.64	0.07	8.60	0.09	4.6	92.8	2.6	Sand
2	4.94	44	0.51	6.20	9.5	207.7	1.8	282.7	97.3	4.63	8.20	0.29	0.63	0.10	0.23	2.71	0.05	54.47	0.06	11.7	83.3	5.0	Loamy Sand
3	5.82	39	0.43	4.85	4.2	81.1	2.1	394.7	39.2	3.64	2.96	0.31	0.50	0.04	0.65	1.15	0.01	1.42	0.05	11.6	76.6	11.8	Sandy Loam
4	4.21	50	1.36	4.58	7.4	41.4	16.9	129.2	29.2	106.10	2.38	0.61	0.87	0.14	0.09	9.89	0.06	1.91	0.07	9.3	88.0	2.7	Loamy Sand
5	6.48	220	1.64	23.90	5.0	862.4	475.0	1766.9	727.5	37.33	79.07	2.33	0.63	0.66	11.40	67.94	0.10	2.91	0.12	59.7	19.8	20.4	Clay
6	6.16	111	0.47	4.25	16.9	56.2	2.0	291.7	77.0	7.00	4.90	0.39	0.85	0.08	0.41	9.35	0.01	192.53	0.05	9.5	85.5	5.0	Loamy Sand
7	5.31	79	0.36	3.59	8.1	34.0	11.4	257.2	28.7	71.54	5.50	0.57	0.47	0.18	0.19	11.20	0.04	0.25	0.07	6.8	90.6	2.6	Sand

8.2.1. Soil Texture

Guidance Note for Soil Texture

The particle size distribution of the soil sampled in the Project Area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle. The size limits for sand, silt and clay used in the determination of soil texture classes are sand: 2.0 – 0.05 mm, silt: 0.05 – 0.002 mm and clay: < 0.002 mm.

Soil water retention characteristics are strongly affected by soil texture. A 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).

The particle size distribution of the soil sampled in the Project Area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle.

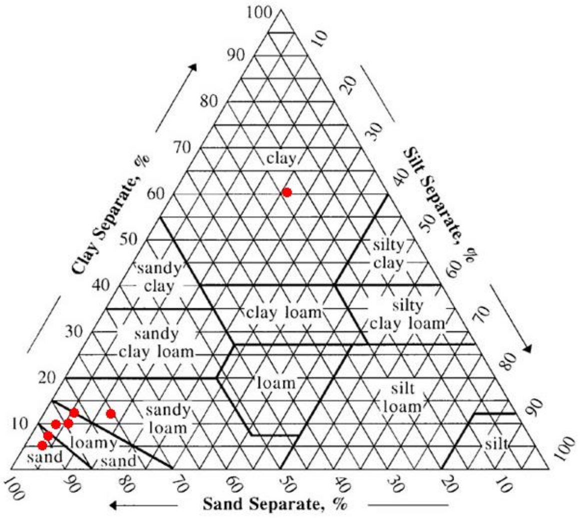
The average soil texture in the Project Area was sand to loamy sand. Soil texture is a direct attribute from the parent material (dominantly sandstone). The following characteristics are related to sandy soils:

- High infiltration and drainage rate;
- High leaching potential; and
- Low soil fertility (Organic Carbon (OC), CEC, EC, pH).

The high clay soils in the large pan contribute to the high fertility of the soils. The higher the clay in the soil, the higher the EC, CEC, Organic Carbon and pH.

Table 8-4: Texture Classification

Sample Number	Texture Classification
1	Sand
2	Loamy Sand
3	Sandy Loam
4	Loamy Sand
5	Clay
6	Loamy Sand
7	Sand



8.2.2. Soil pH

Guidance Note for Soil pH

The measurement of soil acidity is referred to as soil pH. 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 soil chemical, physical and biological properties.

The interaction between soil particles, soil solution and dissolved ions have an important role in holding cations such as calcium (Ca^{+2}), magnesium (Mg^{+2}), potassium (K^{+}) and ammonium (NH_4^{+}) in the soil. The cations are important plant nutrients that are taken up by plants from the soil solution. When the concentration of the solution is out of proportion it will directly impact the biology of the soil as well as the growth of the vegetation. When the concentration is increased, by means of adding lime and fertilizers, the nutrient will first be absorbed by the soil particles until dissolved and released into the soil solution for plant availability. When the holding capacity of the soil particles are low (sandy soil), the nutrient will just leach out of the profile, inherently known as infertile soils whereas clayey soils have a much higher holding capacity for nutrient and thus are more fertile (Neina, 2019).

In addition to the cations in the soil is acid ions. The acid ions include hydrogen protons (H^{+}) and aluminium ions (Al^{+3} and $Al(OH)^{+2}$) causes an acidic reaction and therefore lower the pH of the soil solution (Farina & Channon, 1991).

The pH of the soil samples collected ranged from **4.21** to **6.48**, indicating that the soils are **acidic** to **slightly acidic**. The optimal pH for crops ranges between 5.5 and 7.5. However, some crops have adapted to thrive outside the optimal range. The following can be derived from the data:

- Samples 5 and 6 were within the optimal cultivation pH range;
- Samples 5 and 6 were taken within the large pan (Rensburg soil form) and within shallow Avalon soils with high clay and EC;

- Samples 1, 2, 3, 4, 7 were below the optimum agriculture pH and require liming to increase the pH;
- Due to the sandy nature of the dominant soils (Sample 1, 2, 3, 4, 6 and 7), intensive crop production and high rainfall in the vicinity of the Project Area, the pH tends to decrease over time and require a liming and fertilizer programme to optimise crop production; and
- Soils with a low EC, Magnesium (Mg) and clay content tend to have a lower pH than soils with higher clay and EC.

8.2.3. Exchangeable Cations

Guidance Note for Exchangeable Cations

The higher the CEC value (> 25) the higher the clay and/or OM in the soil. Soils with a high clay and/ or OM content, with a high CEC will have high cation concentrations. Cations are adsorbed by the negatively charged clay and OM particles. Soils with a low CEC (< 5) is usually an indication of sandy soils with low soil fertility and OM. The optimum CEC ranges from 5 to 25 Cmol/kg.

