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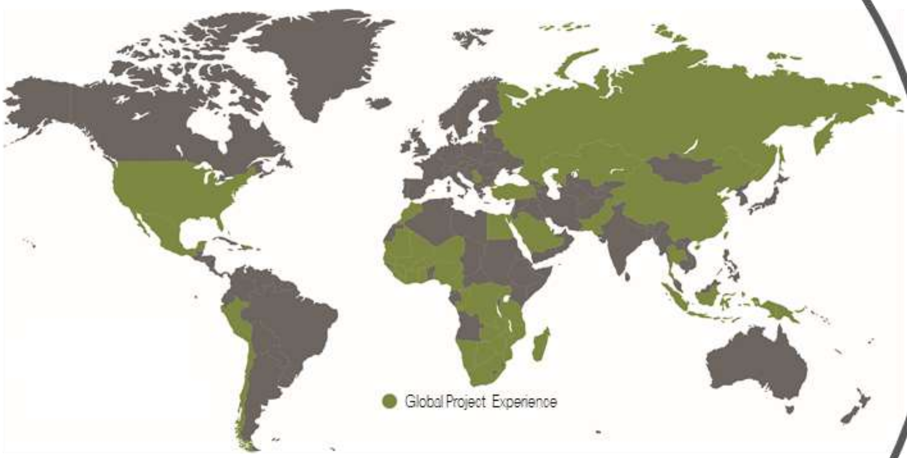

Providing innovative and sustainable solutions throughout the resources sector

Proposed Arnot South Coal Mining Project, Situated near Hendrina, Mpumalanga Province

Wetland Environmental Impact Assessment

Prepared for:
Universal Coal PLC

Project Number:
UCD6802

June 2021

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This document has been prepared by Digby Wells Environmental.

Report Type:	Wetland Environmental Impact Assessment
Project Name:	Proposed Arnot South Coal Mining Project, Situated near Hendrina, Mpumalanga Province
Project Code:	UCD6802

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I, Willnerie Janse van Rensburg, declare that: –

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

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

June 2021

Signature of the Specialist *Date*

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

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EXECUTIVE SUMMARY

Digby Wells & Associates South Africa (Pty) Ltd (Digby Wells) was appointed to conduct an Environmental Authorisation (EA) and Water Use Licence (WUL) required for the proposed Arnot South Underground Coal Mining Project (Arnot South Project). The Prospecting Right, MP 30/5/1/1/2360 PR was issued to Exxaro Resources, and the Applicant for this process will be Exxaro Coal Mpumalanga (Pty) Ltd to mine coal on various farms covering approximately 16,000 hectares (ha) in extent.

This report should be read in conjunction with the other specialist studies of the EA and constitutes the Wetland Impact Assessment in support of the Environmental Impact Assessment (EIA) process and compilation of the Environmental Management Programme (EMPr), Integrated Water Use License Application (IWULA) and Integrated Water and Waste Management Plan (IWWMP).

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).

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.

The overall impacts of the Project were determined to be **Minor** to **Major** prior-mitigation 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. However, post-mitigation the impacts are reduced to **Negligible** and **Major**. Underground mining contains the risk of subsidence, dewatering, decanting and contamination which might impact the wetlands significantly.

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 (refer to Section 8);
- 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.

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 wetland management and monitoring requirements as set out in Sections 11 and 12 and the recommendations in Section 14 should form part of the conditions for the EA. A wetland offset strategy should be implemented to compensate for residual wetlands lost and should improve wetland health and functionality of wetlands and freshwater systems in the adjacent area and catchment. It is recommended to include at least a 100 m buffer around the wetlands for the surface infrastructure. Wetlands and natural water resources are a valuable natural asset, especially within the Highveld area*.*

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degree Celsius
AIP	Alien Invasive Plant
AMD	Acid Mine Drainage
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CBA	Critical Biodiversity Area
cm	Centimetre
CMA	Catchment Management Agencies
CSIR	Council for Scientific and Industrial Research
CVB	Channelled Valley Bottom
DEA	Department of Environmental Affairs
Digby Wells	Digby Wells Environmental
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation, previously Department of Water Affairs and Forestry (DWAF)
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIA Regulations, 2014	Environmental Impact Assessment Regulations, 2014 (GN R982 of 04 December 2014, as amended)
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EP	Environmental Practitioner
ESA	Ecological Support Area
FEPA	Freshwater Ecological Priority Area
GA	General Authorisation
GN	General Notice
ha	Hectare
HGM	Hydro-geomorphic
I&APs	Interested and Affected Parties
IUCN	International Union for Conservation of Nature
IWUL	Integrated Water Use License

IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
km	Kilometre
LoM	Life of Mine
m	Metre
m.a.m.s.l.	Metres above mean sea level
MAP	Mean Annual Precipitation
MBSP	Mpumalanga Biodiversity Sector Plan
mm	Millimetre
MM	Mine Manager
MPRDA	Mineral and Petroleum Resources Development Act
MRA	Mining Right Area
Mt	Million tonnes
MTPA	Mpumalanga Tourism and Parks Agency
NBA	National Biodiversity Assessment
NBF	National Biodiversity Framework
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM: BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM: WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NFEPA	National Freshwater Ecological Priority Area
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PES	Present Ecological State
PPP	Public Participation Process
RoM	Run of Mine
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SCC	Species of Conservational Concern
SEP	Stakeholder Engagement Process
SFI	Soil Form Indicator
STP	Sewage Treatment Plant

SWI	Soil Wetness Indicator
TUI	Terrain Unit Indicator
UVB	Unchannelled Valley Bottom
VBs	Valley Bottoms (including channelled and Unchannelled valley bottoms)
WET-EcoServices	Wetland Ecological Services
WET-Health	Wetland Ecological Health Assessment
WRC	Water Research Commission
WTP	Water Treatment Plant
WUL	Water Use License
WWF	Worldwide Fund for Nature

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-xiv	
(a)	details of-	xiv
	(i) the specialist who prepared the report; and	xiv
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	xiv
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	1.7
cA	And indication of the quality and age of the base data used for the specialist report;	1.7
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	10.2
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	5
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	5
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	8
(g)	an identification of any areas to be avoided, including buffers;	8
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	10
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	3
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	7
(k)	any mitigation measures for inclusion in the Environmental Management Programme (EMPr);	9
(l)	any conditions/aspects for inclusion in the environmental authorisation;	14
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	12
(n)	a reasoned opinion (Environmental Impact Statement) -	15

Legal Requirement		Section in Report
	whether the proposed activity, activities or portions thereof should be authorised; and	
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	11
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	13
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	15

1. Introduction

Digby Wells has been appointed to conduct environmental-legal applications required for the proposed Arnot South Project. The Prospecting Right, MP 30/5/1/1/2360 PR was issued to Exxaro Resources, and the Applicant for this process will be Exxaro Coal Mpumalanga (Pty) Ltd to mine coal on various farms in the Mpumalanga province. The proposed Mining Right Area (MRA) covers approximately 16,000 ha in extent, however not all of the MRA will be mined.

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) prior to the lapsing date (on 8 September 2020). The Applicant was issued reference number MP 30/5/1/2/2/10292 MR.

Digby Wells has been appointed to undertake various environmental-legal applications for the underground mining of various farm portions within the proposed MRA. This report should be read in conjunction with the other specialist studies and constitutes the Wetland Impact Assessment.

1.1. Terms of Reference

Digby Wells has completed a comprehensive reconnaissance Wetland Impact Assessment for the proposed underground mining and associated surface infrastructure to be established for the mining of Arnot South Project Area. The Wetland Impact Assessment has been completed in support of the Environmental Impact Assessment (EIA) process and compilation of the Environmental Management Programme (EMPr), Integrated Water Use License Application (IWULA) and Integrated Water and Waste Management Plan (IWWMP), in accordance with the following relevant legislation:

- EIA Regulations, 2014 (General Notice (GN) R982 of 04 December 2014, as amended) (the "EIA Regulations, 2014) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- 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).

1.2. Project Background

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 mineral reserve consists of one economically mineable underground section (No. 2 coal seam), producing approximately 2.4 million tonnes per annum (Mtpa) of Run of Mine (RoM) coal for approximately 17 years. Further drilling will be required to confirm a resource to the south of the MRA. The potential future resource of the remaining RoM coal is approximately 32,912,300 tonnes, allowing an additional mining period of approximately 13 years. This application only considers the use of underground board-and-pillar mining with continuous miners due to the depth and thickness of the reserve, for the initial 17-year Life of Mine.

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 this reserve. Digby Wells is the appointed Environmental Assessment Practitioner (EAP) to undertake the environmental applications in support of the proposed Project.

1.3. Study Areas

For the purpose of this report, the following applies:

- MRA defines the farms included in the Arnot South Project Area boundary (red outlined area on the maps);
- Project Area defines farm portions directly associated with Arnot MRA (red outlined area on the maps);
- Infrastructure area refers to the area where the proposed surface infrastructure will be constructed (small zoomed in section in all the maps); and
- The Zone of Regulation is the 500m area surrounding a wetland in which activities must be authorised by a Water Use Licence (WUL).

1.4. Project Locality

The Project Area falls under the jurisdiction of the Chief Albert Luthuli and Steve Tshwete Local Municipalities, located in the Gert Sibande and Nkangala District Municipalities respectively, Mpumalanga Province (Table 1-1; Figure 1-1).

There are five farm homesteads situated within the planned underground mining area. 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.

Table 1-1: Summary of the Project Location Details

Province	Mpumalanga
District Municipality	Gert Sibande District Municipality Nkangala District Municipality
Local Municipality	Chief Albert Luthuli Local Municipality Steve Tshwete Local Municipality
Nearest Town	Hendrina (10 km), Carolina (25 km), Middleburg (50 km)
Property Name and Number for the Arnot MRA	Groblersrecht 175 IS Schoonoord 164 IS Mooiplaats 165 IS Vlakfontein 166 IS Tweefontein 203 IS Vryplaats 163 LQ Vaalwater 173 IS Helpmakaar 168 IS Weltevreden 174 IS Op Goeden Hoop 205 IS Nooitgedacht 493 JS Klipfontein 495 JS Leeuwpan 494 JS
Application Area (Ha):	~16,000 ha
Distance and direction from nearest town:	50 km southeast of Middelburg
GPS Co-ordinates **(Relative centre point of study area)**	29.8634 -26.0171

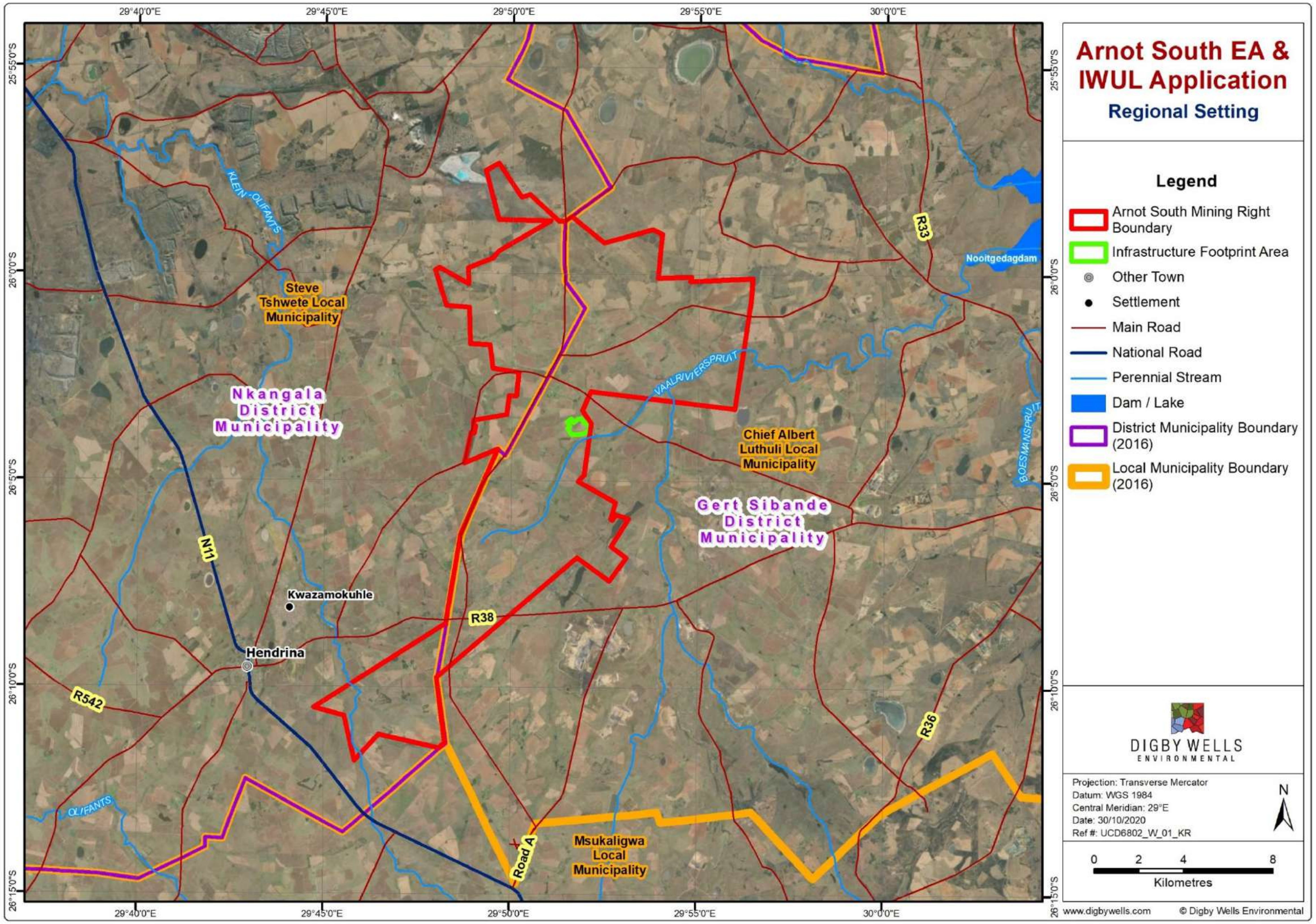


Figure 1-1: Regional and Local Setting

1.5. Proposed Infrastructure and Activities

As indicated in Table 1-2 and illustrated in Figure 1-2 and Figure 1-3 below, proposed activities for the Arnot South Project will trigger listed activities under Listing Notice 1 (GN R983 of 04 December 2014, as amended) and Listing Notice 2 (GN R984 of 04 December 2014, as amended) of the EIA Regulations, 2014; and therefore, an EIA process must be undertaken and approval received prior to the activities commencing. Table 2-1 details the Project activities for the duration of the Construction, Operational and Rehabilitation Phases.

Table 1-2: Project Phases and Associated Activities

Phase	Activity
Construction	Site/vegetation clearance (52.281385 ha)
	Diesel storage and explosives magazine
	Establishment of infrastructure (Infrastructure footprint - 13.2849 ha; linear infrastructure - 51 501 m) Ventilation fans, change houses, offices, ablutions, workshops, cable workshop, weighbridge, weighbridge control room and access control office
	Construction of access and haulage road (19 113 meters), Power line construction 22kV line, 2.3 km long
	Construction of Pollution control dam (PCD) (1.6078 ha), Raw water pipeline, Process water, Sewage treatment plant (STP)
	Stockpiling of soils, rock dump and discard dump establishment.
Operational	Operating STP (18.3168 m (combination of two delineations)), PCD, raw water pipeline, process water, washing plant
	Mining of coal by underground mining (underground) (5 050.83 ha) Removal of rock (blasting). Rock/discard dumps, soils, ROM, discard dump (discard dump 2946 ha and Overburden stockpile 13716 ha)
	Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste
	Maintenance of haul roads, pipelines, machinery, water, effluent and stormwater management infrastructure and stockpile areas.
	Continue with exploration activities
Decommissioning	Demolition and removal of infrastructure.
	Post-closure monitoring and rehabilitation.
	Closure of the underground mine.

