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Arnot South Environmental Authorisation and Water Use License Application

Closure Planning Reports Aligned with the Requirements of the Financial Provisioning Regulations, 2015 (as Amended)

Prepared for:
Exxaro Coal Mpumalanga (Proprietary) Limited

Project Number:
UCD6802

August 2021

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This document has been prepared by Digby Wells Environmental.

Report Type:	Closure Planning Reports Aligned with the Requirements of the Financial Provisioning Regulations, 2015 (as Amended)
Project Name:	Arnot South Environmental Authorisation and Water Use License Application
Project Code:	UCD6802

Name	**Responsibility**	**Signature**	**Date**
Stawm Malan	Report Compiler		July 2021
Leon Ellis	Report Review		July 2021

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DECLARATION OF INDEPENDENCE

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I, Stawm Malan, as duly authorised representative of Digby Wells and Associates (South Africa) (Pty) Ltd., hereby confirm my independence (as well as that of Digby Wells and Associates (South Africa) (Pty) Ltd.) and declare that neither I nor Digby Wells and Associates (South Africa) (Pty) Ltd. have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of the proposed Arnot South Project, other than fair remuneration for work performed.

Full name:	Stawm Malan
Title/ Position:	Mine Closure Consultant
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PROJECT INFORMATION

The contact details of the Proponents are provided in the table below.

Name of company	Exxaro Coal Mpumalanga (Proprietary) Limited
Name of Mine	Arnot South
Name of project	Proposed Arnot South Coal Mining Project
Postal address	The Connexxion, 263B West Avenue, Die Hoewes Centurion
Contact details	012 307 3000

<u>Rights, permits, licenses and authorisations associated with the operation</u>

Exxaro Coal Mpumalanga (Pty) Ltd is applying for the following authorisations and licences, which are required prior to the commencement of mining operations:

- An Environmental Authorisation (EA) in terms of the National Environmental Act;
- A Waste Management Licence (WML) in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA); and
- An Integrated Water Use Licence (IWUL) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).

EXECUTIVE SUMMARY

Structure of This Document

This document consolidates the necessary closure planning reports for the Arnot South Coal Mining Project being undertaken by Exxaro Coal Mpumalanga (Pty) Ltd, in terms of the Financial Provisioning Regulations, 2015 (GN R1147 of 20 November 2015) (as amended) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

The reports required for compliance with the Financial Provisioning Regulations, 2015 (as amended) are included in this report as follows:

- Part A: Final Rehabilitation, Decommissioning and Mine Closure Plan (Appendix 4 of GN R1147);
- Part B: Environmental Risk Assessment (Appendix 5 of GN R1147); and
- Part C: Annual Rehabilitation Plan (Appendix 3 of GN R1147).

A regulatory checklist detailing what is required in terms of the Financial Provisioning Regulations, 2015 (as amended) is included at the beginning of each Part and provides cross references to the relevant sections of the report where these requirements are addressed.

An overarching introduction and site context information pertaining to the Arnot South Coal Mining Project is included in the beginning of the report and is relevant to each Part of the report listed above.

An Annual Rehabilitation Plan (ARP) was not developed as part of this work since the proposed Arnot South Coal Mining Project is yet to commence, and therefore annual rehabilitation is not applicable at this stage in the project life cycle. In addition the proposed project involves underground exploitation of the coal reserve which limits concurrent rehabilitation opportunities.

Part A: Final Rehabilitation, Decommissioning and Mine Closure Plan

The closure measures set out in the Final Rehabilitation, Decommissioning and Mine Closure Plan (RCP) (included in Section 15, Part A) are based on a risk assessment undertaken for the proposed Arnot South Coal Mining Project (included in Section 9, Part A), which is informed by relevant biophysical information and available specialist studies. The closure measures developed are then costed in the Digby Wells closure costing model to determine the closure costs required for financial provisioning for the proposed Arnot South Coal Mining Project.

The immediate closure costs were determined using contractor rates. Quantities used to determine the closure cost estimates were taken from available plans, maps and information provided by Exxaro.

The immediate closure costs for the proposed Arnot South Coal Mining Project, amount to approximately **R 81,982,207** as detailed in Section 22 (Part A) of this report. The costs exclude VAT but include Preliminary and General (P&Gs) at 15% and contingencies at 10%. It is noted that this closure cost total also accounts for discounted residual closure costs, to manage post-closure water treatment and subsidence monitoring. The residual closure costs were discounted using a rate of 4.5%, since the Financial Provisioning Regulations, 2015, allow for discounting of long-term residual/ latent costs.

Part B: Environmental Risk Report (ERR)

This Part relates to the identification and costing of residual and latent environmental risks. The preliminary residual risks were identified in the environmental risk assessment undertaken for mine closure, and the significant residual/ latent risks and mitigation measures resulting from the environmental risk assessment are summarised in this Part (see Section 28, Part B).

The residual risks currently costed for include post-closure water treatment and subsidence monitoring, for immediate closure (i.e. after Year 1 of the operations). The high-level water treatment and subsidence monitoring costs for the proposed Arnot South Coal Mining Project amount to **R9,108,118** and **R 12,029,601**, respectively**.** The detail considered as part of this cost estimation is reflected in Section 34 (Part B). These costs were discounted to present value over the relevant management period using a discount rate of 4.5%.

The work required to address the identified knowledge gaps to further inform the necessary mitigation measures for the residual and latent risks identified, is detailed in Section 35 (Part B).

The understanding of the residual and latent risks will gradually improve with annual iterative updates of this document, as more information becomes available.

Part C: Annual Rehabilitation Plan (ARP)

The ARP assesses planned rehabilitation at the mine for the next 12 months, and the rehabilitation undertaken on site to date. This part is therefore not applicable at this stage in the project life cycle since the mine is still to be developed.

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LIST OF TERMS AND ABBREVIATIONS

Terms	
Care and maintenance	The action is performed over rehabilitated areas and includes application of soil ameliorants (fertiliser, manure, irrigation etc.) and any minor corrective action that may be required over the rehabilitated area.
Closure	The time at which the mine reaches its life of mine due to resource depletion.
Contingencies	A percentage allowance applied to account for risk associated with uncertainty.
Preliminary and Generals (P&Gs)	A percentage allowance applied to account for third-party contractors setting up on site, and includes costs such as establishment and de-establishment of equipment, electricity, water consumption etc.
Remediation	A process undertaken to remove and stop contamination.
Rehabilitation	A process undertaken to rehabilitate disturbed land to a functional end use, which usually includes soil amelioration, ripping, soil placement and seedings to establish a vegetation cover.
Planned closure	The year the mine plans to cease production after life of mine has been reached, as per the current mine plan.
Immediate closure	The closure scenario for unexpected closure of the mine for whatever reason.
Site relinquishment	The mine closure period that commences once all rehabilitation and post-closure activities are complete.
Abbreviations	
AMD	Acid Mine Drainage
ARP	Annual Rehabilitation Plan
BPGs	Best Practice Guidelines
CALLM	Chief Albert Luthuli Local Municipality
DEA	Department of Environmental Affairs
Digby Wells	Digby Wells Environmental
DMRE	Department of Minerals
DWA	Department of Water Affairs

IA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
ERR	Environmental Risk Assessment Report
GN R. 1147	Financial Provisioning Regulations, 2015 (Government Notice No. 1147 published in GG 39425
GSDM	Gert Sibanda District Municipality
HDPE	High Density Polyethylene
I&APs	Interested and Affected Parties
ICMM	International Council for Ming and Metals
IDP	Integrated Development Plan
LoM	Life of Mine
LUP	Land Use Plan
MAMSL	Metres Above Mean Sea Level
MAP	Mean Annual Precipitation
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MR	Mining Right
MRA	Mining Rights Area
MWP	Mine Works Programme
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
RA	Risk Assessment
RCP	Rehabilitation, Decommissioning and Mine Closure Plan
SLP	Social and Labour Plan
SoW	Scope of Work
STLM	Steve Tshwete Local Municipality
TDS	Total Dissolved Solids
VAT	Value Added Tax
WMA	Water Management Area
WTP	Water Treatment Plant

WUL	Water Use License
ZLD	Zero Liquid Discharge
Units of Measure	
%	Percent
°C	Degree Celsius
ha	Hectare
km	Kilometre
m	Metre
m^2	Square metre
m^3	Cubic metre
mg/l	Milligram/litre
m^3/day	Cubic metres per day
Ml/d	Megalitres per day
mm	Millimetres
t	Tonne

1. Introduction

Exxaro Coal Mpumalanga (Pty) Ltd (Exxaro) is applying for environmental authorisations required for the proposed Arnot South Coal Mining Project (Arnot South Project). Exxaro held a Prospecting Right [Reference No. MP 30/5/1/1/2/360 PR] to mine coal on various farms covering approximately 16,000 hectares (ha) in extent.

The Prospecting Right was renewed in September 2017 and lapsed on 10 September 2020. However, a Mining Right Application (MRA) and Mine Works Programme (MWP) for underground mining were submitted to the Department of Mineral Resources and Energy (DMRE) on 8 September 2020. The Applicant was issued reference number MP 30/5/1/2/2/10292 MR.

Exxaro proposes to extract coal through underground mining methods with a confirmed Life of Mine (LoM) of 17 years.

In support of the environmental authorisations required, Digby Wells Environmental (Digby Wells) was appointed to compile the Final Rehabilitation, Decommissioning and Mine Closure Plan (RCP) and Environmental Risk Report (ERR), and finally to calculate the associated closure costs in terms of the Financial Provisioning Regulations, 2015 (GN R1147 of 20 November 2015) (as amended) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

2. Project Approach

The approach followed in compiling this closure planning document is as follows:

- Review all available supporting information to inform the compilation of the RCP and ERR, including the specialist studies undertaken by Digby Wells as part of the environmental authorisation process;
- Identify and assess the risks pertinent to mine closure through an Environmental Risk Assessment undertaken using the Digby Wells risk assessment model in Microsoft Excel, including residual and latent risks;
- Develop closure measures based on the mitigation measures identified in the Environmental Risk Assessment;
- Calculate the immediate closure costs for financial provisioning based on the closure measures developed; and
- Develop site relinquishment criteria based on the envisioned preliminary post-mining land use.

A high-level overview of the mine closure planning processes is presented in Figure 2-1.

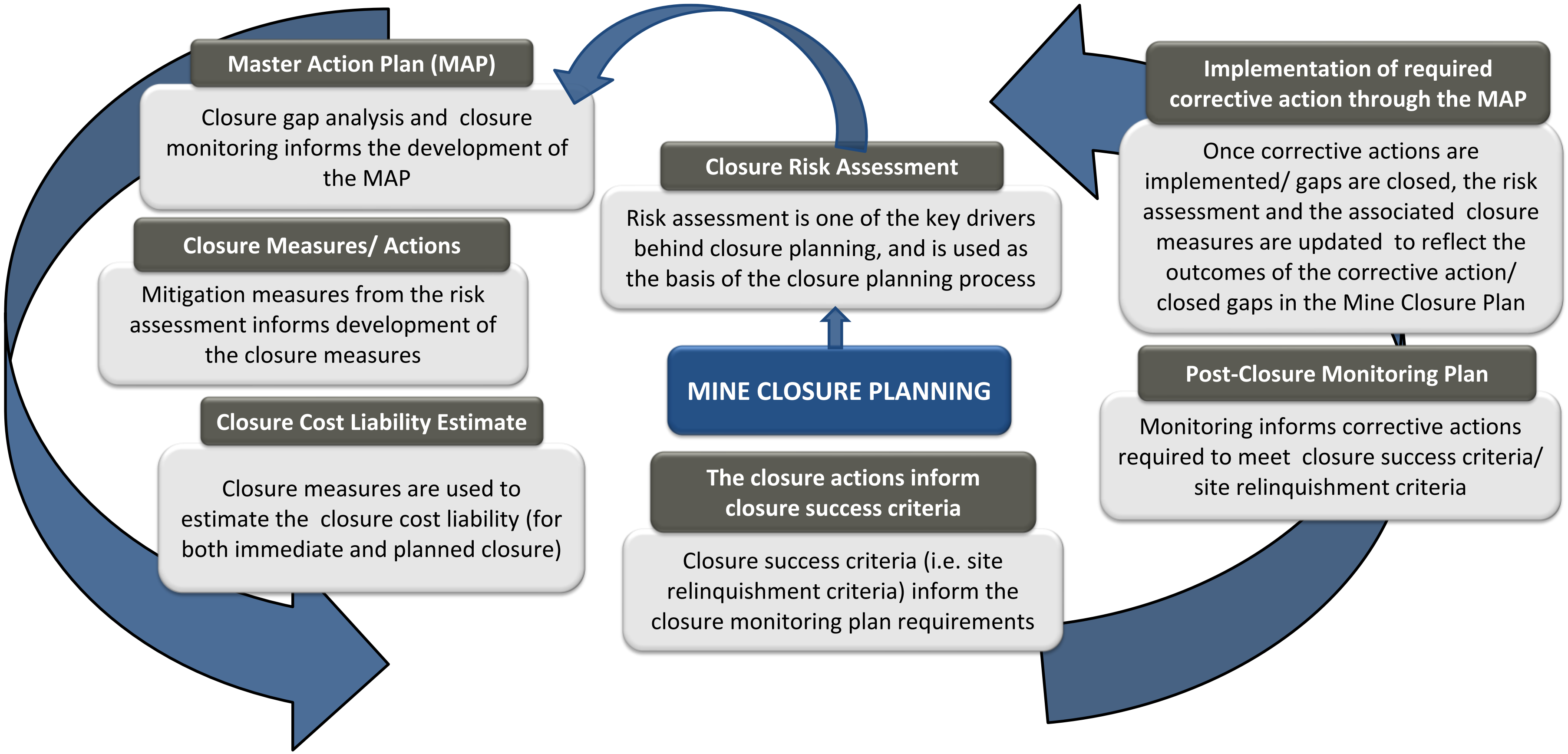

Figure 2-1: High-Level Mine Closure Planning Process

3. Supporting Information

The information made available for the review and update of the closure planning document is summarised in Table 3-1. Specialist studies undertaken by Digby Wells in support of the Environmental Authorisation (EA) and Water Use License Application (WULA) were integrated into this RCP.

Table 3-1: Supporting Information

Report/ Plan Title	Author	Date
Proposed Arnot South Coal Mining Project, Situated near Hendrina, Mpumalanga Province – Final Scoping Report	Digby Wells	March 2021
Arnot South Coal Asset Mining Works Programme Submission A Mining Right Application	Mindset Mining Consultants	August 2020
Arnot South Coal Social and Labour Plan 2020 - 2024	Exxaro	2020
Arnot South Scoping Environmental Baseline Input for Hydrogeology	Digby Wells	June 2021
Arnot South Scoping Environmental Baseline Input for the Hydropedological Assessment	Digby Wells	June 2021
Arnot South Environmental Authorisation and Water Use License Application Social Impact Assessment	Digby Wells	June 2021
Arnot South Environmental Authorisation and Water Use License Application - Soils, Land Use and Land Capability Impact Assessment	Digby Wells	July 2021
Environmental Impact Assessment for Universal Coal Development III, Arnot South Prospecting Area - Surface Water Impact Assessment	Digby Wells	July 2021
Proposed Arnot South Coal Mining Project, Situated near Hendrina, Mpumalanga Province - Wetland Environmental Impact Assessment	Digby Wells	July 2021

4. Legal Requirements

The legislation pertinent to mine closure is summarised in Table 4-1.

Section 41 (1) of the Mineral and Petroleum Resources Development Act (MPRDA) has been repealed and in terms of Section 24(P) of the NEMA, as amended, which provides that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds to undertake the following:

- Rehabilitation of the adverse environmental impacts of the listed or specified activities;

- Rehabilitation of the impacts of the prospecting, exploration, mining or production activities, including the pumping and treatment of polluted or extraneous water;
- Decommissioning and closure of the operations;
- Remediation of latent and/ or residual environmental impacts which become known in the future;
- Removal of building structures and other objects; and/or
- Remediation of any other negative environmental impacts.

In addition to Section 24(P), the Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations were promulgated on the 20 November 2015 (GN R.1147). For the purposes of this report, the financial provision estimate and respective reports are in line with the requirements of the Financial Provisioning Regulations, 2015.

Regulation 10 of the Financial Provisioning Regulations, 2015 requires an applicant to determine the quantum of the financial provision through detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for:

- Annual rehabilitation as reflected in the ARP as per the minimum content prescribed by Appendix 3 of the Regulations;
- Final rehabilitation, decommissioning and closure as reflected in a Closure Plan as per the minimum content prescribed by Appendix 4 of the Regulations; and
- The remediation of latent and/ or residual environmental impacts including but not limited to the pumping and treatment of polluted or extraneous water, as reflected in the ERR, as per the requirements of Appendix 5 of the Regulations.

There are several guideline documents which provide recommendations on how rehabilitation and closure should be undertaken. For the purpose of the plan, the following guideline documents were considered:

- Land Rehabilitation Guidelines for Surface Coal Mines. Land Rehabilitation Society of Southern Africa, CoalTech, Minerals Council of Southern Africa (2018);
- Best Practice Guidelines (BPGs) series developed by the Department of Water Affairs (DWA) (2007); and
- Integrated Mine Closure, good practice guideline 2nd edition. International Council of Mining and Metals, 2019 (ICMM, 2019).

Table 4-1: Applicable Closure Related Legislation

Applicable legislation and guidelines	Details
Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)	Section 24 of the Constitution states that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that –
	a) Prevent pollution and ecological degradation;
	b) Promote conservation; and
	c) Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)	The NEMA, as amended was set in place in accordance with section 24 of the Constitution of the Republic of South Africa. Certain environmental principles under NEMA have to be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.*
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NE<BA)	NEMBA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and also takes into account the management of alien and invasive species. This Act works in accordance to the framework set under NEMA. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance: • Alien and Invasive Species Lists, 2014 published (GN R.599 in GG 37886 of 1 August 2014) ;

Applicable legislation and guidelines	Details
	• National Environmental Management: Biodiversity Act, 2004: Threatened and Protected Species Regulations; and • National list of Ecosystems Threatened and in need of Protection under Section 52(1) (a) of the Biodiversity Act (GG 34809, GN R.1002, 9 December 2011).
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	The NWA provides for the sustainable and equitable use and protection of water resources. It is founded on the principle that the National Government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest, and that a person can only be entitled to use water if the use is permissible under the NWA.
National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) (NEM: AQA)	According to the NEM: AQA the Department of Environmental Affairs (DEA), the provincial environmental departments and local authorities (district and local municipalities) are separately and jointly responsible for the implementation and enforcement of various aspects of NEM: AQA. A fundamental aspect of the new approach to the air quality regulation, as reflected in the NEM: AQA is the establishment of National Ambient Air Quality Standards (NAAQS) (GN R 1210 of 2009). These standards provide the goals for air quality management plans and also provide the benchmark by which the effectiveness of these management plans is measured.
The Conservation of Agricultural Resources, 1983 (Act No. 43 of 1983) (CARA)	The Conservation of Agricultural Resources Act 43 of 1983 states that the degradation of the agricultural potential of soil is illegal; and
	The Conservation of Agricultural Resources Act 43 of 1983 requires that protection of land against soil erosion and the prevention of water logging and salinization of soils means of suitable soil conservation works to be constructed and maintained.
Mineral and Petroleum Resource Development Act. 2002 (Act No. 28 of 2002) (MPRDA)	The MPRDA sets out the requirements relating to the development of the nation's mineral and petroleum resources. It also aims to ensure the promotion of economic and social development through exploration and mining related activities; Section 41 (1) of Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) has been repealed and in terms of Section 24P in the National Environmental Management Act, 1998 (Act No. 107 of 1998)

Applicable legislation and guidelines	Details
	(NEMA) as amended which provides that the holder of a mining right must make financial provision for rehabilitation of negative environmental impacts. The financial provision must guarantee the availability of sufficient funds to undertake the- • Rehabilitation of the adverse environmental impacts of the listed or specified activities; • Rehabilitation of the impacts of the prospecting, exploration, mining or production activities, including the pumping and treatment of polluted or extraneous water; • Decommissioning and closure of the operations; • Remediation of latent or residual environmental impacts which become known in the future; • Removal of building structures and other objects; and/or • Remediation of any other negative environmental impacts. In addition to Section 24(P), the Regulations pertaining to the financial provision for prospecting, exploration, mining or production operations were promulgated on the 20 November 2015 (Government Notice No. 1147 published in GG 39425). Regulation 10 of the Financial Provision Regulations requires an applicant to determine the quantum of the financial provision through detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for: • Annual rehabilitation, as reflected in Annual Rehabilitation Plans (ARPs); • Final rehabilitation, decommissioning and closure of the mining operations as per the RCPs which includes the findings of the Environmental Risk Assessment Report (ERR); and • Remediation of latent or residual environmental impacts as identified in the ERR.

5. Mine Description and Context

An overview of the Proposed Arnot Project is summarised in the Sections that follow.

5.1. Regional Locality

The Arnot South Project is situated approximately 10 km east of the town of Hendrina, 25 km west of Carolina, and 50 km southeast of Middelburg in the Mpumalanga Province of South Africa. The proposed Project is close to two of Eskom's operating power stations; Hendrina (25 km) and Arnot (5 km).

The target area for mining and mining-related infrastructure lies mainly on the farms Weltevreden 174 IS, Mooiplaats 165 IS, Vlakfontein 166 IS, and Schoonoord 164 IS. The farms are located within the jurisdictions of Steve Tshwete Local Municipality (STLM) and Chief Albert Luthuli Local Municipality (CALLM), situated in the Nkangala District Municipality (NDM) and Gert Sibanda District Municipality (GSDM), respectively, in the Mpumalanga Province. The locality map is depicted in Figure 5-1.

5.2. Mining Method Operational Processes

Due to the depth and thickness of the No. 2 coal seam, the Arnot South resource area shall be mined by underground mining methods. Underground bord and pillar mining utilising continuous miners and shuttle cars is considered as the optimal mining method for the mining of the initial reserve. The mining of the initial reserve on which the mining is planned consists of one economically mineable underground block (No. 2 coal seam). Mining shall commence on the south-eastern end of the block from where the underground mining shall develop northwest.

The No. 2 coal seam shall be accessed via a boxcut located at the south-eastern end of the planned mining layout. An eight-degree ramp, 8.0 m wide, shall give access into the box cut and to the underground entrance portals. The inclination of the ramp shall allow rubber-wheeled equipment to travel up and down the ramp unassisted. The basis of the selected position of the boxcut is on the most practical underground mining layout with the least conveyor belt transfer points.

The main underground trunk conveyor belt shall run in a north-western direction to the north-western end of the mining layout. Continuous miners shall be deployed to cut and load the Run of Mine (ROM) coal into shuttle cars. Shuttle cars shall be utilised to deliver the ROM coal to a system of conveyor belts that shall deliver the coal to the surface by a shaft conveyor belt. The ROM coal will be fed into a primary and secondary crusher before being stacked on a coal product stockpile and then transported to the respective markets. The ROM coal shall be processed through a double-stage dense medium washing plant to produce export and Eskom products.