The levels of the basic cations (**Ca**, **Mg**, **K** and **Na**) 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 which is driven by the balance of the exchangeable cations. Excess **Na** and **K** causes dispersion (soil is broken down in very fine particles which is particularly sensitive to erosion), whereas high levels of **Ca** would 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 CEC values ranged from **3.24** to **23.90 Cmol/kg**. This is a wide range within the Project Area, clearly indicating impacts from historical and current land uses. The following can be derived from the data regarding the CEC and the exchangeable cations:

- The CEC for Samples 1, 3, 4, 6 and 7 were below the SSV;
- The Sodium (Na) and Mg in these samples were below the SSV;
- The CEC for Samples 2 and 5 were within the SSV, with adequate Potassium (K), Calcium (Ca) and Mg in Samples 2 and concentrations of K, Na and Mg above the SSV in Sample 5;
- Sample 2 (has slightly a higher clay and loam fraction than the other samples, whereas Sample 5 has a very high clay content (Rensburg soils);

- The low CEC and cations in the dominant soils (all samples, except for Sample 5 taken in the large pan) can be attributed to the sandy nature of the soil (sandstone parent material), low OM, low clay content and intensive cultivation practices; and
- Soils with a low CEC and cations have low soil fertility and require fertilization for optimal crop production.

8.2.4. Phosphorus

Guidance Note for Phosphorus Content

Phosphorus (**P**) is required in plants for root development and promote plant sugars for more efficient ripening of fruits and promote larger flowers. Soil pH and depth are just as important to note as **P** is immobile in soil and will be higher at a depth where there is a free flow of water.

P deficiencies in soil causes low crop production, thin and week stems of plants, stunted growth, and shorter, dark leaves.

Excessive levels of phosphorus in a growth medium are not particularly harmful to plant health, however, may impede the uptake of **Zn** and Iron (**Fe**) even when there are adequate amounts of these nutrients in the material. Excessive levels of **P** are not easily remedied and takes a long time to lower. It is therefore important to avoid fertilisers containing phosphorus, such as NPK and cattle manure as fertiliser. The optimum P in soils for crop production range from 5 to 35 mg/kg.

The P in the samples ranged from **4.2** to **16.9** mg/kg. This is slightly low, and soils will require P-fertilizer for optimum crop production. The following was derived from the data:

- Only Sample 3 had P-values below the SSV. Sample 3 was taken in a maize field and could clarify the low P-level (crop uptake and P-demand);
- P in the other six samples were within the SSV, with the highest concentration in Sample 6;
- The higher concentration in Sample 6 (intensively cultivated land in Clovelly soils) can be attributed to the recent application of P-fertilizer; and
- The slightly low P in Sample 5 (large pan) indicates that the P-demand of the crops in the catchment is high and that the P in the soils are most likely fixed and not easily leached.

8.2.5. Heavy Metals and Potential Harmful Elements

Guidance Note for Heavy Metal Content and Potential Harmful Elements

Heavy metal contamination is a serious form of inorganic pollution which has a long-term negative effect on the natural environment. These heavy metals include **Al, Hg, Cd, Pb, As, Cu, Zn, Mn, Ni, U** and **Se.** To a greater or lesser extent, these elements are toxic to living organisms. **Cd** and **As** are extremely toxic, whereas **B, Cu, Zn** and **Mn** are relatively lower in toxicity to living organisms.

The optimum level of nitrates in soil for commercial crops ranges from 5 to 10 parts per 1 million (ppm). Optimum nitrate level for soil used for corn production is more than 25 ppm.

The heavy metals and potentially harmful elements in all the samples were below the SSV values. This is a good indication that there is currently no inorganic pollution in the Project Area. The following was derived from the data:

- Copper (Cu), Zink (Zn), Nickle (Ni) and Fluoride (F) were analysed and were all below the SSV in all seven samples;
- Other potential harmful elements, including Chloride (Cl), Nitrite (NO_2), Nitrate (NO_3) and Ammonium (NH_4) were low in all the samples and will not cause harm to crop production; and
- The soils are not impacted by potential harmful elements, nor heavy metals. This baseline data should be used for future soil and water monitoring.

8.2.6. Organic Carbon

Guidance Note for Organic Carbon Content

Soil Organic Carbon indicates organic material content in the soil, therefore soil fertility. Organic Carbon releases nutrients to plants, promotes root development, soil structure, soil health and increases the buffer of the soil against harmful elements. The higher the level of Organic Carbon, the higher the OM and thus the more fertile the soil. Levels above 2 - 3% Organic Carbon are considered moderate to high for soils in South Africa according to du Preez et al., (2010).

The soil Organic Carbon ranged from **0.36** to **1.64** % in the seven soil samples. The Organic Carbon in all the samples were thus below the SSV. The following was derived from the data:

- Sample 7 (pan, outside the Project Area) had the lowest Organic Carbon and a very sandy texture;
- Sample 5 (pan, inside the Project Area) had the highest Organic Carbon with the highest clay levels;
- The higher the clay in the soil, the higher the CEC, EC, absorption potential and Organic Carbon; and
- All the samples had a lack of Organic Carbon and organic fertilizer would be required for optimum crop production.

9. Sensitivity

Guidance Note

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 U.S. Department of Agriculture (1973) and 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.

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

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

Based on the soil delineations, land use and soil chemical and physical analysis, the following areas must be regarded as **sensitive areas (areas with a high land capability and suitability**) (Table 9-1 and Figure 9-1):

Table 9-1 Soil Sensitivity

Soil Form	Land Use (Dominant current)	Land Capability (Dominant current)	Land Class	Sensitivity
Avalon	Cultivation	Intensive Cultivation (IC)	I	High
Cartref/Glenrosa	Cultivation	Moderate Cultivation (MC)	IV	High
Clovelly	Cultivation	IC	I	High
Glencoe	Cultivation	IC	I	High
Glenrosa	Cattle grazing	Moderate Grazing (MG)	VI	Medium
Katspruit	Cattle grazing/ wetland	MG	V	Medium
Kroonstad	Cattle grazing/ wetland	MG	V	Medium
Mispah	Cattle grazing	Light Grazing (LG)	VII	Low
Pinedene	Cultivation/ wetland	IC	III	High
Rensburg	Cattle grazing/ wetland	MG	V	Medium
Witbank	Cattle grazing/ industrial	LG	VII/ VIII	Low