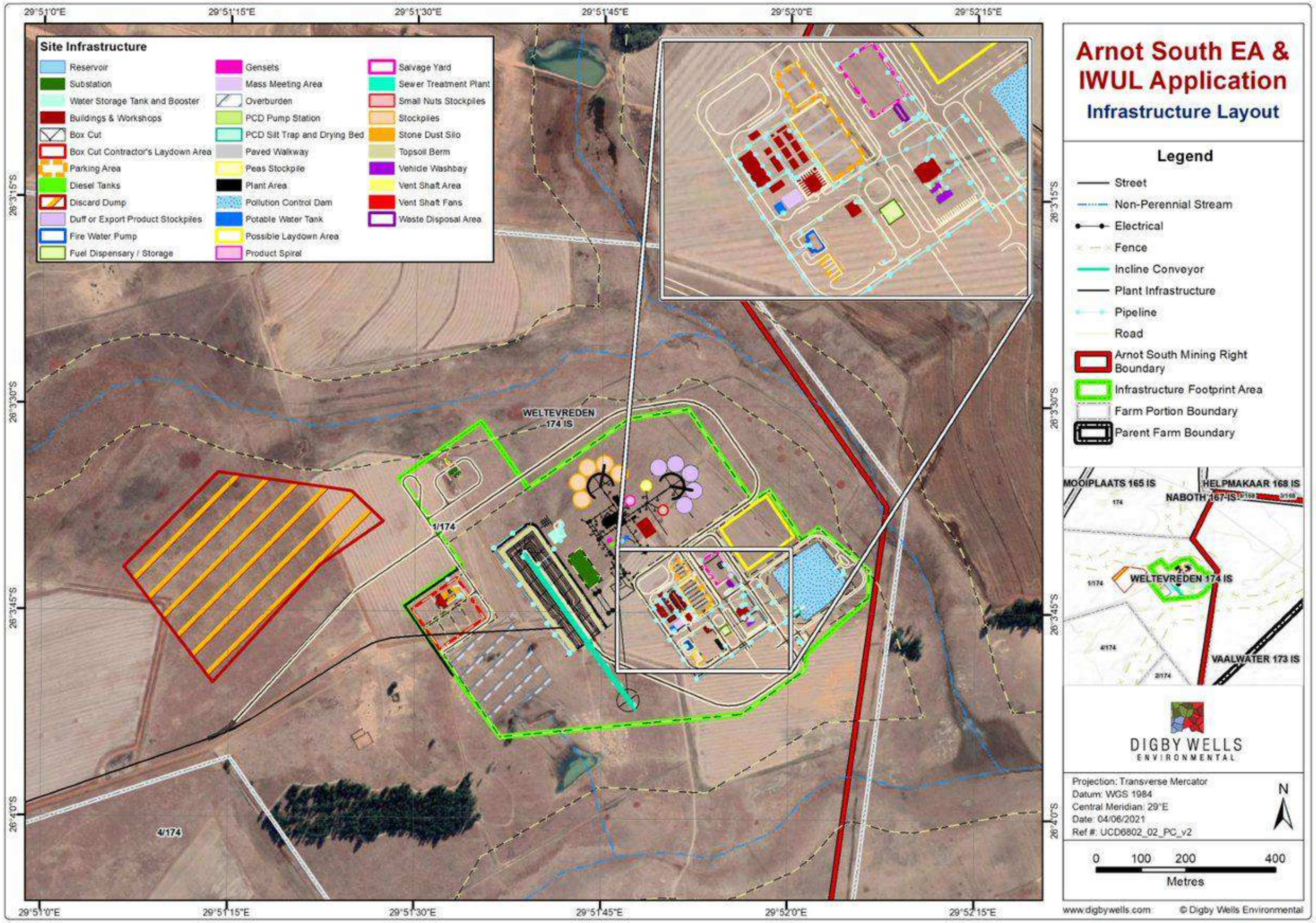


Figure 1-2 Preliminary Infrastructure Layout Plan

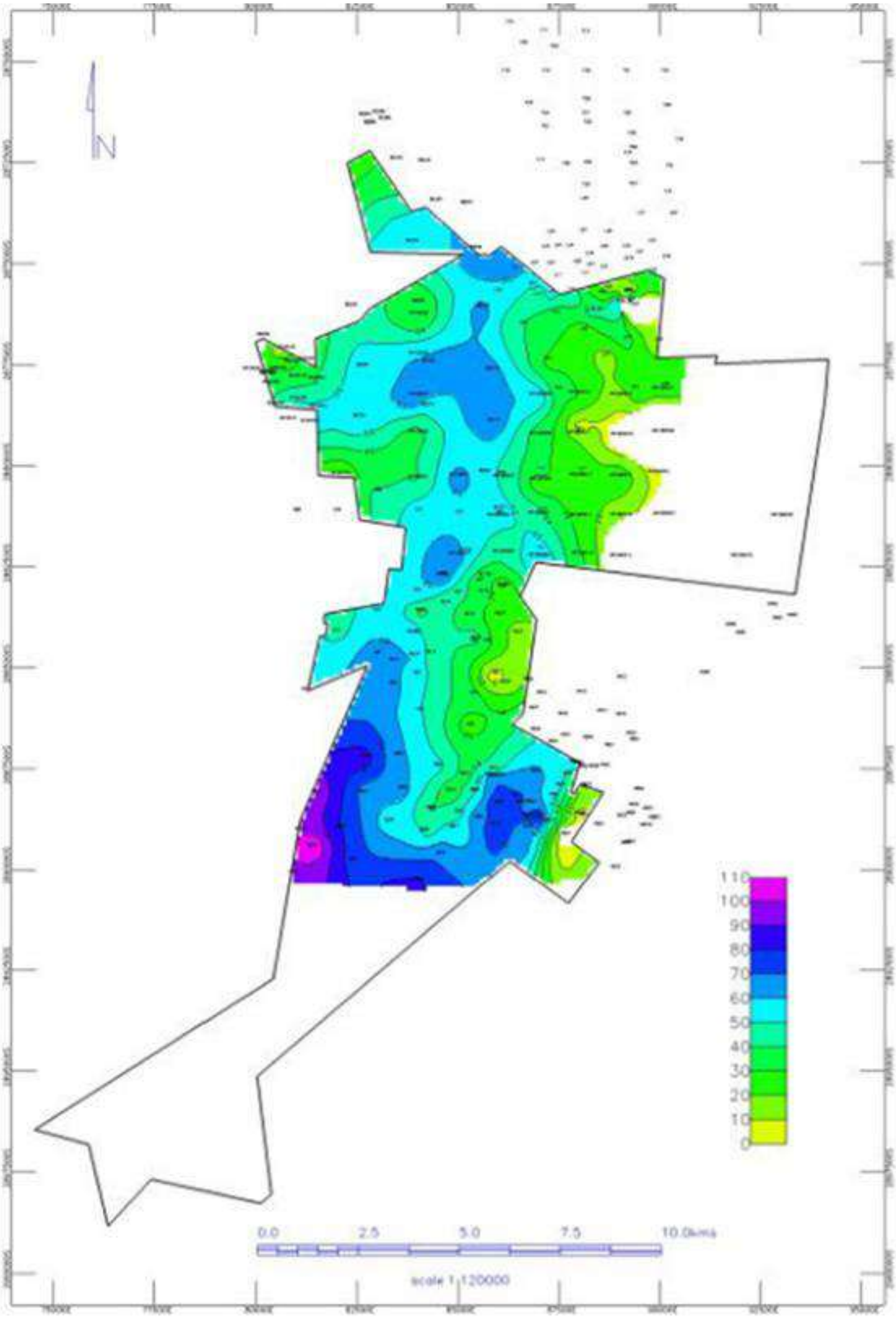


Figure 1-3 No. 2 Coal Seam Elevation (Source: Arnot South Mining Works Programme, 2020)

1.6. Alternatives Considered

Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives also help identify the activity with the least environmental impact. The alternatives to be considered to ensure minimal impacts to the wetlands are described in Table 1-3.

Table 1-3: Alternatives and Consequences

Alternative	Consequence
Location of the Project The location was dictated by Exxaro's Prospecting / Mining Right and therefore there are no feasible alternative locations for Exxaro.	The Project Area consist of various wetlands that may potentially be impacted due to subsidence, dewatering, decanting and impacts from the proposed surface infrastructure. The proposed surface infrastructure is proposed to be located within in delineated wetlands as well as in the 500 metre (m) zone of regulation.
Mining Method Alternatives Due to the depth of the No. 2 coal seam to be mined, the method of coal extraction will be by underground mine and bord and pillar mining with continuous miners and shuttle cars and not opencast mining.	Underground mining activities are proposed to have less impacts to the wetlands than opencast mining, however, there will likely be impacts to the wetlands e.g., potential dewatering, decanting, subsidence and surface infrastructure related impacts.
Technology Alternatives The preferred technology for the Project is wet washing processing technology and not dry processing.	Wet washing of coal increases the use of water and potential contaminated water re-entering the freshwater systems and wetlands. This will lead to potential wetland contamination and reduced wetland health and functionality.
The "No-Go" Alternative The No-go alternative is the option of not mining coal in the area. This option also means that all potential negative impacts associated with the proposed mine and its associated infrastructure would not occur.	'No-go' areas (e.g., buffer zones, 500 m and 100 m zone of regulations) will assist in protecting wetlands and their functionality. 'No-go' areas are discussed in Section 0. However, subsidence, dewatering and decanting of wetlands is likely to occur.
Consider identifying wetlands in the Project Area that will be avoided, protected and rehabilitated to compensate for wetlands to be impacted by the surface infrastructure and potential dewatering and decanting due to underground mining.	The impacts to the wetlands will be reduced however, wetlands might still be impacted by drawdown water, soil and wind pollution, runoff, sedimentation, contamination, erosion and loss of biodiversity.
Consider finding alternative areas for the surface infrastructure to avoid wetlands	This will reduce impacts on wetlands, as well as adjacent and downstream freshwater systems.

1.7. Scope of Work

The field assessment for the Wetland Impact Assessment was carried out on the 20th to the 23rd of April 2021. The Scope of Work for the Wetland Impact Assessment included:

- **Desktop Assessment** of historical reports, previous delineations, catchment data, regional background information and identifying additional freshwater resources within the Project Area;
- **Wetland Delineation Verification**, identification and characterisation of wetlands and Zone of Regulation within the Study Area. Due to time and budget constraints, focus was given to the proposed surface infrastructure areas and areas where extraction will be close to the surface;
- **Wetland Health Assessment** of the wetlands within the Study Area, including the PES, wetland ES, and EIS;
- **Sensitivity mapping** and recommendations of Zone of Regulation according to the guidelines set out in Water Research Commission (WRC) Report No. TT610/14, 2014 (Macfarlane, D.D., *et al*, 2014);
- **Impact assessment** of the proposed activities based on the findings of the desktop and field assessments concerning the proposed activities and infrastructure; and
- **Mitigation and Management Plan** together with recommendations for inputs to the rehabilitation and management plan for the LoM.

2. Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the National legislations, regulations, guidelines and by-laws. The guidelines directing the Wetland Impact Assessment are detailed in Table 2-1.

Table 2-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA) The NEM:BA 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. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance: • Alien and Invasive Species Lists, 2020 (terms of GN R1003 of 18 September 2020 – effective from 18 October 2020); • 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 (GN R1002 of 9 December 2011).	• The Wetland Impact Assessment process was undertaken to identify wetlands, potential impacts to the wetlands and freshwater systems, threatened species, protected species and areas dominated by Alien Invasive Plants (AIPs); and • As part of the Wetland Impact Assessment, applicable mitigation measures, monitoring plans and/or remediation were recommended to ensure that any potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution.
National Water Act, 1998 (Act No. 36 of 1998) (NWA) • Section 19 of the NWA that include the prevention and remediation of the effects of pollution; and • Section 21 (c), (g) and (i) of the NWA that include the use of water.	• A Wetland Impact Assessment was undertaken as part of the EIA Phase. The EIA identified possible water usages, impacts, and possible preventions and remediation strategies; • EMPr and Monitoring Program is included in the EIA Phase; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) NEMA (as amended) was set in place under Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment must be considered, investigated and assessed before their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated.	• Activities that will influence the Wetlands are listed in Section 1.5 and have been identified as Listed Activities in the Listing Notices (as amended) and therefore require environmental authorisation before being undertaken.
Department of Water and Forestry (DWAF) Guidelines for the Delineation of Wetlands (2005) To delineate any wetland the following criteria are used as in line with the DWAF: A practical field procedure for identification and delineation of wetlands and riparian areas (2005). These criteria are: • Topographical location of the wetland in the landscape; • Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation (such as grey horizons, mottling streaks, hardpans, organic matter depositions, iron and manganese concretion resulting from prolonged saturation); • A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 centimetres (cm) of the soil; and • The presence, at least occasionally, of water-loving (hydrophilic) plants (i.e. hydrophytes).	• This guideline is a tool for wetland practitioners, at all levels, to improve procedures for mapping wetlands using a set of standards for data collection and storage, so that data feeds into national-level databases such as the National Wetland Inventory and that informs national policy tools such as National Freshwater Ecosystem Priority Areas (NFEPA); and • It also includes tips on recognising, digitising, and classifying wetlands and human impacts on wetlands from desktop imagery and in the field.

Legislation, Regulation, Guideline or By-Law	Applicability
Wetland Management Series (published by Water Research Commission (WRC, 2007) The WET-Management Series is a set of integrated tools that can be used to guide well-informed and effective wetland management and rehabilitation. The WET-Management tools are designed to be used at different spatial and institutional levels as needed, from national and provincial to the level of specific wetland sites involving individual landowners, to meet a range of wetland management and rehabilitation needs.	• Provides background information about wetlands and natural resource management as well as tools that can be used to guide decisions around wetland management.
National Freshwater Ecological Priority Area (NFEPA) The NFEPA project was a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water and Sanitation (DWS) formerly known as the Department of Water Affairs and Forestry (DWAF)), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute for Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The NFEPA project aimed to: • Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and • Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers. The NFEPA study responded to the high levels of threat prevalent in a river, wetland, and estuary ecosystems of South Africa. It provides strategic spatial priorities for conserving the country's freshwater ecosystems and supporting the sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or 'FEPAs'.	• This guideline assisted to ensure that healthy freshwater ecosystems continue to form the cornerstone of the implementation of our water resource classification system and the development of catchment management strategies throughout the country. They also inform planning and decisions about land use and the expansion of the protected area network. By highlighting which ecosystems should remain in a healthy and well-functioning state, the maps provide a tool to guide our choices for the strategic development of water resources and to support sustainable development.
South African National Biodiversity Institute (SANBI), in collaboration with the Department of Water and Sanitation (DWS) report on "Wetland offsets: a Best-Practice Guideline for South Africa" This guideline serves as a practical tool to aid in the consistent application of wetland offsets in South Africa. The guideline is primarily aimed at wetland offsets required as part of water use authorisation processes (e.g., in an IWULA under the NWA) where compensatory actions are required to achieve water resources management and biodiversity conservation objectives. The guideline is equally relevant for use in EIA processes (e.g., as part of the environmental authorisation process in terms of the NEMA or an application for a mining right or development of an EMPr under the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)). Wetland offsets are enduring measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse impacts on wetlands. They are implemented to address any anticipated significant residual impacts arising from development projects after appropriate avoidance, minimisation, and rehabilitation measures have been considered. The goals of wetland offsets are to achieve 'No Net Loss' and preferably a net gain concerning the full spectrum of functions and values provided by wetlands. These include: • Water resource and ecosystem service value, especially concerning regulating and supporting functions pertinent to water resource management and disaster risk reduction, such as flood control and water quality enhancement, but also including direct services such as food and water provisioning and cultural services such as spiritual, recreational, and cultural benefits that sustain communities; • Ecosystem conservation, especially in terms of meeting national, provincial and local objectives for habitat protection and avoiding a deterioration in ecosystem threat status; and • Species of conservation concern, to ensure that the status of threatened, rare or keystone wetland dependant species is maintained or improved.	• The guideline provides practical guidance for determining the size and characteristics of a wetland offset and determining the requirements for its implementation once a decision on the need for a wetland offset has been taken through the water use authorisation process by the DWS.
General Authorisation (GA) in Terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) The General Authorisation (GA) defines a 'regulated area of a water course' for, Section 21(c) Or Section 21(i) of the Act water uses in terms of this notice as: • The outer edge of the 1 in 100-year flood line and /or delineated riparian habitat whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench *(subject to compliance to section 144 of the Act)*; or A 500 m radius from the delineated boundary (extent) of any wetland or pan.	• The guideline provides practical guidance for determining the Wetland delineations and sensitivity maps include a 500 m and a 100 m "regulated area of a water course', also known as a 500 m 'zone of regulation'.

3. Assumptions, Limitations and Exclusions

The compilation of this Report is based on the following assumptions and limitations in Table 3-1.

Table 3-1: Limitations and Assumptions with Resultant Consequences of this Report

Assumptions and Limitations	Consequences
Wetlands within a 500 m zone of regulation outside the Project Area were assessed to account for potential catchment-based impacts. These wetlands were assessed on a desktop level with only limited ground-truthing.	Some discrepancies within the buffer zone of regulation may occur such as the confidence level of delineations and wetland health assessments.
Due to the size of the Project Area and cost and time limitations: • Site assessment was mostly focused on the proposed surface infrastructure areas as well as areas of high extraction which are expected to be impacted to a greater extent; • HGM units were grouped according to dominant land use and catchments; and • Access to the entire MRA was not granted.	• Some discrepancies within the Project Area may occur such as the confidence level of delineations and wetland health assessments. These systems were mostly scrutinised at a desktop level using aerial imagery; • Some discrepancies with the wetland assessments (PES, EIS and ES) might occur due to grouping of systems; and • Field verification was limited to areas where access was granted.
This wetland study forms part of a larger EIA and should be read in conjunction with the EIA and other related specialist studies. No form of this report may be amended or extended without the prior written consent of the author and/or a relevant reference to the report by the inclusion of an appropriately detailed citation. Any recommendations, statements, or conclusions drawn from or based on this report must cite or reference this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.	This report does not include any other specialist studies other than the wetland assessment. The wetland report cannot be used as a stand-alone report in the EMPr, IWULA or IWWMP.

Assumptions and Limitations	Consequences
The Wetland Assessment was conducted during a one-season survey only	Some restrictions to vegetation diversity, identification and flows in the systems. Findings, recommendations, and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation.
Wetlands are dynamic systems and change over time. Due to historical and current land use activities (dominantly intensive agropastoral activities) some areas have been highly impacted, changing the naturally occurring vegetation, hydrology and geomorphology.	Some discrepancies with the wetland delineations may occur due to changing impacts on the wetlands; for example, intensive vegetation clearing, sedimentation, water extraction, damming, excavations, stockpiling and cultivation within or in proximity of wetlands.
The Wetland Impact Assessment does not include a wetland offset strategy.	A wetland offset should be considered only after appropriate avoidance, minimisation and restoration measures have been applied and must adhere to the 'like-for-like' or 'better-principle'. External experts with knowledge in offset design and implementation should be approached, after the EIA has been approved.