During the 17 years of planned mining, the Applicant shall conduct additional drilling towards the south of the current underground mining layout. The results of this drilling shall be applied to plan the life extension of Arnot South that shall include additional underground mining of the No. 2 seam and opencast mining of the No. 4 lower and upper coal seam. The total estimated LoM is 30 years (including the assumed resource (No. 2 and No. 4 coal seams) earmarked for mining towards the south of the Mining Right).

5.3. Life of Mine

The mineral reserve consists of one economically mineable underground block (No. 2 coal seam), producing approximately 2.4 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal for approximately 17 years.

*The closure costs are based on the current planned 17 year LoM.

5.4. Mine Battery Limits for Closure

The battery limits for mine closure are detailed in Table 5-1, and visually presented in Figure 5-2 and Figure 5-3.

Table 5-1: Battery Limits for Mine Closure

Mine aspect	Infrastructure/ facility
Mine infrastructure	• Medical facility; • Temporary guardhouse; • Site access (perimeter fencing and gates); • Possible laydown area; • Substation; • Weighbridges; • Vent shaft; • Fuel dispensary/storage; • Conveyors; • Offices; • Stores; • Brake-test ramp; • Stormwater management infrastructure; • Workshop; • Vehicle wash bay; • Laundry facility; • Pollution Control Dam (PCD); • Washing plant; • Potable water tank; • Water storage tank and booster; • Ventilation shafts (including fans);

Mine aspect	Infrastructure/ facility
	• Sewage Treatment Plant; • Change-house; • Salvage yard; • Coal Handling and Processing Plant; • Parking area; • Water Treatment Plant (WTP); and • New 3.0 km access road.
Mining areas	• Adit/ Boxcut
Stockpiles and waste	• ROM stockpiles; • Discard dump; • Topsoil stockpiles; and • Overburden stockpiles.

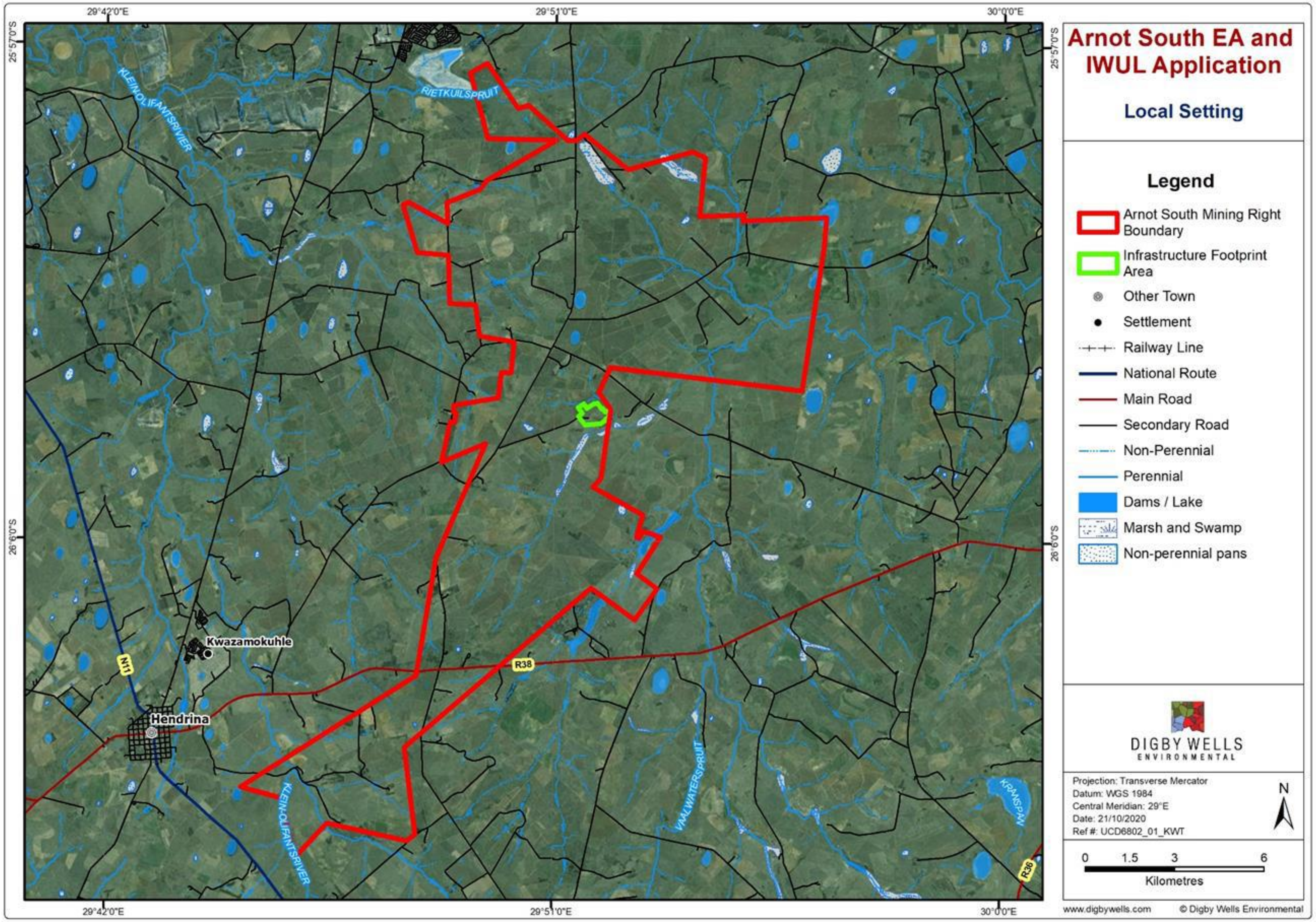

Figure 5-1: Site Locality Map

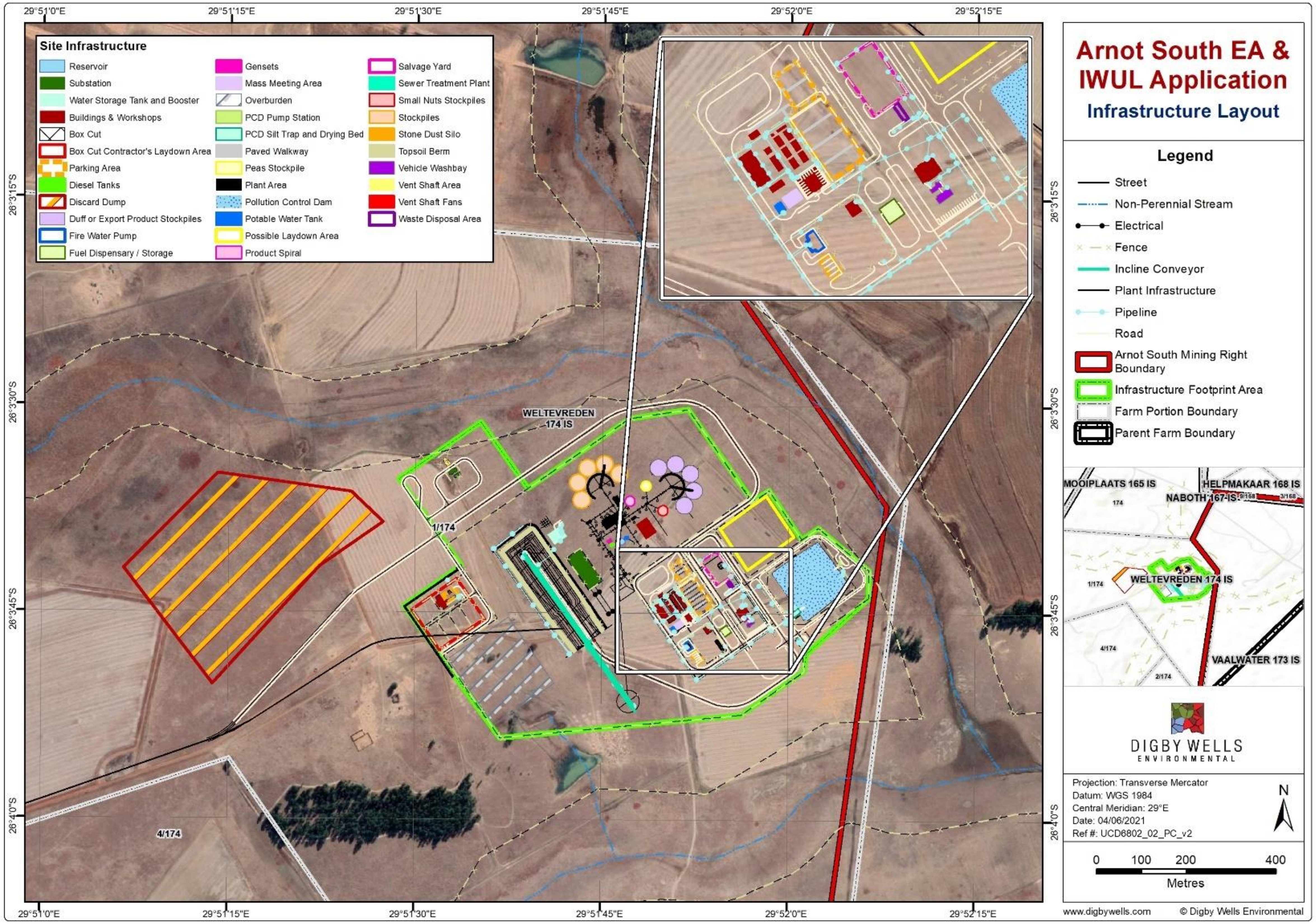

Figure 5-2: Infrastructure Layout

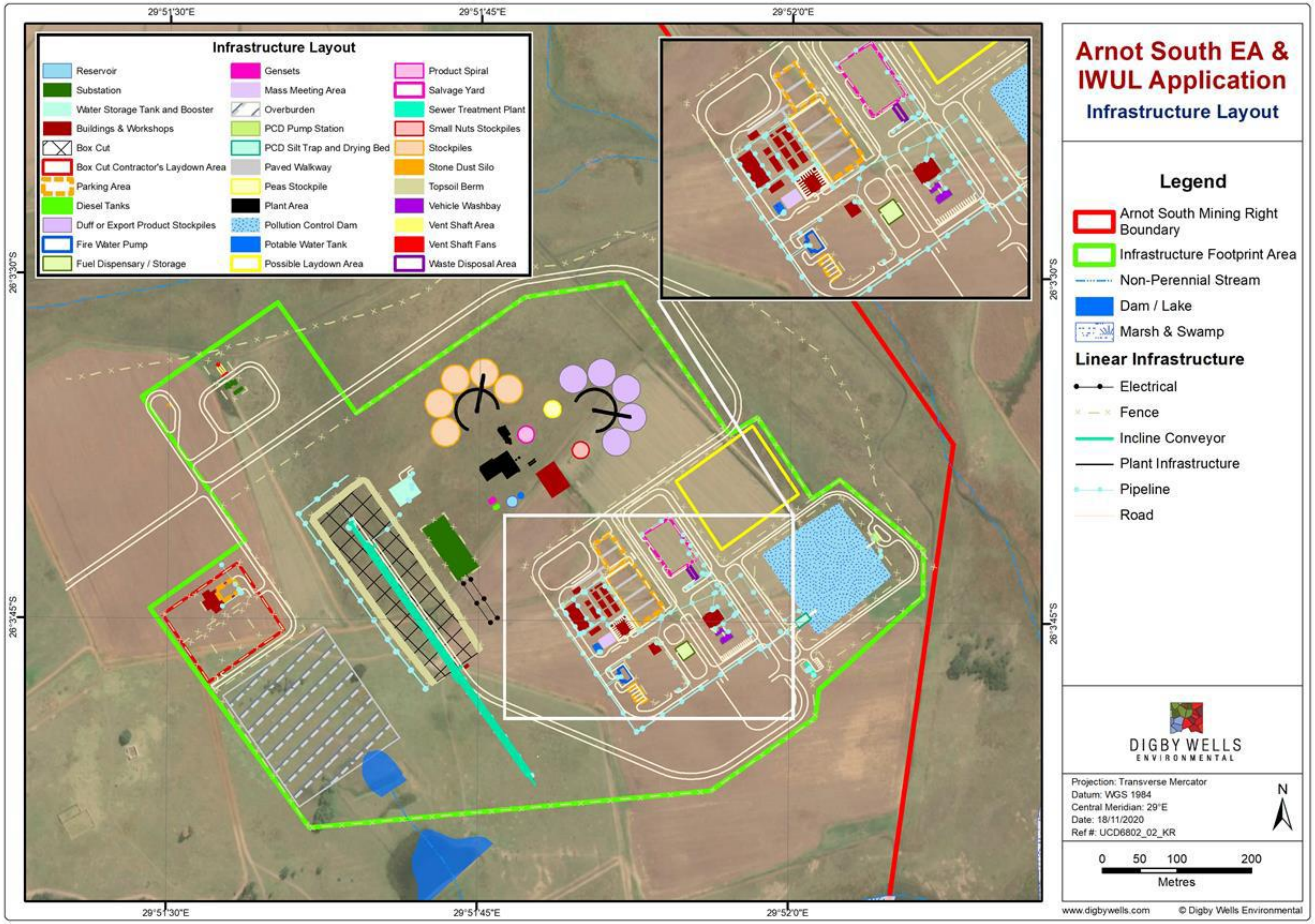

Figure 5-3: Detailed Mining-Related Infrastructure

PART A: FINAL REHABILITATION, DECOMMISSIONING AND MINE CLOSURE PLAN

6. NEMA Compliance Checklist

The Final Rehabilitation, Decommissioning and Mine Closure Plan (RCP) is structured to align with the minimum requirements set out in Section 3 of Appendix 4 of the Financial Provisioning Regulations, 2015 (as amended). The requirements are provided in Table 6-1 which includes reference to the relevant Section where the requirement is addressed in this report.

Table 6-1: Minimum Requirements of the Final Rehabilitation, Decommissioning and Mine Closure Plan (Financial Provisioning Regulations, 2015, as amended)

Ref	Requirement	Section
3a	Details of- (i) the person or persons that prepared the plan; and (ii) the professional registrations and experience of the preparers.	See Page i at the beginning of this document
3b	The context of the project, including— (i) material information and issues that have guided the development of the plan; (ii) an overview of— aa) the environmental context, including but not limited to air quality, quantity and quality of surface and groundwater, land, soils and biodiversity; and bb) the social context that may influence closure activities and post-mining land use or be influenced by closure activities and post-mining land use. (iii) stakeholder issues and comments that have informed the plan; and (iv) the mine plan and schedule for the full approved operations, and must include— aa) appropriate description of the mine plan; bb) drawings and figures to indicate how the mine develops; cc) what areas are disturbed; and dd) how infrastructure and structures (including ponds, residue stockpiles etc.) develops during operations.	See Section 5 at the beginning of the document Section 7 (Part A) Section 8 (Part A)
3c	Findings of an environmental risk assessment leading to the most appropriate closure strategy, including— (i) a description of the risk assessment methodology including risk identification and quantification, to be undertaken for all areas of infrastructure or activity or aspects for which a holder of a right or permit has a responsibility to mitigate an impact or risk at closure;	Section 9 (Part A)

Ref	Requirement	Section
	(ii) an identification of indicators that are most sensitive to potential risks and the monitoring of such risks with a view to informing rehabilitation and remediation activities; (iii) an identification of conceptual closure strategies to avoid, manage and mitigate the impacts and risks; (iv) a reassessment of the risks to determine whether, after the implementation of the closure strategy, the residual risk has been avoided and / or how it has resulted in avoidance, rehabilitation and management of impacts and whether this is acceptable to the mining operation and stakeholders; and (v) an explanation of changes to the risk assessment results, as applicable in annual updates to the plan;	
3d	Design principles, including— (i) the legal and governance framework and interpretation of these requirements for the closure design principles; (ii) closure vision, objectives and targets, which objectives and targets must reflect the local environmental and socio-economic context and reflect regulatory and corporate requirements and stakeholder expectations; (iii) a description and evaluation of alternative closure and post-closure options where these exist that are practicable within the socioeconomic and environmental opportunities and constraints in which the operation is located; (iv) a motivation for the preferred closure action within the context of the risks and impacts that are being mitigated; (v) a definition and motivation of the closure and post-closure period, taking cognisance of the probable need to implement post-closure monitoring and maintenance for a period sufficient to demonstrate that relinquishment criteria have been achieved; (vi) details associated with any on-going research on closure options; and (vii) a detailed description of the assumptions made to develop closure actions in the absence of detailed knowledge on site conditions, potential impacts, material availability, stakeholder requirements and other factors for which information is lacking.	Section 4 (at the beginning of this document) Section 11 (Part A) Section 12 (Part A) Section 14 (Part A) Section 15 (Part A) Section 19 (Part A)
3e	A proposed final post-mining land use which is appropriate, feasible and possible of implementation, including— (i) descriptions of appropriate and feasible final post-mining land use for the overall project and per infrastructure or activity and a description of the methodology used to identify final post-mining land use, including the requirements of the operations stakeholders; and	Section 13 (Part A)

Ref	Requirement	Section
	(ii) a map of the proposed final post-mining land use.	
3f	Closure actions, including— (i) the development and documenting of a description of specific technical solutions related to infrastructure and facilities for the preferred closure option or options, which must include all areas, infrastructure, activities and aspects both within the mine lease area and off of the mine lease area associated with mining for which the mine has the responsibility to implement closure actions; and (ii) the development and maintenance of a list and assessment of threats and opportunities and any uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty.	Section 14 Section 16
3g	A schedule of actions for final rehabilitation, decommissioning and closure which will ensure avoidance, rehabilitation, management of impacts including pumping and treatment of extraneous water— (i) linked to the mine works programme, if greenfields, or to the current mine plan, if brownfields; (ii) including assumptions and schedule drivers; and (iii) including a spatial map or schedule, showing planned spatial progression throughout operations.	Section 18 (Part A)
3h	An indication of the organisational capacity that will be put in place to implement the plan, including— (i) organisational structure as it pertains to the plan; (ii) responsibilities; and (iii) training and capacity building that may be required to build closure competence.	Section 21 (Part A)
3i	An indication of gaps in the plan, including an auditable action plan and schedule to address the gaps.	Section 17 (Part A)
3j	Relinquishment criteria for each activity or infrastructure in relation to environmental aspects with auditable indicators.	Section 20 (Part A)
3k	Closure cost estimation procedure, which ensures that identified rehabilitation, decommissioning, closure and post-closure costs, whether on-going or once-off, are realistically estimated and incorporated into the estimate, on condition that— (i) cost estimates for operations, or components of operations that are more than 30 years from closure will be prepared as conceptual estimates with an accuracy of ± 50 per cent. Cost estimates will have an accuracy of ± 70 per cent for operations, or components of operations, 30 or less years (but more than	Section 22 (Part A)

Ref	Requirement	Section
	ten years) from closure and ± 80 per cent for operations, or components of operations ten or less years (but more than five years) from closure. Operations with 5 or less years will have an accuracy of ± 90 per cent. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy; (ii) the closure cost estimation must include— aa) an explanation of the closure cost methodology; bb) auditable calculations of costs per activity or infrastructure; and cc) cost assumptions. (iii) the closure cost estimate must be updated annually during the operation's life to reflect known developments, including changes from the annual review of the closure strategy assumptions and inputs, scope changes, the effect of a further year's inflation, new regulatory requirements and any other material developments.	
3l	Monitoring, auditing and reporting requirements which relate to the risk assessment, legal requirements and knowledge gaps as a minimum and must include— (i) a schedule outlining internal, external and legislated audits of the plan for the year, including— aa) the person responsible for undertaking the audit(s); bb) the planned date of audit and frequency of audit; and cc) an explanation of the approach that will be taken to address and close out audit results and schedule. (ii) a schedule of reporting requirements providing an outline of internal and external reporting, including disclosure of updates of the plan to stakeholders; and (iii) a monitoring plan which outlines— aa) parameters to be monitored, frequency of monitoring and period of monitoring; and bb) an explanation of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities.	Section 19 (Part A)
3m	Motivations for any amendments made to the final rehabilitation, decommissioning and mine closure plan, given the monitoring results in the previous auditing period and the identification of gaps as per 2(i).	Section 24 (Part A)

7. Biophysical Closure Knowledge Base

This Section describes the environmental knowledge base available to inform closure planning. This Section will be updated in annual iterations of this closure planning document, as more specialist studies become available to close the knowledge gaps identified.

The information in the subsequent Sections was sourced from the various specialist studies Digby Wells carried out in support of the environmental authorisation for the proposed Arnot South Project. Where new specialist study information was unavailable, the baseline information was extracted from the Final Scoping Report (Digby Wells Environmental, 2021).

7.1. Climate

The Arnot South Project area is characterised by warm, rainy summers and dry winters with sharp frost (South African Weather Bureau, 1986). According to the Köppen-Geiger system, the climate here is classified as Cwb (Oceanic Subtropical Highland Climate). The Mean Annual Precipitation (MAP) for B12A, B12B and X11A is 695 mm, 672 mm, and 688 mm, respectively (WRC, 2015). The average MAP for the Project area is estimated at 685 mm, which is likely to be distributed as indicated in Figure 10-1. The wettest month is January with a 90th percentile of 192 mm and 10th percentile of 65 mm. This implies that the region experiences moderate to high volumes of rainfall

7.2. Geology

The Arnot South Project area is situated within the Witbank Coalfield, which is underlain by formations of the Dwyka and Ecca Groups as shown in Figure 10-9. Woodford & Chevallier (2002) states that the Dwyka Group is composed of glacial ice-shelf deposits, displaying well-developed striated glacial pavements in places. The group consists mainly of diamictite (tillite) and to a lesser extent also contains conglomerate, sandstone, rhythmite and mudrock. The Ecca Group comprises a total of 16 formations which are observed from the lateral facies changes that characterise this succession. The two groups collectively are known to host coal seams and sedimentary rocks, such as conglomerates, sandstone, shale and mudstone (siliciclastic rocks). In line with the area being located on the Ecca and Dwyka Groups, the Project area is predominantly underlain by siliciclastic rocks.

7.3. Topography and Drainage

The topography of the Project area is generally flat, with a gentle rise of 15 m from the western boundary to the centres of the Project area and dip of 60 m over 7 km to the eastern boundary. The topography ranges from high elevations on the northern and southern side of the Project area to lower elevations in the east and central area. The elevation of the Project area ranges from 1,565 to 1,745 metres above mean sea level (mamsl), which equates to a range of 180 m between the lowest and highest points of elevation within the area. The average slope for the entire Project area is approximately 2.8 degrees (°).

One of the major tributaries of the Olifants River is the Klein Olifants River which flows within the portion of the Project area that is located within the Olifants Water Management Area (WMA). Drainage within the portion of the Project area that is located within the Inkomati-Usuthu WMA is facilitated by the Vaalrivierspruit, which drains into the Nooitgedacht Dam that adjoins the Komati River.

7.4. Soils

The following information is extracted from *Arnot South Environmental Authorisation and Water Use License Application - Soils, Land Use and Land Capability Impact Assessment* (Digby Wells, July 2021). This report should be referred to for further detail relating to soils, land capability and land use on site.