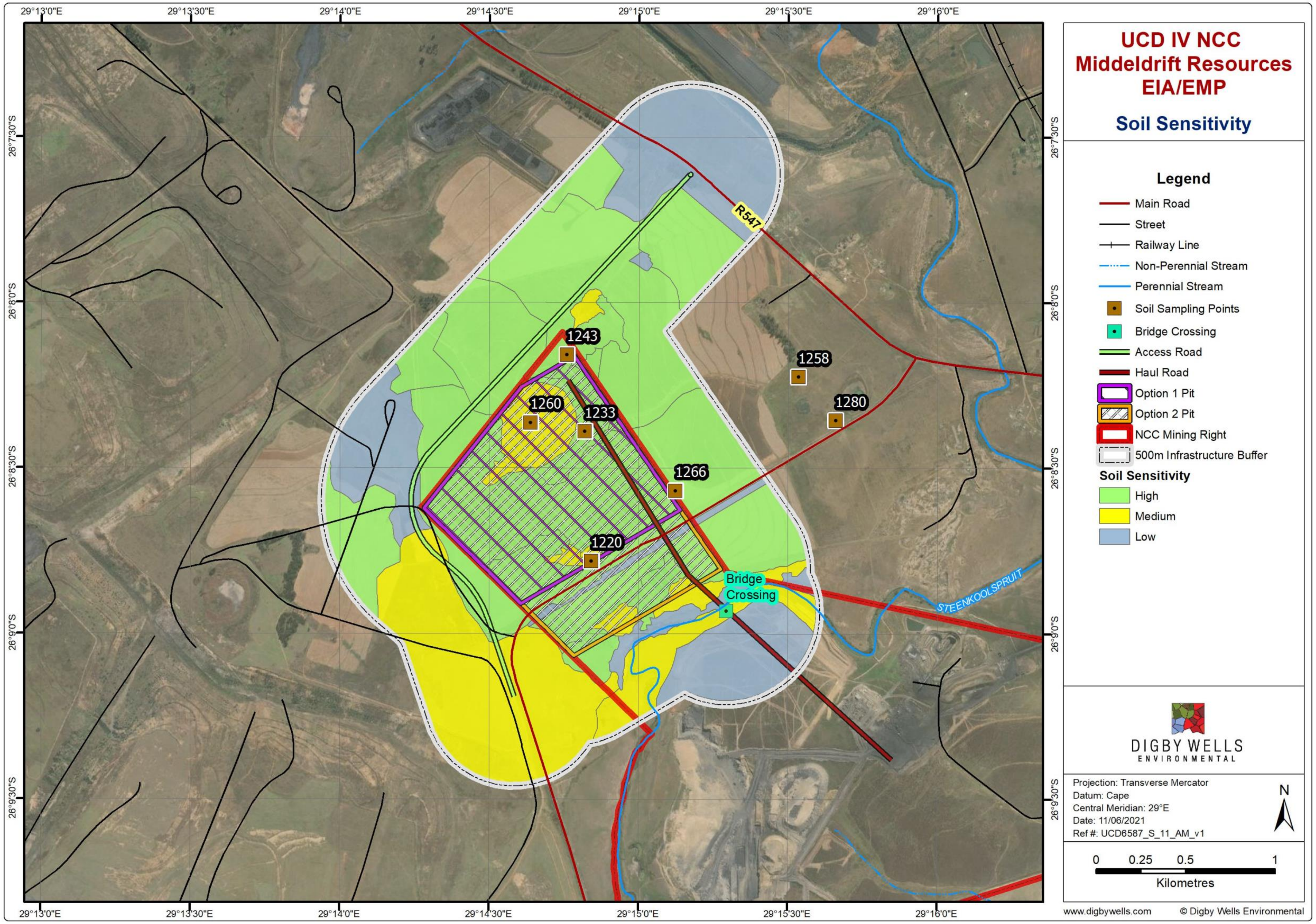


Figure 9-1 Soil Sensitivity Map

10. Mitigation Hierarchy

Guidance Note on Mitigation Hierarchy

The aim of the IA is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate.

The mitigation hierarchy for the soils within the Study Area is described in Table 10-1 below.

Based on previous studies and similar projects within the Mpumalanga province it is inevitable that the proposed activities will pose impacts on the soil, land use and land capability. Even when areas of high land capability are avoided, impacts might still arise due to erosion, sedimentation, soil degradation and soil and water pollution.

However, it is not always possible to avoid or prevent an impact and therefore minimization and rehabilitation should be considered. When it is not possible and feasible to avoid mining land of high capability and sensitivity, Soil/Land Offset should form part of the biodiversity (wetland) Offset plan. This should be implemented to compensate for residual negative effects on the soil, land use and land capability after effort have been made to minimize, avoid and rehabilitate impacts.

Land degradation is a major problem we currently have worldwide and will directly affect food security, water quality and quantity and sustainable land management.

Mining of the sensitive areas (specifically the large pan) might have major impacts on the biodiversity and soils (please refer to the Wetland Impact Assessment, 2021). Offsetting must be the last resort as ideally sensitive areas must be avoided and rehabilitated when impacted, however, an Offset Strategy must be implemented when these areas are going to be impacted, mined and removed.

Table 10-1: Mitigation Hierarchy for Soil, Land Use and Land Capability

Mitigation Step	Actions
Avoid or prevent	*Avoid mining of all areas with high land capability and suitability.*
	• Avoid mining and infrastructure in highly sensitive areas; and • Establishment of a buffer zone around these areas to avoid secondary impacts to the sensitive areas (e.g., erosion, sedimentation, contamination). This is however not feasible as it will require avoiding most of the Study Area.

<table>
<tr><th>Mitigation Step</th><th>Actions</th></tr>
<tr><td rowspan="2">Minimise</td><td>Minimise impacts to the soil, land use and land capability by establishing a buffer zone around the highly sensitive areas (Figure 9-1) and only mine areas outside this buffer or select areas of high sensitivity to be protected/avoided.</td></tr>
<tr><td>Avoid mining and infrastructure in highly sensitive areas;
Establishment of a buffer zone to protect soils from infrastructure and mining-related impacts within the Project Area;
Select highly sensitive areas on-site to avoid and rehabilitate to minimize the impacts on site as well as adjacent to the Project Area; and
Consider moving infrastructure outside areas of high land capability (sensitive areas).
This is not feasible as it will require avoiding large areas of the Project Area, however, it is advised to minimise activities in selected areas of high land suitability and soils adjacent to sensitive wetland areas.</td></tr>
<tr><td rowspan="2">Rehabilitate</td><td>Rehabilitate the entire Project Area, as well as the adjacent areas impacted by the mining activities. Rehabilitation should be done to achieve pre-mining land capability (cultivation and cattle grazing) as far as possible.</td></tr>
<tr><td>The land capability should at least be rehabilitated to Arable and Grazing Land with the aim on wildlife, moderate grazing and light cultivation;
Ensure concurrent rehabilitation with special attention to reshaping the areas and re-vegetating;
Landscape and reshape the Project Area to near natural topographies with at least 1 000 mm of topsoil; and
Contaminated soils must be disposed of at a registered landfill site prior to rehabilitation to prevent further soil and water contamination and increase rehabilitation success.
The land capability will almost certainly not be rehabilitated back to Intensive Cultivation due to soil and land degradation; however, the aim should be to get the land back to a high land uses and capability as far as possible.</td></tr>
<tr><td rowspan="2">Offset
(Not included in this phase)</td><td>Mine the entire Project Area</td></tr>
<tr><td>Soil/Land Offset should form part of biodiversity (wetland) Offset plan that will have to be developed and implemented after the residual impacts have been determined; and
This should only be implemented once all prevention, avoidance, mitigation and rehabilitation has been done and the residual impacts are still high.
This is a costly activity and requires selecting land/wetlands outside the Project Area to mitigate and rehabilitate. This could lead to cost implications.</td></tr>
</table>