4. Details of the Specialist

The following is a list of Digby Wells' staff who was involved in the Wetland Environmental Impact Assessment:

- **Kathryn Terblanche** is the Rehabilitation and Soils Manager at Digby Wells. She received a Bachelor of Science in Ecology and Environmental Science and an Honours degree in Environmental Management from the University of Cape Town. She also has received her M.Sc. in Restoration Ecology through the University of KwaZulu-Natal. Kathryn is an ecologist with fields of interest in wetlands, flora, restoration and rehabilitation. In her eight-year career she has undertaken various wetland delineations and assessments, flora assessments, rehabilitation assessments and audits, as well as project management of various implementation projects. She has also worked extensively with alien invasive species removal programmes, ecological restoration projects and sustainable development programmes within the Government Sector. She has published a variety of environmental documents/articles and presented at various South African and international conferences.
- **Willnerie Janse van Rensburg** is a Soil Scientist in the Rehabilitation, Closure and Soils Division at Digby Wells. She received her Bachelor of Science in Environmental Geography as well as her Honours degree in Soil Science from the University of the Free State. She has five years' experience in the fields of Soil Science and Environmental Science. She has experience in completing soil surveys, land capability assessments, irrigation scheduling and provides recommendations on soil

amelioration. Willnerie also completes wetland delineations and assessments. She has undertaken work in Lesotho, Botswana and throughout South Africa. Willnerie is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.

- **Aamirah Dramat** is an Assistant Rehabilitation Consultant in the Rehabilitation, Closure and Soils Department at Digby Wells. She received her Bachelor of Science Degree in Applied Biology and Environmental and Geographical Science (EGS) as well as her Honours Degree in Biological Sciences from the University of Cape Town. She joined Digby Wells in 2020 as a Rehabilitation Intern and has since gained experience in the environmental services sector with specialised focus in Soils, Wetlands and Rehabilitation, both locally and internationally. She has been involved in the report compilation and undertaking of Baseline Assessments, Environmental Impact Assessments (EIAs), Rehabilitation and Closure Plans (RCPs), Rehabilitation Strategy and Implementation Plans (RSIPs), Alien Invasive Plant (AIP) Assessments, Re-vegetation Trial Studies and Monitoring Assessments. Aamirah is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.

5. Methodology

This section provides the methodology used in the compilation of the Wetland Impact Assessment. A detailed methodology is described in Appendix A and is summarized in Figure 5-1 below.

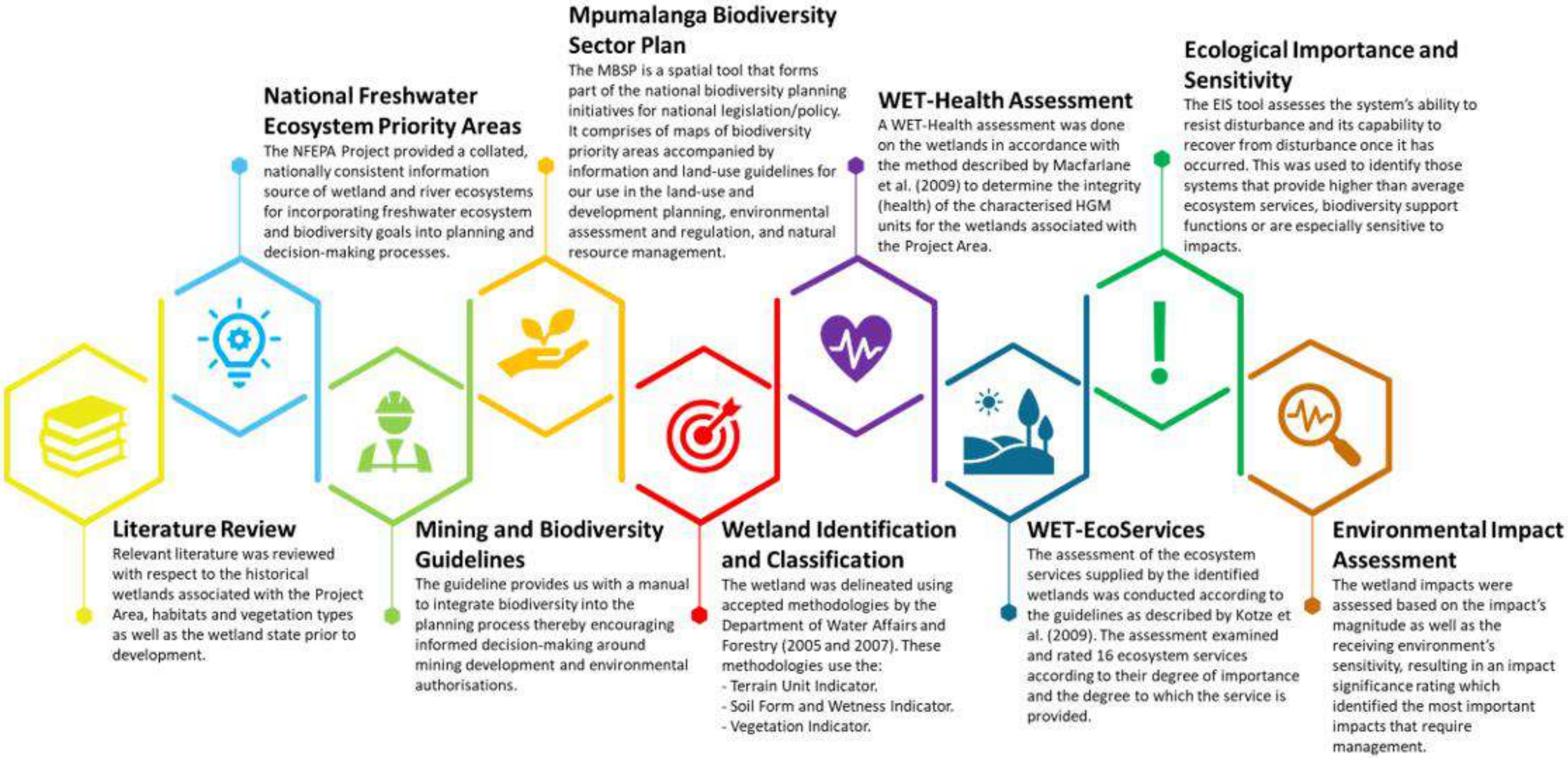


Figure 5-1: Wetland Assessment Methodology

6. Baseline Environment

Table 6-1: Baseline Environment of the Arnot South Project Area

Bioregional Context (Darwell W. , Smith, Tweddle, & Skelton, 2009)		**Characteristics of the Highveld Ecoregion** (Kleynhans, Thirion, & Moolman, 2005)		**Plant Species Characteristic of the Eastern Highveld Grasslands** (Mucina & Rutherford, 2012) (Figure 6-1)	
Political Region/ Geomorphic Province	Mpumalanga	Terrain Morphology	Plains; Low Relief; Plains; Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to high Relief Closed Hills. Mountains; Moderate and High Relief.	Graminoid Species	*Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. capensis, E. curvula, E. gummiflua, E. patentissima, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata* subsp. *eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris* and *Urelytrum agropyroides.*
Level 1 Ecoregion	Highveld	Vegetation Types	Mixed Bushveld (limited); Rocky Highveld Grassland; Dry Sandy Highveld Grassland; Dry Clay Highveld Grassland; Moist Cool Highveld Grassland; Moist Cold Highveld Grassland; Northeastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).	Herb Species	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides* subsp. *latifolia, Selago densiflora, Senecio coronatus Hilliardiella oligocephala* and *Wahlenbergia undulata.*
Freshwater Ecoregion	Southern Temperate Highveld	Altitude (m.a.m.s.l.) (modifying)	1 100-2 100, 2 100-2 300 (very limited)	Geophytic Herb Species	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula* var. *pilosissima* and *Ledebouria ovatifolia.*
Vegetation Type	Eastern Highveld Grassland	Mean Annual Precipitation (MAP) (mm) (Secondary)	400 to 1 000	Succulent Herb Species	*Aloe ecklonis.*
WMA	Inkomati (X11A) and Olifants (B12B and B12A)	Rainfall Seasonality	Early to late summer	Low Shrub Species	*Anthospermum rigidum* subsp. *Pumilum* and *Seriphium plumosum.*
Sub-WMA	Komati West, Middle Olifants and Upper Olifants	Mean Annual Temp. (°C)	12 to 20	Status	Endangered.
				AIPs observed in the Project Area	*Persicaria lapathafolia, Solanum sisymbriifolium (1b), Verbena brasiliensis (1b), Verbena officianalis, Cirsium vulgare (1b), Myriophyllum aquaticum (1b), Bidens pilosa, Pennisetum clandestinum 1b), Paspalum notatum, Cosmos bipinnatu, Centella asiatica, and Conyza bonariensis* (refer to the Fauna & Flora Impact Assessment, 2021 for a full species list and listed category).
Quaternary Catchment (Figure 6-2)	X11A, B12B and B12A	Mean Daily Summer Temp. (°C): February	10 to 32	**MBSP Category** (MTPA, 2014) (Figure 6-3)	

<table>
<tr>
<td>Watercourse</td>
<td>Komati River and Olifants River</td>
<td>Mean Daily Winter Temp. (°C): July</td>
<td>-2 to 22</td>
<td colspan="2">The Project Area consists of areas classified as:
• CBA Irreplaceable to the northeast and south of the MRA;
• CBA Optimal;
• Other Natural Areas;
• Moderately Modified – Old Lands which is the most dominant and scattered throughout the MRA; and
• Heavily modified.
The Infrastructure Footprint Area consists of an area classified as:
• Other Natural Areas;
• Moderately Modified – Old Lands; and
• Heavily modified (dominant).</td>
</tr>
<tr>
<td colspan="4">Mining and Biodiversity Guideline Category, DEA (2013) (Figure 6-4)</td>
<td colspan="2">NFEPA Wetland Classification (Nel, et al., 2011)</td>
</tr>
<tr>
<td colspan="4" rowspan="2">The Project Area, including the Infrastructure Footprint Area, has large areas classified as:
• (B) Highest Biodiversity Importance – Highest Risk for Mining;
• (C) High Biodiversity Importance – High Risk for Mining; and
• (D) Moderate Biodiversity Importance – Moderate Risk for Mining.</td>
<td>NFEPA Wetlands
(Figure 6-5)</td>
<td>• The Project Area comprises CVBs, Seeps, Valley head seeps, UVB, Depression and Flat NFEPA Wetlands.
• Within the Infrastructure Footprint Area, only a minor area is classified as a CVB NFEPA Wetland, however, is adjacent to a large valley floor: CVB.</td>
</tr>
<tr>
<td>River FEPA
(Figure 6-6)</td>
<td>The Project Area were defined as:
• River FEPA (south-east of the MRA); and
• Upstream Management Areas (dominant in the north and middle section of the MRA).</td>
</tr>
</table>