7.5. Soil Forms

The soil forms within the Project Area were delineated and are illustrated in Figure 7-1. Due to the extent of the Project area, limited access to the entire Project Area, time and budget constraints it was sought to group soil forms together by means of dominant soil horizon, functionality and land use (i.e., hydrogeomorphology, depth, topography and slope).

The following soil groups were identified within the Project Area:

- Cartref/Glenrosa;
- Clovelly/Avalon;
- Clovelly/Hutton;
- Clovelly/Glencoe;
- Clovelly/Pinedene;
- Glencoe/Avalon;
- Glencoe/Mispah;
- Glencoe/Pinedene;
- Katspruit/Kroonstad;
- Mispah/Glenrosa;
- Pinedene/Avalon;
- Rensburg/Arcadia;
- Rensburg/Arcadia/Katspruit/Kroonstad; and
- Witbank

7.5.1. 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 dominant soil textures in the Project Area were **sand** to **loamy-sand**. Soil texture are a direct attribute from the parent material (dominantly sandstone). The following characteristics are related to sand, clay and loam soils (Table 7-1):

Table 7-1 Soil Texture of the Project Area

Sandy soils	Loamy soils	Clay Soils
• High infiltration and drainage rate (low water-holding capacity);	• Moderate infiltration and drainage rate (moderate water-holding capacity);	• Low infiltration and drainage rate (high water-holding capacity);
• High leaching potential;	• Moderate leaching potential;	• Low leaching potential;
• Low soil fertility (OC, CEC, EC, pH);	• High fertility status (nutrients and OM);	• Very high fertility status (nutrients and OM);
• High lying areas; and	• Low-lying areas; and	• Low-lying areas; and
• Low erosion potential.	• High erosion potential	• High erosion potential

Due to the relatively small size of areas covered by clay rich soils, the low potential of these soils, and the fact that most of the impact will occur on the sandy soils the clayey soils were not sent for analysis. However, the high clay soils in the low-lying areas (wetlands) contribute to low infiltration, water ponding, has a high erosion potential and contain high concentration of chemicals. The higher the clay in the soil, the higher the EC, CEC, OC and pH

7.5.2. Soil pH

The pH of the soil samples collected ranged from **3.93** to **4.84**, indicating that the soils are **very acidic** to **acidic**. The optimal pH for agricultural crops range between 5.5 and 7.5. The following can be derived from the data:

- All the samples were below the optimal pH range for agriculture;
- Due to the sandy nature of the soils (siliciclastic sedimentary rocks - conglomerates, sandstones, and mudrock parent material), 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 optimize crop production;
- Soils with a low EC, cations and clay content tend to have a lower pH than soils with higher clay and EC; and

- The pH in Sample 5 were the lowest. As soil pH decreases, Al is solubilized and the proportion of Al-ions increases in the soil solution (consequently the high levels of Al in Sample 5.

7.6. Pre-Mining Land Capability

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 7-2). The pre-mining land capabilities over the MRA are reflected in Figure 7-2.

Table 7-2: Soil Sensitivity

Soil Form	Current Land Use (dominant)	Current Land Capability (dominant) (Figure 7-1)	Land Class (Figure 7-2)	Sensitivity (Figure 7-3)
Cartref/Glenrosa	Cattle grazing	LG	VII	Low
Clovelly/Avalon	Cultivation	VIC	I	High
Clovelly/Hutton	Cultivation	VIC	I	High
Clovelly/Glencoe	Cattle grazing/Moderate cultivation	MC	III	High
Clovelly/Pinedene	Cultivation	IC	II	High
Glencoe/Avalon	Cattle grazing/Moderate cultivation	MC	III	High
Glencoe/Mispah	Cattle grazing	LG	VII	Low
Glencoe/Pinedene	Cattle grazing/Moderate cultivation	MG	VI	Moderate
Katspruit/Kroonstad	Cattle grazing/wetland	MG	V	Moderate
Mispah/Glenrosa	Cattle grazing	LG	VII	Low
Pinedene/Avalon	Cultivation	IC	II	High
Rensburg/Arcadia	Cattle grazing/wetland	MG	V	Moderate
Rensburg/Arcadia/ Katspruit/Kroonstad	Cattle grazing/wetland	MG	V	Moderate
Witbank	Cattle grazing/Infrastructure	LG	VII	Low

7.7. Pre-Mining Land Use

The dominant land use was identified by aerial imagery during the desktop assessment and verified during the site survey. The pre-minign land uses over the MRA are presented in Figure 7-3

- Cultivation;
- Cattle grazing;
- Grazing/Wetland;
- Wetlands/natural; and
- Infrastructure.

The current impacts to the soils, land use and land capability of the Project Area are associated with agropastoral activities (i.e., cultivation, cattle grazing, infrastructure), mining (i.e., mine pits, infrastructure) and anthropological activities (roads, dams, powerlines, pipelines, culverts, bridges).

7.8. Surface Water

The following information is extracted from the *Environmental Impact Assessment for Universal Coal Development III, Arnot South Prospecting Area - Surface Water Impact Assessment* (Digby Wells, July 2021). This report should be referred to for further detail pertaining to surface water on site.

7.8.1. Catchment Area

The Arnot South project area is found within three quaternary catchments, namely, B12A and B12B falling under the Olifants Water Management Area 2 (WMA2) and X11A which falls within the Inkomati-Usuthu WMA3 (see Figure 7-4). The B12A and B12B quaternary catchments are found within the Olifants River Catchment. The X11A quaternary catchment is found in the Inkomati River Basin which is shared between South Africa, Eswatini and Mozambique. Within the project site, lies one of the major tributaries of the Olifants River called the Klein Olifants River. The site is also drained by several streams from the Inkomati River Basin. The Vaalrivierspruit which passes through the project site drains into the Nooitgedacht Dam which adjoins the Komati River. There are several small dams located on farms in and around the project area, and the Nooitgedacht Dam is located within a radius of approximately 12 km from the northern end of the project.

7.8.2. Surface Water Quality

Seven surface water points were sampled during the site visit conducted on the 9th of April 2021. The samples were analysed at Waterlab, a SANAS accredited laboratory. Water quality results were benchmarked against Department of Water and Sanitation (DWS) Resource Water Quality Objectives (RWQO) for the region.

Most of the analysed parameters are within the RWQO of the region in which the proposed Arnot South project site is located. Exceedances were, however, variably noted for Chloride (Cl), Ortho Phosphate (P), Aluminium (Al) and Copper (Cu) both upstream and downstream of the project site. Higher P, Cu, Cl and Al concentrations are likely due to industrial effluents or agricultural chemical released from upstream areas of the Arnot South project site. Sampling point ANTSW1 indicated further RWQO exceedances for Arsenic (As), Cadmium (Cd), Hexavalent Chromium as Cr (VI), Lead (Pb), Manganese (Mn) and Mercury (Hg) while at the other sampling points these parameters were below detection levels. The higher levels of heavy metals at the ANTSW1 point possibly result from already existing mining activities within the region.

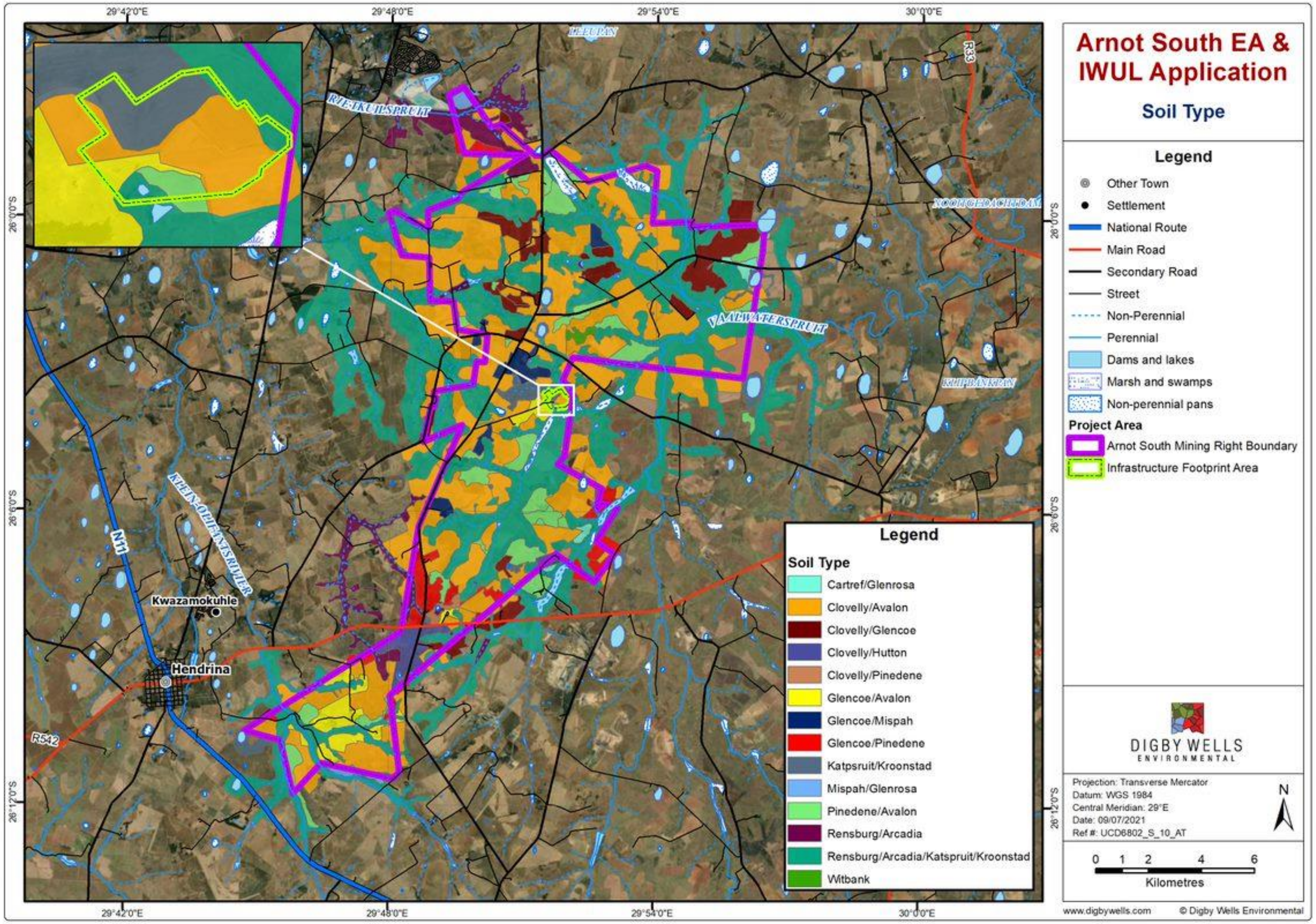

Figure 7-1: Soil Delineations

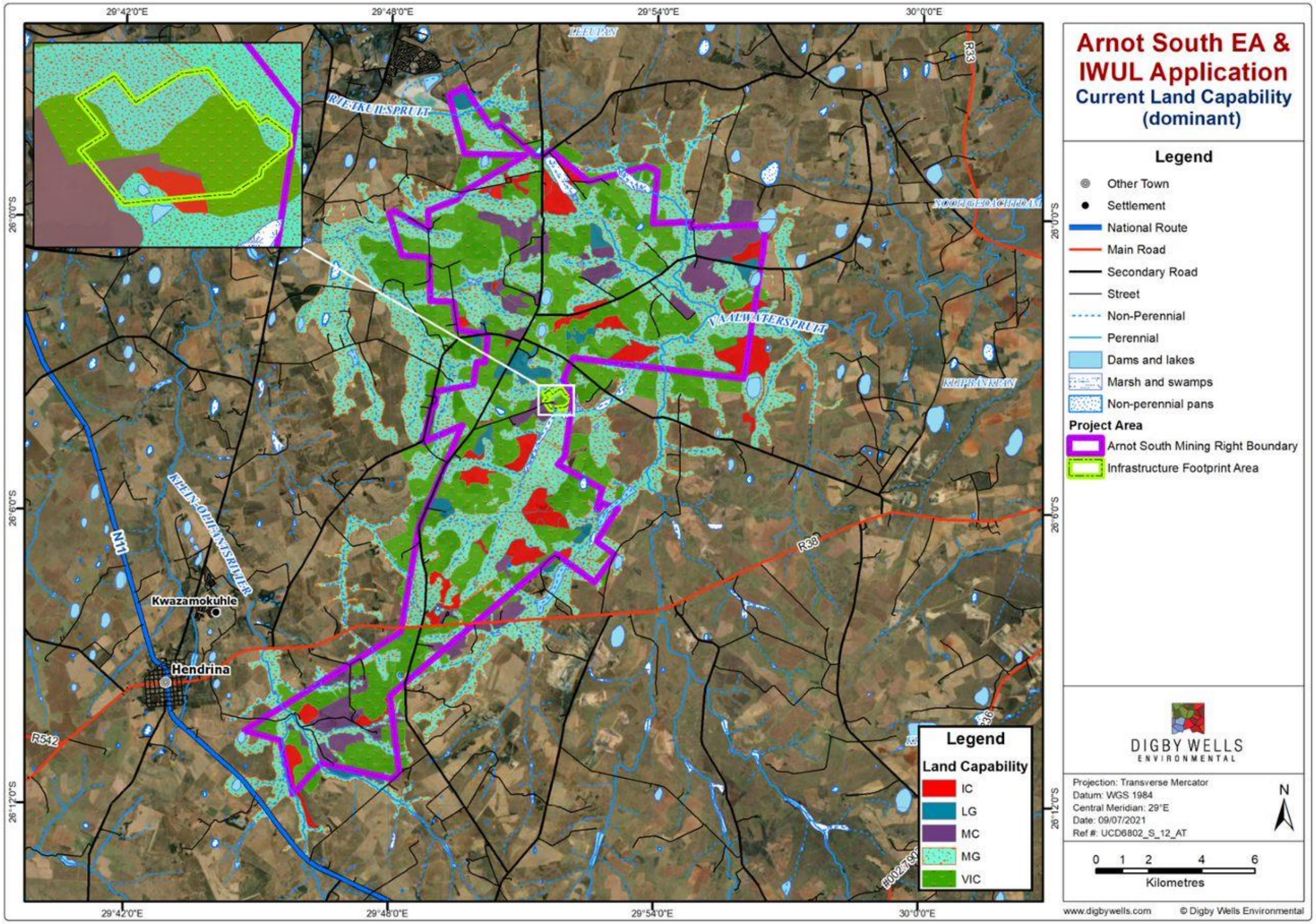

Figure 7-2: Pre-Mining Land Capability

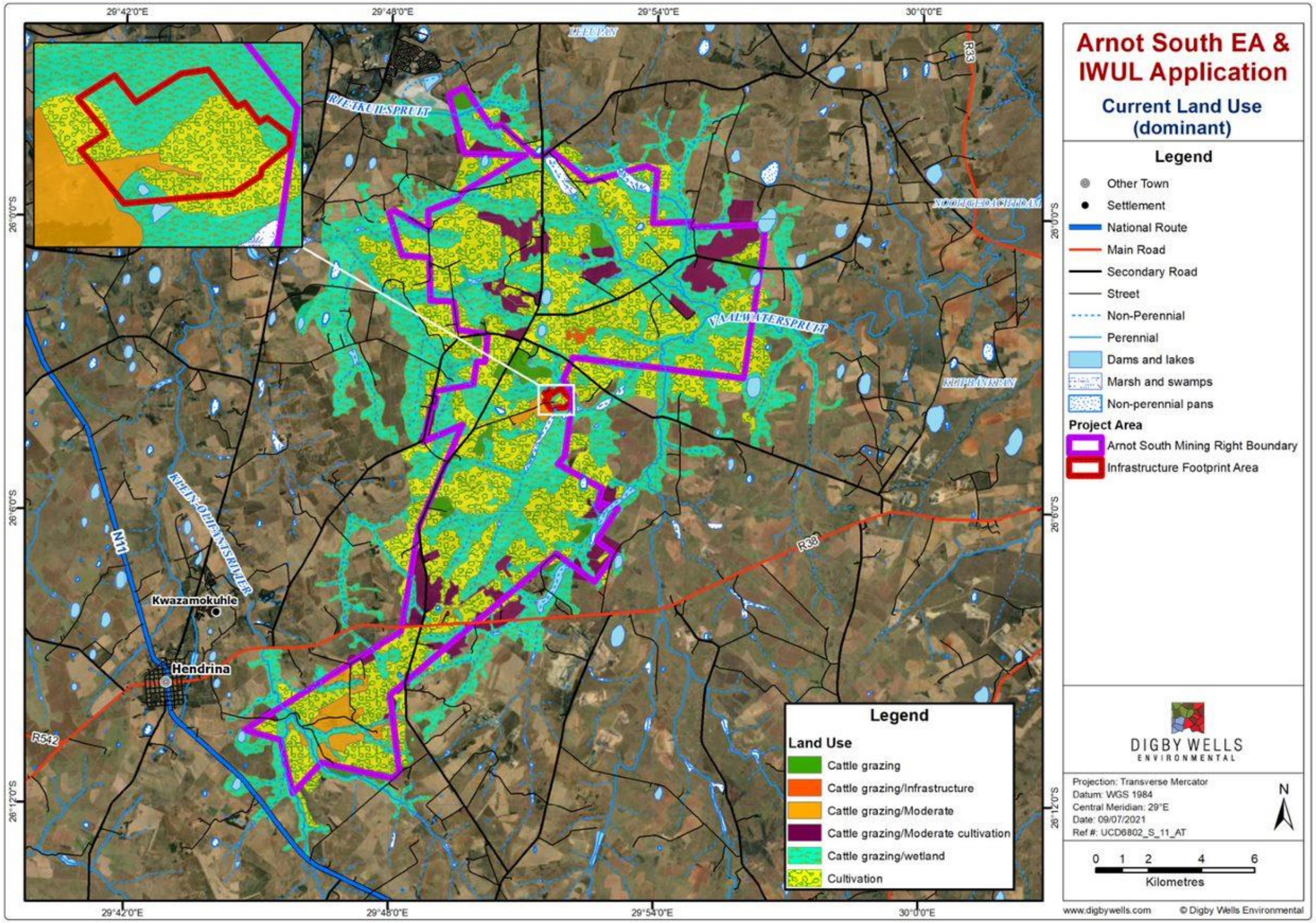

Figure 7-3: Pre-Mining Land Use

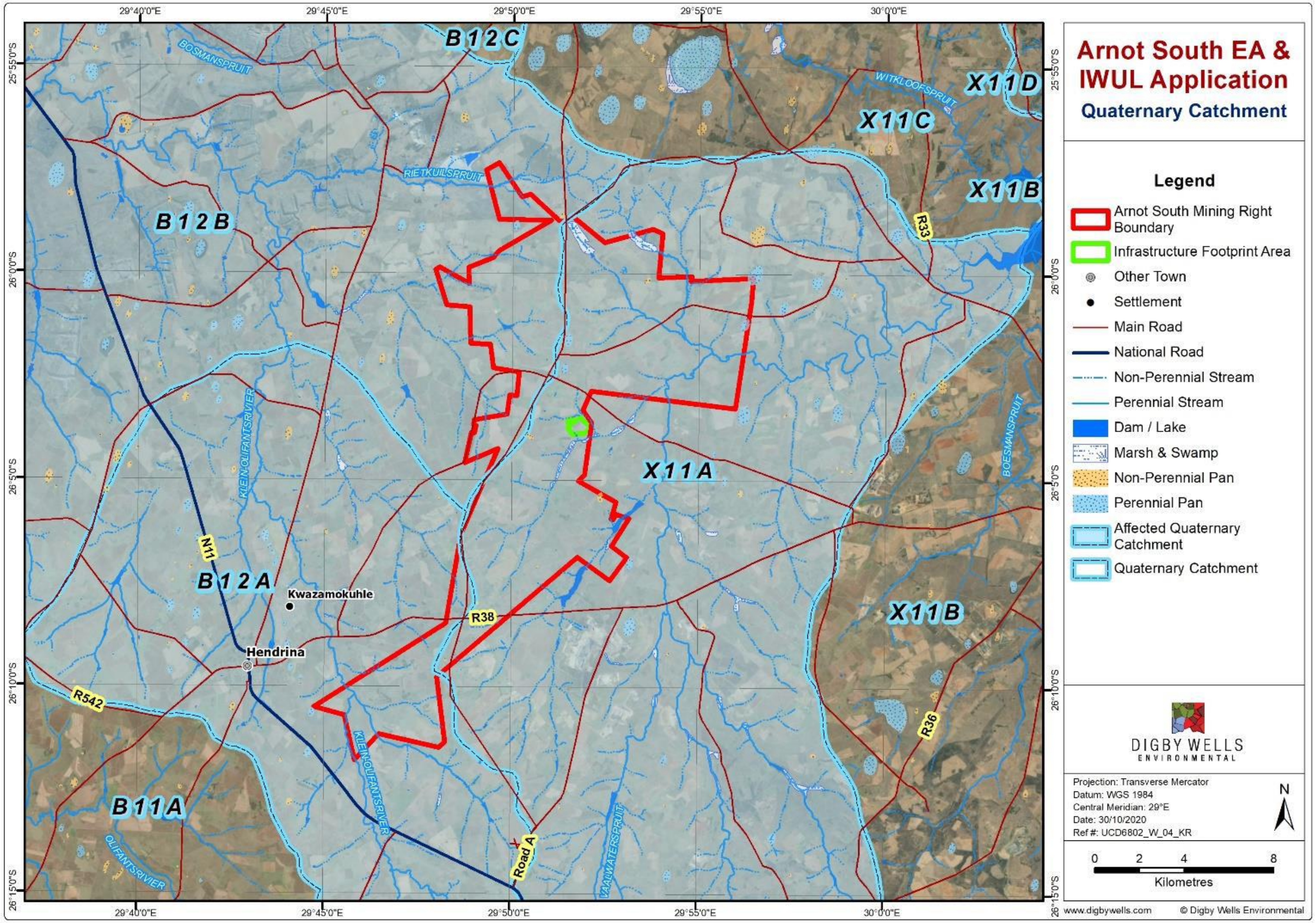

Figure 7-4: Quaternary Catchments

7.9. Wetlands

The following is extracted from the *Proposed Arnot South Coal Mining Project, Situated near Hendrina, Mpumalanga Province - Wetland Environmental Impact Assessment* (Digby Wells, July 2021). This report should be refereed to for further detail regarding wetland impacts on site.

7.9.1. Wetland Delineations

The delineated wetlands cover approximately **7555.5 ha**, comprising approximately **47.2 %** of the total Project Area. The infrastructure area is proposed to cover approximately **79.76 ha** of wetlands. The Hydrogeomorphic (HGM) units were categorised into 15 HGM systems comprising floodplain wetlands, Channelled Valley Bottom (CVB) wetlands, Unchannelled Valley Bottom (UVB) wetlands, depressions (pans) and hillslope seep wetlands.

The dominant land use activities affecting the wetland Present Ecological State (PES), Ecosystem Services (ES) and Ecological Importance and Sensitivity (EIS) include agropastoral activities (e.g., increased Alien Invasive Plants (AIPs), intensive cultivation, cattle grazing and infrastructure), anthropological activities (e.g., national roads, dams, powerlines, fence lines) and current and historical mining activities adjacent to the Project Area (e.g., underground mining, dewatering, groundwater contamination, roads, stockpiling, excavations, housing, AIPs and rehabilitated areas).