11. Soil Impact Assessment

This section aims to rate the significance of the identified potential impacts of pre-mitigation and post-mitigation on Soil, Land Use and Land Capability. The potential impacts identified in this section are a result of both the environment in which the proposed project activities take place, as well as the actual activities. The potential impacts are discussed per aspect and per each phase of the Project (i.e., Construction, Operational and Rehabilitation Phases) where applicable.

Mitigation measures in this section are provided to avoid, minimize and rehabilitate soils within the Study Area (500 m buffer around the Protect Area). However, due to the permanent impact, the proposed activities will have on the soil and land, it is recommended to include soils as part of the Biodiversity (wetland) Offset Strategy to compensate for the land lost.

As the proposed activities include mining out the entire Project Area, the mitigation measures are to mitigate and rehabilitate the Project Area post-mining as well as reduce impacts to the adjacent soil, land use and land capabilities. Mining of the sensitive areas (specifically the large pan) might have major impacts on the biodiversity and soils and therefore Offsetting must be included in the Rehabilitation Plan.

11.1. Interactions and Impacts of Activity

Activities during the Construction, Operational and Rehabilitation Phases that may have potential impacts on the wetlands are described in Table 11-1.

11.2. Management Objectives

The mitigation hierarchy includes firstly the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction and Operational Phases, the next step is or to minimise the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented.

The aim of the management objectives is:

- Minimise impacts to the adjacent soils, land use and land capability;
- Rehabilitate the Project Area to land capability of at least Moderate Arable land and Grazing (medium) (wildlife, moderate grazing and light cultivation); and
- Include soils as part of the Biodiversity (wetland) Offset Strategy to compensate for the soils and land lost due to mining of the entire Project Area and sensitive areas.

As the proposed activities will cover the entire Project Area, large areas of the land will be lost. It is therefore advised that soils form part of the Rehabilitation Plan and Biodiversity (wetland) Offset Strategy to improve the land, soils and land capability in areas outside the Project Area. Mitigation measures are given to minimise and reduce impacts on the adjacent and downstream water, wetlands, soils, land use and land capability.

Table 11-1: Interactions and Impacts of Activity

Project Phase	Project Activity	Impact	Description
Construction Phase	Site/vegetation clearance Contractor laydown yard Access and haul road construction Topsoil stockpiling	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	During site clearing, vegetation will be removed along with topsoil. When soil is removed, the physical and chemical properties may change, and the soils can degrade and change from high land capability to low land capability/ industrial. When the organic material is removed, either by the clearing of an area for the development of infrastructure or by erosion; the soil fertility status can reduce and may result in soil acidification. Vehicles and machinery can lead to soil compaction, increased surface runoff, erosion and loss of vegetation and OM. This can reduce the infiltration rate, and the ability for plant roots and water to penetrate the soil. Once the soil is eroded it can reduce the overall soil depth, soil fertility rate, and as a result the land capability. If the topsoil and subsoil are excavated and stockpiled as one unit, the topsoil's seed bank and natural fertility balance can be diluted. This can affect the regrowth of vegetation using the stockpiled topsoil. Soils should therefore be handled with care from the construction phase through to the decommissioning phase. When usable soil is disturbed, compacted, or eroded, the soil profile can be compromised and its ability to function as a growth medium can be restricted. The sandy soils in the Project Area can be particularly vulnerable to wind and water erosion when exposed during site clearance and stockpiling. An intact vegetation cover is needed to reduce impact from raindrops on the soil, slows down surface run-off, filters sediment and binds the soil together for more stability. The potential for chemical pollution and soil contamination exists during site preparation and construction when spills or leaks of fuels, oils and lubricants from construction or operational vehicles or machinery occur. Fluids used for vehicles and machinery may spill during filling or direct leakage.
Operational Phase	Open pit establishment Removal of rock (blasting) Stockpiling (i.e., soils) establishment and operation Operation of the open pit workings	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	Various unplanned and residual impacts to the remaining and adjacent soils might occur, including soil pollution/contamination, erosion, compaction and loss of soils and land capability. Impacts may include changes to the natural soil physical, chemical and biological activities which changes the land use and capability. Drilling, blasting, dumping of waste rock and crushing of RoM, contamination and sedimentation might occur and the possible impact the remaining and adjacent soils and land. When stockpiles, spills and the overall infrastructure are not well maintained, the soil contamination plume might increase, increasing a much larger area than anticipated. Erosion may occur and result in sedimentation and changes to the adjacent land uses, such as wetlands downstream and adjacent to the Project Area. The area of chemical contamination dependent on the size of the spill and the permeability/infiltration rate of the soil. Contaminants transported by water into the soils can rapidly infiltrate into sandy soils which are dominant across the Project Area. If heavy vehicles and machinery are not confined to the permanent roads, widespread erosion may take place. Land capability and productivity will be lost within the Project Area.
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation Post-closure monitoring and rehabilitation	• Soil compaction; • Soil erosion; • Sedimentation; and • Topsoil degradation.	Rehabilitation of the Project Area will entail backfilling, landscaping and reshaping, placing of topsoil, and revegetation. Even though rehabilitation of the area might have a positive result on the soil, land use and land capability (i.e., restoring soils, change the land capability from industrial back to wildlife, cattle grazing or arable land), several impacts might occur during the rehabilitation phase. During backfilling and placing of topsoil, soils might get compacted and eroded, losing effective rooting depth, water and root penetration, water holding capacity and soil fertility. The movement of heavy machinery on the soil surface could lead to compaction, which reduces the vegetation's ability to grow and as a result erosion. Soils might be lost due to erosion from unprotected surfaces. The loss of usable soil as a resource is a serious impact as the natural regeneration of a few millimetres of usable soil takes hundreds of years. Rehabilitation activities will cover the extent of the infrastructure footprint areas and will include ripping, spreading of overburden and topsoil and establishment of vegetation. The first phase of the rehabilitation plan (demolishing of infrastructure) might have a negative effect on the soil, land use and land capability, however, when rehabilitation of these areas commence, the soil, land use and land capability status will increase and have a positive effect. Ideally, the post-mining land capability should be Agriculture.