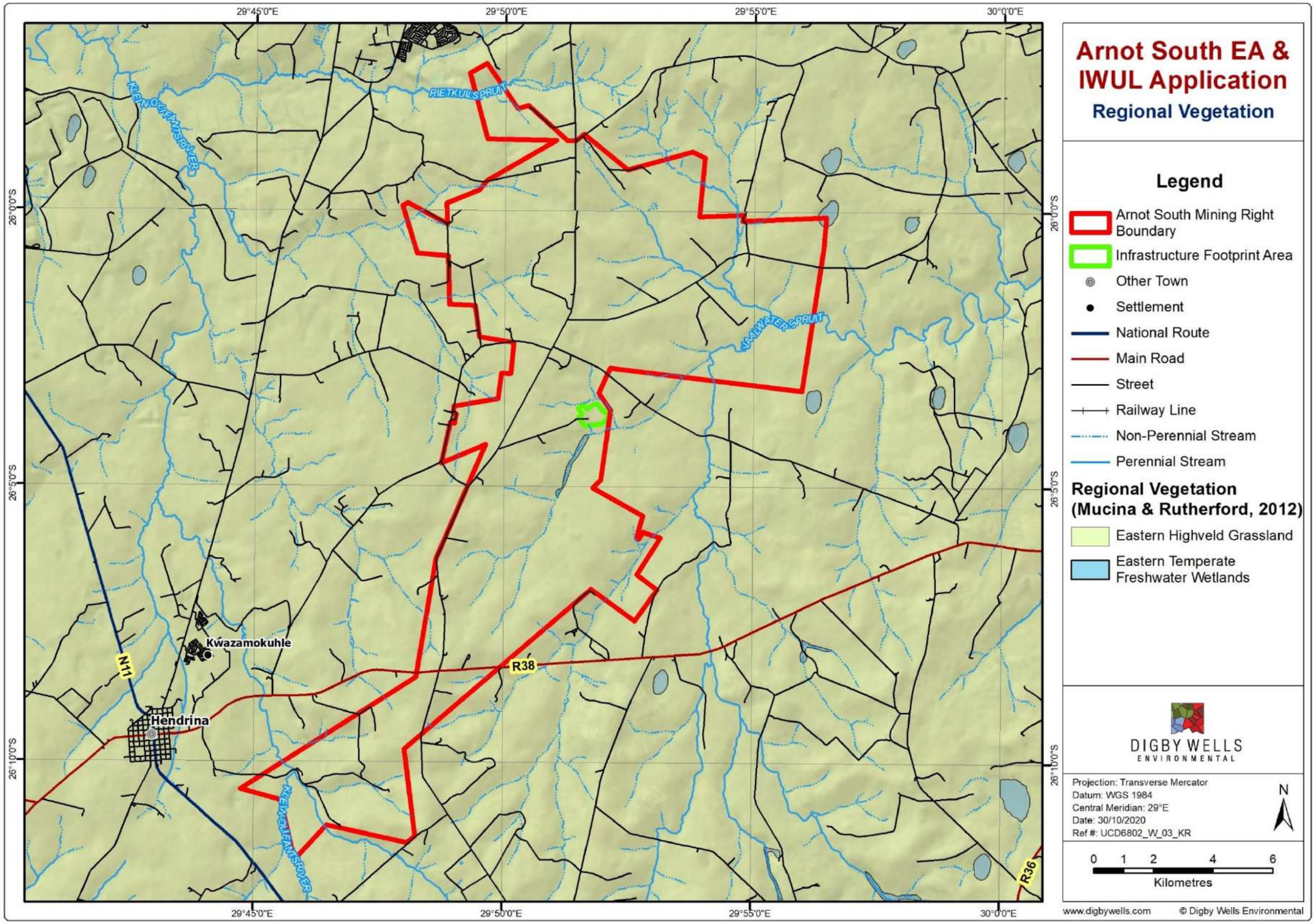


Figure 6-1: Regional Vegetation

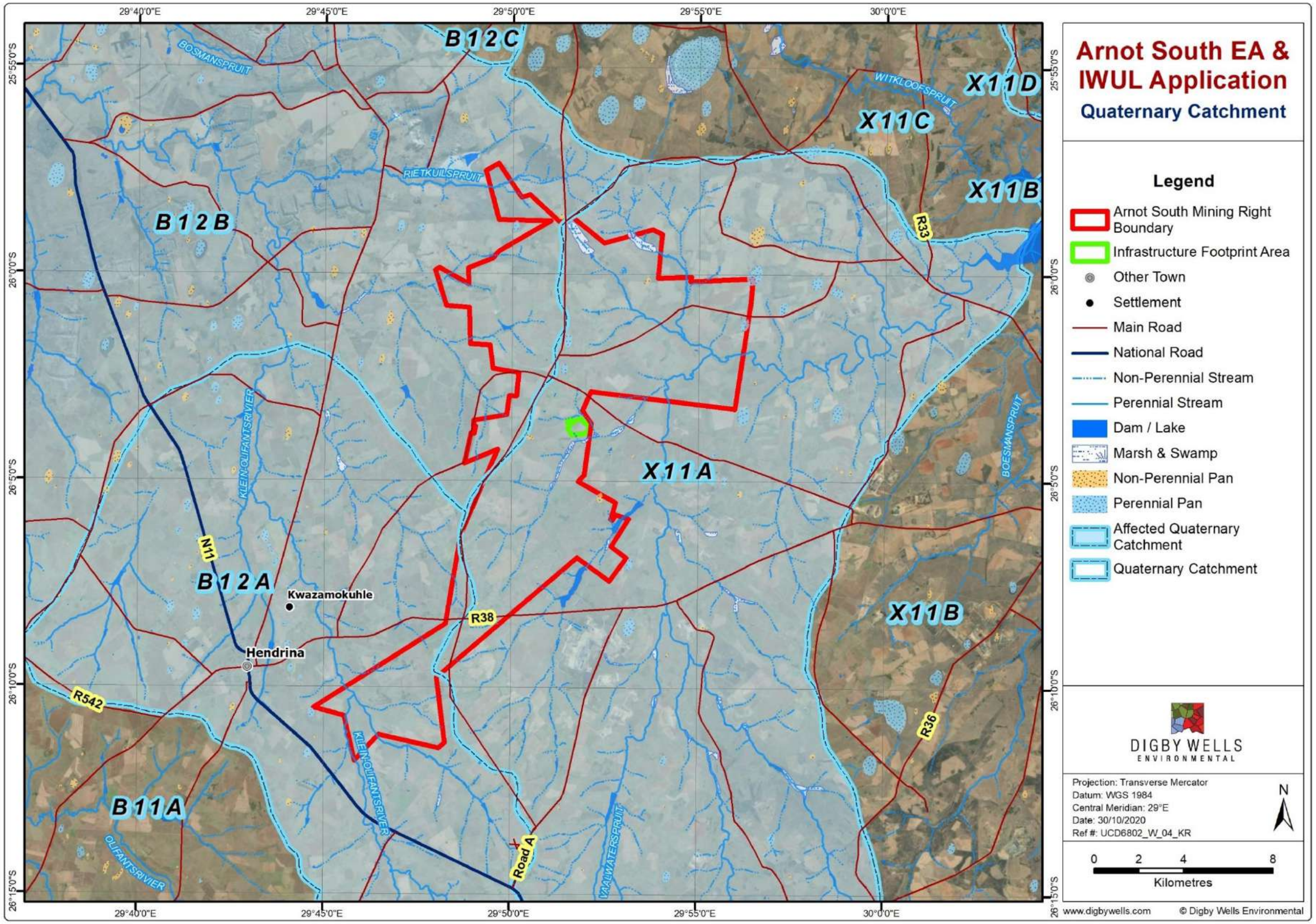


Figure 6-2: Quaternary Catchments

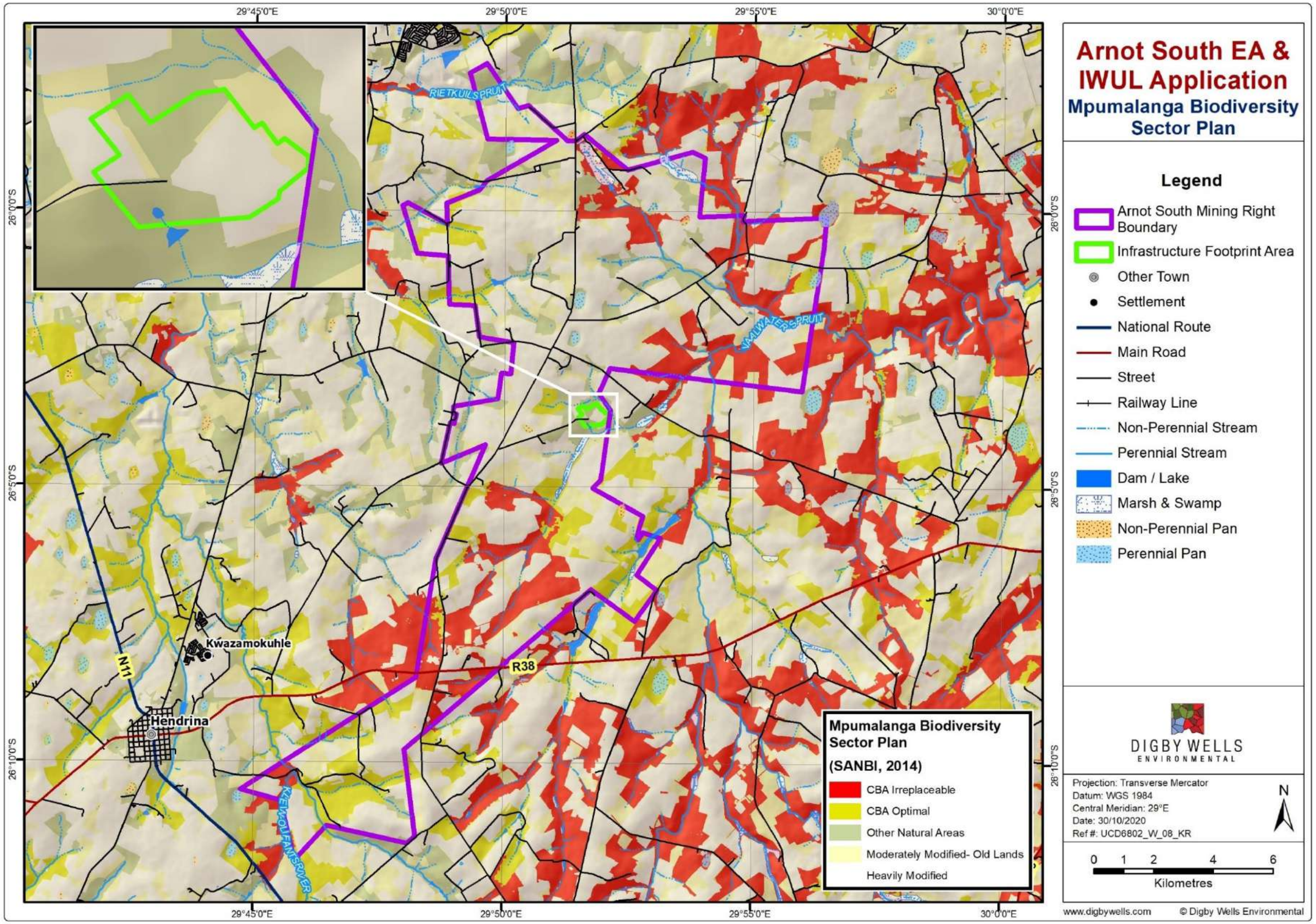


Figure 6-3: Mpumalanga Biodiversity Sector Plan

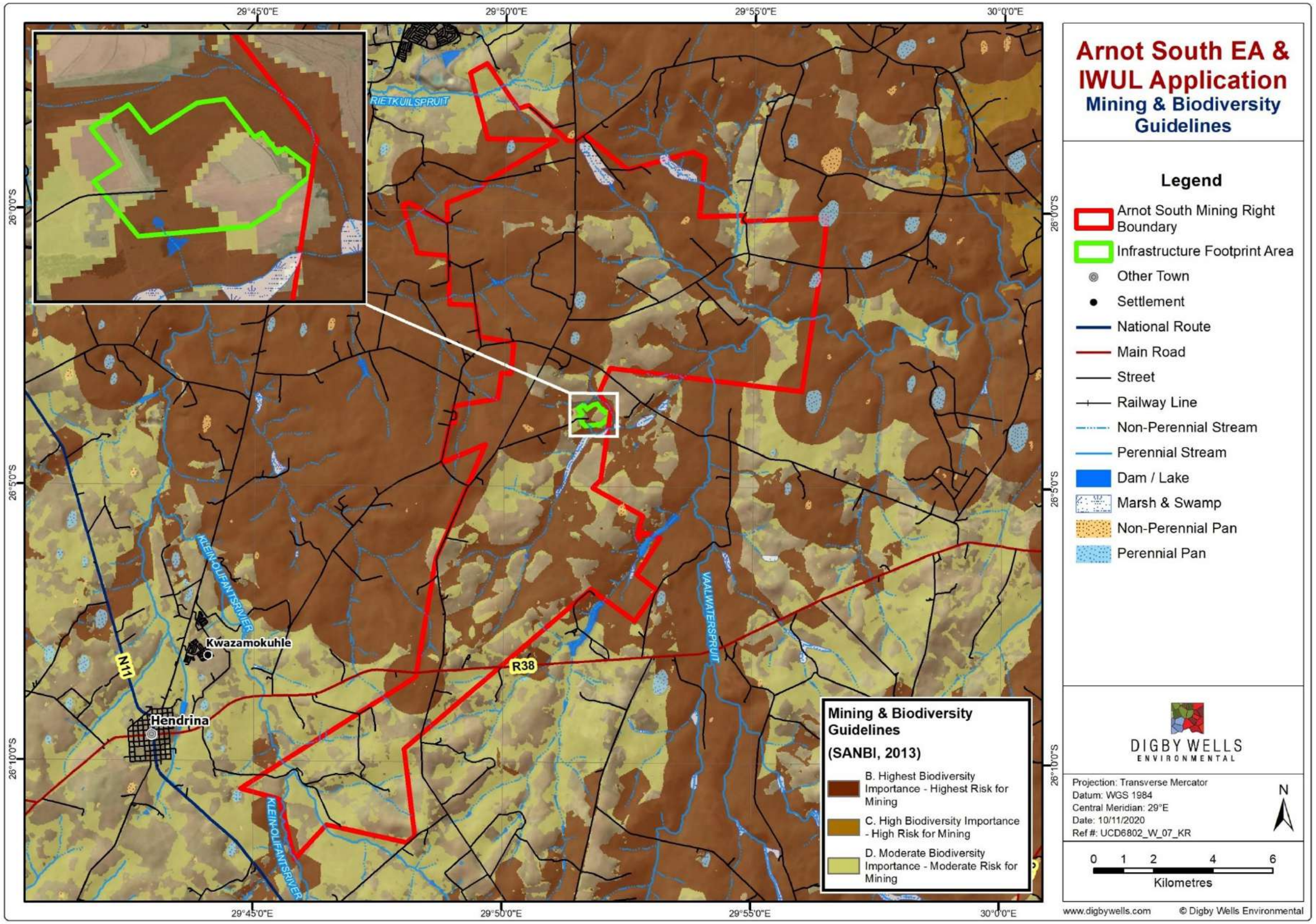


Figure 6-4: Mining and Biodiversity Guidelines

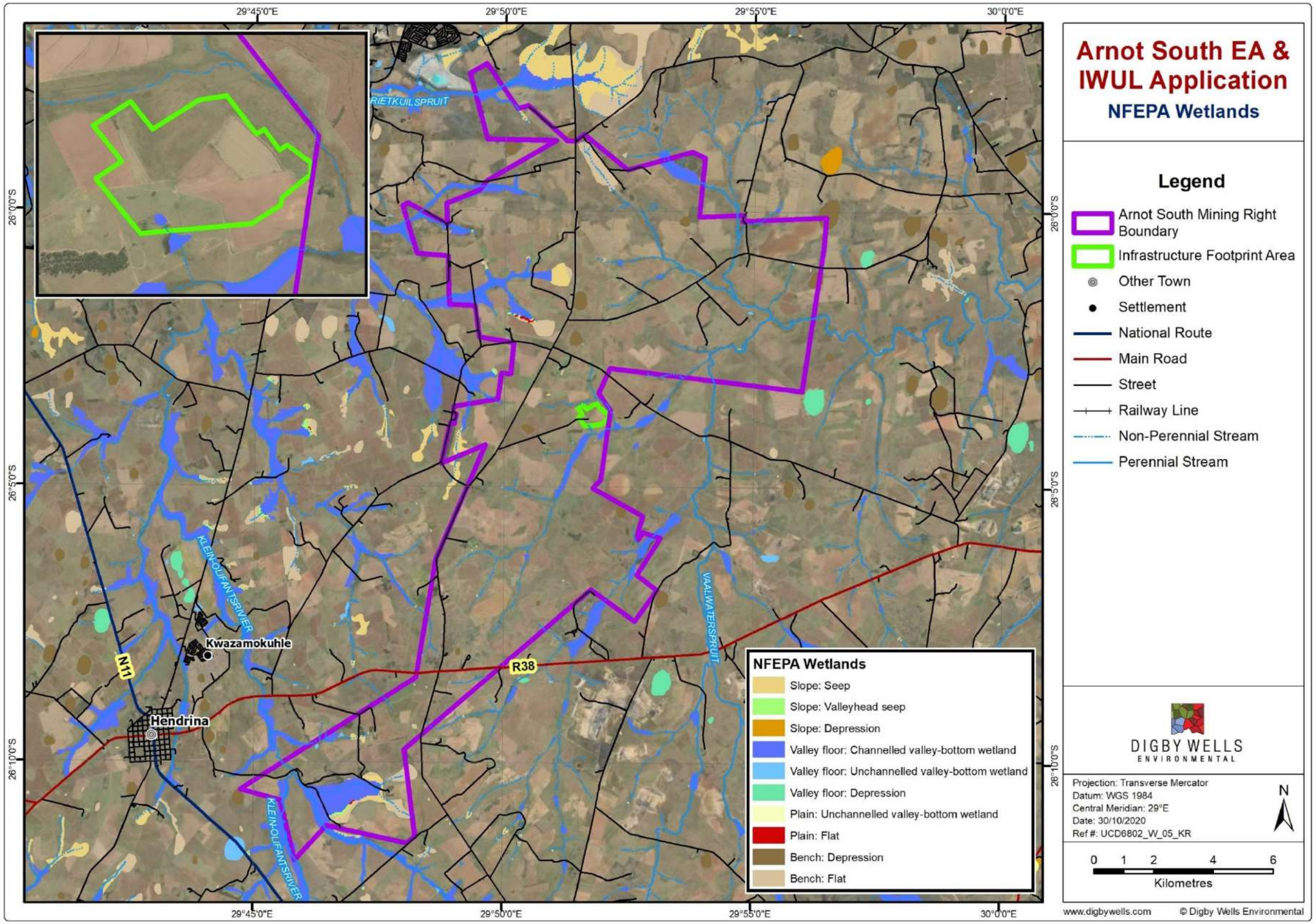


Figure 6-5: National Freshwater Ecosystem Priority Areas

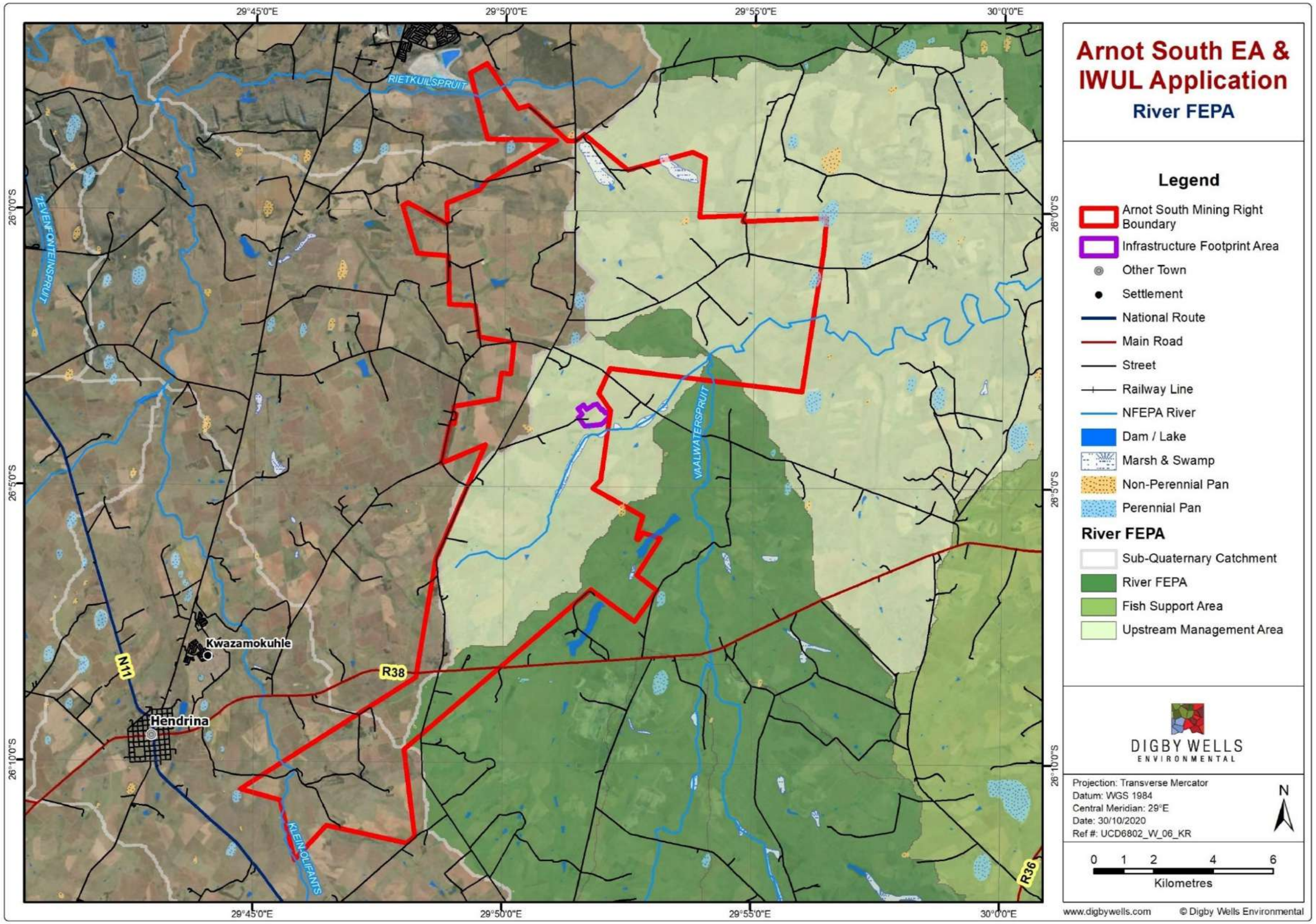


Figure 6-6: River Freshwater Ecosystem Priority Areas

7. Findings and Discussion

Wetlands associated with the Project Area have been delineated at a desktop level using detailed aerial imagery and identifying wetland signatures. These were then confirmed during a rapid site survey undertaken between the 20th and the 23rd of April 2021. The site survey was used to refine the wetland delineation and to determine the PES, ES and the EIS.

Land use activities and in-field studies have shown that some of the wetland systems are similar from a catchment management perspective, as they would be subject to similar overall land use impacts. Therefore, it was considered practical to group the HGM units by systems that have similar land use and impacts to calculate more accurately the PES, ES, as well as EIS scores.

Fifteen wetland HGM systems were identified, some comprising several HGM units. The HGM units were grouped and named into various systems as explained in Table 7-1 and are described in Section 7.2

Table 7-1 HGM System Names

HGM System Number	System Name	Grouping method
1	Infra CVB	Proposed infrastructure area
2	Infra CVB/FP	Proposed infrastructure area
3	Infra Seep	Proposed infrastructure area
4	Infra UVB	Proposed infrastructure area
5	CVB	Combined system
6	CVB	Combined system
7	CVB	Combined system
8	CVB	Combined system
9	CVB/FP	Combined system
10	Pan & Seep	Dominant land use: Cultivated
11	Pan & Seep	Dominant land use: Grazed
12	Seep	Dominant land use: Cultivated
13	Seep	Dominant land use: Grazed
14	UVB	Dominant land use: Cultivated
15	UVB	Dominant land use: Grazed

Following the wetland assessment, an impact assessment was completed to determine the significance each proposed activity will have on the associated wetlands.

7.1. Wetland Indicators

Guidance Note

The wetland delineation was undertaken according to a combination of the accepted methodologies from 'A practical field procedure for identification and delineation of wetlands and riparian areas' (Department of Water Affairs and Forestry, 2005) and the "Updated manual for identification and delineation of wetlands and riparian areas" (Department of Water Affairs and Forestry, 2008).