7.9.2. Ecological Status of Wetlands

The PES ranges from **Largely Natural (B) to Seriously Modified (E)** with the most impacted wetlands associated with agropastoral activities, infrastructure and anthropological activities. The ES ranges from **Moderately Low** to **Moderately High** and the EIS ranges from **Moderate** to **Very High**. All the HGM Systems provides various services and benefits to the biodiversity and humans. Various Species of Conservational Concern (SCC) were observed across the Project Area, increasing the ecological importance of the wetlands. Based on the PES, ES, EIS analysis of the wetlands, the sensitivity of HGM Systems 2, 5, 8, 9, 11 and 13 were rated as **High**; HGM Systems 1, 3, 4, 6, 7 and 15 as **Medium**; and HGM Systems 10, 12 and 14 as **Low.** Sensitive wetlands should be avoided, and impacts minimized as far as possible. When it is not possible to avoid or minimize impacts to these systems, they should be rehabilitated.

7.9.3. Wetland Management

The overall impacts of the Project were determined to be significant and will lead to irreversible impacts to some wetlands as the proposed surface infrastructure may potentially result in complete or partial loss of various wetlands. Recommendations to avoid, minimise and prevent impacts to the wetlands include:

- Avoid construction and infrastructure areas in sensitive wetlands (Moderate and High) as far as possible by implementing no-go zones and buffer zones of at least 100 m;

- A 500 m buffer area around wetlands, when not possible at least a 100 m buffer around the wetlands to ensure no impacts to these wetlands;
- Improve vegetation cover in eroded areas, areas impacted by infrastructure and low basal cover by the establishment of hydrophytic plants and facultative hydrophytes that are native to the area to prevent erosion and loss of wetland habitat;
- 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;
- Monitor underground mining impacts such as possible decant of Acid Mine Drainage (AMD), contamination and dewatering and implement management measures (refer to Groundwater Impact Assessment, 2021);
- Execute a wetland offset calculator to establish the hectare equivalent of wetlands that have been lost due to mining related activities (i.e., infrastructure) which will have to be offset during the rehabilitation phase; and
- Monitor the area for mining related impacts such as subsidence, decanting, dewatering, erosion and sedimentation from the infrastructure, and report to authorities as soon as possible. If areas are unstable and hold a risk to animals and humans, the area should be fenced off.

Underground mining contains the risk of subsidence, dewatering, decanting and contamination which might impact the wetlands significantly. However, if the project is to proceed, it is in the opinion of the specialist that that protection, mitigation and implementation of a wetland offsetting strategy are necessary if there are any residual impacts to the wetlands within the Project Area.

The wetlands delineated on over the MRA as part of this work are depicted in Figure 7-5.

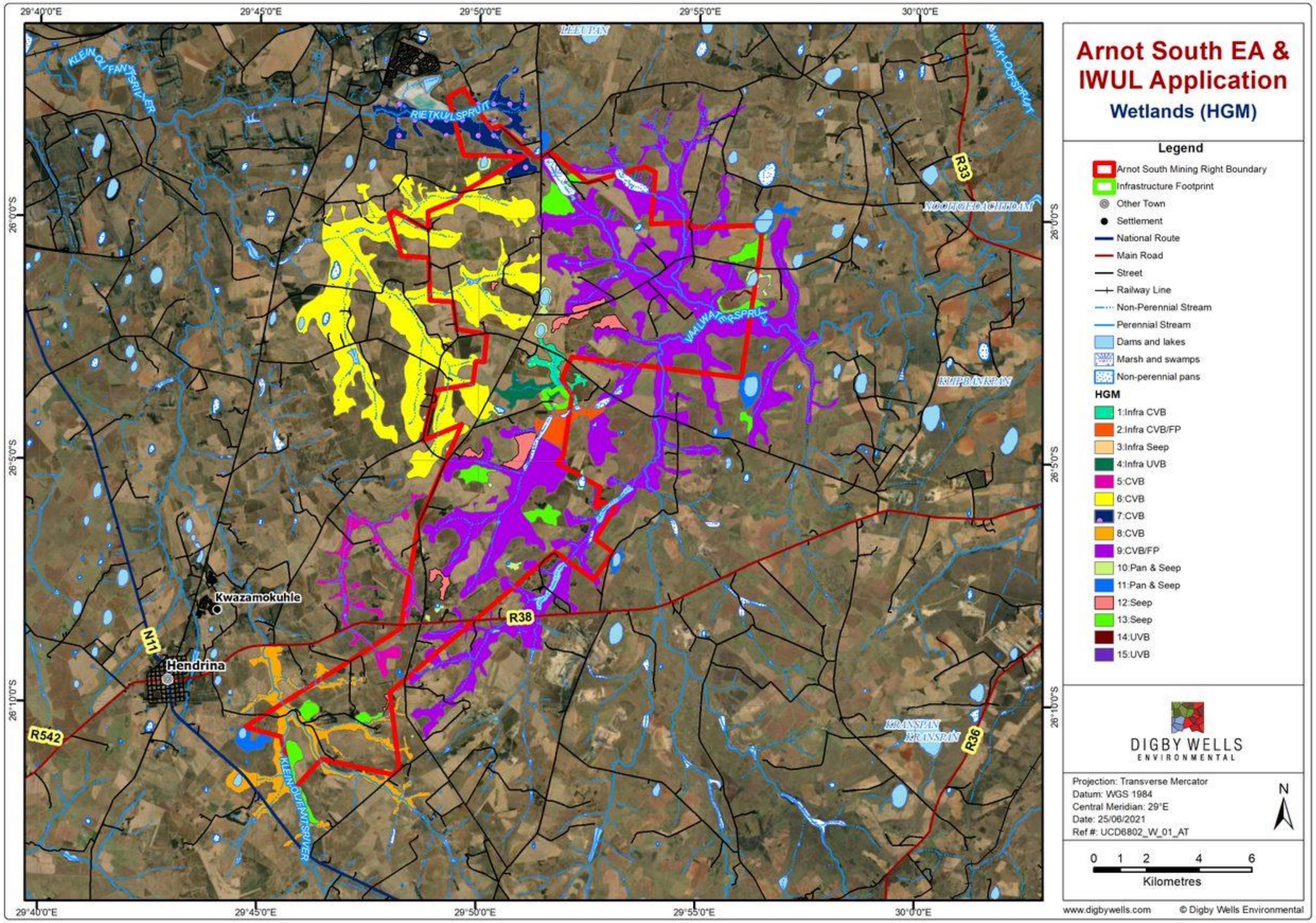

Figure 7-5: Wetland Delineation

7.10. Groundwater

The following information was extracted from the Final Scoping Report (Digby Wells Environmental, 2021). Digby Wells is in the process of completing the groundwater modelling and geochemical analysis reports associated with the Environmental Impact Assessment for the proposed Arnot South Project. Once available this information should be integrated into this Section of the Closure Plan in future updates.

7.10.1. Aquifers on Site

The conceptual hydrogeological model of the area is based on the generally accepted model for the Mpumalanga coal fields. The following three principal aquifers were identified:

- The weathered Karoo aquifer;
- The fractured Karoo aquifer; and
- The fractured pre-Karoo aquifer (Hodgson and Krantz, 1998).

The Karoo rocks are not known for large scale development of aquifers, but occasional high-yielding boreholes can be present. The aquifers that occur in the area can therefore be classified as minor aquifers (low yielding), but of high importance (Parsons, 1995) and are understood to have a low to medium development potential, mostly used for small-scale domestic purposes or occasionally for large-scale irrigation.

The expected aquifer yields from the Arnot South project are found to be <0.5 litres per second (L/s) and the alluvial aquifer within the area of the Vaalwaterspruit is found to have aquifer yields ranging from 0.1 to 0.5 L/s.

Three distinct superimposed groundwater systems are present within the Project area (Hodgson and Krantz, 1998, Woodford and Chevallier, 2002) and can be classified as:

- The upper weathered Ecca aquifer (shallow, intergranular type aquifer formed in the weathered zone of the Karoo sediments; can locally form a perched aquifer on top of fresh bedrock);
- The fractured aquifers within the unweathered, fractured Ecca sediments; and
- The aquifer below the Ecca sediments (deeper aquifer formed by fracturing of pre-Karoo sediments and dolerite intrusions).

These types of groundwater systems are common to the groundwater regime in the Karoo environment. The systems do not necessarily occur in isolation and often form a composite groundwater regime that is comprised of one, some, or all of the systems. Based on the exploration drilling at the site all three aquifer types are present at the site.

In general, the shallow Karoo weathered aquifer depth ranges between 5 m and 20 m overlying the fractured Karoo rock formations throughout the region. This is in line with the results from the on-site exploration drilling, which indicated that the depth of the highly and moderately weathered Karoo aquifer varies between 3 and 20 metres below ground level (mbgl) with an average of ~8 mbgl. In terms of susceptibility to pollution, the shallow primary aquifer is understood to be highly susceptible to pollution due to coal mining in the area as the pollutants travel shorter distance to reach the aquifer system (Hodgson and Krantz, 1998). Low-lying wetlands, where groundwater levels are close to the surface, can indicate interaction between groundwater and surface water and can also serve as conduits for potential contamination

7.10.2. Groundwater Quality

The depositional setting of the Dwyka sediments (marine conditions) has caused associated aquifers to have a tendency of having elevated salinity. The information regarding baseline water quality within the Project area was obtained from a study conducted by Woodford and Chevallier (2002). The expected water quality is described based on the measured geometric mean over representative lithological units for Total Dissolved Solids (TDS), pH and sulphate. The findings are summarised as follows:

- TDS ranges from 100 to 450 mg/L;
- pH ranges from 7 to 7.25; and
- Sulphate ranges from 10 to 100 mg/L.

7.10.3. Groundwater Levels

Groundwater flow directions at the Project area will be derived from a hydrocensus survey planned in the EIA Phase of the project. In general, groundwater level contours for the Karoo Supergroup have a tendency to mimic the topography. Based on this assumption, the Project area is predicted to indicate three dominant groundwater flow directions for each quaternary catchment in which the Project area lies (B12A, B12B and X11A). Some dewatering activities from privately owned boreholes within the area are expected to result in localised drawdown and can therefore affect the groundwater flow directions on a local scale. Groundwater flow for quaternary catchments B12A and B12B is in a general north-westerly direction and flow for quaternary catchment X11A is in a north-easterly direction. The quaternary catchments over the MRA are depicted in Figure 7-4.

7.11. Post-Mining Groundwater Quality

The expected post-closure groundwater quality is still to be predicted. A closure based geohydrological model should be developed as early in the project life cycle as possible, to predict the post-closure mine water volumes to be managed and the qualitied thereof. This will allow for accurate water treatment cost estimation for the required financial provisioning.

8. Social Closure Knowledge Base

The information in the subsequent Sections was sourced from the *Scoping Environmental Baseline Input for Social* undertaken by Digby Wells carried out in support of the environmental authorisation for the proposed Arnot South Project. Where new specialist study information was unavailable, the baseline information was extracted from the Final Scoping Report (Digby Wells Environmental, 2021).

8.1. Socio-economic profile of the Study Areas

The socio-economic baseline profile presented in this section focuses on the primary and secondary study areas, defined in Table 8-1.

Table 8-1- Primary and Secondary study areas

Primary Study Area	Secondary Study Areas		
Ward 21	CALLM	GSDM	Mpumalanga
Ward 3	STLM	NDM	
Ward 7	STLM	NDM	

8.1.1. An Overview of the Demographic Profile of the Study Areas

Mpumalanga Province is the second smallest province in South Africa after Gauteng. However, the province has the fourth largest economy in the country. The province is comprised of three (3) district municipalities which are Nkangala District Municipality (NDM), Gert Sibande District Municipality (GSDM) and Ehlanzeni District Municipality (EDM).

According to the Community Survey of 2016, the province was the sixth most populous province in South Africa. The population of the province resided in 1.2 million households with an average of 3.5 persons per households. Less than one percent of the households were reportedly headed by children, displaying a total of 10 369 households headed by children in the province.

The two project affected districts (GSDM and NDM) are both the largest in terms of population size and the smallest and largest (respectively) in terms of their land sizes. GSDM is divided into seven local municipalities; of which Chief Albert Luthuli Local Municipality (CALLM) is the second smallest in terms of population size, with 187, 830 residents. In turn, NDM is divided into six local municipalities of which Steve Tshwete Local Municipality (STLM) is the third largest in terms of population size with 278,749 residents. The STLM is further divided into 29 wards.

Furthermore, NDM had the largest population density compared to the provincial level owing to the fact that the district is rich in minerals, natural resources and the Maputo Corridor adds to the districts economic growth and strength (Nkangala District Profile, 2020). This was followed by the STLM, having the second highest population density probably because of the Steve Tshwete mining area which attracts a lot of job seekers to the area.

Ninety four percent of the racial population in the province are black African and the most common language spoken in the province is IsiZulu followed by SiSwati. The same patterns are displayed for the GSDM and NDM, with ninety-two and ninety one percent of the population being Black African respectively in these municipalities. IsiZulu is also the most common language spoken in the STLM, compared to the CALLM, where SiSwati is found to be the most common language followed by IsiZulu.

8.1.2. Sectors of the economy

Mpumalanga's economy is dominated primarily by the mining sector, mostly coal mining for the Eskom power plants that are also located in the province (Provincial Review, 2016). Mpumalanga has extensive heavy industry, which forms part of the long-standing Highveld complex, and a strong commercial agricultural sector. These industries have driven its growth since 2011. The primary, secondary and tertiary sectors for the province are highlighted below. Figure 8-1 shows that the mining sector is the most dominant sector. This is followed by the community services, trade, finance, and manufacturing sectors.

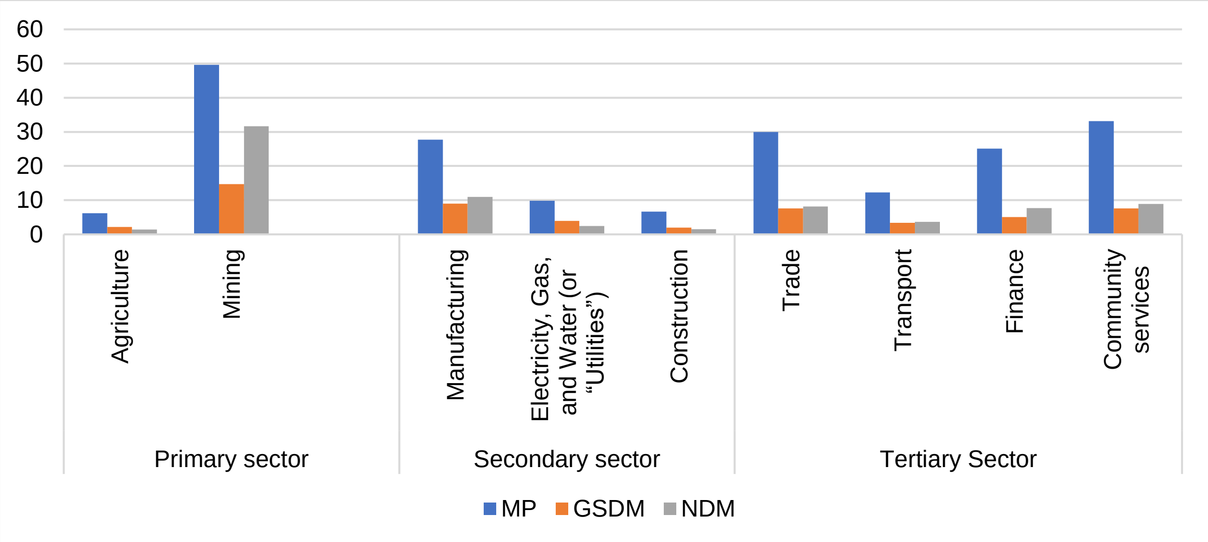

Figure 8-1: Key economic sectors within the secondary study area[1]

Mpumalanga Province has the highest potential of arable land in South Africa as it has fertile soil that supports a diverse range of farming operations. A large portion of Mpumalanga's land area is classified as moderate to high-very high agricultural potential (Mpumalanga Spatial Development Framework, 2019). Agriculture is one of the primary land uses in the province. Figure 8-1 llustrates the distribution of households involved in agricultural activities in Mpumalanga by type of agricultural activity. Poultry and vegetable production are the dominant types of agricultural activities in the province. Poultry and livestock production are the dominant types of agricultural activities in the GSDM, while poultry and vegetable production is a common agricultural practice for the NDM.

The economy of the primary study area (Ward 3, Ward 7 and Ward 21) is characterised mainly of commercial farming specifically crop farming and livestock production (sheep, and cattle).

[1] Adapted from: Mpumalanga Spatial Development Framework, 2019

Majority of the farming operations are on privately owned land. A few of the farmers are leasing land.

8.1.3. Commercial Farming

Most of the farm products are commercially sold to bigger market, while a few of the farmers mentioned that some food /meat is produced for subsistence and supports the household food supply. For most of the farmers (63%) agricultural activities serve as their primary source of income, while 31% of respondents indicated that the produce (mostly maize and beef) is also used as an additional food source for the household. Six percent (6%) of respondents grow crops that are used mainly as a food source for the household.

The main commercial crops produced within the primary study area are soy beans and maize. These are followed by field hay/pasture grass which is sold commercially and used as cattle feed. Most of the farmers reported that the maize is supplied mainly to Agro-processing and bulk-grain traders such as Ingrain , Rand Agri , African Products (Tongaat Hullett site), Lindwater Mills and Carolina Mill. Soybeans are supplied to Rand Agri, as well as Kegel farmers and local markets in the area. Soybeans and maize are sold once a year.

Farmers not engaged in crop farming are instead participating in livestock farming. The main livestock reared are cattle which are sold in livestock auctions to abattoirs. The auctions are held mainly in Witbank (BKB Van Wyk Auctions) and, Belfast (Badenhorst Auctioneers). Majority of the farmers (50%) have responded indicating that sheep is sold twice a year, the same for cattle where 34% of farmers indicating that they sell/auction off twice a year.

Those farmers who do not auction off their cattle keeps their cattle in feedlots. Farmers indicated that the auctions play a big role in the agriculture business, as it also allows farmers the opportunity to benchmark themselves against other farmers and produce high quality livestock. These auctions are also a significant income stream for the farmers.

From the engagements with farmers and affected landowners, socio-economic challenges in the project area were identified. Farmers expressed concern that with mining, the existing socio-economic challenges could get worse. The majority of the respondents expressed concern over crime and theft of cattle, and these were raised as the key socio-economic challenges displaying a response rate of 23% and 29% respectively. Farmers expressed concern over the influx of people due to the mine, which would result in an increase in theft cases.

8.2. Labour force and Employment

A high percentage of people in the STLM (73%) and Ward 7 (79.3%) are employed in the formal sector. A possible reason for these high numbers could be that STLM has a big economy and therefore a significant number of employment opportunities are available (Steve Tshwete Local Municipality IDP, 2019/20). The leading sectors that are driving employment in this municipality are mining, trade (including tourism), manufacturing, and government services (Steve Tshwete Local Municipality IDP, 2019/20.

8.3. Household income

The average annual income for the households in the study areas is presented in Figure 8-2 based on 2011 census data. A significant percentage of households receives no income, this is displayed as he highest for CALLM (15.1%) and GSDM (14.7%). The high unemployment rate recorded in CALLM could be the reason for high number of households reporting no income (Chief Albert Luthuli Local Municipality IDP, 2020/21). The data further illustrates that a significant percentage of households earn between the R10k and R20k and the R40k and R75k bracket.

In NDM, most of the population earn between R20k and R40k per annum, with 19.5% of the population earning within this bracket. This could be directly linked to the high unemployment rate in the district, and the concern of the lack of education and inadequate skills which affects the employability of people (Nkangala District Municipality IDP, 2019/2020).

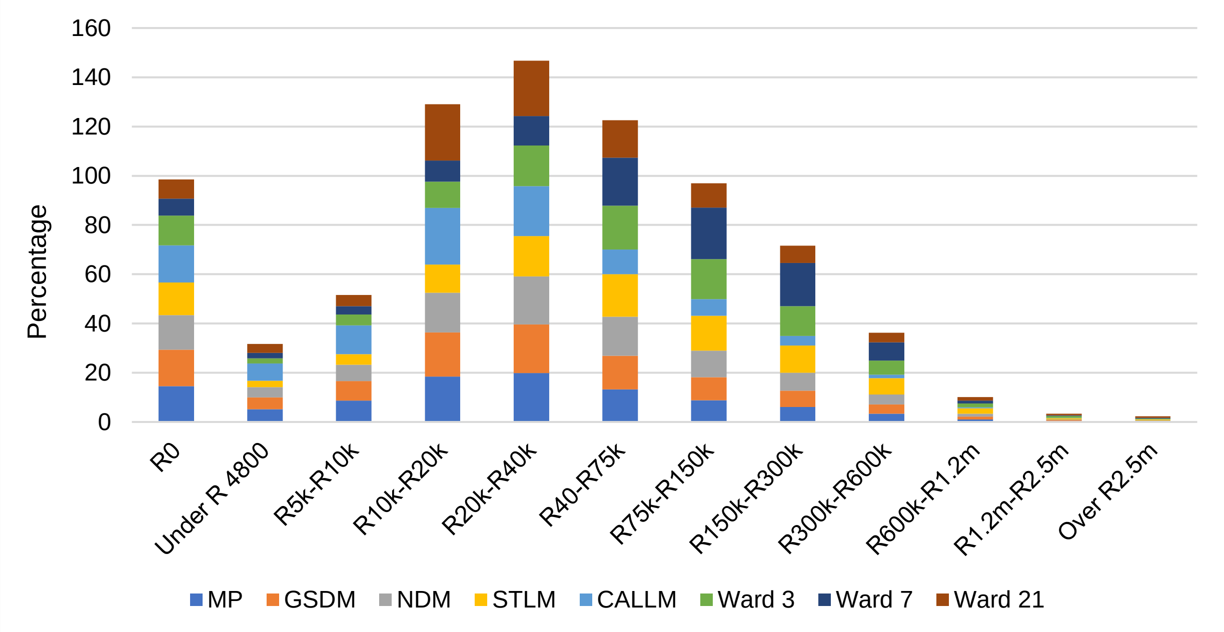

Figure 8-2: Average annual household income[2]

Unemployment was also mentioned as a socio-economic challenge in the area. One of the respondents mentioned that there are a lot of foreigners flocking into the area and this creates competition for jobs and fewer opportunities for the local community. Service delivery related issues were related to access to basic services such as clinics, hospitals, and educational facilities. In addition, it was mentioned that the distances from farms to main roads were difficult, and access to public transportation was inadequate. Crime was also raised as an issue due to lack of employment and income and poverty within the area. One farmer indicated that there is a lack of policing in the area, and no mitigation measures are in place to manage crime in the area.