11.3. Impact Ratings

Table 11-2 and Table 11-4 presents the impact ratings associated with the Project for all the phases prior and post-mitigation, whereas Table 11-3 presents the mitigation measures to be implemented to avoid, reduce, and rehabilitate impacts to the soil, land use and land capability.

Table 11-2: Pre-Mitigation Impact Ratings

Pre-Mitigation Rating								
Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site/vegetation clearance	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Contractor laydown yard		Beyond Project Life (6)	Local (3)	Serious Loss (5)	Almost Certain (6)	Negative	Moderate - 84
	Access and haul road construction		Beyond Project Life (6)	Local (3)	Serious Loss (5)	Almost Certain (6)	Negative	Moderate - 84
	Topsoil stockpiling		Permanent (7)	Local (3)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
Operational Phase	Open pit establishment	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Removal of rock (blasting)		Permanent (7)	Municipal Area (4)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 126
	Stockpiling (i.e., soils, and ROM) establishment and operation		Beyond Project Life (6)	Local (3)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 90
	Operation of the open pit workings		Beyond Project Life (6)	Municipal Area (4)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation	• Soil compaction; • Soil erosion; • Sedimentation; and • Topsoil degradation.	Project Life (5)	Local (3)	Moderate loss (3)	Probable (4)	Negative	Minor -44
	Post-closure monitoring and rehabilitation		Medium Term (3)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -21

Table 11-3: Mitigation Measures

Phase	Mitigation Measures
Construction Phase	• If any erosion occurs on site and adjacent to the Project Area, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • If erosion has occurred on site and adjacent to the Project Area, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • The topsoil should be stripped with vegetation utilizing an excavator bucket and loaded onto dump trucks; • Plan site clearance and alteration activities for the dry season (May to October); • Restrict the extent of disturbance within the Project Area and minimise activity within designated areas of disturbance; • Minimise the period of exposure of soil surfaces through dedicated planning; • Ensure proper stormwater management designs are in place; • If any spillage occurs, clean up and remediate immediately; • Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of spillage with appropriate disposal as necessary; • Implement post-mitigation monitoring to ensure the well-functioning of the road diversion and bridge. This should include an AIP management plan.
Operational Phase	• Re-vegetate cleared areas and stockpiles to avoid wind and water erosion; • Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; • Monitoring of the condition of all unpaved roads is necessary due to the high rainfall and potential water runoff and erosion of the soils present in the Project Area. Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road surface; • Monitoring needs to be carried out of all unpaved roads especially during the rainy season; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • A Topsoil Management Plan (TMP) must be prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition to allow successful mine rehabilitation (Statham, 2014); • 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; and • Soil pollution monitoring should be conducted at selected locations on the project site to detect any high levels of pollutants. • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure; • Operations vehicles and equipment should be serviced regularly; • Service and parking areas must be paved; and • Fuel and heavy hydrocarbon product storage on site should be secured by bunded facilities.
Rehabilitation Phase	• Demolition and removal of infrastructure should be restricted to the dry season (May to October); • Minimise the period of exposure of soil surfaces through dedicated planning; • Ensure proper stormwater management designs are in place and should be kept in place until all infrastructure is removed. Where infrastructure will remain, stormwater and culverts should be maintained and monitored for erosion and AIPs; • Continue with concurrent rehabilitation and implement land rehabilitation measures; • Address compacted areas by deep ripping to loosen the soil, and revegetate the area; • Only designated access routes are to be used to reduce any unnecessary compaction; • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions; • Monitoring of the condition of all unpaved roads and rehabilitated areas; and • If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place.

Table 11-4: Post-Mitigation Impact Ratings

Prior Mitigation Rating								
Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site/vegetation clearance	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soils, however other impacts, such as contamination, compaction and erosion will be Minor. Impacts after mitigation on site and the adjacent areas include: • Erosion; • Sedimentation; • Compaction and increased runoff; and • Mixing of subsoil and topsoil (low rehabilitation success).	Permanent (7)	Municipal Area (4)	Irreplaceable Loss (6)	Definite (7)	Negative	Major - 119
	Contractor laydown yard		Project Life (5)	Limited (2)	Serious Loss (4)	Likely (5)	Negative	Minor - 55
	Access and haul road construction		Project Life (5)	Local (3)	Serious Loss (5)	Almost Certain (6)	Negative	Moderate - 84
	Topsoil stockpiling		Permanent (7)	Limited (2)	Serious Loss (5)	Probable (4)	Negative	Minor - 56
Operational Phase	Open pit establishment	After mitigation and rehabilitation of the site, impacts will still be Major due to the loss of soil and land capability, however other impacts, such as contamination and compaction will be Minor.	Permanent (7)	Municipal Area (4)	Irreplaceable Loss (6)	Definite (7)	Negative	Major - 119
	Removal of rock (blasting)		Permanent (7)	Local (3)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
	Stockpiling (i.e., soils, and ROM) establishment and operation		Project Life (5)	Limited (2)	Serious Loss (4)	Probable (4)	Negative	Minor - 44
	Operation of the open pit workings		Project Life (5)	Local (3)	Serious Loss (5)	Likely (5)	Negative	Minor - 65
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation	Impacts from rehabilitation and monitoring are negligible when mitigation is followed. The impact that might however arise over time include: • Erosion when areas are not revegetated instantly; • Low rehabilitation success; • Decreased land capability; • Compaction; and • Spreading of AIPs.	Long Term (4)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -24
	Post-closure monitoring and rehabilitation		Short Term (2)	Very Limited (1)	Minimal to no loss (1)	Highly Unlikely (1)	Negative	Negligible -4

11.4. Cumulative Impacts

The land uses within and adjacent to the Project Area have already contributed to losses of soil, land use and land capabilities. Historical and current land uses (e.g., infrastructure, historical mining activities, crop cultivation and cattle grazing) has led to major geomorphological and hydrological changes, vegetation loss, overgrazing, the contamination of soil and water resources and increased surface inflows.

The historical mining infrastructure and agropastoral activities within the catchment have led to land degradation, changing the land capability in large areas. The alteration of vegetation and surface flow has led to the onset of erosion and may be perpetuated further by the proposed activities. In addition to mining and agropastoral activities were linear infrastructures such as roads, dams, powerlines, and fences. The impacts include the creation of preferential flow paths, erosion, sedimentation and compaction of soils.