The methodology includes four wetland indicators; Soil Wetness Indicator (SWI), Soil Form Indicator (SFI), Vegetation and Terrain and are discussed in the subsections below.

7.1.1. Terrain Unit Indicators

Guidance Note:

Terrain indicators help to identify areas in the landscape where wetlands are more likely to occur. The topography is typically the physical characteristics of an area with a variation of soils against the slope, each with its own characteristics because of its relative position in the landscape and terrain.

Detailed imagery and contours, coupled with field verifications, allows the geomorphic setting of the wetland and catchments to be understood and the HGM unit to be determined. Terrain indicators are important for understanding the hydrological and specific functionality of the wetland and determining the potential risks from anthropological activities on the wetland.

The topography of the Project Area is typical of the Eastern Highveld Grassland with gentle, rolling grassland slopes and many valley systems and depressions scattered across the landscape. Typical terrain indicators identified in the Project Area can be seen in Figure 7-1. **Due to the size of the Project Area, the terrain indicator was used as the dominant wetland indicator for the wetland delineations**.

Typical valley bottom system. Well vegetated with open water bodies, grazed fields and AIPs in the catchment.

Natural pan with hillslope seep wetland. Area is heavily grazed with low basal cover and fence line.

Figure 7-1: Terrain Indicators

7.1.2. Soil Indicators

Guidance Note:

Soil indicators, including soil forms (i.e., Katspruit, Kroonstad and Rensburg) and soil wetness (i.e., mottling, gleying and leaching) were used, where possible, to identify and confirm wetland delineations. SWI were mostly used to delineate the wetlands as the mottling and leaching indicators were prominent in most cases. Where soil mixing and disturbances had taken place (Witbank soils), focus was given to the topography and vegetation indicators to assist in the delineations.

The low-lying areas of the Project area were characterised by increased clay content and increased soil wetness. These soils were identified as hydromorphic soils and are saturated for long periods with a fluctuating water table, altering the morphology of the soils. These soils are somewhat limited for cultivation and highly mobile (high erosion probability). The delineated wetlands were mostly defined as **permanent** and **seasonal** wetlands due to their setting in the landscape and clear SWI (mottles and gleying). Various land use activities limited SWI and SFI due to geomorphological changes, hydrogeomorphic changes and changes to the natural vegetation (Table 7-2).

Table 7-2 Soil Indicators

<table>
<tr><td>Dominant hydromorphic soils</td><td colspan="2">• Arcadia;
• Rensburg;
• Avalon;
• Champagne;
• Katspruit;
• Kroonstad;
• Clovelly; and
• Pinedene</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2">Hydromorphic soil (G-horizon) with high clay content and iron (Fe) mottles. Typically located within seep wetlands.</td><td>Hydromorphic soil (Vertic A-horizon overlying a G-horizon) with clear mottling of Fe and high clay content. Typically located within valley bottom and pan wetlands.</td></tr>
</table>

7.1.3. Vegetation Indicators

Guidance Note:

Plant communities undergo distinct changes in species composition along the wetness gradient from the centre of the wetland to the edge and into adjacent terrestrial areas. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze & Marneweck, Guidelnes for delineating the wetland boundary and zones within a wetland under the South African Water Act, 1999); (Department of Water Affairs and Forestry, 2005).

Plant communities undergo distinct changes in species composition along the wetness gradient from the centre of the wetland to the edge and into adjacent terrestrial areas. Vegetation communities of the various wetlands and their respective HGM units were relatively variable. Large portions of the natural vegetation communities had been historically altered, impacting the natural vegetation communities (Table 7-3). Refer to the Fauna and Flora Impact Assessment Report for a detailed list of species (DWE, 2021).

Table 7-3 Vegetation Indicators

Dominant Species	*Juncus effusus*, *Monopsis decipiens, Schoenoplectus brachyceras, Typha capensis*, *Cyperaceae Sp*., *Agrostis lachnantha, Leersia hexandra, Paspalum distichum, Hemarthria altissima, Hyparrhenia tamba, Setaria sphacelata; Aristida junciformis, Themeda triandra, Eragrostis plana, Eragrostis gummiflua, Chironia palustris, Helichrysum pillosellum* and *Imperata cylindrica*.
	*Eucomis autumnalis* (Species of Conservational Concern (SCC)) within seep and valley bottom wetlands.
	*Salix Sp., Juncus effusus, Typha capensis and Eragrostis Sp.* in valley bottoms and pans.

7.2. Wetland Delineation and HGM Unit Identification

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. Figure 7-2 below depicts the delineated wetlands with details of each HGM unit subsequently provided in Table 7-4.

The HGM units were categorised into 15 HGM systems (Table 7-1). The wetland delineations are illustrated in Figure 7-2.

Table 7-4 HGM System Names

HGM System Number Name	Area (ha)
1 Infra CVB	120.4
2 Infra CVB/FP	135.6
3 Infra Seep	4.9
4 Infra UVB	140.9
5 CVB	116.6
6 CVB	1247.6
7 CVB	242.4
8 CVB	344.7
9 CVB/FP	4006.9
10 Pan & Seep (cultivated)	141.8
11 Pan & Seep (grazed)	18.5
12 Seep (cultivated)	258.6
13 Seep (grazed)	755.6
14 UVB (cultivated)	11.9
15 UVB (grazed)	9.1
Total Area	**7555.5**

Following the wetland assessment, an impact assessment was completed to determine the significance each proposed activity will have on the associated wetlands. Field verification focused specifically on the proposed infrastructure areas as well as on areas proposed for high extraction (shallow coal resources). Wetlands that will be impacted to a lesser extent, such as wetlands located within the 500 m Zone of Regulation were verified at a desktop level.

The Zone of Regulation and each HGM unit type identified within the Project Area are described in the subsections below.

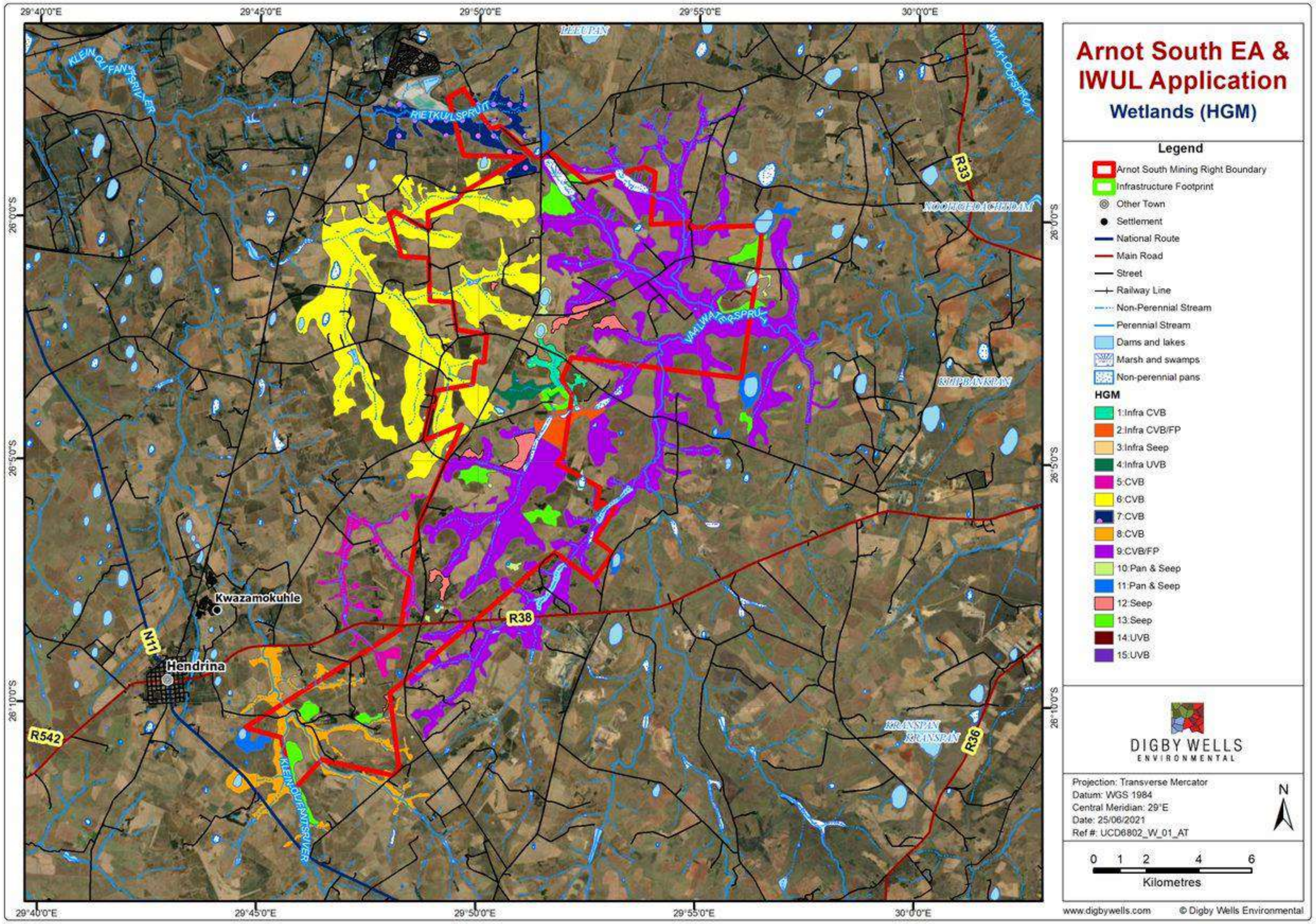


Figure 7-2 Wetland Delineations

7.2.1. Floodplains

The general features that are typical of floodplain wetlands such as oxbows and depressions, were identified in the floodplain wetlands (HGM Systems 2 and 9). Floodplains have however been impacted by historical and current land uses (e.g., agropastoral activities, mining and anthropological activities) altering the hydrology, geomorphology and vegetation.

The floodplains are unlikely to contribute significantly to stream flow regulation. The generally clayey nature of floodplain soils retain water, which is likely to be lost through evapotranspiration, thereby limiting their contribution to stream flow regulation and groundwater recharge (Kotze *et al.,* 2005). However, due to the deep incisions, erosion gullies and increased runoff, the floodplains are contributing more than natural flow to the catchment. Naturally, once the flood overflows the riverbanks, the velocity of flow decreases laterally, permitting the deposition of particles within the floodplain landscape. Whereas in this case, the riverbanks are head cut, heavily grazed and cultivated leading to low vegetation cover, increasing the flow and preventing riverbanks from overflowing.

7.2.2. Channelled Valley Bottoms

According to Kotze *et al.* CVBs are characterised by less active deposition of sediment and an absence of oxbows and other floodplain features such as levees and meander scrolls. These wetlands tend to be narrower and have somewhat steeper gradients and the contribution from lateral groundwater input relative to the mainstream channel is generally greater. Erosion is the primary cause of this channelling.

The CVBs within the Study Area (HGM Systems 1, 2, 5, 6, 7, 8 and 9) are narrow, deeply eroded and somewhat well vegetated. The systems however have indications of cattle trampling and overgrazing in some areas reducing the natural vegetation cover leading to loss of basal cover, erosion and sedimentation. These systems are an important service provider to both the environment (e.g., habitat, food source, sediment trapping, toxicant removal and flood attenuation) and humans (e.g., water provisions, food sources and fishing).

7.2.3. Unchannelled Valley Bottoms

UVBs delineated include HGM Systems 4, 14 and 15. The UVB wetlands are generally well vegetated and characterised by gentle slopes that are dominantly used for cultivation and cattle grazing. The agricultural impacts on this wetland will ultimately result in the formation of channels whereby the HGM unit will be converted to a CVB where the associated ecosystem services will be lost/ changed. By forming a channel, the wetland will be narrowed and concentrated, drying out the sides of the UVB and seeps. These may arise because of overgrazing, the establishment of farm roads, infrastructure, culverts and dams that initiate the process of erosion, compaction and increased runoff. The UVBs of the Project Area were generally well functioning and accommodated various SCC.

7.2.4. Depressions (Pans)

Depressions are usually hydrologically disconnected from the stream network as they are inward draining wetlands. Most of the depressions together with their catchments within the Project Area are impacted by cultivation, cattle grazing and historical mining activities. Impacts include cattle trampling, excavations, construction of berms, loss of vegetation cover in the catchments, sedimentation, cultivation and increased nitrates and phosphates. The pans were grouped into two categories:

- Cultivated Pans & Seeps (HGM System 10) – Cultivation was the dominant land use in these systems, where impacts include:
  - Complete/partial destruction of the natural geomorphology;
  - Changes to the natural hydrology; and
  - Compete/partial removal of natural vegetation and increased AIPs.
- Grazed Pans & Seeps (HGM System 11) – Cattle grazing was the dominant land use in these systems, where impacts include:
  - Partial destruction of the natural geomorphology (e.g., erosion, compaction, hardened surface);
  - Changes to the natural hydrology (e.g., increased runoff, drying out of seeps, water ponding); and
  - Partial removal of natural vegetation and increased AIPs.

7.2.5. Hillslope Seep Wetlands

Seep wetlands are usually associated with a perched groundwater table. Precipitation within the greater catchment is temporarily stored within the soils as a result of impervious strata in the soil profile. The impervious strata are generally made up of weathered parent material or swelling clays typically associated with granites, sandstones or shales. Hillslope seepage wetlands are expressed where the soil profile is shallow enough such that impervious layer and the water stored within the soil profile are expressed on the surface. The soils are waterlogged long enough for oxygen to be depleted through a chemical process of reduction which results in the presence of redox features (mottles) in the soil. Hillslope seepage wetlands are created and maintained by infiltration processes that occur in the surrounding non-wetland areas within the catchment.

The Seeps (HGM 3, 12 and 13) were all connected to a watercourse. The dominant land use is intensive cultivation and cattle grazing where the soil depth was not adequate for cultivation. The Seeps contribute significantly to the groundwater as the soils are dominantly interflow and recharge soils (deep, sandy soils). The Seeps were grouped according to the dominant land use:

- Infrastructure-impacted Seep – The Seep wetlands within the proposed infrastructure area were assessed separately as these wetlands will most likely be impacted by the proposed activities, these include:
  - Complete/partial removal of Seep wetlands (geomorphology);
  - Complete/partial removal of natural vegetation (e.g., soil stripping, stockpiling, construction of infrastructure, linear infrastructure);
  - Complete/partial destruction of the natural hydrology (e.g., hardened surfaces, increased flow, erosion and sedimentation).
- Cultivated Seeps (HGM System 12) – Cultivation was the dominant land use in these systems, where impacts include:
  - Complete/partial destruction of the natural geomorphology;
  - Changes to the natural hydrology; and
  - Compete/partial removal of natural vegetation and increased AIPs.
- Grazed Seeps (HGM System 13) – Cattle grazing was the dominant land use in these systems, where impacts include:
  - Partial destruction of the natural geomorphology (e.g., erosion, compaction, hardened surface);
  - Changes to the natural hydrology (e.g., increased runoff, drying out of seeps, water ponding); and
  - Partial removal of natural vegetation and increased AIPs.

7.3. Wetland Assessment

The dominant land use activities affecting the wetland health, integrity and functionality in the Project Area are shown in Figure 7-3 and include:

- Agropastoral activities (e.g., increased AIPs, intensive cultivation, cattle grazing and infrastructure);
- Anthropological activities (e.g., national roads, dams, powerlines, fence lines);
- Current and historical mining activities (e.g., underground mining, dewatering, groundwater contamination, roads, stockpiling, excavations, housing, AIPs and rehabilitated areas).

The overall approach to determine the wetland health and functionality is to quantify the impacts of human activity or visible impacts, and then to convert the impact scores to a PES score. This takes the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area.

Agropastoral activities, including planted pastures and crop lands.

Hillslope seep impacted by agropastoral activities leading to erosion and loss of vegetaiton cover.

Mine infrastructure, leading to hardened surfaces, increased AIPs and changes to the natural hydrology, geomorphology and vegetation.

Figure 7-3 Land Use Activities

7.3.1. Wetland Ecological Health Assessment

Guidance Note:

According to Macfarlane, Kotze, & Ellery (2009), the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A level 1 WET-Health (PES) assessment was conducted on the wetlands following the method described by Macfarlane et al., (2009) to determine the integrity (health) of the characterised HGM units for the Project area. Level 1 was selected due to the large size of the Project area.

A PES analysis was conducted to establish baseline integrity (health) for the associated wetlands. The PES assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to, or deviation from, natural conditions.

According to the PES score determination method described by Macfarlane *et al.,* (2009):

- **Category B** wetlands are moderately modified. The wetlands are moderately changed in ecosystem processes and loss of natural habitats has taken place, however the natural habitat remains predominantly intact;
- **Category C** wetlands have moderate changes to the ecosystem. Loss of natural habitat has taken place, but the natural habitat remains predominantly intact;
- **Category D** wetlands have been subject to changes in the ecosystem processes and loss of natural habitat and biota has occurred; and
- **Category E** wetlands are defined as wetlands where the change in ecosystem processes and loss of natural habitat and biota is serious but some remaining natural habitat features are still recognisable.

The PES of the HGM Systems range from **Largely Natural (B) to Seriously Modified (E)** with the most impacted wetlands associated with agropastoral activities, infrastructure and anthropological activities.

The following was derived from Table 7-5 and Figure 7-4.