[2] Adapted from Wazimap, 2017

8.4. Socio-Economic Considerations for Mine Closure

The following key aspects will impact the way socio-economic closure planning is undertaken should the proposed project go ahead:

- The mine is contributing to the local, regional and national economy through job creation and power generation, and is currently a significant employer in the district, both of skilled and unskilled labour. At decommissioning and closure, there will be a notable impact on employment and the local economy if the required mitigation measures are not in place;
- It is essential that appropriate training programmes be implemented as the mine approaches closure, so that employees are able to find work in sectors other than mining at closure;
- Measures should be incorporated as part of the mine closure planning process to ensure that above communities do not become a ‘ghost town’ after closure of the mine;
- On-going consultation and transparent relationships with local communities, clearly communicating intended next land uses and closure scheduling, will mitigate unrealistic expectations at closure;
- Commercial farming plays a significant role in the local economy around the proposed project area, and should be considered as a post-mining land use; and
- The RCP is to consider the optimal use of mine land and infrastructure during the operational phase as well as the closure phase of the mining life cycle aligned with the local economic diversification plans. While the Social and Labour Plan (SLP) is geared towards mitigating the impact of mine closure on mine communities and labour supply areas, specific planning is also required regarding the post-mining use of the physical assets for potential community development purposes.

9. Environmental Risk Assessment

A closure related Environmental Risk Assessment (ERA) was completed with the aim of informing the rehabilitation and closure measures required to meet the closure objectives and promote sustainable mine closure.

The ERA is based on the specialist studies undertaken by Digby Wells in support of the environmental authorisation (see Table 3-1 for the information provided). The identified risks should be revisited and updated annually to incorporate new information as closure planning progresses and the knowledge gaps identified are closed.

The objectives of the ERA, as outlined in the Financial Provisioning Regulations, 2015 (as amended) are as follows:

- Ensure timeous risk reduction through appropriate interventions;

- Identify and quantify the potential latent or residual environmental risks related to post-closure;
- Detail the approach to managing the risks;
- Quantify the potential liabilities associated with the management of the risks; and
- Outline monitoring, auditing and reporting requirements.

9.1. Risk Assessment Methodology

Closure related risks were identified and ranked based on the review of specialist studies undertaken by Digby Wells in support of the environmental authorisation for the proposed Arnot South Project.

The approach followed during the ERA is outlined below:

- Review of specialist studies undertaken and baseline information available;
- Including possible closure related risk and in the Digby Wells RA model, which is based on a 5X5 risk matrix;
- Ranking the risks in terms of likelihood and consequence pre-mitigation;
- Developing mitigation measures to reduce the likelihood of the risk occurring;
- Reranking the risk for likelihood of occurrence, with the assumption that the mitigation measure is effectively applied; and
- Summarising the significant and high level risks in this report to emphasise the need for their mitigation.

The risk ratings used to classify the risks are presented in Table 9-1, these ratings are based on the likelihood and consequence rating applied, as reflected in Table 9-2 .

Table 9-1: Risk Rankings

Risk Rating	Risk Level	Guidelines for Risk Matrix
21 to 25	High	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.
13 to 20	Significant	A significant risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
6 to 12	Medium	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
1 to5	Low	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.

9.2. Significant Closure-Related Risks Identified

The significant and high risks identified during the RA (i.e. risks with a risk level of 13 or higher) are summarised in Table 9-3. The complete RA, showing the full suite of closure risks identified is presented in Appendix A.

The residual/ latent risks identified for mine closure as part of the RA are presented and discussed in the Environmental Risk Report (Part B of this report).

Table 9-2: Risk Estimation Matrix (5x5)

Capital Projects Risk Matrix		**CONSEQUENCE (Where an event has more than one 'Consequence Type', choose the 'Consequence Type' with the highest rating)**				
Consequence Type		1 - Insignificant	2 - Minor	3 - Moderate	4 - High	5 - Major
Schedule		Less than 1% impact on overall project timeline	May result in overall project timeline overrun equal to or more than 1% and less than 3%	May result in overall project timeline overrun of equal to or more than 3% and less than 10%	May result in overall project timeline overrun of equal to or more than 10% and less than 30%	May result in overall project timeline overrun of 30% or more
Cost		Less than 1% impact on the overall budget of the project	May result in overall project budget overrun equal to or more than 1% and less than 3%	May result in overall project budget overrun of equal to or more than 3% and less than 10%	May result in overall project budget overrun of equal to or more than 10% and less than 30%	May result in overall project budget overrun of 30% or more
Safety		First aid case	Medical treatment case	Lost time injury	Permanent disability or single fatality	Numerous permanent disabilities or multiple fatalities
Environment		Lasting days or less; affecting small area (metres); receiving environment highly altered with no sensitive habitats and no biodiversity value (e.g. urban / industrial areas).	Lasting weeks; affecting limited area (hundreds of metres); receiving environment altered with little natural habitat and low biodiversity value	Lasting months; affected extended area (kilometres); receiving environment comprising largely natural habitat and moderate biodiversity value	Lasting years; affecting area on sub-basin scale; receiving environment classified as having sensitive natural habitat with high biodiversity value	Permanent impact; affecting area on a whole basin or regional scale; receiving environment classified as highly sensitive natural habitat with very high biodiversity value
Legal & Regulatory		Technical non-compliance. No warning received; no regulatory reporting required	Breach of regulatory requirements; report/involvement of authority. Attracts administrative fine	Minor breach of law; report/investigation by authority. Attracts compensation/ penalties/ enforcement action	Breach of the law; may attract criminal prosecution, penalties/ enforcement action. Individual licence temporarily revoked	Significant breach of the law. Individual or company law suits; permit to operate substantially modified or withdrawn
Social / Communities		Minor disturbance of culture/ social structures	Some impacts on local population, mostly repairable. Single stakeholder complaint in reporting period	Ongoing social issues. Isolated complaints from community members/ stakeholders	Significant social impacts. Organized community protests threatening continuity of operations	Major widespread social impacts. Community reaction affecting business continuity. "License to operate" under jeopardy
Reputation		Minor impact; awareness/ concern from specific individuals	Limited impact; concern/ complaints from certain groups/ organizations (e.g. NGOs) period	Local impact; public concern/ adverse publicity localised within neighbouring communities	Suspected reputational damage; local/ regional public concern and reactions	Noticeable reputational damage; national/ international public attention and repercussions
PROBABILITY		RISK LEVEL				
5 - Almost Certain >90%	90% and higher likelihood of occurring	11 (Medium)	16 (Significant)	20 (Significant)	23 (High)	25 (High)
4 - Likely 30%-90%	Between 30% and less than 90% likelihood of occurring	7 (Medium)	12 (Medium)	17 (Significant)	21 (High)	24 (High)
3 - Possible 10%-30%	Between 10% and less than 30% likelihood of occurring	4 (Low)	8 (Medium)	13 (Significant)	18 (Significant)	22 (High)
2 - Unlikely 3%-10%	Between 3% and less than 10% likelihood of occurring	2 (Low)	5 (Low)	9 (Medium)	14 (Significant)	19 (Significant)
1 - Rare <3%	Less than 3% likelihood of occurring	1 (Low)	3 (Low)	6 (Medium)	10 (Medium)	15 (Significant)

Table 9-3: Significant and High Level Risks Identified

Aspect	Risk driver	Consequence	Mitigation Measure(s)
Mine Infrastructure			
Bunded areas (stockpiles, hardstand and laydown areas etc.)	Stockpiled material standing for long periods of time	Compaction over these areas resulting in poor and unsustainable revegetation	Ensure stockpile footprints are adequately ripped to alleviate compaction.
		Residual stockpile veneers remaining over footprint areas resulting in poor and unsustainable revegetation and potential contamination of surface water (from coal discard stockpiles)	Clean-up stockpile veneers by excavation and appropriate disposal of this material within the incline shaft prior to final backfilling.
	Mine equipment stored at hardstand areas	Compaction over these areas resulting in poor and unsustainable revegetation, and potential hydrocarbon contamination from oil spills	Ensure hardstand footprints are adequately ripped to alleviate compaction and ensure any hydrocarbon contamination is appropriately excavated and disposed of or remediated through bioremediation. These spills should be cleaned up during operations as they occur to prevent contamination of surface water and reduce the closure liability.
Dams and Diversions			
Dams and silt traps	Contaminated sediment accumulation within the pollution control dam (PCD)	Contamination of surface and groundwater	Ensure contaminated sediment accumulated within PCDs and silt traps is adequately removed and disposed of at closure. Undertake regular maintenance of these facilities during the operational period to reduce contamination potential during operations and at closure.
		Contamination of the topsoil placed over the PCD during the rehabilitation process	
Water Treatment Plant (WTP)	WTP has insufficient capacity to treat the post-closure excess water volumes	Uncontrolled decant of contaminated mine water from the underground workings into the groundwater resource	Undertake regular monitoring of rebounding groundwater in the underground workings and feed this information into the closure-based geohydrological model to predict post-closure decant periods and groundwater qualities and ensure the WTP meets the capacity requirements to treat the expected water make and qualities post-closure.
Mining Areas			
Box cut for adit access	Box cut adits are not appropriately sealed	Increased water ingress through the box cut and adits into the underground workings, resulting in increased volume of water requiring treatment post-closure	Ensure the adit entrances are appropriately sealed prior to backfilling of the box cut, to reduce water ingress into the underground workings.
		Increased water ingress through the adit decreasing the rebound period and reducing the time until water treatment is required, which increases the water treatment costs due to a reduced discount period	
	Insufficient backfill material available for box cut due to extraction of the coal seam over this area	Box cut areas is not backfilled to be free draining resulting in ponding, vegetation die-back and increased water ingress post-closure	Ensure a final landform design is developed for the backfill of the box cut to ensure the area is free draining post-closure and does not accumulate water.

Aspect	Risk driver	Consequence	Mitigation Measure(s)
Underground Workings	Post-closure decant from the underground workings	Seepage of decant into the groundwater resource, and eventually into surface water resources through hydraulic linkages	Update the closure-based geohydrological model on a regular basis during the operational period to ensure that any decant from the underground workings is prevented through the required water treatment. Rebound periods for the underground workings should be predicted and planned for based on this model.
	Extraction of the shallow coal seam (10 m depth)	Subsidence over large areas resulting in surface ponding, vegetation die-back and increased recharge into the underground workings at closure	Undertake a subsidence risk assessment over areas where shallow coal extraction is planned and run a cost-benefit analysis to assess whether mining the shallow coal is feasible, given the high subsidence risk and high potential of increased water recharge, which would decrease the rebound period of the underground workings and increase the water treatment costs. Ensure subsided areas are rehabilitated as soon as it occurs to reduce recharge.
Discard Dump	Topsoil over the dump footprint area is not adequately stripped	The topsoil cover applied over the discard dump at closure is not thick enough, resulting in an in sustainable vegetation cover and increased water ingress into the discard material	Ensure the topsoil over the discard dump footprint is stripped to the full depth of topsoil available over that area.
	Topsoil stripped over the dump footprint area is not stockpiled appropriately (exceeds heights of 3 m, stands unvegetated, no berm around the base to prevent soil loss etc.)	Topsoil structure and fertility is degraded resulting in soil compaction when placing topsoil over the dump for rehabilitation, resulting in an unsustainable vegetation cover, increased erosion and water ingress into the dump	Topsoil stripped from the dump footprint must be stockpiled appropriately according to a topsoil management plan, to ensure topsoil is not degraded and can be effectively used for rehabilitation at closure.
	A detailed design for the dump is not developed as per a closure design	Costly shaping of the dump at closure to meet the required slopes to allow for capping with a soil cover	Develop a detailed engineering design for the discard dump with closure in mind, and progressively shape the slopes to reduce rehabilitation costs at closure
	Contaminated seepage through the base of the dump into the groundwater system	Groundwater contamination resulting in in the formation of a contamination plume that will require costly management at closure	Concurrently shape and place topsoil over the dump and seed to create a vigorous vegetation cover to reduce water ingress into the dump and thereby reduce the formation of a contamination plume, and the costs required to manage this contamination. Consider alternative, such as backfilling the box cut with the discard material to reduce groundwater contamination and risk of cover failure post-closure.
Soils, Land Capability and Land Use			
Soil compaction and fertility	Inappropriate stockpiling of stripped soil	Topsoil degradation resulting in unsustainable vegetation covers over rehabilitated areas, which could require costly amelioration at closure	Ensure stripped topsoil is stockpiled appropriately to maintain soil fertility and to ensure ethe soil structure is not impacted. Topsoil stockpiles should not exceed 3 m and should be vegetated and bunded around the stockpile toe areas.
	Overtripping of topsoil due to use of inappropriate equipment for stripping	The topsoil structure is compromised due to mixing of plinthic soil layers beneath the topsoil layer, resulting in hard setting and compaction after placing topsoil for rehabilitation	Ensure topsoil is not overtripped and that the correct equipment is used for stripping (D6 Dozer with balloon tires, not a grader, or heavier dozer).
	Inappropriate equipment used for rehabilitation	Soil compaction resulting in unsustainable vegetation covers over rehabilitated areas	Ensure the correct equipment is used for rehabilitation implementation (i.e. do not use a grader for shaping, use a D6 Dozer with balloon tires) and ensure the disturbed areas area adequately ripped to the correct/ required depth (using a D6 Dozer) to reduce compaction and promote a sustainable vegetation cover.

Aspect	Risk driver	Consequence	Mitigation Measure(s)
Topsoil availability	Topsoil stripping is not undertaken over the full available topsoil depth	Topsoil deficit at closure for rehabilitating disturbed footprint areas (infrastructure footprints, PCDs, overburden stockpile footprints etc.)	Ensure all topsoil stripped on site is stripped to the full depth of the topsoil available over the stripping area.
Land capability	Land capability targets over areas to be rehabilitated are not set	Inconsistency of topsoil placement depth resulting in incohesive land capabilities over rehabilitated areas that are unable to support a productive land use	Set land capability targets for areas to be rehabilitated based on the volume of topsoil available and the slopes over the areas to be rehabilitated, and ensure rehabilitation is implemented to reach these targets.
Land use	Lack of land use planning during the operational period	Insufficient stakeholder engagement related to post-closure land use planning, inability to set a meaningful closure vision and ensure closure measures are able to meet an intended productive land use, agreed upon by all stakeholders	Compile a post-mining land use plan early on during the operational period and ensure the required stakeholder engagement is undertaken to attain buy-in and ensure their inputs are considered where appropriate.
Biodiversity (over rehabilitated areas and within in MRA in the post-closure period)			
Alien invasives	Uncontrolled infestation of alien invasive plants	Alien invasive plants outcompeting indigenous plants resulting in a reduction of biodiversity	Ensure an alien invasive management plan is developed during the operational period and effectively implemented to reduce occurrences of infestation.
Wetlands and Other Sensitive Receptors			
Wetlands on site	Contaminated groundwater plume	Contaminated plume intercepts the wetlands due to hydraulic linkages resulting in contamination and degradation of the wetlands	Ensure contamination plumes resulting from underground workings and the discard dump are monitored and managed to prevent contamination of wetlands.
Surface and Groundwater			
Surface water	Hydraulic linkages from groundwater to surrounding rivers/ drainage lines through the shallow weathered aquifer	Contamination of surface water resources through migration of contaminated mine water through the shallow aquifer	Ensure subsidence risk is avoided where possible. Undertake a subsidence risk assessment and ensure the rock engineer plans the shallow coal extraction in such a way that minimises subsidence risk. Plan and provision for areas expected to subside and ensure these areas are infilled and rehabilitated to be free draining timeously.
	Shallow coal extraction through underground mining	Subsidence over shallow underground mine workings resulting in surface water contamination due to ingress of rainwater into contaminated mine water over subsided areas	
Groundwater	Unknown groundwater qualities in the underground workings and around the discard dump at closure	Inability to adequately plan and provision for groundwater management at closure	Ensure continued groundwater monitoring is undertaken, particularly in rebounding portions of the underground workings, and use the monitoring results to feed into a closure based geohydrological model, to predict groundwater qualities at closure and enable a suitable post-closure water management strategy to be developed.
	Underground mine workings and discard dump	Contaminated groundwater plume resulting in groundwater contamination	Ensure the appropriate groundwater monitoring is undertaken to manage groundwater plume migration where/ if required.

9.3. Receptors Most Sensitive to Closure Related Risks

The receptors most sensitive to risk include the following:

Downstream water users: contaminants transported through decant and seepage from the underground workings post-closure will impact ground and surface water unless this excess decant/seepage water is treated.

Surrounding farmers: should land disturbed by mining not be reinstated to its previous land capability (especially where this land was previously arable), farmers looking to lease this land post-closure could be negatively impacted, since the arable capability of the land could be lost.

Mine employees: once mining operations cease, employees face the risk of job losses, leading to an increase in unemployment and poverty in the area. Approved partners should be used to reskill employees, to enable them to find alternative employment and to explore opportunities for alternative industry/livelihoods.

9.4. Risk Monitoring

Groundwater and surface water monitoring will be undertaken quarterly through the operational phase to track contaminant levels and develop mitigation measures to ensure key contaminants are kept under the legislated threshold.

Subsidence monitoring should be undertaken over areas where extraction of shallow coal is planned through underground mining methods. Mitigation measures should be put in place to reduce subsidence potential where possible.

10. Assumptions Applied in the Closure Plan Development

The compilation of this RCP is based on the following assumptions and limitations:

- All infrastructure on site will be demolished unless these assets can be legally transferred to a third party and a contract is in place detailing the conditions of transfer;
- Decommissioning and rehabilitation activities will follow directly after the cessation of mining;
- Information, mitigation measures and recommendations provided in this report are based on the specialist studies completed by Digby Wells as part of the environmental authorisation for the proposed Arnot South Project;
- Vegetation monitoring and maintenance will take place for five years post-closure. Similarly, groundwater and surface water monitoring will be undertaken for five years post-closure. It is noted that these monitoring periods may need to be extended to prove that site relinquishment criteria have been met;

- The recommendations contained within this report currently exclude any comments or issues raised by stakeholders and/or Interested and Affected Parties (I&APs). Comments from stakeholders or I&APs will be incorporated into subsequent annual updates of the RCP as and when received;
- This report must be considered as a living document and should be updated as additional information become available and as monitoring and rehabilitation progresses, should the proposed project go ahead; and
- Should the proposed project go ahead, this report should be updated and submitted annually as additional information becomes available (as stipulated in the Financial Provisioning Regulations, 2015.

11. Closure Vision

The mine's closure vision, summarised below, provides a framework to guide the mine's rehabilitation, closure planning and implementation. The closure vision provides the envisioned status, and land use over the final rehabilitated landscape post-mining.

The proposed Arnot South Project will aim to build collaborative partnerships with stakeholders, to establish a safe, stable, and non-polluting, post-mining landscape that is sustainable over the long-term while achieving successful implementation of the desired post-mining land use.

This closure vision has been set as a preliminary closure vision. Should the project go ahead, this will need to be updated once the post-mining land use plan has been developed.

12. Closure Objectives

Outlined below are specific objectives which support the overall closure vision and the closure measures developed:

- Return land disturbed by mining activities as far as possible to land capabilities similar to that which existed prior to mining;
- Ensure that contamination of surrounding areas by mine affected water is limited as far as possible, and that mine affected water is contained or treated post-closure;
- Remove mine infrastructure that cannot be used by a subsequent landowner or a third party. Where buildings can be used by a third party, arrangements will be made to ensure their long-term sustainable use;
- Clean up all stockpile footprint areas and loading areas and rehabilitate these areas to a land capability similar to that which existed prior to mining;

- Follow a process of closure that is progressive and integrated into the short and long term mine plans, and that will assess the closure impacts proactively at regular intervals throughout project life;
- Rehabilitate the disturbed land to a state that facilitates compliance with applicable environmental quality objectives,
- Landscape the rehabilitated areas in alignment with the surrounding topography to prevent the unnecessary ponding of water and ensure all rehabilitated areas are free draining;
- Physically and chemically stabilise any remaining mining structures (i.e. discard dumps), where required, to minimise residual risk post-closure;
- Leave a safe and stable environment for both humans and animals;
- Prevent soil and surface/groundwater contamination by effectively managing water on site, and ensure clean/ dirty water separation is implemented during the operational period to minimise post-closure contamination potential;
- Comply with local and national regulatory requirements; and
- Ensure the Social and Labour Plan speaks to the closure plan and land use plan, and that social closure objectives (e.g. reskilling, retrenchment management, land use engagement etc.) are progressively met during the operational phase.

13. Final Land Use Plan

The final land use plan is the end land use to which the mine would like to return the land disturbed by mining activities. The closure objectives set as part of the mine closure planning process should aim to support achievement and effective implementation of the final land use plan. The plan should ensure long-term sustainability and strive to promote post-closure land productivity for the potential offset of post-closure costs (i.e. monitoring and maintenance).

The post-mining land use plan will be developed should the proposed project go ahead.

13.1. Post-Mining Land Uses

A land use evaluation was undertaken for the site at a high-level, which assessed the potential land use options for the site. The land use options were evaluated based on the following criteria, and are reflected in Table 13-1:

- **Likely end land uses:** Primary or anchoring end land uses, that are likely to be functionally self-sufficient over the long term;
- **Possible end land uses:** Secondary or supporting land uses, that are reliant on likely uses or other external factors to be sustainable; and
- **Unlikely end land uses:** Undesirable end land uses, or land uses that are unlikely to be sustainable or that would be contextually inappropriate.

Table 13-1: Evaluation of Post-Mining Land Use Options

Likely	Possible	Unlikely
• Ecological conservation areas along floodplains of spruits • Grazing and /or a mix of agricultural activities • Water treatment for use by agricultural and other potential industries	• Agricultural processing • Forestry/timber production • Aquaculture • Birding tourist attraction	• Intensive agriculture (dependent on post mining land capability) • Dry-land agriculture (dependent on post mining land capability) • Large-scale commercial or urban development • Large-scale solar energy generation

13.2. Preliminary Final Land Use Plan

This proposed land use plan is to be developed should the proposed project go ahead. Once complete, the final land use plan should be shared with the relevant stakeholders to ensure their inputs are included in the plan where applicable, and to attain their buy-in which will avoid potential conflict/ misalignment with surrounding land users post-closure.

14. Closure Actions and Measures

The closure actions supporting the preferred closure option are presented in Table 14-1. The closure measures are developed in support of achieving the closure objectives and mitigating post-closure contamination potential over the site.

Alternative closure measures are also presented in Table 14-1, where these are deemed relevant. The closure measures should be refined once more detailed supporting information becomes available (i.e. engineered landform designs, contaminated land assessments, land capability assessments, geohydrological studies etc.).