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;
- Erosion, destruction of agricultural land, loss of topsoil and organic material;
- Sedimentation and pollution of watercourses (wetlands); and
- Soil contamination through acid and sulphate, mine impacted water (decant water) and heavy metals.

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

11.5. Unplanned and Low-Risk Events

The entire Project Area is planned to be lost/mined out. However, there is a risk that the adjacent and downstream soils, land use and land capability will be impacted due to the proposed activities. Table 11-5 outlines mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the proposed Project.

Table 11-5: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
• Erosion from the additional infrastructure	• Ensure proper stormwater management, including culverts and road design; • Monitor erosion; • Maintain infrastructure; and

Unplanned Risk	Mitigation Measures
	• Install silt traps, re-vegetate area after construction and ensure proper slopes (avoid water ponding and steep slopes).
• Coal spillage from moving machinery	• Machines and trucks must be checked and maintained regularly; • Access roads and the bridge crossing 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.
• 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; • 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; • All machines are to be serviced and refuelled in demarcated bunded areas, workshops, or at appropriate off-site locations; • Contaminated soils must be disposed of in a registered and licensed Waste Land Facility; and • Conduct monitoring after spills if and where necessary to prevent secondary impacts to the adjacent and downstream soils.

12. Environmental Management Programme

The EMPr to mitigate impacts to Soil, Land Use and Land Capability is described in Table 12-1 below.

Table 12-1: Environmental Management Programme

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
Construction Phase	Site/vegetation clearance Contractor laydown yard Access and haul road construction Topsoil stockpiling	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	• Control and Remedy. If any erosion occurs on site and adjacent to the Project Area, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • Control and Remedy. If erosion has occurred on site and adjacent to the Project Area, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Control. The topsoil should be stripped with vegetation by means of an excavator bucket and loaded onto dump trucks; • Control. Plan site clearance and alteration activities for the dry season (May to October); • Control. Restrict the extent of disturbance within the Project Area and minimise activity within designated areas of disturbance; • Control. Minimise the period of exposure of soil surfaces through dedicated planning; • Control. Ensure proper stormwater management designs are in place; • Control and Remedy. If any spillage occurs, clean up and remediate immediately; • Control and Remedy. Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of spillage with appropriate disposal as necessary; • Control and Remedy. Implement post-mitigation monitoring to ensure the well-functioning of the road diversion and bridge. This should include an AIPs plan.	Concurrent rehabilitation through the life of mine	Life of Construction Phase
Operational Phase	Open pit establishment Removal of rock (blasting)	• Soil compaction; • Soil erosion; • Sedimentation; • Topsoil degradation; • Chemical soil pollution/contamination; and • Decreased land capability and agricultural potential.	• Remedy. Re-vegetate cleared areas and stockpiles to avoid wind and water erosion; • Control and Remedy. Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; • Control. Soil stockpiles should be monitored for fertility via sampling and testing; • Control and Remedy. Monitoring of the condition of all unpaved roads is necessary due to the high rainfall and potential water runoff and erosion of the soils present in the Project Area. Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road surface; • Control. Monitoring needs to be carried out of all unpaved roads especially during the rainy season; • Control and Remedy. If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • Control and Stop. A TMP must be prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition to allow successful mine rehabilitation (Statham, 2014);	Concurrent rehabilitation through the life of mine	Life of Operational Phase

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
	Stockpiling (i.e., soils) establishment and operation Operation of the open pit workings		• Control, Remedy and Stop. 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; and • Control, Remedy and Stop. Soil pollution monitoring should be conducted at selected locations on the project site to detect any high levels of pollutants. • Control. Only the designated access routes are to be used to reduce any unnecessary compaction; • Control and Remedy. Compacted areas are to be ripped to loosen the soil structure; • Control and Stop. Operations vehicles and equipment should be serviced regularly; • Control and Stop. Service and parking areas must be paved; and • Control and Stop. Fuel and heavy hydrocarbon product storage on site should be secured by bunded facilities.		
Rehabilitation Phase	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation Post-closure monitoring and rehabilitation	• Soil compaction; • Soil erosion; • Sedimentation; and • Topsoil degradation.	• Modify, Control and Remedy. Demolition and removal of infrastructure should be restricted to the dry season (May to October); • Modify, Control and Remedy. Minimize the period of exposure of soil surfaces through dedicated planning; • Control and Stop. Ensure proper stormwater management designs are in place and should be kept in place until all infrastructure is removed. Where infrastructure will remain, stormwater and culverts should be maintained and monitored for erosion and AIPs; • Modify, Control and Remedy. Continue with Concurrent Rehabilitation, and implement land rehabilitation measures; • Modify, Control and Remedy. Address compacted areas by deep ripping to loosen the soil, and revegetate the area; • Control and Stop. Only designated access routes are to be used to reduce any unnecessary compaction; • Modify, Control and Remedy. The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions; • Modify, Control and Remedy. Monitoring of the condition of all unpaved roads and rehabilitated areas; and • Modify, Control and Remedy. If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place.	Concurrent rehabilitation through the life of mine and after mine	Life of Rehabilitation Phase

13. Monitoring Programme

Guidance Note for Monitoring Programme

A monitoring programme 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 effectiveness of the management measures in place.

Soil monitoring should be done in terms of:

- EIA Regulations, 2014 promulgated under the NEMA;
- NEMA;
- NEM: WA; and
- The CARA.

Results of chemical analyses of soils obtained must be measured against the SSV and reference samples and clearly demonstrate that the selection of guideline values is consistent with the principles of the Framework.

The Mine Manager and the Environmental Practitioner are responsible to report on results of the monitoring program.

Internal monitoring reports should be required, reporting on the progress of the state of the monitoring and rehabilitation programme. This should be completed after each external monitoring report.

Table 13-1 describes the monitoring plan which should be followed from the Construction Phase through to the Rehabilitation and Monitoring phase. The table includes each element of monitoring together with the frequency of monitoring and the person responsible thereof.