- Pans & Seeps (Grazed) (HGM System 11) were measured as PES **B** wetlands as impacts to these wetlands were minimal. Although impacts were observed in these wetlands, such as cattle grazing, AIPs and in some cases sections of erosion, modifications to these systems were limited and the habitat predominantly intact;
- The Floodplains and UVBs were all measured as PES **C** (HGM Systems 2, 9 and 15), as well as some CVBs and Seeps (HGM Systems 3, 4, 8 and 13). These systems were dominantly used for cattle grazing and some untransformed areas;
- The larger grouped systems (catchments) were measured as PES **D** (HGM Systems 1, 5, 6 and 7) as these systems have been changed largely due to various anthropological, agropastoral and mining activities. Impacts include cultivation, dams,

water extraction, subsidence, cattle grazing, erosion, sedimentation, habitat loss, AIPs proliferation and changes to the natural geomorphology;

- Pans, Seeps and UVBs that were dominantly used for cultivation (HGM Systems 10, 12 and 14) were measured as PES **E** due to the extent of impacts to these systems. Extensive areas of these systems have been completely removed or partially removed by cultivation practices, changing the natural geomorphology, hydrology and natural vegetation almost completely.

Table 7-5 Wetland Present Ecological State

HGM System	Threat descriptions			Total Impact Score	Pes Category
	Hydrology	Geomorphology	Vegetation		
1	19.5	1.65	15.4	5.221	D
2	12	2.05	13.8	3.979	C
3	3	0.3	12.12	2.203	C
4	10.5	1	14.48	3.711	C
5	12	2.7	15.1	4.257	D
6	19.5	3.55	16.8	5.693	D
7	18	1.55	13.1	4.664	D
8	12	2.35	12.9	3.893	C
9	12	4.2	12.42	4.089	C
10	19.5	7.3	17.6	6.343	E
11	3	0.75	6.1	1.407	B
12	19.5	7.6	16.8	6.271	E
13	12	0.55	11.5	3.436	C
14	19.5	7.6	16.04	6.163	E
15	6	2.9	11.74	2.949	C

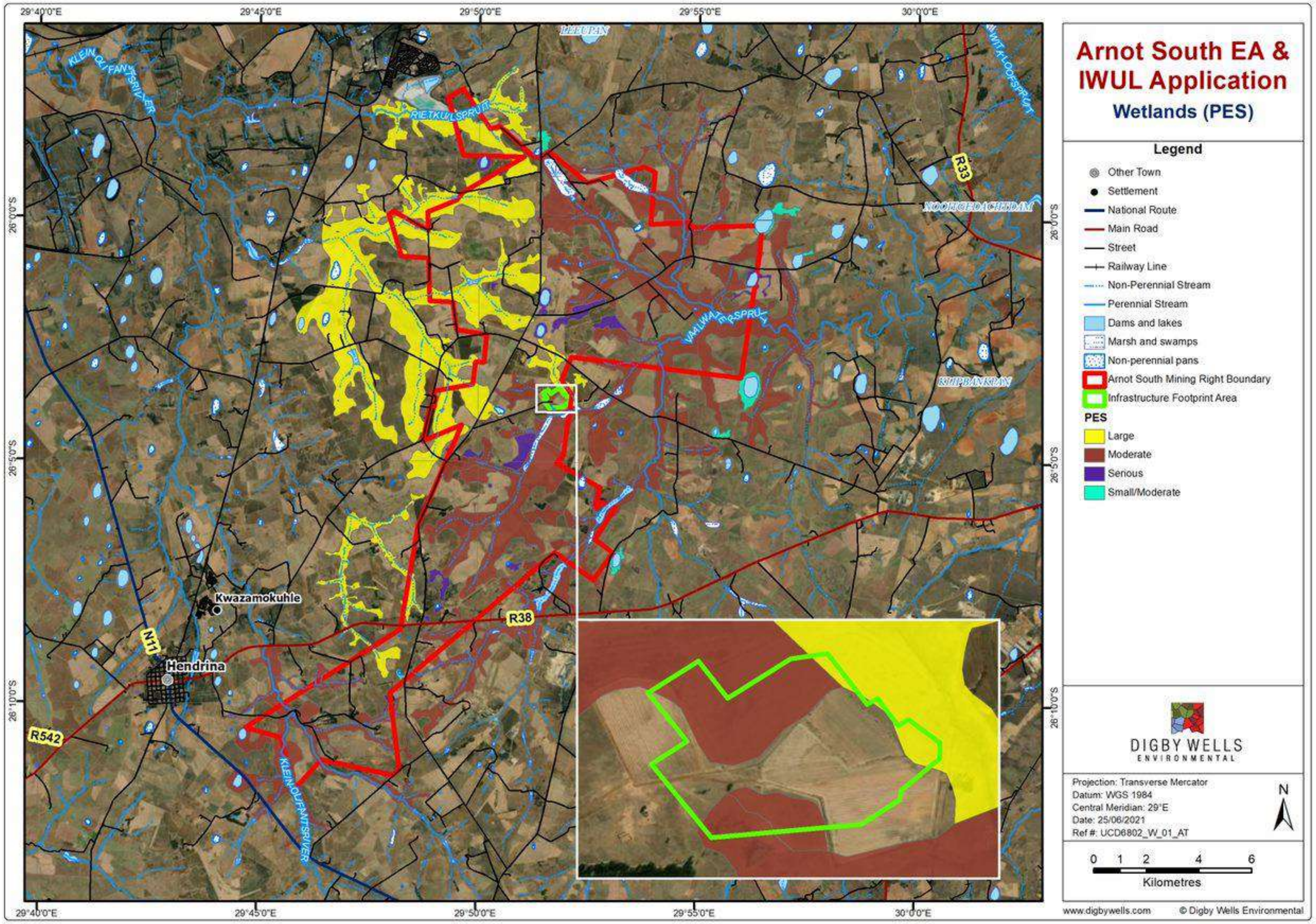


Figure 7-4 Wetland Present Ecological State

7.3.2. Wetland Ecological Services (WET-EcoServices)

Guidance Note:

The importance of a water resource in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class' (South African Department of Water Affairs and Forestry, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines described by Kotze et al. (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided.

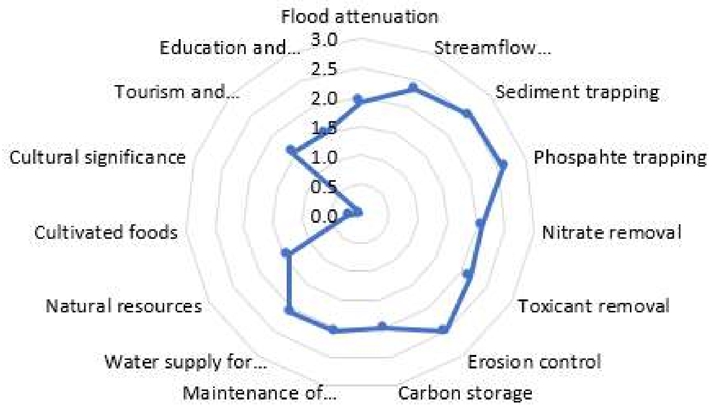
The characteristics were used to quantitatively determine the value and, by extension, the sensitivity of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

The ES of the 15 HGM Systems ranged from **Moderately Low** to **Moderately High**. It is however important to note that the ES vary from one HGM unit to the other.

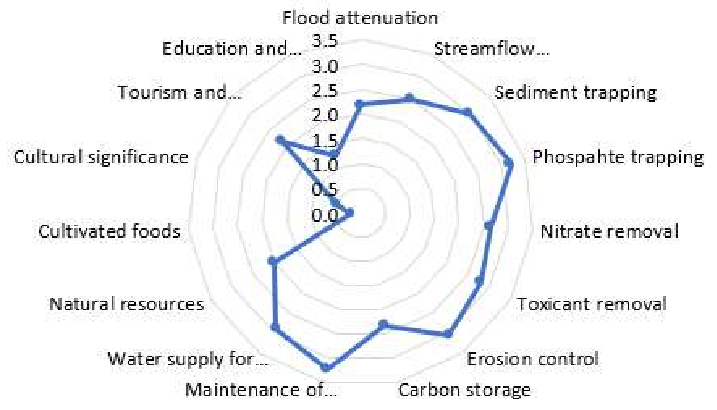
Figure 7-5 represents radial plots showing the relative importance of each ecosystem service and lists the summary of the scores obtained. The following was derived from the data:

- The highest ES provided includes (HGM Systems 2, 5 and 9):
- Sediment trapping;
- Phosphate assimilation; and
- Biodiversity maintenance.
- All the HGM Systems provides various services and benefits to the biodiversity and humans. Although the catchments of the wetlands are heavily cultivated and grazed, most farmers avoid farming in wetlands;
- Wetlands used for cattle grazing provide natural resources and water to cattle;
- Wetlands that have been cultivated, provide less natural resources, however provide food resources to humans;
- HGM Systems 2, 5 and 9 were rated as ecologically important systems with **Moderately High** ES;
- HGM Systems 1, 4, 6, 7, 8, 10, 11, 12, 13, 14 and 15 all were rated as **Intermediate Importance** due to various impacts influencing the natural habitat, vegetation, hydrology, geomorphology and ecological provision of services; and
- HGM System 3 was rated as **Moderately Low** due to the high impacts to the wetlands and land uses (agriculture). This system has little to no natural functionality and therefore providing low ecological services.

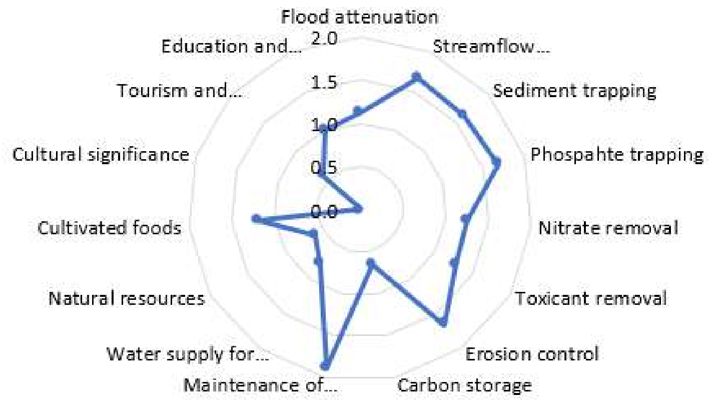
HGM System 1



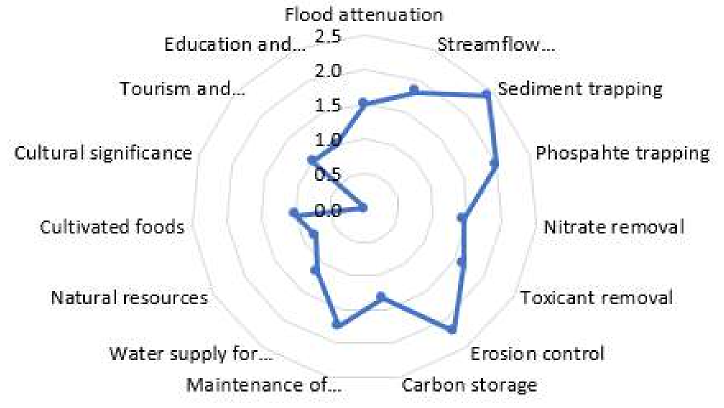
HGM System 2



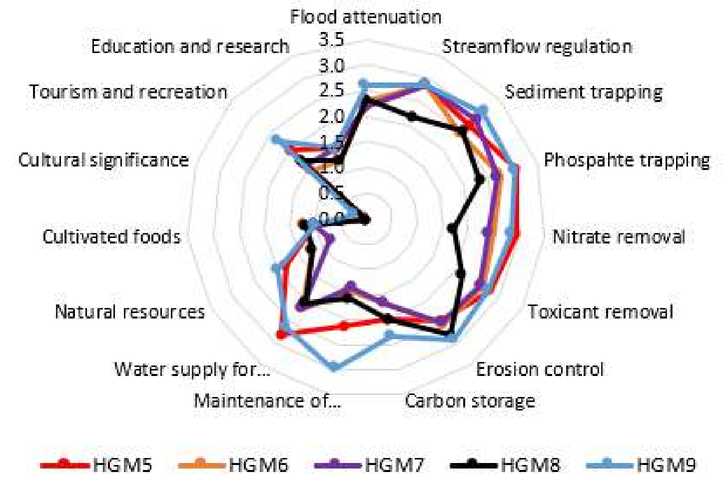
HGM System 3



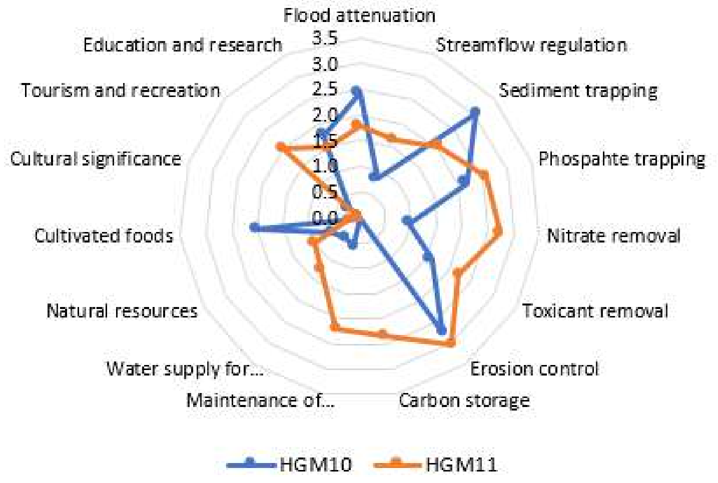
HGM System 4



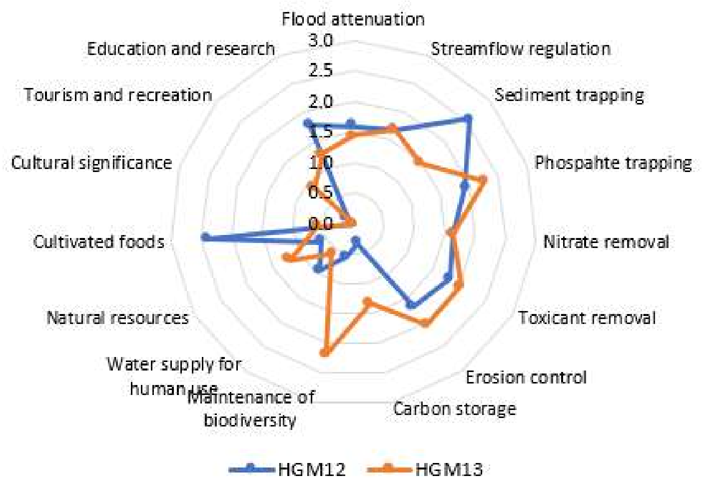
HGM Systems 5, 6, 7, 8 and 9



HGM Systems 10 and 11



HGM Systems 12 and 13



HGM Systems 14 and 15

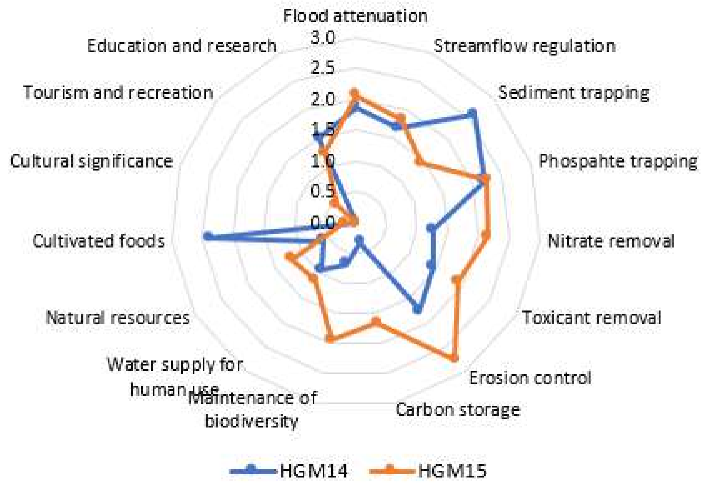


Figure 7-5: Wetland Ecological Services

Table 7-6: Wetland Ecological Services

HGM System	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Flood attenuation	1.9	2.2	1.1	1.5	2.2	2.3	2.2	2.3	2.6	2.4	1.8	1.6	1.4	1.9	2.1
Streamflow regulation	2.3	2.5	1.7	1.8	2.8	2.8	2.8	2.2	2.8	0.8	1.7	1.7	1.7	1.7	1.8
Sediment trapping	2.5	3.0	1.6	2.4	2.7	2.5	2.9	2.5	3.1	3.0	2.1	2.6	1.5	2.6	1.4
Phosphate trapping	2.6	3.2	1.7	2.0	3.1	2.7	2.7	2.3	3.1	2.2	2.6	1.9	2.2	2.2	2.2
Nitrate removal	2.1	2.7	1.3	1.5	3.0	2.5	2.4	1.7	2.9	1.0	2.8	1.7	1.7	1.3	2.2
Toxicant removal	2.2	2.8	1.3	1.7	2.8	2.6	2.6	2.2	2.8	1.6	2.2	1.8	2.0	1.5	1.9
Erosion control	2.5	3.0	1.7	2.2	2.5	2.5	2.5	2.8	2.9	2.8	3.0	1.7	2.0	1.8	2.8
Carbon storage	2.0	2.3	0.7	1.3	2.0	1.7	1.7	2.0	2.3	0.0	2.3	0.3	1.3	0.3	1.7
Maintenance of biodiversity	2.1	3.3	1.9	1.8	2.1	1.4	1.4	1.6	3.0	0.6	2.2	0.6	2.2	0.7	1.9
Water supply for human use	2.1	2.9	0.8	1.1	2.8	2.1	2.1	2.0	2.6	0.5	1.3	0.9	0.6	0.9	1.1
Natural resources	1.4	2.0	0.6	0.8	1.8	1.2	0.8	1.2	2.0	0.6	1.0	0.6	1.2	0.6	1.2
Cultivated foods	0.2	0.2	1.2	1.0	1.0	1.2	1.0	1.2	1.0	2.0	0.2	2.4	0.6	2.4	0.2
Cultural significance	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Tourism and recreation	1.6	2.1	0.6	1.0	2.0	1.4	1.6	1.7	2.3	0.3	2.0	0.1	0.9	0.0	0.4
Education and research	1.5	1.3	1.0	1.0	1.5	1.3	1.5	1.3	1.5	1.8	1.5	1.8	1.3	1.5	1.3
Average	1.8	2.3	1.1	1.4	2.2	1.9	1.9	1.8	2.3	1.3	1.8	1.3	1.4	1.3	1.5
Rating	Intermediate	Moderately high	Moderately low	Intermediate	Moderately high	Intermediate	Intermediate	Intermediate	Moderately high	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate

7.3.3. Ecological Importance and Sensitivity (EIS)

Guidance Note:

The general features of the wetlands were assessed in terms of functioning and the overall importance of each HGM System was then determined at a landscape level. The ecological importance of a wetland is an expression of its importance to the maintenance of ecological diversity and functioning on a local and wider scale. Additionally, ecological sensitivity refers to the wetland's ability to resist disturbance and capability to recover from disturbance that has occurred (Department of Water Affairs and Forestry, 1999). It is important to note that the EIS score is a combination of the Ecological Importance & Sensitivity, Hydrological/Functional Importance, and the Direct Human Benefits.