The assumptions applied in the development of these closure measures are included in the closure cost Section (Section 22.3)

Table 14-1: Closure and Rehabilitation Measures

Aspect	Rehabilitation measures
Infrastructure (Plant, Security, Offices & Workshop)	<u>Infrastructure demolitions and clean-up:</u> • Demolish and remove all concrete structures to 1 m below ground level; • Demolish all brick buildings ; • Demolish concrete bund wall; • Dismantle streel structures and store in designated salvage yard prior to removal/selling off; • Dispose of inert building rubble in inclined shaft prior to backfilling within a 1 km hauling distance; • Remove transformers prior to closure; • Remove fences; and Remove all contractor containers from site prior to closure. <u>General rehabilitation</u> • Shape and level all areas where infrastructure is removed to align surface water runoff with the site wide drainage framework; • Replace 300 mm of topsoil across the reshaped contractor yard footprint; • Rip to alleviate compaction; and • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix;
Linear Infrastructure	<u>Haul roads and gravel roads</u> • Rip all untarred roads to break compaction. <u>Pipelines and Powerlines</u> • Remove all wire fencing; • Demolish and remove all surface pipelines; and

Aspect	Rehabilitation measures
	• Remove all powerlines. General rehabilitation • Replace 300 mm of topsoil over gravel and tar roads; • Rip all areas to alleviate compaction; and • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix.
Mining area (boxcut and incline shaft)	Boxcut and incline shaft • Seal the shaft portals according to the DMRE standard; • Backfill the void using a combination so truck and shovel and dozer, assuming a maximum load and haul distance of 1 km from overburden stockpile to void; • Shape area to be free draining as per the detailed landform design; • Place topsoil to a depth of at least 300 mm; • Rip to alleviate compaction; and • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix. All dumps (Hards, Softs, Topsoil & Berms) • Remove residual stockpile material to a depth of 300 mm; • Replace topsoil cover; • Rip all replaced topsoil to alleviate compaction; and • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix.

Aspect	Rehabilitation measures
Discard dump	Discard dump • Shape side slopes to a gradient that does not exceed 1:5; • Implement the required storm management measures as per detailed engineering design; • Compact two layers of clay at 150 mm thickness each for use as a salinity breaker layer; • Apply dolomitic lime to increase the pH; • Place soft overburden material to a depth of 300 mm; • Place topsoil to a minimum depth of 800 mm (to be specified by the detailed engineering design), which should ensure water ingress does not exceed more than 5% MAP); • Rip to alleviate compaction; and • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix. Alternative to consider: Backfill boxcut/ incline shaft or the underground workings with the discard material to reduce the residual risk associated with continued contamination from the dump post-closure.
Pollution Control Dams	Pollution Control Dams • Remove contaminated sediment to a depth of 300 mm; • Remove and appropriately dispose of high density polyethylene (HDPE) liner; • Breach wall and reshape to at least 1:5 (V:H) where ancillary dam structures were removed to align storm water runoff with the surrounding surface water drainage framework; • Replace 300 mm of topsoil across the reshaped footprint; • Rip all areas to alleviate compaction; and • Establish vegetation including soil amelioration based on dedicated sampling and analysis, seed bed preparation and the application of an appropriate seed mix.

Aspect	Rehabilitation measures
Water Treatment Plant	No rehabilitation required since it is assumed that the water treatment plant will remain post-closure to treat water.
Monitoring and maintenance	• Surface and groundwater monitoring will continue for a minimum period of ten years post-closure, or until site relinquishment criteria are met; and • Vegetation monitoring and maintenance over rehabilitated areas will continue for a minimum period of five years post-closure, or until site relinquishment criteria have been met.

15. Alternative Closure Measures

A potential alternative to be considered is backfilling the boxcut or underground workings with discard material to reduce the residual risk associated with cover failure over the dump post-closure. The dump will also continue to contribute to the formation of a groundwater plume post-closure which will require mitigation and increase the water treatment costs, due to the increased salt load (TDS) and sulphate concentrations.

Another potential alternative to consider is to exclude certain shallow coal seams from the mine plan, since mining shallow coal (10 m deep) will very likely result in surface subsidence which will increase residual risks post-closure and the associated costs required to provision for management/ mitigation of these risks. It is recommended that a cost benefit analysis be carried out to ensure the benefit outweighs the risk, and associated cost, in this regard. The shallow coal covers an extensive area and carries a high risk of subsidence should the entire shallow coal seam be extracted through underground mining.

The closure and rehabilitation measures provided as part of this RCP aligned with international best practice and are considered the preferred option for closure. The proposed closure actions and measures (reflected in Section 14) are designed to support the closure objectives included in Section 12.

16. Threats, Opportunities and Uncertainties

The threats, opportunities and uncertainties associated with closure of the proposed project are reflected in Table 16-1.

Table 16-1: Threats, Opportunities and Uncertainties Analysis for Mine Closure

Threats	• Contamination of the groundwater and surface water resource through mining activities; • Wetland degradation; • Biodiversity loss through mining activities; and • Extensive potential subsidence over an area of more than 5,000 ha, should the entire area of shallow col be mined out.
Opportunities	• Adequately prepare for water treatment to actively reduce groundwater and surface water contamination through proactive closure based geohydrological modelling; • Use coal discard to backfill the boxcut and/ or incline shaft to ensure free draining elevations are reached over these areas, and to prevent long-term contamination and residual risk associated with the discard dump post-closure; • Best practice topsoil stripping, stockpiling and placing to be informed by a dedicated soils handling plan to be developed; and

	• Ensuring all areas to be disturbed by mining activities (including infrastructure areas) are appropriately stripped of topsoil prior to disturbance, to prevent a topsoil deficit at closure.
Uncertainties	• Post-closure mine water qualities; • Water treatment period required post-closure; • Decant period for the underground workings; • Area to be impacted by subsidence post-closure; and • Discard dump cover requirements/ specifications to reduce to MAP ingress to less than 5%.

17. Closure Planning Knowledge Gaps Identified

The following preliminary knowledge gaps, presented in Table 17-1, were identified during the compilation of this RCP. These knowledge gaps will be revisited and addressed should the proposed project go ahead.

Table 17-1: Identified Knowledge Gaps

Identified Knowledge Gaps
Determination of long-term water management strategy and associated costs: • A geohydrological model should be developed for the operational and closure period, considering the outcomes of the geochemical study and the water and salt balance; and • The outcomes of the geohydrological model for the closure period should be used to inform the development of a post-closure water management strategy for the site. This strategy should then be used to refine and improve the post-closure water treatment costs (which will need to be provisioned for under both the immediate and planned closure scenario).
Detailed engineering design for the discard dump: • Ensure a closure based detailed engineering design is developed for the dump to potentially reduce groundwater contamination; • The design should include concurrent rehabilitation (i.e. shaping of slopes and placement of topsoil) to reduce water ingress into the discard material and to reduce the rehabilitation costs at closure; and • Consider removing the discard dump by using this material to backfill underground workings during the operational period, to reduce residual contamination potential and the associated costs.
Subsidence risk assessment: • Undertake a subsidence risk assessment evaluated by a rock engineer, to assess the risk associated with subsidence areas where shallow coal is planned to be extracted; and • Assess whether extracting shallow coal over the 5,202 ha area should go ahead given the high residual risk and cost associated with this activity.

Identified Knowledge Gaps
Post-mining land use plan: • Engage with regulatory authorities to confirm the waste disposal strategy and environmental authorisations needed for waste disposal associated with demolition activities; and • Develop a detailed post-mining land use plan, based on the post-mining land capabilities currently planned, and ensure this plan is shared with the relevant stakeholders through effective stakeholder engagement. These engagements should ensure the buy-in of local communities and any input supplied by stakeholders should be included in the land use plan where appropriate.

18. Preliminary Mine Closure Schedule

The mine closure schedule addresses the timing of rehabilitation and closure activities performed during the decommissioning and post-closure phases. The schedule presented is high level and identifies the key activities the mine will conduct during the decommissioning and post-closure phases. This scheduled will be refined in future updates of this plan should the proposed project go ahead.

It is expected that the decommissioning phase will last five years after which monitoring, and maintenance will continue for an estimated period of five years. Monitoring and maintenance will need to continue until the site relinquishment criteria are met and a closure certificate is issued by the DMRE. Water treatment will also continue into the pre-site relinquishment phase until the mine water has been adequately treated and is proved to be non-polluting.

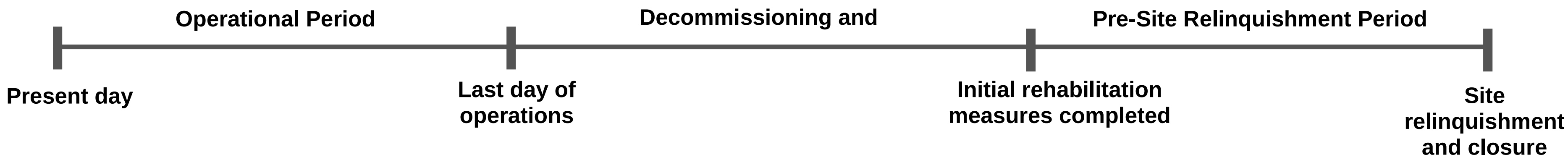

Figure 18-1: Preliminary Mine Closure Schedule

Remianining oprational period	Decommissioning and Closure Period	Pre-site Relinquishment Period
2022-2039	**2039-2044**	**2044 – onwards**
Update the closure plan, annual rehabilitation plan, closure costing and environmental risk assessment annually.	Decontaminate the plant area and demolish surface infrastructure and ensure that access to the mining areas is prevented.	Undertake rehabilitation monitoring as per the post-closure monitoring programme to confirm success of rehabilitation measures, by assesing whether site relinquishment criteria are being achived.
Reduce the identified theats and uncertanties identified in the plan by closing the identified closure knowledge gaps, through undertaking the required additional studies.	Rehabilitate the disturbed footprints once infrastructure is removed.	Undertake care and maintenance (corrective action) where applicable. This will be informed by the rehabilitation monitoring.
Engage with the relevant stakeholders regarding the final land use plan.	Complete all outstanding rehabilitation on site, in line with the mine's closure objectives and final land use plan.	Continue surfce and groundwater monitoring until site relinquishment criteria area achieved.
Identify potential infrastructure for third-party transer and ensur ethe required agreements/ contracts are in place.	Continue rehabilitation monitoring and undertake land capability assessments over rehabilitated areas (if not completed operationally).	Continue monitoring for the manifestation of residual risks (subsidene monitoring, decant monitoring) and continue mitigation of long-term closure risks (continues water treatment).

19. Monitoring Auditing and Reporting

Initial monitoring, auditing and reporting requirements which relate to the risk assessment, legal requirements and knowledge gaps are shown in Table 19-1.

Monitoring provides data to prove whether the rehabilitation techniques implemented have been successful (i.e. whether site relinquishment criteria are being met) and allows for effective management measures to be implemented. Monitoring should provide an early indication of problems that may arise so that corrective action can be taken.

The post-closure monitoring period will begin after the decommissioning phase. Negative monitoring findings should be clearly linked to specific corrective actions.

The duration of post-closure monitoring will be determined based on environmental performance and until it can be demonstrated that the rehabilitation work has achieved the agreed endpoints and is sustainable; however, at present, it has been assumed that post-closure monitoring will not continue for more than five years. The purpose of monitoring is to ensure that the objectives of rehabilitation are met to enable successful mine closure.

Table 19-1: Post-closure Monitoring, Auditing and Reporting Programme

Component / Aspect	Monitoring		Performance / success criteria	Corrective action
	Methodology	Frequency / duration		
Soil Management				
Erosion	• Conduct a visual assessment to determine areas of potential erosion • Undertake field investigations, fixed point photography to document the significance of the erosion occurring on site	• Bi-annually for at least 5 years after decommissioning or as deemed necessary	• No evidence of significant erosion • 70% vegetation cover and species composition in line with best practice.	As required: • Re-shape areas to ensure that they are free-draining • Establish vegetation on bare patches if practical • Repair and stabilisation of erosion gullies and sheet erosion
Soil fertility	• Undertake a visual assessment and delineate areas where poor vegetation growth has occurred • Submit soil samples to an accredited soil laboratory to conduct soil fertility analysis	• Annually until soil fertility supports the final land use or for at least 5 years after decommissioning or as deemed necessary	• Soil analysis results comply with remediation targets at a 95-percentile level in line with best practice; and • Self-sustaining vegetation establishment.	• Apply amelioration where required as informed by sampling undertaken
General site status	• Conduct a visual assessment with respect to compliance of the afore-mentioned closure measures and to ensure that the site is aesthetically neat and tidy, and that no health or safety risks exist on site	• Once-off following implementation of rehabilitation measures	• Waste/rubble free sites	As required: • Clear remnant rubble and dispose of at a registered landfill site
Post-mining end land use	• Assess activities completed, as well as legal and related documentation completed and signed-off; and • Ensure rehabilitation measures are aligned to the LUP.	• Once off, at mine closure.	• Area has been rehabilitated to an aesthetic quality not to compromise potential tourism; • Transfer to third party operator has taken place once the area has been proven to be safe for redevelopment; • Legal and zoning issues have been addressed; and • Vegetation re-establishment, cover and composition are sustainable.	• Refer to end land use approach and refine measures to be implemented in achieving the desired final land use.
Topography	• Conduct a visual assessment to determine areas of potential erosion; and • Undertake regular digital surveys of rehabilitated areas to confirm that final topography is aligned with landform designs.	• During rehabilitation phase	• No evidence of significant erosion; • No evidence of water ponding on rehabilitated areas; and • The final profile achieved must be acceptable in terms of surface water drainage requirements and the end land use objectives.	As required: • Re-shape areas to ensure that they are free-draining; and • Refer to end land use approach and refine measures to be implemented in achieving the desired final land use.
Terrestrial- and Aquatic Ecosystem Health Management				

Component / Aspect	Monitoring		Performance / success criteria	Corrective action
	Methodology	Frequency / duration		
Vegetation establishment	• Determine whether re-etsablishment of vegetation communities are on a course of achieving a stable self-sustaining community dominated by species typical of the climax-species present in the adjacent areas • Inspect rehabilitated areas to assess vegetation re-establishment and provide for early detection of erosion in recently planted/seeded areas • Undertake fixed point photography at specific points at the rehabilitated sites to obtain a long term directly comparable method of determining changes in the landscape • Conduct evaluation of rehabilitated areas by means of field inspections. During these assessments measurement of growth performance and species abundance will be carried out to determine • Plant basal cover and species abundance in the grassed areas. Estimates of vegetation canopy and ground cover as well as height • Distribution, growth and survival of woody species • Dominant plant species (woody and herbaceous) • Presence of exotic invasive species, and degree of encroachment • Browsing or grazing intensity • Notes regarding erosion, such as, type, severity, degree of sediment build-up • Species composition and richness.	• Yearly for at least 5 years after decommissioning or as deemed necessary	• Vegetation basal cover should be at least 15% at all times; • Limited to no erosion; and • Self-sustaining vegetation ecosystem.	As required: • Rip and prepare areas to promote re-growth of vegetation • Re-vegetate poorly established rehabilitated areas where practical • Apply additional fertiliser and/or organic matter, depending on the condition of the vegetation and the initial organic material application

Component / Aspect	Monitoring		Performance / success criteria	Corrective action
	Methodology	**Frequency / duration**		
Invasive alien species	• Visually inspect areas where invasive species have been previously eradicated and areas prone to invasive species (e.g. eroded/degraded areas, along drainage lines, etc.) • Undertake surveys on relevant sites where bush encroachment has previously been identified to determine the status quo of invasive vegetation	• Yearly for at least 5 years after decommissioning or as deemed necessary	• Limit and/or prevent declared Category 1a,1b, 2 and 3 invader species establishing • Minimise extended threat to ecosystems, habitats or other species • Increase the potential for natural systems to deliver goods and services • Minimise economic or environmental harm or harm to human health	• Saplings of alien trees establishing on rehabilitated areas should be removed before they reach 1m in height • Revisit mitigation measures • Continue control and management
Wetlands bio-monitoring	• Continue with the current wetland bio-monitoring programme	• Annual for at least 5 years after decommissioning or as deemed necessary	• In situ water quality within ranges of the WUL and/or DWS standards • Free movement of wetland species, including migratory species • Maintained levels of biodiversity	• Refer to the objectives set-out in the wetland management and rehabilitation plan; and • Revisit mitigation measures
Surface Water and Groundwater Management				
Surface water flow	• Determine whether the rehabilitated mine site is free draining and that unnecessary impoundment of surface run-off is prevented • Conduct a site inspection after the onset of the rainy period, after all closure related measures have been implemented • Inspect all notable drainage lines on the rehabilitated mine site and establish whether these lines are free draining and have a limited potential for scouring • Check the catchments of the respective drainage lines for possible unnecessary impoundment of surface run-off	• Annually for 10 years after decommissioning or as deemed necessary	• Free-draining landforms • Re-instated pre-mining surface water flow patterns maximising the clean surface water runoff into natural drainage lines	As required: • In-fill erosion gullies • Re-establish covers • Amelioration, cultivate and re-vegetate as required • Re-instate surface drainage • Manage the spread of invasive plant species
Surface water quality	• Visually assess the functionality of the surface water drainage systems feeding surface water runoff from rehabilitated areas. • Monitor surface water quality in terms of the monitoring network that is aligned to the closure monitoring network	• After major rains during the season and after major storms. • Annually for at least a 10 year period after decommissioning or as deemed necessary	• No evidence of significant erosion and water pooling on rehabilitated areas. • Acceptable threshold levels of salts, metals and other potential contaminants over the rehabilitated sites allocated in terms of the land use and downstream users • No possible surface contaminant sources remaining on the rehabilitated mine site that could compromise the planned land use and/or pose health and safety threats • Water quality results within ranges of the WUL and/or DWS standards	As required: • Re-shape areas to ensure that they are free draining; • Undertake a source-pathway investigation; • Devise measures to clean-up sources of contamination; and • Refer to end land use approach and refine measures to be implemented in achieving the desired final land use.

Component / Aspect	Monitoring		Performance / success criteria	Corrective action
	Methodology	Frequency / duration		
Groundwater quality	• Monitor groundwater quality and levels in terms of the monitoring network that is aligned to the closure monitoring network;and • Carry out analysis in accordance with the methods prescribed by and obtainable fro South African National Standards (SANS)	• Annually for at least a 10 year period after decommissioning or as deemed necessary	• Acceptable threshold levels of salts, metals and other potential contaminants over the rehabilitated sites allocated in terms of the land use; • The applicable thresholds do not pose a threat to surrounding land uses or land users; • Water quality results within ranges of the WUL and/or DWS standards.	As required: • Increase monitoring frequency and detect point sources; • Optimise monitoring plan if needed; • Investigate the drilling and operation of scavenger boreholes • Treat water at the WTP as a long-term remediation measure.
Groundwater quantity	• Sample and monitor groundwater balance and levels in the vicinity of the mine.	• Annually for at least 10 years period after decommissioning or as deemed necessary	• Water quality results within ranges of the WUL and/or DWS standards • No evidence of dewatering and lowering of water tables within the vicinity of the mine.	As required: • Implementation of water treatment plant; • Continue to investigate various water treatment options including pH adjustment, controlled release and further containment options; • Increase monitoring frequency and detect point sources. • Optimise monitoring plan if needed.
Dust Management				
Dust	• Continuous PM_{10} and $PM_{2.5}$ monitoring buy designated air quality officer at a sensitive receptor location	• Quarterly for at least a 3 year period after decommissioning or as deemed necessary	• Acceptable threshold levels that meet the South African National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004) Dust Control Regulations (2013)	As required: • Undertake an investigation to the source of the dust • Devise measures to reduce dust to acceptable levels
General				

Component / Aspect	Monitoring		Performance / success criteria	Corrective action
	Methodology	Frequency / duration		
Audit Reports	• Auditing against the conditions outlined within the approved EMP and EIA/EMP Performance Assessment) or RCP at time of mine closure. • To determine compliance to EMP or RCP conditions. • To ensure that the mine is compliant with the financial provision regulations and that there is enough funding provided by the mine for closure and rehabilitation cost and meets the requirements as stipulated in Regulation 11 of the Financial Provision Regulations.	• Annually and must be audited by an independent auditor.	• Annual Performance Assessment.	As required: • Environmental Officer/Independent Third Party and update annually.

20. Site Relinquishment Criteria

Site relinquishment requires formal acceptance from the regulatory authority to ensure that all obligations associated with closure are achieved, prior to a closure certificate being issued. To achieve site relinquishment, criteria need to be set, measured and met for all parties to understand what needs to be done to obtain a closure certificate.

This provides all stakeholders involved in the process a target that needs to be achieved and sets the standards that closure and rehabilitation actions are measured against. Table 20-1 provides the preliminary site relinquishment criteria for the proposed project. These criteria will need to be updated should the proposed project go ahead.

Table 20-1: Site Relinquishment Criteria

Environmental Aspect	Closure criteria	Monitoring Requirement	Reporting Requirement
Biodiversity	Ensure establishment of vegetation has a basal cover of a reference site 5 years post-closure and that it is self-sustaining and can be measured over a 5 year period after mine closure, indicating that natural succession has occurred.	Bi-annual vegetation monitoring and rehabilitation monitoring for five years after mine closure.	Vegetation Monitoring Reports.
Groundwater	Groundwater qualities after mine closure need to comply with the qualities as stipulated in the Water Use Licence Application (WULA) and the appropriate standards set by the Department of Water and Sanitation (DWS) and South African National Standards (SANS).	Monthly and quarterly groundwater monitoring for five years after mine closure.	Groundwater Monitoring Reports.
Surface Water	Surface water qualities after mine closure need to comply with the qualities as stipulated in the WULA and the appropriate standards set by the DWS and SANS.	Monthly and quarterly surface water monitoring for five years after mine closure.	Surface Water Monitoring Reports.

Environmental Aspect	Closure criteria	Monitoring Requirement	Reporting Requirement
Social	Engagement with stakeholders and employees regarding closure related aspect and formulisation of a retrenchment and downscaling policy demonstrating training initiatives and skills development assisting in employees being up-skilled, which would help individuals to seek for alternative employment at the time of closure.	Engagement, training and skills development policies during operational phase.	Records of correspondence, training matrices and records of training.
Air Quality	Dust, PM_{10} and $PM_{2.5}$ must comply with the minimum standards and limits as set by the NEM:AQA and applicable regulations and guidelines.	Monthly air quality monitoring during the decommissioning and rehabilitation phase.	Air Quality Monitoring Reports
Soil, Land Capability and Land Use	Post land use mining assessment to determine status of rehabilitated areas with respect to soil quality and that rehabilitated areas have been rehabilitated to an agreed upon land use. In addition to the above, inspections should be undertaken to identify areas of erosion and that erosion measures have been constructed.	Yearly soil chemistry and physical properties analysis during the rehabilitation phase. Daily soil erosion monitoring during the rehabilitation phase.	Soil Quality and Erosion Monitoring Reports.

Environmental Aspect	Closure criteria	Monitoring Requirement	Reporting Requirement
Erosion	Implementation or construction of erosion control measures.	Geotechnical and hydrological studies of existing structures. Evidence in rehabilitation report that appropriate risk assessment has been	Erosion Monitoring Reports.
Safety	Ensure dangerous mining areas, such as open pit areas or underground workings have been appropriately sealed, backfilled and/or bunded and appropriate signage erected.	Visual inspections and sign off report by a registered engineer.	Signed off report by registered engineer.

21. Organisational Capacity

The responsibility of management, at both the corporate and operational levels, and all personnel on site, including contractors form part of the organisational structure and responsibilities. Specific roles and accountabilities are contained within the specific roles are included in job descriptions. Performance against responsibilities and specific performance indications are assessed as part of annual performance appraisals of employees.

This Section aims to establish and guide the organisational structure required for closure implementation, and guide capacity building to ensure this is successfully carried out.