Table 13-1: Monitoring Plan

Monitoring Element	Comment	Requirement	Frequency	Phase	Responsibility	Duration
Stockpiles (i.e., height, erosion, compaction, low vegetation cover)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Stockpile update report and recommendations for impact mitigation, if any.	Twice every year and after storm events	Construction	Environmental Officer	Up to Rehabilitation
				Operational		
			N/A	Rehabilitation		
Soil health and fertility	Implementation of intervention/mitigation measures.	Soil update report and recommendations for impact mitigation, if any.	Twice every year	Construction	Environmental Officer	3 years after Rehabilitation
			Once every year	Operational		
				Rehabilitation		
Soil physical attributes (vegetation, erosion, sedimentation)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take photos of impacted areas and record any impacts seen.	Twice every year and after storm events	Construction	Mine Environmental Manager.	3 years after Rehabilitation
				Operational		
			Once every year	Rehabilitation		
Soil contamination assessment (incl. decant points)	Report any irregularities to the Environmental Officer for assessment and mitigation/remediation measures.	Take soil samples for laboratory analysis, measuring heavy metals and potentially harmful elements. Measure against the baseline data and SSV.	Only after a spill has occurred	Construction	Environmental Officer	3 months after (monthly) the spill has occurred
				Operational		
				Rehabilitation		

14. Stakeholder Engagement Comments Received

Guidance Notes on the Public Participation Process

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 completed in part, as a process separate from the Soil 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.

15. Recommendations

The following actions are recommended to reduce adverse effects on the soil resources of the Project Area (Table 15-1).

Table 15-1: Possible Impacts and Recommendations

Possible Impacts	Recommendations
Soil disturbance (erosion), and decreasing biodiversity resulting in increased sedimentation and increased erosion.	• Improved vegetation cover native to the area; • Remove AIPs; and • Reduced risk of erosion and sedimentation through vegetation and installation of silt traps.
Loss of the soil resource due to: • Change in land use, and removal of the soil; and • Erosion from unprotected soils	• 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 (soil texture) due to compaction of	• Restriction of vehicle movement over sensitive areas to reduce compaction;

Possible Impacts	Recommendations
areas and associated mine infrastructure.	• Only the designated access routes are to be used to reduce any unnecessary compaction; and • Deep rip compacted areas, cover with at least 1000 mm of topsoil and revegetate.
Contamination of the soil resource due to hydrocarbons spillages.	• 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; • Re-fuelling 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 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.
Livestock impacts.	• Fence off rehabilitated areas from livestock until vegetation has been 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 the biodiversity (wetland) Offset plan that will have to be developed and implemented after the residual impacts have been determined.

16. Reasoned Opinion Whether Project Should Proceed

The overall impacts of the Project were determined to be major and may lead to irreversible damage to the soil, land use and land capability. Based on the impact assessment significance ratings, it is the opinion of the specialist that the Project will have major effects on the soil, land use and land capability as the area will completely be mined and will most certainly have impacts on the adjacent land uses and land capabilities due to possible erosion, sedimentation, contamination, dewatering and dust. It is however highly recommended to mitigate and protect adjacent land as well as include Soil/Land Offset inputs, forming part of the Biodiversity (Wetland) Offset to compensate for the land degradation and loss of wetlands and agricultural land.

In the opinion of the specialist, mining of the sensitive areas (specifically the large pan) might have major impacts on the biodiversity and soils (please refer to the Wetland Impact Assessment, 2021). Offsetting must be the last resort as ideally sensitive areas must be avoided and rehabilitated when impacted, however, an Offset Strategy must be implemented when these areas are going to be impacted, mined and removed.

It is highly recommended that rehabilitation, mitigation and monitoring of the soil resources are correctly implemented and managed. The Soil, Land Use and Land Capability management and monitoring requirements as set out in Section 12 and Section 13 should form part of the conditions for environmental authorisation. Soils and land use should form part of the Biodiversity (Wetland) Offset Strategy to compensate for the degradation of land.

17. Conclusion

The Project Area can be described as uneven slopes with moderate undulating plains running towards a low-lying valley (Steenkoolspruit) on the east and south of the Project Area. Depressions/pans are scattered throughout the western and eastern sides of the landscape.

The land capability ranges from II and IV, with the land uses being predominantly cultivated land and grassland, with minor areas of wetlands, thicket/dense bush, plantation/woodlot, woodland/open bush and adjacent urban areas. Large areas of the Project Area have been rated as high sensitivity, due to the high land capability (intensive cultivation).

The typical augured soil horizons were identified as Orthic A-horizons, overlying Yellow-brown to Red Apedal B-horizons with a Plinthic B-horizon. The soils were very sandy, deep fertile soils; and are generally used for commercial agriculture. Scattered pans were identified on-site, with typical soil horizons of Vertic-A overlying G-horizon and E-horizons overlying a G-horizon (Rensburg and Kroonstad soil forms).

The overall chemical and physical soil analysis indicated that the average soil fertility is low, with the exception of the large pan. The pan had elevated K, Na and Mg. This can be attributed to the clayey nature of the soils in the pan, increasing the CEC, EC and pH.

To conclude, the overall impacts of the Project were determined to be major and may lead to irreversible damage to the soil, land use and land capability. Based on the impact assessment significance ratings, it is the opinion of the specialist that the Project will have major effects on the soil, land use and land capability as the area will completely be mined and will most certainly have impacts on the adjacent land uses and land capabilities.

The following is recommended:

- Mitigate and protect adjacent land, as well as include soil/land offset inputs, forming part of a biodiversity (wetland) offset to compensate for the land degradation and loss of agricultural land;

- Rehabilitation, mitigation and monitoring of the soil resources should be correctly implemented and managed. The Soil, Land Use and Land Capability management and monitoring requirements as set out in Section 12 and Section 13 of this report should form part of the conditions for EA; and
- Soils and land use should form part of the Biodiversity (Wetland) Offset Strategy to compensate for the degradation of land. In the opinion of the specialist, mining of the sensitive areas (specifically the large pan) might have major impacts on the biodiversity and soils (please refer to the Wetland Impact Assessment, 2021). Offsetting must be the last resort as ideally sensitive areas must be avoided and rehabilitated when impacted; however, an Offset Strategy must be implemented if these areas are going to be impacted, mined and removed.

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Appendix A: Methodology

Methodology

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

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:

- 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; and
- Land use and land capability were described with specific reference to the interaction between water and land use through a review of existing studies conducted in the area as well as publicly available information.

Soil Classification

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 metres (m) or to 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 Soil Classification: A Taxonomic System for South Africa (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.

Soil Physical and Chemical Analysis

Seven (7) representative soil samples (0 to 0.6 m) were collected from the proposed areas 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. In accordance with 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);
- Metals (Fe, Mn, Cu, Zn and Ni);
- Macro-elements (F and Cl);
- Nitrogen (NH_4, NO_2, NO_3); and
- Soil texture (Sand, Silt and Clay fractions).