The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. This study utilised the methodology outlined by DWAF (1999) and updated in Kotze and Rountree (Kotze, Ellery, Macfarlane, & Jewitt, 2012; Rountree, Malan, & Weston, 2013).

SCC in the Project Area include *Crinum macowanni, Eucomis autumnalis, Gladioulus sp, Watsonia gladioloides and Brusnvigia radulosa*. The dominant species within the Project Area included *Persicaria lapathafolia, Solanum sisymbriifolium (1b), Verbena brasiliensis (1b), Verbena officianalis, Cirsium vulgare (1b), Myriophyllum aquaticum (1b), Bidens pilosa, Pennisetum clandestinum 1b), Paspalum notatum, Cosmos bipinnatus, Centella asiatica, and Conyza bonariensis.* A full species list is provided in the Fauna & Flora Impact Assessment Report.

The EIS scores range from **Moderate** to **Very High** as shown in Table 7-6 and Figure 7-6 below. The following can be derived from the data:

- The EIS for HGM System 2 rated as **Very High**. This can be attributed to the high ecological sensitivity (SCC) and importance as well as the hydrological functioning;
- HGM Systems 1, 5, 6, 7, 8, 9 and 11 were all rated as **High** due to the hydrological functioning and the ecological importance of these systems. These systems provide various services to the environment and ecology and are well functioning (i.e., flood attenuation, natural resources, habitat, water supply, phosphorus trapping and well-connected systems);
- HGM Systems 3, 4, 10, 12, 14 and 15 were rated as **Moderate**. These systems were dominantly cultivated and provided moderate to low ecological services and importance to the environment;
- Direct Human Benefits were the lowest due to the nature of the wetlands and the wetlands being away from villages. Some wetlands were utilized by farmers, however, are commonly protected and unused. Human benefits (e.g., drinking water, firewood,

thatching grass, medicinal plants) are low in these systems, however, some systems are cultivated and grazed; and

- The EIS scores should be assessed individually, as well as combined, to determine the EIS of the wetlands.

Table 7-7: Wetland Ecological Importance and Sensitivity Scores

HGM System	Ecological Importance & Sensitivity	Hydrological/Functional Importance	Direct Human Benefits	Final EIS	EIS Category
1	2.1	2.3	1.2	2.3	High
2	3.3	2.7	1.2	3.3	Very high
3	1.9	1.4	0.8	1.9	Moderate
4	1.8	1.8	0.9	1.8	Moderate
5	2.1	2.6	1.2	2.6	High
6	1.4	2.5	1.0	2.5	High
7	1.4	2.5	1.0	2.5	High
8	1.6	2.3	1.0	2.3	High
9	3.0	2.8	1.2	3.0	High
10	0.6	1.7	0.9	1.7	Moderate
11	2.2	2.3	0.9	2.3	High
12	0.6	1.7	0.9	1.7	Moderate
13	2.2	1.7	0.8	2.2	High
14	0.7	1.6	0.9	1.6	Moderate
15	1.9	2.0	0.8	2.0	Moderate

The overall catchment has been modified due to anthropological impacts, specifically historical mining and agricultural practices. The outcomes are changes in the water input volumes and flow regimes, as well as water distribution and retention patterns of water passing through the wetlands. Sedimentation from mining and agricultural activities decrease the quality of water, as well as affect large areas of vegetation, the geomorphology and natural habitats. Roads, buildings and other infrastructure that have been built increase run-off, cause fragmentation, creating preferential and artificial flow paths.

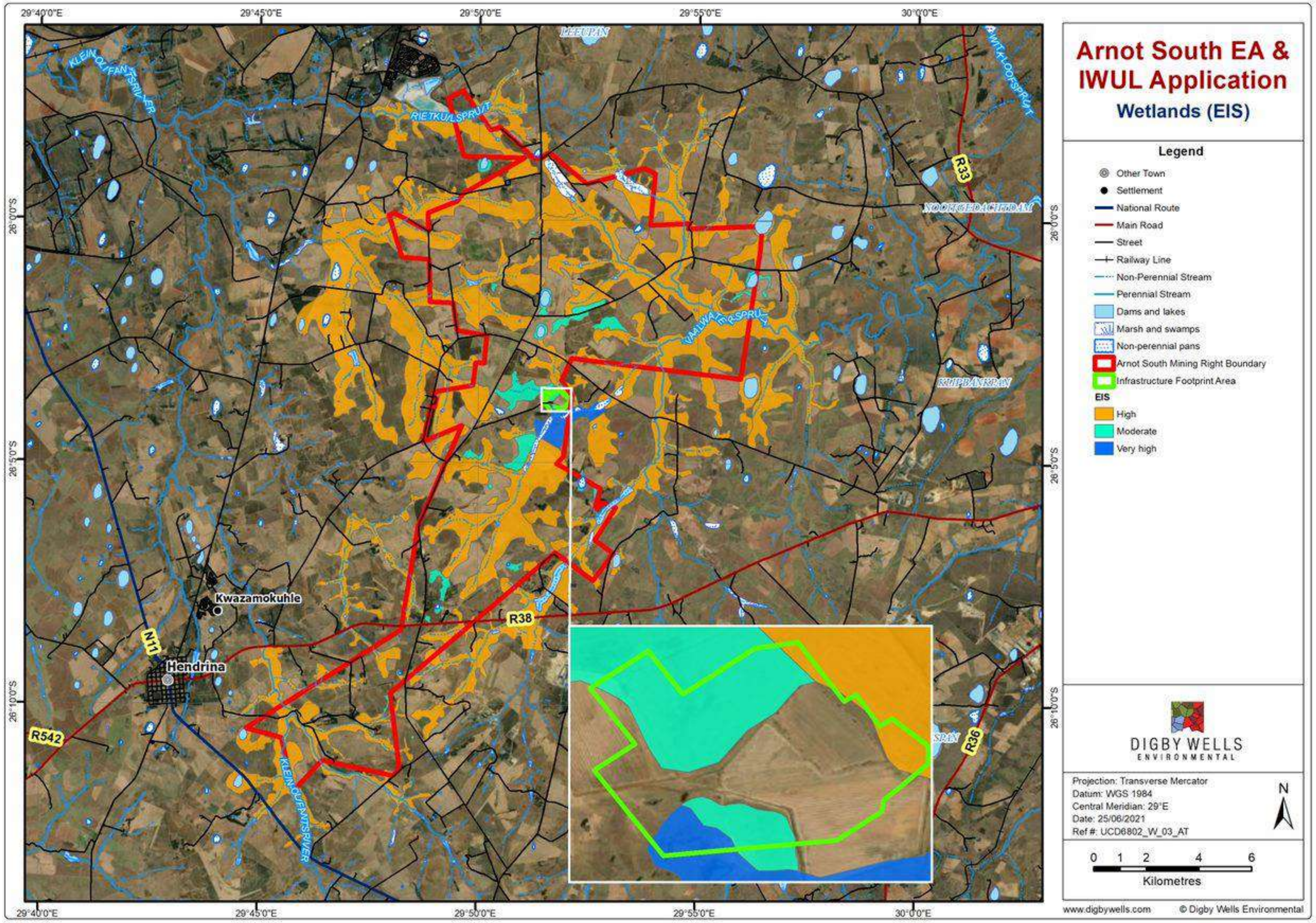


Figure 7-6 Wetland Ecological Importance and Sensitivity

8. Sensitivity Analysis

Based on the PES, ES and 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** (Table 8-1 and Figure 8-1).

Table 8-1: Sensitive Areas

HGM System	PES	PES Rating	EIS	EIS Rating	ES	ES Rating	Sensitivity
1 Infra CVB	D	Large	2.3	High	1.8	Intermediate	Moderate
2 Infra CVB/FP	C	Moderate	3.3	Very high	2.3	Moderately high	High
3 Infra Seep	C	Moderate	1.9	Moderate	1.1	Moderately low	Moderate
4 Infra UVB	C	Moderate	1.8	Moderate	1.4	Intermediate	Moderate
5 CVB	D	Large	2.6	High	2.2	Moderately high	High
6 CVB	D	Large	2.5	High	1.9	Intermediate	Moderate
7 CVB	D	Large	2.5	High	1.9	Intermediate	Moderate
8 CVB	C	Moderate	2.3	High	1.8	Intermediate	High
9 CVB/FP	C	Moderate	3	High	2.3	Moderately high	High
10 Pan & Seep (cultivated)	E	Serious	1.7	Moderate	1.3	Intermediate	Low
11 Pan & Seep (grazed)	B/C	Moderate	2.3	High	1.8	Intermediate	High
12 Seep (cultivated)	E	Serious	1.7	Moderate	1.3	Intermediate	Low
13 Seep (grazed)	C	Moderate	2.2	High	1.4	Intermediate	High
14 UVB (cultivated)	E	Serious	1.6	Moderate	1.3	Intermediate	Low
15 UVB (grazed)	C	Moderate	2	Moderate	1.5	Intermediate	Moderate

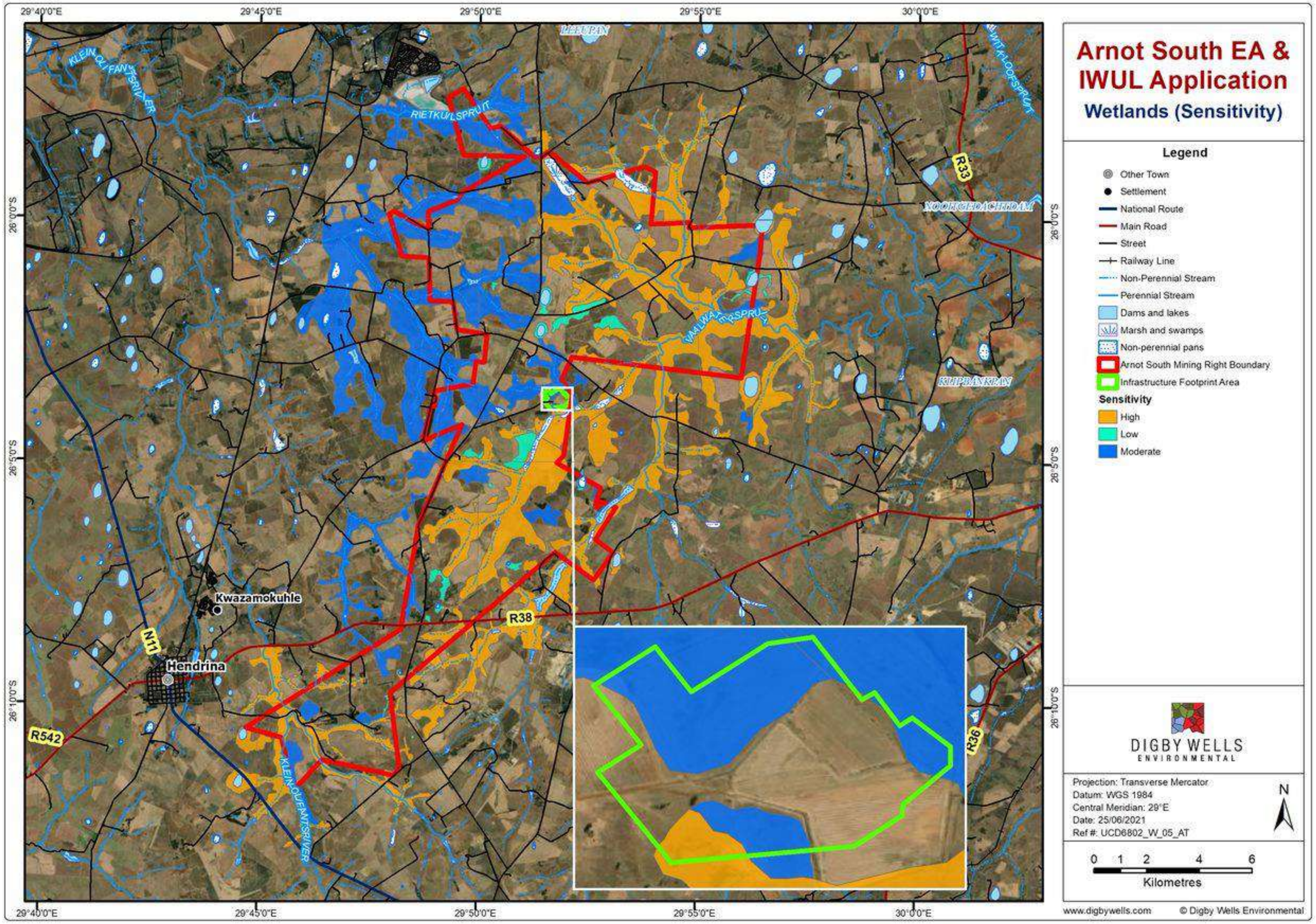


Figure 8-1 Wetland Sensitivity

9. Mitigation Hierarchy

Guidance note:

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

Based on previous studies and similar projects within the Mpumalanga Province, it is inevitable that the proposed activities will impact on the wetlands. Even when wetlands are avoided, impacts to the wetlands may still arise from other mining activities in the area. Mining particularly affects surface and subsurface water flow in a catchment and consequently affects recharge and discharge of water and the hydrological expression in wetlands.

However, it is not always possible to avoid or prevent impacts and therefore, minimisation of impacts and future rehabilitation should be considered. If this is not possible or feasible, wetland offsetting should be implemented where rehabilitation may be included as part of the Offset Plan.

The mitigation hierarchy for the wetlands within the Project Area are described in Table 9-1 below.

Table 9-1: Mitigation Hierarchy for Wetlands

Mitigation Step	Actions
Avoid or prevent	*Consider options to avoid impacts on biodiversity, ecosystem services and people (e.g., project location, siting, scale, layout, technology and project phase). This is the best option, however not always possible. Where the social and environmental impacts are too high, mining should not take place as it would be unlikely to rely on the taller steps to prove effective remedy for impacts.*
	• Avoid mining and infrastructure within all delineated wetlands; and • Establishment of a 500 m buffer zone to protect wetlands from infrastructure and mining. This would require that development occur further than 500 m from a delineated wetland area.
	• Placement of infrastructure will be as far as possible from delineated wetlands; • Underground mining was considered to prevent and reduce impacts on wetlands and surfaces; • To avoid/prevent impacts to all delineated wetlands will require to avoid mining in the entire Project Area and therefore will not be feasible; and • Underground mining can potentially lead to unforeseen and residual impacts, such as subsidence and decanting which is unavoidable.
Minimize	*Consider alternatives to minimise impacts on biodiversity and ecosystem services (e.g., project location, scale, technology and layout). In areas where the*

Mitigation Step	Actions
	environmental and social constraints are not too high, minimising should still be taking place.
	● Avoid mining and infrastructure within wetlands with a High and Medium Sensitivity that could lead to impacts (e.g., subsidence, dewatering, decanting and contamination); ● Establish at least a 100 m buffer around the wetlands to protect wetland areas from infrastructure and mining within the Project Area. This would require that development occur further than 100 m from a delineated wetland; ● Select wetlands on-site to avoid (High Sensitivity) and rehabilitate to minimize the impacts on wetlands within the catchment and Project Area; and ● Consider moving infrastructure outside wetlands and the 100 m buffer zone.
	● This will require moving the some of the proposed infrastructure areas to outside delineated wetlands, however the placement of the infrastructure are strategically placed due to shaft access and other related surface infrastructure. Placement of infrastructure in one concise area reduces the footprint of impact on the overall Project Area; and ● Underground mining can potentially lead to unforeseen and residual impacts, such as subsidence and decanting which is unavoidable.
Rehabilitate	*Rehabilitate areas where impacts were unavoidable. Measures must be taken to return impacted areas to conditions ecologically similar to their 'pre-mining natural state' or an agreed land use after mine closure. Rehabilitation is important and necessary, however even with significant resources and effort, rehabilitation is limited and almost always falls short of replicating the biodiversity and complexity of a natural system.*
	● Rehabilitate selected wetlands within the Project Area (impacted by surface infrastructure and potential underground mining impacts); ● Recreate wetlands on-site after mining and rehabilitation; ● Monitor and mitigate wetlands affected by decanting, subsidence, contamination and dewatering of wetlands; and ● Ensure concurrent rehabilitation with special attention to reshaping the areas, re-vegetating and mitigation of decanting and contamination.
	● Rehabilitation will be implemented as far as possible, however not all wetlands will be restored back to pre-mining conditions, therefore wetland offsetting will still have to be considered; and ● Underground mining can potentially lead to unforeseen and residual impacts, such as subsidence and decanting which is unavoidable. These areas will be rehabilitated as far as possible, however offsetting may be required.
Offset	*Compensating for remaining and residual (unavoidable) negative impacts on the biodiversity. Offset should be implemented when every effort has been made to*

Mitigation Step	Actions
	minimise and rehabilitate remaining impacts to a degree of 'no net loss' of biodiversity against biodiversity targets.
	• Develop and implement a Wetland (biodiversity) Offset Strategy and Rehabilitation Plan for the wetlands in the Project Area that will be unavoidable; and • Monitor and mitigate subsidence, dewatering, decanting and contamination of wetlands.
	• This is a costly activity and requires selecting wetlands outside the impacted area to rehabilitate. This could lead to cost implications and often entails selecting wetlands located outside the current catchment. However, due to the size of the MRA, wetlands within the MRA could be selected to implement offsetting.