21.1. Organisational Structure

The following closure organisational considerations have emerged as good practice and is suggested for consideration. Once the relevant persons have been selected then the training and capacity building needed for closure can be determined.

The establishment of a closure committee, which has emerged as international best standard, is key to ensure that closure planning is carried out in terms of the relevant legal requirements and company policies. Although closure planning forms part of the environmental management function, the establishment of a multi-disciplinary committee can help ensure that closure planning is an integrated activity which is incorporated into mine planning. Figure 21-1 below shows typical key roles that may be identified for a closure committee as defined by ICMM (2019).

The role of the closure champion in a committee is critical, as the champion will be responsible for liaising with other key leaders within the organisation. The community liaison and development officer engages with the relevant stakeholders, which can be actioned through a stakeholder forum. Human resources consider the transition into closure and develops plans to minimise job losses. The technical specialists focus on addressing the knowledge gaps and guides rehabilitation implementation. The finance officer ensures that sufficient funds are available for closure.

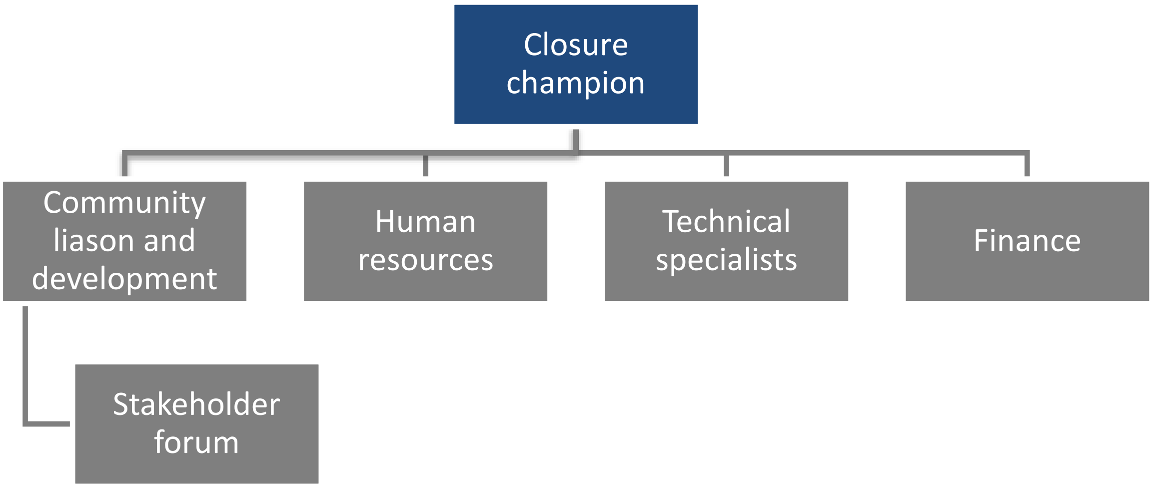

Figure 21-1: Typical Closure Committee Roles

22. Closure Cost Determination

The Section details the approach and assumptions applied in the closure cost estimate undertaken in support of the financial provisioning requirements for mine closure.

The closure cost estimate was undertaken using third party rates from Digby Wells' database and mine specific rates, supplied by the mine, where applicable. The methodology followed is aligned with the requirements of the Financial Provisioning Regulations, 2015 (as amended).

22.1. Approach and Methodology

The following approach was applied in the estimation of the closure costs:

- Review supporting information supplied by the mine (see Table 3-1 as the beginning of this document for all information provided and reviewed);
- Collate infrastructure quantities using GIS attribute data, as per the current infrastructure layout supplied by the mine;
- Input infrastructure attributes into the Digby Wells closure cost model, and include mine-related disturbance into the model (including the boxcut and discard dump);
- Compute the rehabilitation costs for all mine disturbances, based on a set of assumptions applied (see Section 22.3);
- Summarise the closure cost estimation outcomes in this Section of the RCP; and
- Detail all assumptions applied to facilitate the closure cost estimate.

22.2. Battery Limits for Closure

The closure cost estimation is based on the battery limits for closure, which are detailed in this RCP (see Section 5.4, and further illustrated in Figure 5-2 and Figure 5-3).

22.3. Closure Costing Assumptions and Qualifications

The following closure cost assumptions and qualifications were applied in the closure cost estimation. These should be reviewed and updated in future iterations of the closure cost estimate to ensure they remain appropriate.

It is noted that immediate closure costs were estimated assuming closure in Year 1 of the planned Arnot South Project.

22.3.1. Infrastructure Aspects

- Demolition/ removal of underground infrastructure is excluded from the cost assessment;
- Allowance for the disposal of inert demolition waste has not been accounted for since the volume of demolition waste expected at closure is currently unavailable;
- Conveyors leading into the boxcut and incline shaft have been accounted for (it was assumed total length is 30 m;
- Allowance for dismantling/ demolition of pipelines is excluded from this assessment; and
- Demolition of roadways into the boxcut leading to the three portals has been included, it was assumed that there will be three roads and each will be 30 metres in length and that each road is 6.5 metres wide (as per the MWP, 2020).

22.3.2. Mining Aspects

22.3.2.1. Boxcut

- It is assumed that the boxcut will be 30 m deep (depth to S2 coal seam appears to be about 30 m according to Fig. 4-2 in the MWP, 2020). The ramp angle will be built at an 8 degree slope (MWP, 2020), and the width of the boxcut is 69 m (KML polygons supplied). The estimated backfill volume was calculated based on these parameters;
- It was assumed that backfill will be undertaken using a combination of dozer (to move 20% of the backfill material) and truck and shovel (to move 80% of the backfill material). A maximum 1 km load and haul distance was applied; and
- It was assumed topsoil will be replaced to a death of 300 mm, to meet grazing land capability depth.

22.3.2.2. Discard dump

- A factor of 1.5 was applied to the discard dump footprint area to account for the side slopes and top surface area to be sloped at closure;
- It was assumed clay would be available within a 1 km radius for use in creating a compacted clay liner for the dump cover;

- Lime application was applied at 3 tonnes per ha and it is assumed this concentration will be enough to neutralise acidity resulting from acid mine drainage. This assumption will need to be confirmed through geochemical analysis of the discard dump material during operations (should the project go ahead);
- It was assumed soft overburden material will be available to cover the dump to a depth of 300 mm using this material as an additional breaker layer;
- It was assumed 800 mm of topsoil will be available for the dump cover; and
- All load and haul distances (for clay material, softs material and the topsoil) were limited to a 1 km load and haul from stockpile.
- Stockpiles
- It was assumed that 300 mm of contaminated material will need to be excavated over the following areas: overburden footprint, stockpile footprint, waste disposal area; salvage yard footprint and the contractor's laydown area; and
- Allowance for load and haul of this material is not included in the cost assessment and should be included in future iterations of the closure estimation.

22.3.3. Dams

- It was assumed the dams are HDPE lined and that 300 mm of contaminated sediment would need to be removed from the dams at closure; and
- Allowance for appropriate disposal of the contaminated sediment has not been included in this assessment and should be included once the volume and waste characterisation of the sediment is able to be estimated more accurately.

22.3.4. Monitoring and Maintenance

- Quarterly surface water and groundwater monitoring costs were included for a period of ten years post-closure, it is currently assumed that site relinquishment criteria will be achieved in this period; and
- Vegetation monitoring and maintenance costs were included for five years post-closure It is currently assumed that site relinquishment criteria will be achieved in this period.

22.3.5. Additional Allowances

- Preliminaries and General (P&Gs) were applied at 15% and Contingencies were applied at 10%;
- P&Gs and Contingencies were applied to the total rehabilitation and the total demolition costs, these allocations were not applied to the monitoring and maintenance costs, or the residual closure cost estimations; and

- These percentage allocations should be reassessed in future closure cost updates to ensure they are market -related, should the project go ahead.

22.4. Residual/ Latent Closure Costs

The costs determined to manage residual/ latent risks are presented in the ERR, which is described in Section 34 (Part B) of this report.

The closure cost summary in the Section below indicates the discounted costs for managing subsidence and mine affected water post-closure.

22.5. Closure Cost Summary

A summary of the closure costs for immediate closure is reflected in Table 22-1. The total immediate closure cost estimate amount to **R 81,982,207** (excluding VAT) and including P&Gs and Contingencies at 15% and 10%, respectively.

Discounted residual closure cost estimates for long-term water treatment and subsidence management have also been included, and the methodology and assumptions applied in estimating these costs are included in the ERR, Section 34 (Part B).

Table 22-1: Closure Cost Summary

DIGBY WELLS ENVIRONMENTAL	Digby Wells Environmental **Exxaro Coal Mpumalanga (Proprietary) Limited, Proposed Arnot South Project**
Area and Description	**Immediate Closure (Year 1)**
Infrastructure Demolition	
Area 1: Arnot South Project	R11,306,841
Rehabilitation	
Area 1: Arnot South Project	R31,966,080
Total Demolition & Rehabilitation	**R43,272,921**
Monitoring and Maintenance	
Monitoring Costs (Groundwater and Surface water)	R4,772,259
Monitoring Costs (Vegetation)	R55,762
Maintenance Costs (Vegetation)	R1,925,315
Sub-total	**R6,753,336**
Residual Costs (Discounted)	
Monitoring of Subsided Areas (10 years)	R12,029,601
Water Treatment Costs (100 years)	R9,108,118

Sub-total	**R21,137,719**
Preliminary and General (15%)	R6,490,938
Contingency (10%)	R4,327,292
Sub-total	**R10,818,230**
GRAND TOTAL	**R81,982,207**

22.6. Current Closure Cost Accuracy

The accuracy level for the closure cost assessment is estimated at ±50%. Should the proposed project go ahead, the level of accuracy will need to be increased to at least ±30%. This is based on the Financial Provisioning Regulations, 2019, which give guidance on the level of accuracy required based on the remaining LoM, as reflected in Table 22-2.

Table 22-2: Required Accuracy Based on Remaining LoM (Financial Provisioning Regulations, May 2019)

End of life of operation (or components of operation) from year of assessment	Design effort	Degree of accuracy in cost estimation
> 30 years	Pre -Conceptual 1 Class 5 Estimate I up to 2% of complete definition	-50% to + 50%
10 to 30 years	Conceptual / Pre-feasibility 1 Class 4 Estimate / up to 15% of complete definition	-30% to + 30%
5 to 10 years	Preliminary 1 Feasibility 1 Class 3 Estimate / up to 40% of complete definition	-20% to + 20%
Less than 5 years	Detailed Designs I Bid 1 Tender 1 Class 2 estimate up to 75% of complete definition	-10% to + 10% (or less)
The calculations for operations with five or less years must include a line item for carrying out specialist studies up to Detailed Design effort to improve the degree of accuracy to +1 -10% as well as a contingency to ensure sufficient funds for closure by a third party. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy.		

22.7. Actions Required for Improvement of Closure Cost Accuracy

The following actions are recommended to refine the closure cost estimation going forward:

- The volume of demolition waste expected at closure should be determined by a quantity surveyor early in the project life cycle. Once this information is available the cost for disposal of demolition waste should be included in the closure cost estimation;

- A detailed closure cover design for the discard dump should be undertaken early in the project life cycle to ensure there required material is available on site and the cost estimation should be updated to accurately account for implementation of this cover;
- A landform design for backfill of the boxcut should be developed, and this should include potential materials balance for closure, to ensure the surface area is free-draining;
- The above work should also consider any overburden material that may be required for rehabilitation of the discard dump, and this should be included in the overall materials balance;
- The capping requirements for the adits should be confirmed and costed for based on detailed engineering designs going forward;
- Once the infrastructure has been constructed on site the closure costs should be updated to reflect the as-built infrastructure quantities;
- It is assumed that site relinquishment criteria for surface water and groundwater will be achieved within ten years post-closure, and that site relinquishment criteria over the rehabilitated areas will be achieved with in five years. These post-closure monitoring periods should be reassessed and updated as/ if required; and
- The percentage allocations applied for P&Gs and Contingencies should be reassessed and updated to ensure these are market-related.

**Recommendations to improve the provision set aside for management of long-term residual impacts, including post-closure water treatment and subsidence are detailed in Section 35 (Part B)*.

23. Recommendations for Improvement

The following recommendations are made to improve the RCP in future updates:

- A landform design is required for backfill and rehabilitation of the boxcut and discard dump areas requiring backfill;
- A detailed material balance should be undertaken to ensure ethe boxcut is rehabilitated to be free draining and the discard dump is adequately capped, as per a detailed closure capping design to be implemented;
- The option of using the discard material as backfill or selling the material to a contractor should be investigated, as this will decrease residual risk associated with this waste facility;

- Geohydrological modelling based on the closure period must be undertaken to inform the post-closure water treatment measures required, to enable the required provisioning to be made for both the immediate and planned closure scenarios;
- The above geohydrological model should be used to inform the capacity requirements of the water treatment plant to be constructed during operations;
- Regular groundwater monitoring should take place to determine possible changes in groundwater flow and groundwater quality, which should feed into updating the geohydrological model for the site;
- A post-mining land use plan should be developed early in the project life cycle to inform the closure measures and site relinquishment criteria;
- There should be regular interaction and communication with local stakeholders and local farmers, so that their requirements can be taken into consideration in the rehabilitation process, and particularly the post-mining land use plan development;
- Invasive alien plants should be removed on an on-going basis; and
- Monitoring and maintenance of the rehabilitated areas should take place on an annual basis for at least five years post-closure and should also be implemented during the operational period. This enables corrective rehabilitation to be implemented during operations and reduces the residual risk associated with post-closure vegetation failure.

24. Motivation for Amendments

No amendments are made at this stage of reporting. Should any amendments to the closure plan be made in future updates/ iterations of this plan, details of the amendments made will be included in this Section.

Amendments will be made if the current mine plan changes and could also be applicable once the identified knowledge gaps in this closure plan are addressed through undertaking the required specialist studies to support improvement of this closure planning document.

PART B: ENVIRONMENTAL RISK ASSESSMENT FOR SCHEDULED AND UNSCHEDULED POST-CLOSURE RESIDUAL/ LATENT RISKS

25. NEMA Compliance Checklist

The Environmental Risk Assessment report (ERR) is structured to align with the minimum requirements set out in Appendix 5 of the Financial Provisioning Regulations, 2015 (as amended). The requirements are provided in Table 25-1, which includes reference to the relevant section where the requirement is addressed in this report.

Table 25-1: Minimum Requirements of the Environmental Risk Assessment Report for Scheduled Closure

Content of An Environmental Risk Assessment for Scheduled Closure	Section
The Environmental Risk Assessment report must contain information that is necessary to determine the potential financial liability associated with the management of latent environmental liabilities post-closure, keeping in mind the planned post-mining end state of the land, once the initial risk threshold criteria have been achieved an must include-	
a) Details of- (i) The person or persons who prepared the plan (ii) The professional registrations and experience of the person or persons who prepared the plan (iii) The applicant or holder including but not limited to name, physical address, postal address, contact details; and (iv) Rights, permits, licences and authorisations associated with the operation including the right or permit number, environmental authorisation number, and similar details of all other authorisation received e.g. water use licence, waste licence etc.	See page i at the beginning of this document
b) Details of the assessment process used to identify and quantify the residual risks, including- (i) A description of the risk assessment methodology inclusive of risk identification and quantification;	Section 27 (Part B)
(ii) Substantiation why each risk is residual, including why the risk was not or could not be mitigated during concurrent rehabilitation and remediation or during the implementation of the final rehabilitation, decommission and closure plan;	Section 26 Section 28
(iii) A detailed description of the drivers that could result in the manifestation of the risks after closure;	Section 28 (Part B) Section 29 (Part B)
(iv) A description of the expected timeframe in which the risk is likely to manifest, typically as expected years after closure, and the duration of the impact, including motivation to support these timeframes;	Section 32 (Part B)
(v) A detailed description of the triggers which can be used to identify that the risk is imminent or has manifested, how this will be measured and any cost implications thereof;	Section 30 (Part B)

Content of An Environmental Risk Assessment for Scheduled Closure	Section
(vi) Results and findings of the risk assessment or risks which will occur post-closure; and	Section 28 (Part B) Appendix A
(vii) An explanation of changes to the risk assessment results as applicable in annual updates to the plan.	Section 33 (Part B)
c) Management activities, including- (i) Monitoring of results and findings, which informs adaptive or corrective management and/or risk reduction activities (ii) An assessment of alternatives to mitigate or manage the impacts once the risk has become manifested, which must be focussed on practicality as well as cost of the implementation (iii) Motivation why the selected alternative is the appropriate approach to mitigate the impact; and (iv) A detailed description of how the alternative will be implemented.	Section 30 (Part B)
d) Calculation of costs for implementing the activities to manage and monitor residual and latent impacts until the agreed risk threshold is reached using market related figures and the current value of money and no discounting or net present value calculations which must- (i) Include costs to determine whether the risk is imminent or has manifest are to be included in the assessment as there are monitoring costs likely to be incurred during the implementation of the strategy to manage or mitigate the impacts once the risk has become manifest; (ii) Be based on the management, rehabilitation, remediation, maintenance and long-term monitoring of activities undertaken by a third party (iii) Be calculated for the management, rehabilitation, remediation, maintenance and long-term monitoring of residual and latent impacts for all disturbed areas and associated environmental impacts (iv) Include the costs for the management, rehabilitation, remediation, maintenance and long-term monitoring of activities for residual and latent impacts must include cost assumptions and auditable calculations of costs per activity or infrastructure (v) Include the risk modelling and the calculation of post-closure cost estimation must be updated annually during the operation's life to reflect known developments, including changes from the annual review of the closure strategy assumptions and inputs, scope changes; and (vi) Include the cost estimates for modelling and calculating the post-closure costs must be calculated using accuracy estimations as follows:	Section 34 (Part B)

Content of An Environmental Risk Assessment for Scheduled Closure	Section
<table><tr><th>End of life of operation (or components of operation) from year of assessment</th><th>Design effort</th><th>Degree of accuracy in cost estimation</th></tr><tr><td>>30 years</td><td>Pre -Conceptual / Class 5 Estimate / up to 2% of complete definition</td><td>-50% to +50%</td></tr><tr><td>10 to 30 years</td><td>Conceptual / Pre - feasibility / Class 4 Estimate / up to 15% of complete definition</td><td>-30% to +30%</td></tr><tr><td>5 to 10 years</td><td>Preliminary / Feasibility / Class 3 Estimate / up to 40% of complete definition</td><td>-20% to + 20%</td></tr><tr><td>Less than 5 years</td><td>Detailed Designs / Bid / Tender / Class 2 estimate up to 75% of complete definition</td><td>-10% to +10% (or less)</td></tr></table> *The calculations for operations with 5 or less years must include a line item for carrying out specialist studies up to Detailed Design effort to improve the degree of accuracy to +/-10% as well as a contingency to ensure sufficient funds for closure by a third party. Motivation must be provided to indicate the accuracy in the reported number and as accuracy improves, what actions resulted in an improvement in accuracy.	

26. Introduction

The main intention of the Environmental Risk Assessment (ERA) report is to identify residual and latent risks that remain, or will manifest, after site relinquishment, and to determine the likely financial liability associated with managing these risks in the long-term.

Risk assessment is the overall process of risk identification, risk analysis and risk evaluation followed by the development of mitigation measures to reduce the likelihood and consequence rankings of the risks identified.

Residual risks are defined as post site relinquishment risks that remain after the implementation of sound mitigation measures at closure and during the post-closure period.

These risks typically will only require management in the long-term since there is a delay in risk manifestation. Latent risks are unforeseen risks that could manifest post-closure.

The residual/ latent environmental risks were identified and assessed during the Environmental Risk Assessment (ERA) undertaken for the proposed mine (as reported on in Section 9 – Part A). This Part of the closure planning document focuses on the residual/ latent risks identified and the recommended mitigation measures to manage these risks post-closure. The costs for management/ mitigation of these risks is also addressed, where these costs were able to be estimated.

27. Risk Assessment Methodology

Risks were identified based on the review of available information supplied by Universal Coal, and the specialist studies compiled in support of the EIA/ EMPr application for the proposed mine.

Key steps in the risk assessment include:

- Review available specialist studies undertaken by Digby Wells in support of the EIA/ EMPr for the proposed project, and other pertinent information supplied by the Universal Coal (as reflected in Table 3-1, at the beginning of this closure planning document);
- Identify potential residual/ latent risks that could manifest post-closure based in the information available;
- Rank these risks based on the likelihood of them occurring, and the consequence of the risk should it occur (without any mitigation controls in place);
- Develop mitigation measures to reduce the likelihood of the risk occurring, and then re-rank the risk assuming these mitigation measures are in place;
- Include residual/ latent risks that are ranked as significant or high level risks in this Section of the closure planning document (the full Environmental Risk Assessment undertaken), including all residual/ latent risks identified, regardless of their ranking, is included in Appendix A;
- Estimate the costs required to mitigate the significant residual/ latent risks identified, for risks where the required information to undertake this estimation is available;
- Assess the potential timeframe within which the identified residual/ latent risks could occur, for risks where the required information to inform this assessment is available; and
- Identify the knowledge gaps to be addressed in order to further inform the manifestation period, consequence and associated mitigation costs for the residual/ latent risk identified.

The risks levels applied in the RA undertaken, are classified as shown in Table 27-1 (Part B) below.

The Digby Wells RA model was used for the assessment, which uses a risk matrix based on the Anglo Plc 5X5, as previously reflected in Table 9-2 (Part A). This matrix was used to rank the likelihood of the risk occurring as well as the consequence, should the risk manifest (pre and post implementation of the proposed mitigation measure).

Table 27-1: Risk Levels

Risk Rating	Risk Level	Guidelines for Risk Matrix
21 to 25	High	A high risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised immediately.
13 to 20	Significant	A significant risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as soon as possible.
6 to 12	Medium	A moderate risk exists that management's objectives may not be achieved. Appropriate mitigation strategy to be devised as part of the normal management process.
1 to 5	Low	A low risk exists that management's objectives may not be achieved. Monitor risk, no further mitigation required.

28. Significant Residual/ Latent Risks Identified

The residual/ latent risks identified with a risk level of significant or high, are presented in Table 28-1. The full suite of risks, including their risk rankings and mitigation measures, are included in Appendix A.

Table 28-1: Residual/ Latent Risks Identified with the Highest Severity

Aspect	Risk driver	Unwanted Event	Mitigation measure(s)
Residual Risks			
Underground workings	Decant from the underground workings	Contamination of the groundwater resources, and potential contamination of surface water resources through the weathered shallow aquifer	Ensure the WTP meets the capacity required to treat extraneous mine affected water after post-closure to ensure decant into surrounding water resources is prevented as far as possible.
Discard Dump	Seepage from the base of the discard dump into the groundwater	Formation of a groundwater contamination plume, that could result in further contamination of surface water through hydraulic linkages	Monitor the groundwater contamination plume post-closure and prevent migration of the plume into the shallow aquifer through scavenger boreholes (should this be required). Consider alternatives such as using the discard material for backfill of the box cut, should this approach be feasible.
	The soil cover implemented over the discard dump is not sustainable in the long-term resulting in cover failure	Increased soil erosion exposing the discard material and resulting in increased oxidation, and increased water ingress through the discard, further worsening the quality of the groundwater contamination plume associated with the discard dump	Ensure long-term care and maintenance is provisioned for and undertaken over the dump. Ensure appropriate soils handing (stripping, stockpiling and subsequent placement) is undertaken as per best practice guidelines to promote cover sustainability. Consider alternatives such as using the discard material for backfill of the box cut, should this approach be feasible.
Post-closure water treatment	The WTP does not have sufficient capacity to treat the amount of excess mine water required to prevent decant post-closure	Contamination of surface and groundwater through decant of mine water impacted by Acid Mine Drainage	Ensure the WTP to be constructed is designed to mee the post-closure water treatment requirements and not just the operational requirements. Excess mien water volumes to be treated post-closure to ensure decant is prevented should be determined through regular updated of the closure-based geohydrological model.