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

Soil texture is defined as the relative proportion of sand, silt and clay particles found in the soil. The relative proportions of these 3 fractions (clay, sand and silt) as illustrated in Figure 1, determines 1 of 12 soil texture classes, for example sandy loam, loam, sand, sandy clay loam etc. The different texture class zones are demarcated by the thick black line in the diagram.

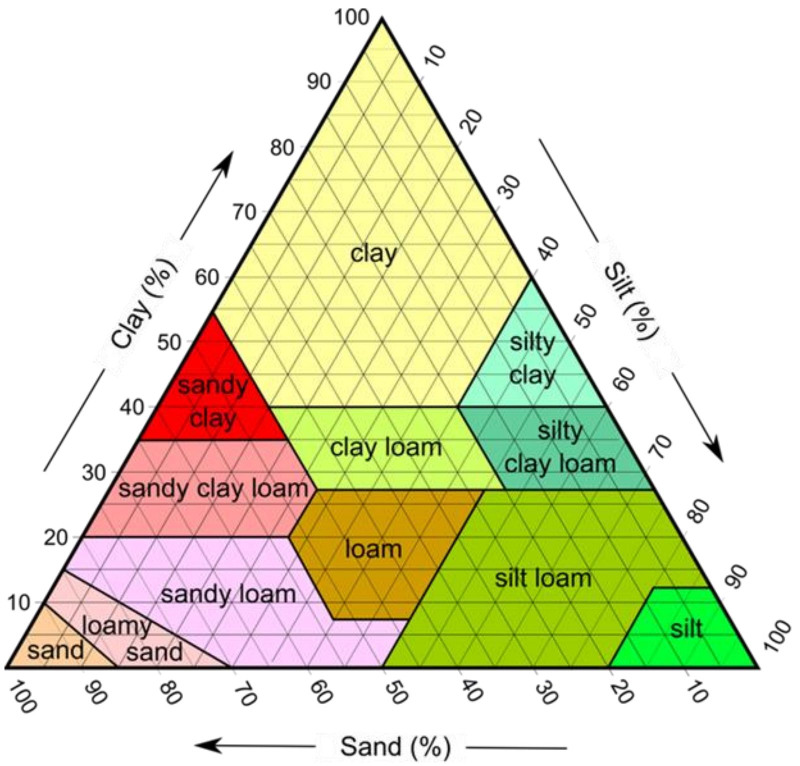


Figure 1: Soil Textural Diagram

(Source: (South African Sugar Association, 1999)

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.

Land Capability

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 U.S. Department of Agriculture (1973) and 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 1). The land will be rated into eight classes which include 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 I, excess water (w), soil root zone (s) and climatic I limitations. Classes I-IV represent arable land and Classes V-VIII represent non-arable land according to the guidelines (Soil Conservation Service: U.S. Department of Agriculture, 1973; Schoeman, et al., 2000).

Table 1: Land Capability Classes

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

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

Land Suitability (Agricultural Potential)

The process of land suitability classification is the grouping of specific areas of land in terms of their suitability for a defined land use. Soil agricultural potential or suitability mapping was determined by considering the soil forms, land capability classes, soil analysis results, the hydrology of the site and the current land use. The process involved allocating terrain factors (topography and slope) and soil factors (depth, texture, internal drainage and mechanical limitations) which define soil forms, to an area of land. The soil chemical analysis, which includes pH, cations and phosphorus compositions, was considered in determining the final suitability of the soil. The suitability guidelines according to Schoeman et al., (2000) were used.

Soil chemical, physical and biological processes depend on five soil forming factors, including time, topography, organic material, climate, and parent material. These soil forming factors changes the soil characteristics and therefore are considered when soils are grouped into land capability and suitability. Depending on which of these are limiting, the soils fall under one of the following suitability classes (Table 2):

Table 2: Land Classes – Descriptions and Suitability

Class	Definition	Conservation Need	Use-Suitability
I	• No or few limitations. • Very high arable potential. • Very low erosion hazard.	Good agronomic practice.	Annual cropping.
II	• Slight limitations. • High arable potential. • Low erosion hazard.	Adequate run-off control.	Annual cropping with special tillage or ley (25%).
III	• Moderate limitations. • Some erosion hazards.	Special conservation practice and tillage methods.	Rotation of crops and ley (50%).
IV	• Severe limitations. • Low arable potential. • High erosion hazard.	Intensive conservation practice.	Long term leys (75%).
V	• Watercourse and land with wetness limitations.	Protection and control of water table.	Improved pastures or Wildlife.
VI	• Limitations preclude cultivation. • Suitable for perennial vegetation.	Protection measures for establishment e.g. Sod-seeding.	Veld and/or afforestation.
VII	• Very severe limitations. • Suitable only for natural vegetation.	Adequate management for natural vegetation.	Natural veld grazing and afforestation.
VIII	• Extremely severe limitations. • Not suitable for grazing or afforestation.	Total protection from agriculture.	Wildlife.

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 national guidelines and legislation, the following criteria were taken into consideration when potentially significant impacts were examined relating to soils:

- 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);

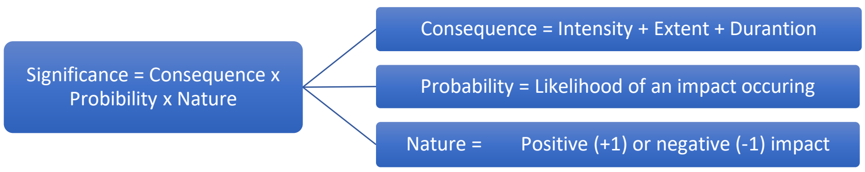
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

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 EMP. Details of the impact assessment methodology used to determine the significance of physical, bio-physical 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 4. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

Parameter Rating

Impacts are rated prior to 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 3, which is extracted from Table 4. The description of the significance ratings is discussed in Table 5.

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.

Mitigation Hierarchy

The aim of the Impact Assessment is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is represented in Table 3.

Table 3: Mitigation Hierarchy

↓	**Avoid or Prevent**	Refers to considering options in Project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the other steps in the mitigation.
	Minimise	Refers to considering alternatives in the Project location, sitting, scale, layout, technology and phasing that would minimize impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimize impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable, and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure. Rehabilitation can, however, fall short of replicating the diversity and complexity of natural systems.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimize and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Table 4: 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 definitely 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 highly** sensitivity.	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. >65 but <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 including the site and its immediate surrounding 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 local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	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 5: Probability/Consequence Matrix

Probability	Significance																																					
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
Consequence	-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

Table 6: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in 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 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 being approved. These impacts will result in 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 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 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) (-)