Aspect	Risk driver	Unwanted Event	Mitigation measure(s)
Subsidence	Mining of shallow coal through underground extraction	Subsidence over areas where shallow coal has been extracted resulting in ponding, vegetation die-back, and increased recharge into the underground mine workings (resulting in increased water treatment costs and increased contamination potential of surface water resources)	Ensure the potential benefit of mining shallow coal outweighs the potential cost for rehabilitation of subsided areas and increased water treatment costs. If mining of the shallow seam goes ahead ensure a subsidence risk assessment is undertaken and provision is made to rehabilitate the subsided areas and treat the increased volume of water post-closure.
Latent Risks			
Climate	Climate change	Increased periods of drought and severe thunderstorms impacting on rehabilitation and resulting in cover failure	Climate change modelling into specialist studies where this data may be pertinent (water/ salt balances, geohydrological modelling etc.). Assess climate change data predictions for the area and if there is a high likelihood of climate change impacts, provision for increased care and maintenance over rehabilitated area to ensure this impact can be mitigated post-closure.

29. Risk Drivers Identified

The risk drivers causing the manifestation of the residual/ latent risks identified are included in Table 28-1. The identified risk drivers should be prevented or reduced through implementation of the mitigation measures developed, which are also presented in Table 28-1.

30. Auditing and Monitoring Risk Manifestation

The auditing and monitoring that will be required post-closure to assess, measure and mitigate the identified residual/ latent risks will be included in more detail once there is sufficient information available to support this requirement.

The manifestation of mine affected water decant post-closure can be monitored through on-going groundwater monitoring programme. It must be ensured that boreholes are fully functional and positioned in the correct locations to inform the rate of rebound of groundwater into the mine workings, which will further inform the potential decant date. This groundwater monitoring should regularly be fed into the closure-based geohydrological model to continually improve the accuracy of the model, and the output data supplied by the model (i.e. predictive post-closure groundwater qualities, volumes and expected potential decant). This will allow for more accurate costing of the mitigation measures required to manage this risk in the long-term.

Data collected during continued monitoring and maintenance of rehabilitated areas post-closure should be used to assess potential impacts that climate change may have on the sustainability of vegetation covers. Costs for the corrective rehabilitation action required can be recorded and then projected forward to potentially account for costs required to achieve vegetation covers that are sustainable in the long-term. All rehabilitation monitoring data and maintenance activities implemented should be recorded, and the data should be tested against the site relinquishment criteria to track whether the vegetation is trending towards achievement of these criteria.

31. Alternative Mitigation Measures

At this stage in the project life-cycle alternatives for managing the residual/ latent risks identified have not been evaluated in detail. The long-term water management requirements will likely require an evaluation of alternatives for the treatment of mine water post-closure, where different treatment technology options should be evaluated.

This will only be possible once a closure-based geohydrological model and geochemical assessment has been developed for the mine. This geochemical and geohydrological modelling for closure will inform the expected volumes and qualities of mine water to be managed post-closure, which can then be used for assessing alternative water treatment options.

The discard dump presents a potential alternative, in that this facility could potentially be removed by backfilling the boxcut using discard material, or by selling the material to a contractor for reprocessing. Removing this material will reduce the residual impact associated with groundwater quality deterioration (through seepage from the dump) and will also reduce the chances of cover failure post-closure. It is recommended that options be explored to remove this landform during the operational period to ensure long-term contamination and the associated costs in mitigating these, are reduced or completely prevented.

32. Estimation of Risk Manifestation Timeframes

32.1. Post-Closure Water Treatment

The most significant risk manifestation timeframe to be estimated, is for decant of mine affected water post-closure. Once decant starts water treatment will need to commence, therefore the decant timeframe must be deduced as soon as possible. The decant timeframes should be estimated using the closure-based geohydrological model, and this estimation should be updated on a regular basis, as per the most recent groundwater sampling results.

In the absence of a geohydrological model, a high-level water treatment assessment was undertaken using a first principles approach. An estimation of the time to decant was undertaken using the following parameters:

- Area of the underground workings (year 1): 120 ha (as per the mine plan, see Figure 34-1).
- Assumed average stoping height: 2 m.
- Volume of underground workings: estimated using the above parameters: 2,400,000 m3.
- An extraction rate of 60% was assumed resulting in a total underground void volume of 1,440,000 m3;
- Recharge rate: 8%.
- MAP: 0.78 m.

Base on the above parameters the estimated time to decant is 19 years post-closure, calculated as follows:

- Estimated discharge m^3/annum) = 1,200,000 m^2 (area of underground workings) X 8% (recharge) X 0.78 m (MAP) = 74,880 m^3/annum
- Rebound period = 1,440,000 m^3 (volume of underground workings) / 74,880 m^3/annum = 19 years.

32.2. Subsidence

The time that subsidence will manifest post-closure is yet to be determined. This should be assessed as early as possible in the project life cycle, should the project go ahead, to ensure that the cost to manage this risk is provisioned for appropriately. The time to manifestation of this risk will influence the discount period, and therefor impact the mitigation cost to be provisioned for. Once this time period has been determined the estimated costs for rehabilitation if potential subsidence should be revisited.

33. Amendment Made to the Risk Assessment

This section will be updated with any amendments that may be made to the residual/ latent risk assessment in annual updates of this closure planning document. As knowledge gaps are addressed and new information becomes available to further inform the risks, the risks and the associated rankings and mitigation measures will be amended accordingly.

34. Residual/ Latent Risk Costs

The methodology and results for estimating the residual costs for post-closure water treatment and subsidence is detailed below. The residual closure cost estimate is summarised in Table 34-1.

The cost to implement the mitigation measures for the remaining residual/ latent risks identified will be estimated once the required supporting information is available.

The knowledge gaps to be closed in order to determine these costs is reflected in Section 11 (Part B). These gaps should be closed as soon as possible, to ensure the mine is able to effectively provision for mitigation of these long-term risks to prevent contamination potential post-closure and post site relinquishment.

34.1. Water treatment Cost Estimation

The water treatment costs were estimated for Year 1 of operations (i.e. 120 ha of undergrounding mining disturbance, see Figure 34-1). The water treatment costs are based on the following parameters:

- 4.5% discount rate.
- 19 year rebound period (i.e. time until treatment is required to manage decant).
- Cost per m^3: R 27.00 (typical cost for modular zero liquid discharge (ZLD) treatment in the highveld).
- Discharge (m^3/d): 205 m^3/d.
- Treatment period: 100 years.

The estimated post-closure water treatment costs were calculated as follows:

- 205 m^3/d (decant to be treated per day) X R27.00 (cost per m3) X 365 (days in the year) = R 2,021,760 for treatment per annum.
- It was assumed that the project will go ahead in Year 2022, meaning that water treatment would be required in Year 2042 (2022+1+19).
- This resulted in a total discounted water treatment cost estimate of **R 9,108,118** over a 100 year treatment period, using a 4.5% discount rate.

34.2. Subsidence Cost Estimation

According to the mine plan for the Proposed Arnot South Project the total underground mining area will be 2 081 ha, as reflected in Figure 34-1.

The estimation to mitigate post-closure subsidence assumes that 10% of the underground workings area will require monitoring and maintenance for a period of ten years.

The costs required to rehabilitate the potential subsidence through infilling and revegetation are still to be deduced and included in the residual closure cost estimate, should the proposed project go ahead. The costs for this rehabilitation should be estimated based on the findings of a detailed subsidence risk assessment that is able to predict the backfill requirements for high potential subsidence areas.

The cost for subsidence monitoring was calculated based on the following parameters:

- Risk manifestation: 2039 (i.e. at closure).
- Discount rate: 4.5%.
- Monitoring area: 208 ha.
- Monitoring period: 10 years.

The estimated cost for subsidence monitoring costs were calculated as follows:

- The total discounted cost for subsidence monitoring and maintenance over a ten tear period amounts to **R 12,029,601** (discounted over 27 years, LoM and 10 year post-closure monitoring period).
- The undiscounted cost estimate amounts to **R 39,481,266**.

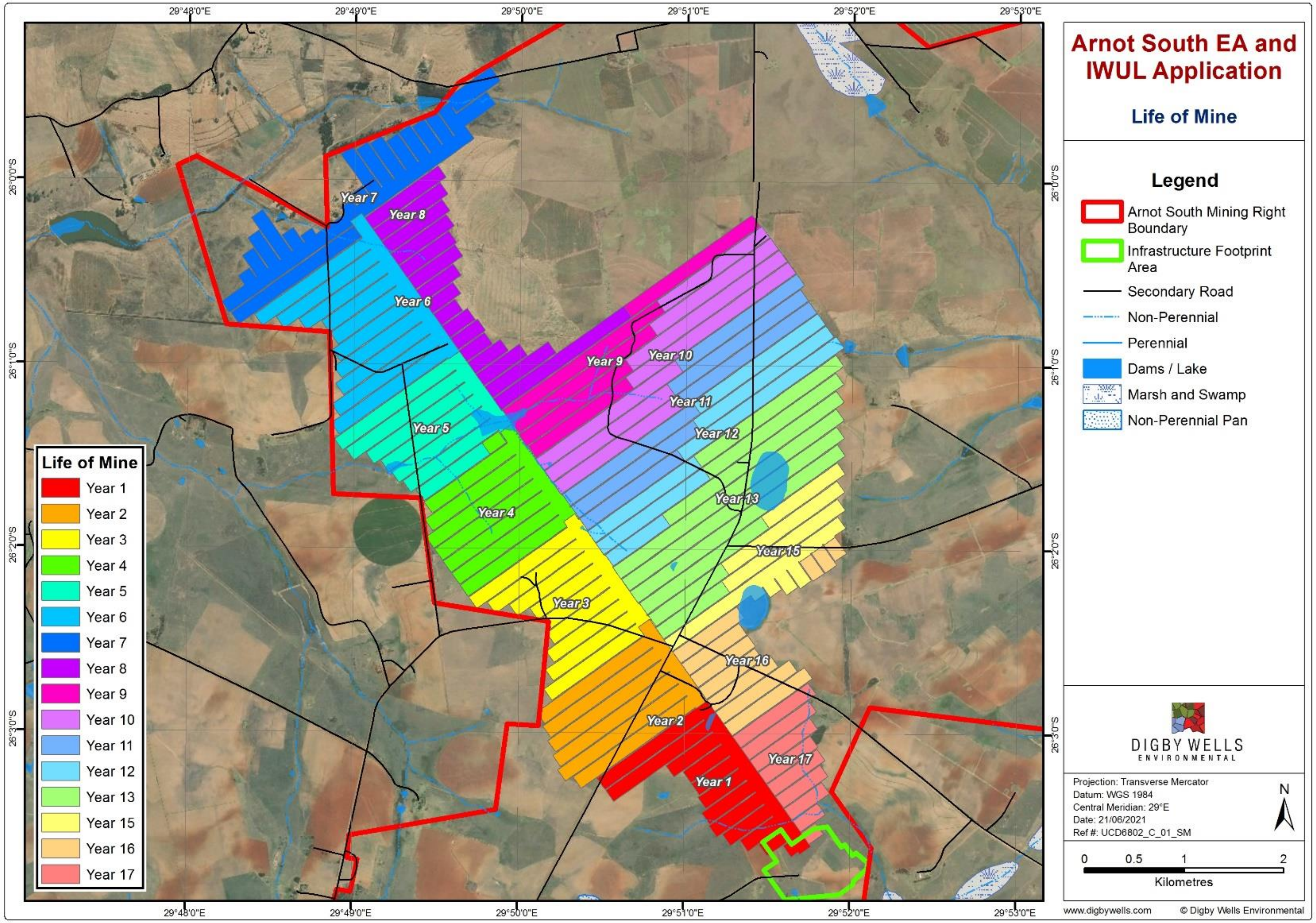

Figure 34-1: Mine Plan Over the LoM

34.3. Residual Closure Cost Estimation Summary

The total discounted residual closure cost estimation amounts to **R 170,002,747** as summarised in Table 34-1. These costs account for post-closure subsidence monitoring and water treatment as described above, and have been discounted at a rate of 4.5%, since the Financial Provisioning Regulations, 2015, allow for discounting of residual risk.

Table 34-1: Residual Closure Cost Estimation Summary

Area and Description	Immediate Closure (Year 1)
Residual Costs (Discounted)	
Rehabilitation of Subsided Areas and Monitoring (10 years)	R 12,029,601.00
Water Treatment Costs (100 years)	R 9,108,118.07
Sub-total	**R 21,137,719**

35. Knowledge Gaps Identified for Residual/ Latent Risks

The following additional work is required to further inform the quantification of the residual/ latent risks identified:

35.1. Post-Closure Water Treatment

- The cost estimate for long-term water treatment was undertaken using high level assumptions and will need to be reworked once more accurate supporting information is available;
- Key parameters to be reassessed include the recharge rate applied and the volume of the underground workings. It is noted that subsidence over shallow mining areas could significantly increase the recharge of rainwater to the underground workings and could therefore increase the required water treatment cost;
- These parameters should be fed into a closure based geohydrological model to more accurately predicted decant dates, and water treatment costs based on the predicted geochemistry of the mine water; and
- The water treatment cost estimation was based on ZLD modular treatment per cubic meter, which is inclusive of Capex and Opex. This treatment methodology should be updated to reflect the mines long-term water management strategy, should the project go ahead.

35.2. Subsidence

- A detailed subsidence risk assessment should be undertaken by a rock engineer as early in the project life cycle as possible, to estimate the potential subsidence impact post-closure, and to estimate the time of manifestation of this risk;

- The above is especially pertinent, since the cost implications for management of this risk could be significant, because shallow underground mining is planned over a large area; and
- The costs required for infilling/ backfilling subsided areas post-closure are still to be estimated and provisioned for to further mitigate this residual risks. Potential backfill volumes over high subsidence areas should be assessed through a detailed predictive subsidence risk assessment.

35.3. Post-Closure Care and Maintenance

- There may be potential residual liability associated with prolonged monitoring and care and maintenance over the rehabilitated areas, which may currently be under-provisioned for (i.e. five years for rehabilitation monitoring and care and maintenance may not be a long enough period to meet the site relinquishment criteria), particular over the discard dump, should this facility remain post-closure; and
- Operational rehabilitation monitoring is required to inform the monitoring period required post-closure and the intensity and period of care and maintenance required over the rehabilitated areas post-closure.

36. Conclusions

The identification and ranking of residual/ latent risks for closure will continue to be assessed on an annual basis should the proposed project go ahead. The risk rankings and the required mitigation measures may change once the work detailed in Section 35 becomes available to further inform the likelihood and consequence of the risks identified. This additional work will also be used to assess the cost for mitigation of the risks where applicable.

The cost to mitigate these risks will be refined base on this information and included as residual/ latent costs in the mines financial provisioning for closure, to ensure that the required provision is available to manage post-closure contamination in the long-term.

PART C: ANNUAL REHABILITATION PLAN

37. NEMA Compliance Checklist

The Annual Rehabilitation Plan (ARP) is structured to align with the minimum requirements set out in Appendix 3 of the Financial Provisioning Regulations, 2015 (as amended). The requirements are provided in Table 37-1.

The ARP is not applicable to the proposed Arnot South Project at this stage, since the mine is still to be developed, should the project be approved by the relevant regulatory authorities.

Should the project go ahead, this Section will be updated annually to reflect any annual rehabilitation that is planned on site.

Table 37-1: Minimum Requirements of the Annual Rehabilitation Plan (Financial Provisioning Regulations, 2015, as amended)

Content of an Annual Rehabilitation Plan
The Annual Rehabilitation Plan will be relevant for a period of 12 months, after which the plan is to be updated to reflect progress relating to rehabilitation and remediation activities in the preceding 12 months and the updated extraction and rehabilitation schedules as well as the budget for the forthcoming 12 months. The Annual Rehabilitation Plan must contain information that defines concurrent rehabilitation and remediation activities for the forthcoming 12 months and how these relate to the operations' closure vision and sustainable end state, as detailed in the final rehabilitation, decommissioning and closure plan. The Annual Rehabilitation Plan must indicate what closure objectives are being achieved through the implementation of the plan, it must be measurable and auditable and must include-
(a) Details of the- (i) Specialist or specialists that prepared the plan; (ii) Professional registrations and experience of the specialist or specialists; (iii) Applicant or holder, including but not limited to the name, physical address, postal address and contact details; and (iv) Timeframes of implementation of the current, and review of the previous rehabilitation activities.
(b) The pertinent environmental and project context highlighting issues which are different to those indicated and considered in the final rehabilitation, decommissioning and mine closure plan which relate directly to the planned annual rehabilitation and remediation activity (e.g. drought, machine failure or anomaly).
(c) Results of modelling and monitoring plans for the preceding 12 months with a view to informing rehabilitation and remediation activities going forward.
(d) An identification of shortcomings experienced in the preceding 12 months.
(e) Any risk which materialised or anomalies which impacted on the environment over the preceding 12 months, and how these were incorporated into the risk model for the operations.

Content of an Annual Rehabilitation Plan
(f) Details of the planned annual rehabilitation and remediation activities or measures for the forthcoming 12 months, including those which will address the shortcomings contemplated in (d) above or which were identified from monitoring in the preceding 12 months, and including- (i) If no areas are available for annual rehabilitation and remediation concurrent with mining, an indication to that effect and motivation why no annual rehabilitation or remediation can be undertaken;
(ii) Where areas are available for annual rehabilitation and remediation the following information must be tabulated; (aa) Nature or type of activity and associated infrastructure to be undertaken; (bb) Planned remaining life of the activity under consideration; (cc) Area already disturbed or planned to be disturbed in the period of review; (dd) Percentage of the area already disturbed, including the bulking factor and material stockpiled; (ee) Percentage of the area to be disturbed and the anticipated bulking factor and volume of material for stockpiling; (ff) Area and volume of material available for concurrent rehabilitation and remediation activities; (gg) Percentage of the area disturbed and volume of material identified in (dd) above and on which concurrent rehabilitation and remediation can be undertaken; (hh) Notes to indicate why total available or planned to be available area differs from area already disturbed or planned to be disturbed; (ii) Notes to indicate why concurrent rehabilitation will not be undertaken on the full available or planned to be available area; (jj) Details of rehabilitation activity planned on the area for rehabilitation for the forthcoming 12 months; (kk) Description of the relevant closure design criteria adopted in the annual rehabilitation and remediation activities and the expected final sustainable end state of land once all rehabilitation and remediation activities are complete for the activity or aspect.
(g) A site plan indicating at least the total area disturbed, area available for rehabilitation and remediation and the area to be rehabilitated or remediated per aspect or activity;
(h) A review of the preceding 12 months annual rehabilitation and remediation activities, indicating a comparison between activities planned in the previous year's annual rehabilitation and remediation plan and actual rehabilitation and remediation implemented, which should be tabulated and as a minimum contain- (i) Area planned to be rehabilitated and remediated during the period under review; (ii) Actual area rehabilitation or remediated; and (iii) If the variance between planned and actual exceeds 15%, motivation indicating reasons for the inability to rehabilitate or remediate the full area.

Content of an Annual Rehabilitation Plan
(i) Costing, based on market related figures, including- (i) An explanation of the closure cost methodology; (ii) Auditable calculations of costs per activity or infrastructure; (iii) Cost assumptions; and (iv) Monitoring and maintenance costs likely to be incurred during the period of execution of the annual rehabilitation.

38. Introduction

Annual rehabilitation planning is essential to ensure concurrent rehabilitation is implemented on site where possible. Concurrent rehabilitation lowers the financial provisioning required for closure and timely rehabilitation also allows the opportunity to undertake operational rehabilitation monitoring and maintenance, which reduces the residual risk of post-closure vegetation failure.

The ARP describes the concurrent rehabilitation actions to be committed to, implemented, and subsequently reported on in iterative annual updates of the closure planning reports. The ARP also costs the planned concurrent rehabilitation to be implemented by the mine, to ensure that these actions can be budgeted for appropriately.

The ARP is not applicable to the proposed Arnot South Project at this stage, since the mine is still to be developed, should the project be approved by the relevant regulatory authorities.

Should the project go ahead, this Section will be updated annually to reflect any annual rehabilitation that is planned on site.

39. Closing Statement

Closure and rehabilitation is a continuous series of iterative activities that should begin with planning prior to the project's design and construction; and end with achievement of long-term site stability and the establishment of a self-sustaining ecosystem.

Not only will the implementation of this concept result in a more satisfactory environmental outcome, but it will also reduce the financial burden of closure and rehabilitation. This closure plan provides a sound foundation for developing detailed rehabilitation measures to close the operational activities safely and sustainably and according to its closure objectives, should the proposed project go ahead.

Figure 39-1 illustrates that there are feedback loops between each element resulting in the iterative planning process as the knowledge base is expanded.

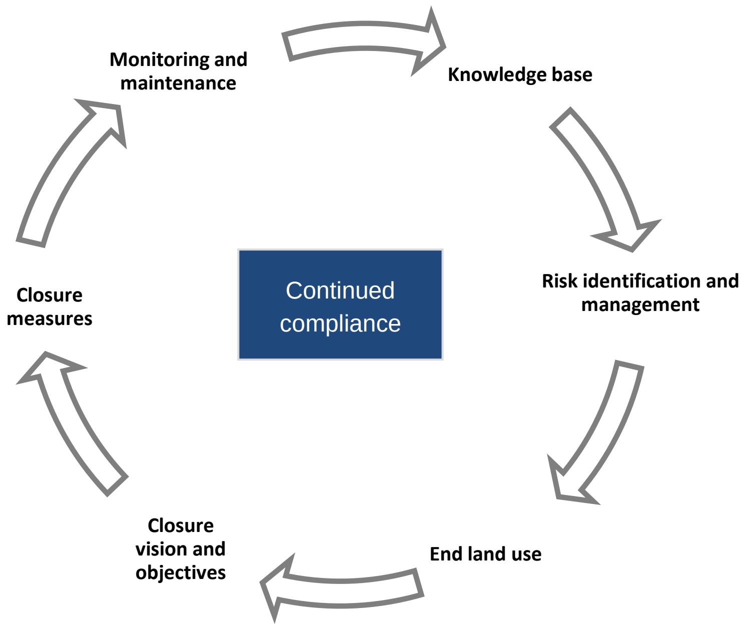

Figure 39-1: Iterative process of mine closure planning elements

40. References

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Appendix A: Environmental Risk Assessment