10. Wetland Impact Assessment

> **Guidance Note:**
>
> This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are a result of both the environment in which the proposed project activities take place, as well as the actual activities. The potential impacts are discussed per aspect and per each phase of the Project, i.e., the Construction Phase, Operational and Rehabilitation/Closure Phases where applicable.
>
> Mitigation measures in this section are provided to avoid, minimise and rehabilitate wetlands within the Project Area. However, due to the loss of wetlands, it is recommended to develop and implement a Wetland Offset Strategy to compensate for the wetlands lost.
>
> The mitigation hierarchy includes firstly the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction and Operational Phases, the next step is or to minimise the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented.

Activities during the Construction, Operational and Rehabilitation Phases that may have potential impacts on the wetlands are described below. Wetlands directly impacted by the proposed surface infrastructure, needs to be avoided and minimised as far as possible, when it is not possible to avoid impacts, the wetlands need to be rehabilitated and or offset implemented.

Wetlands impacted by underground mining activities, such as subsidence, groundwater contamination, dewatering and decanting must be rehabilitated. A wetland Offset Calculation must be done to determine the residual impacts to the wetlands. Offsetting must be implemented to compensate for the hectare equivalent lost (“like-for-like”).

The following are discussed below:

- Table 10-1: Interactions and Impacts of Activity;
- Table 10-2: Pre-Mitigation Impact Ratings;
- Table 10-3: Mitigation Measures; and
- Table 10-4: Post-Mitigation Impact Ratings.

Figure 10-1 refers to the proposed infrastructure in relation to the wetland delineations. Approximately 79.76 ha of wetland are proposed to be lost.

DIGBY WELLS ENVIRONMENTAL

Table 10-1: Interactions and Impacts of Activity

Project Phase	Project Activity	Impact	Description
Construction Phase	Site/vegetation clearance (52.28 ha)	• Direct loss of 79.76 ha wetlands; • Loss of habitat and biodiversity; • Erosion and sedimentation of adjacent wetlands and water courses; • Erosion and sedimentation from stockpiles, rock dump and discard dump; • Water and soil contamination and deterioration; • Increased runoff from hardened surfaces; • Decreased water supply to the wetlands systems; and • Change in habitat and potential change in species composition.	The site clearance, removal of vegetation, soil stripping and stockpiling will result in the complete loss of wetlands within the vicinity of the proposed infrastructure. This will alter the hydrological regime and flow of water to adjacent and downstream wetlands and watercourses. This could contribute to further loss of wetlands adjacent and downstream of the infrastructure area, referred to as indirect loss. Increased flow velocity from hardened surfaces and concentrated flow may increase the erosion risk and sedimentation of water resources. Stockpiles and dumps might erode and cause sedimentation of downstream and adjacent wetlands and water courses as well as lead to soil and water contamination. Construction of infrastructure (i.e., linear infrastructure, PCD, STP, shaft, workshops etc.) will result in complete and or partial loss of wetlands within the proposed infrastructure area. Construction may possibly lead to soil compaction, increased surface runoff and increased risk of erosion, contamination and sedimentation of the wetlands. During construction, spills from machinery, STP, PCD and wastewater may occur which will in effect contaminate the wetlands. The contamination of water resources will result in the deterioration of water quality which will result in impacts to the aquatic faunal species, terrestrial faunal species and vegetation.
	Diesel storage and explosives magazine		
	Establishment of infrastructure (Infrastructure footprint - 13.28 ha; linear infrastructure - 51 501 m) Ventilation fans, change houses, offices, ablutions, workshops, cable workshop, weighbridge, weighbridge control room and access control office		
	Construction of access and haulage road (19 113 meters), Power line construction 22kV line, 2.3 km long		
	Construction of Pollution control dam (PCD) (1.61 ha), Raw water pipeline, Process water, Sewage treatment plant (STP)		
	Stockpiling of soils, rock dump and discard dump establishment.		

Operational Phase	Operating STP (18.31 m (combination of two delineations)), PCD, raw water pipeline, process water, washing plant	• Infrastructure area:
		  • Water and soil quality contamination and deterioration;
		  • Loss of habitat and biodiversity;
		  • Erosions and sedimentation;
		  • Increased runoff and flow from hardened surfaces; and
		  • Change in habitat and potential change in species composition.
		• Underground mined areas:
		  • Subsidence;
		  • Decanting;
		  • Dewatering; and
		  • Groundwater contamination;
			The operation, maintenance and potential spills from the PCD, STP, raw water, processed water and washing plant could potentially lead to water and soil contamination, leading to contamination of the low-lying areas such as wetlands. Contamination of the environment will lead to deterioration and loss of biodiversity, habitat, clean water and have various social constrains.
			The operation of the mine will result in exposed surfaces for prolonged periods and the generation of loose soil and contaminated material which may be washed to downstream wetlands and water courses that may lead to sedimentation and contamination. The exposed surfaces will have no ability to slow water flow and as such may cause an altered or elevated water flow to the wetland areas which may prompt the onset of erosion in wetland areas.
			Furthermore, the underground mining activities may lead to unforeseen impacts such as subsidence, dewatering, contamination and decanting. Areas of high extraction and shallow resources (Figure 1-3) should be monitored and mitigated as soon as impacts are observed to prevent secondary impacts leading from the aforementioned.

	Mining of coal by underground mining (underground) (5 050.83 ha) Removal of rock (blasting), rock/discard dumps, soils, ROM, discard dump (discard dump 2946 ha and Overburden stockpile 13716 ha)		
	Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste		
	Maintenance of haul roads, pipelines, machinery, water, effluent and stormwater management infrastructure and stockpile areas.		
	Continue with exploration activities		

Rehabilitation Phase	Demolition and removal of infrastructure.	• Impacts to the wetlands and watercourses include:
		  • Erosion and sedimentation;
		  • Increased AIPs;
		  • Change in habitat and potential change in species composition;
			Rehabilitation of the infrastructure area may lead to exposed areas that could lead to erosion and sedimentation. This might impact wetlands within and downstream and adjacent of the infrastructure area.
			Sedimentation will lead to habitat and biodiversity loss and decreased overall wetland health. The activities that will be performed during the final rehabilitation will entail the movement of material, shaping of the topography and soil spreading and will include the establishment of vegetation on

	Post-closure monitoring and rehabilitation.		
	Closure of the underground mine.		

Project Phase	Project Activity	Impact	Description
		• Soil and water contamination due to decanting and the groundwater contamination plume; • Subsidence; and • Dewatering.	exposed surfaces. The movement of material and large areas of exposed surfaces could result in erosion, sedimentation, change in species composition and increase in AIPs. Demolishing of the infrastructure, PCD, STP, raw water, processed water and washing plant could potentially lead to soil, water and wetland contamination, resulting in wetland degradation. Removal of linear infrastructure may lead to erosion, compaction, spills and re-wetting of areas (positive). It is not clear if dewatering, decanting and subsidence are expected in the area, however, could lead to various impacts to wetlands, including water ponding, drying out of wetlands, loss of biodiversity and contamination.

10.1. Impact Ratings

Table 10-2 and Table 10-4 present the impact ratings associated with the Project for all the phases prior to and post-mitigation, whereas Table 10-3 presents the mitigation measures to be implemented to avoid, reduce, and rehabilitate impacts.

Table 10-2: Pre-Mitigation Impact Ratings

Pre-Mitigation Rating								
Project Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site/vegetation clearance (52.28 ha)	• Direct loss of 79.76 ha wetlands; • Loss of habitat and biodiversity; • Erosions and sedimentation of adjacent wetlands and water courses; • Erosion and sedimentation from stockpiles, rock dump and discard dump; • Water and soil contamination and deterioration; • Increased runoff from hardened surfaces; • Decreased water supply to the wetlands systems; and • Change in habitat and potential change in species composition.	Permanent (7)	Local (3)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 119
	Construction of diesel storage and explosives magazine		Beyond Project Life (6)	Municipal Area (4)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96
	Establishment of infrastructure (Infrastructure footprint - 13.2849 ha; linear infrastructure - 51 501 m) Ventilation fans, change houses, offices, ablutions, workshops, cable workshop, weighbridge, weighbridge control room and access control office		Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Construction of access and haulage road (19 113 meters), Power line construction 22kV line, 2.3 km long		Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Construction of Pollution control dam (PCD) (1.6078 ha), Raw water pipeline, Process water, Sewage treatment plant (STP)		Permanent (7)	Region (5)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 133
	Stockpiling of soils, rock dump and discard dump establishment.		Beyond Project Life (6)	Municipal Area (4)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 96

Operational Phase	Operating STP (18.31 m (combination of two delineations)), PCD, raw water pipeline, process water, washing plant	• Infrastructure area:
		  • Water and soil quality contamination and deterioration;
		  • Loss of habitat and biodiversity;
		  • Erosion and sedimentation;
		  • Increased runoff and flow from hardened surfaces; and
		  • Change in habitat and potential change in species composition.
			Permanent (7)	National (6)	Irreplaceable Loss (7)	Almost Certain (6)	Negative	Major - 120

	Mining of coal by underground mining (underground) (5 050.83 ha) Removal of rock (blasting). Rock/discard dumps, soils, ROM, discard dump (discard dump 2946 ha and Overburden stockpile 13716 ha)		Permanent (7)	National (6)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 140
	Storage, handling, and treatment of hazardous products (including fuel, explosives and oil) and waste		Beyond Project Life (6)	Municipal Area (4)	Irreplaceable Loss (7)	Almost Certain (6)	Negative	Moderate - 102

DIGBY WELLS ENVIRONMENTAL

Pre-Mitigation Rating									
Project Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
	Maintenance of haul roads, pipelines, machinery, water, effluent and stormwater management infrastructure and stockpile areas.	• Underground mined areas: • Subsidence; • Dewatering; and • Groundwater contamination.	Beyond Project Life (6)	Local (3)	Irreplaceable Loss (7)	Likely (5)	Negative	Moderate - 80
	Continue with exploration activities		Project Life (5)	Local (3)	Serious loss (5)	Almost Certain (6)	Negative	Moderate - 78
Rehabilitation Phase	Demolition and removal of infrastructure.	• Impacts to the wetlands and watercourses include: • Erosion and sedimentation; • Increased AIPs; • Change in habitat and potential change in species composition; • Soil and water contamination due to decanting and the groundwater contamination plume; • Subsidence; and • Dewatering.	Beyond Project Life (6)	Local (3)	Serious loss (5)	Likely (5)	Negative	Minor - 70
	Post-closure monitoring and rehabilitation.		Project Life (5)	Local (3)	Serious loss (5)	Likely (5)	Negative	Minor -65
	Closure of the underground mine.		Permanent (7)	National (6)	Irreplaceable Loss (7)	Definite (7)	Negative	Major - 140

Table 10-3: Mitigation Measures

Phase	**Mitigation Measures**
Construction Phase	• If the destruction of wetlands is unavoidable, disturbance must be minimised and suitably rehabilitated; • At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing; • Environmental Practitioner to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction, • Monitor infrastructure, stockpiles and dumps to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • Monitor PCD, STP, raw water, processed water and washing plant, if spills have occurred, clean up immediately and implement a monitoring program for at least three months after the spill has occurred; • Stockpiles must be vegetated and allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; and • Locate stockpiles and dumps outside wetlands and at least a 100 m buffer.

Phase	Mitigation Measures
Operational Phase	• Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present, and if so that a remedy is put in place as soon as possible; • If it is unavoidable that any of the wetlands will be affected, the disturbance must be minimised and suitably rehabilitated; • All vehicle maintenance must occur within designated areas and inspected regularly for leaks; • All spills must be cleaned up immediately to prevent contaminants to enter the wetlands. Monitoring must take place at least three months after the spill have occurred to determine any contamination; • Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel; • No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines; • Culverts, roads, conveyors, powerlines and river crossings must be maintained, cleared and monitored; • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads and within the operational footprint; • Stockpiles should be monitored and vegetated to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • Stockpiles must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • Stockpiles must be located outside wetlands and at least a 100 m buffer; • A Storm Water Management Plan (SWMP) should already be implemented. This should consider all wetlands and other watercourses adjacent and downstream of the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey contaminated water to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Monitoring of subsidence, dewatering and contamination must take place regularly to access possible impacts to wetlands; • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; and • Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical’s specific storage descriptions.
Rehabilitation Phase	• Rehabilitation should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands; • Mine-affected water should be reintroduced into the environment without treatment, if necessary, and a WUL; • Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation into wetland areas; • Implement and maintain a Wetland and AIPs Management Plan for the duration of the rehabilitation phase and into closure; • No material should be dumped/stockpiled within any wetlands or watercourses; • No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffers. All vehicles must remain on demarcated roads; • Wetland monitoring must be carried out during the Rehabilitation phase into mine closure to ensure no unnecessary impact to wetlands takes place; • Rehabilitation must be done as soon as any impacts are observed (decanting, subsidence and contamination); • Monitor subsidence and possible decant of Acid Mine Drainage (AMD) and implement management measures which include for example an abstraction borehole placed down gradient of the decant point and in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment, 2021); • Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion; and • Implement a Wetland Offset Strategy to compensate for residual impacts to the wetlands.

Table 10-4: Post-Mitigation Impact Ratings

Pre-Mitigation Rating									
Project Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site/vegetation clearance (52.28 ha)	After avoidance, minimisation, mitigation and rehabilitation of the site, impacts should be Moderate to Minor, however impacts might still arise over time due to the construction phase (infrastructure area): • Erosion; • Sedimentation; • Compaction and increased runoff; • Mixing of subsoil and topsoil; and • AIPs proliferation.	Beyond Project Life (6)	Local (3)	Serious loss (5)	Definite (7)	Negative	Moderate - 98
	Diesel storage and explosives magazine		Project Life (5)	Limited (3)	Serious loss (4)	Probable (4)	Negative	Minor - 48
	Establishment of infrastructure (Infrastructure footprint - 13.28 ha; linear infrastructure - 51 501 m) Ventilation fans, change houses, offices, ablutions, workshops, cable workshop, weighbridge, weighbridge control room and access control office		Beyond Project Life (6)	Local (3)	Serious loss (5)	Definite (7)	Negative	Moderate - 98
	Construction of access and haulage road (19 113 meters), Power line construction 22kV line, 2.3 km long		Project Life (5)	Municipal Area (4)	Serious loss (4)	Probable (4)	Negative	Minor - 52
	Construction of Pollution control dam (PCD) (1.60 ha), Raw water pipeline, Process water, Sewage treatment plant (STP)		Beyond Project Life (6)	Local (3)	Serious loss (5)	Likely (5)	Negative	Minor - 70
	Stockpiling of soils, rock dump and discard dump establishment.		Project Life (5)	Local (3)	Serious loss (4)	Likely (5)	Negative	Minor - 60
Operational Phase	Operating STP (18.32 m (combination of two delineations)), PCD, raw water pipeline, process water, washing plant	• Some wetlands will be completely/partially removed due to surface infrastructure; • Subsidence, decanting, dewatering and groundwater contamination will possibly still take place even tough various mitigation measures are followed; • When rehabilitaiton, mitigation and monitoring is done correctly, impacts from infrastructure and monitoring should be minor.	Project Life (5)	Municipal Area (4)	Serious loss (5)	Likely (5)	Negative	Minor - 70
	Mining of coal by underground mining (underground) (5 050.83 ha) Removal of rock (blasting). Rock/discard dumps, soils, ROM, discard dump (discard dump 2946 ha and Overburden stockpile 13716 ha)		Beyond Project Life (6)	Municipal Area (4)	Irreplaceable loss (6)	Definite (7)	Negative	Major - 112
	Storage, handling, and treatment of hazardous products (including fuel, explosives and oil) and waste		Project Life (5)	Local (3)	Serious loss (5)	Probable (4)	Negative	Minor - 52
	Maintenance of haul roads, pipelines, machinery, water, effluent and stormwater management infrastructure and stockpile areas.		Project Life (5)	Limited (2)	Serious loss (4)	Unlikely (3)	Negative	Negligible - 33
	Continue with exploration activities		Long Term (4)	Limited (2)	Moderate loss (3)	Probable (4)	Negative	Minor - 36
Rehabilitation Phase	Demolition and removal of infrastructure.	Impacts from rehabilitation and monitoring is rare/negligible. However, there is a possibility for subsidence, dewatering and decanting that will most probably impact wetlands after mine closure.	Project Life (5)	Limited (2)	Moderate loss (3)	Unlikely (3)	Negative	Negligible - 30
	Post-closure monitoring and rehabilitation.		Long Term (4)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -24

Pre-Mitigation Rating									
Project Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
	Closure of the underground mine.	Even after the proposed mitigation measures, some impacts might still occur, including: • Erosion when areas are not revegetated instantly; • Compaction; • Spreading of AIPs; • Subsidence; • Groundwater and possible surface water contamination; • Dewatering of wetlands; and • Decanting, impacting wetlands and freshwater resources.	Permanent (7)	Municipal Area (4)	Irreplaceable Loss (6)	Almost Certain (6)	Negative	Moderate - 102

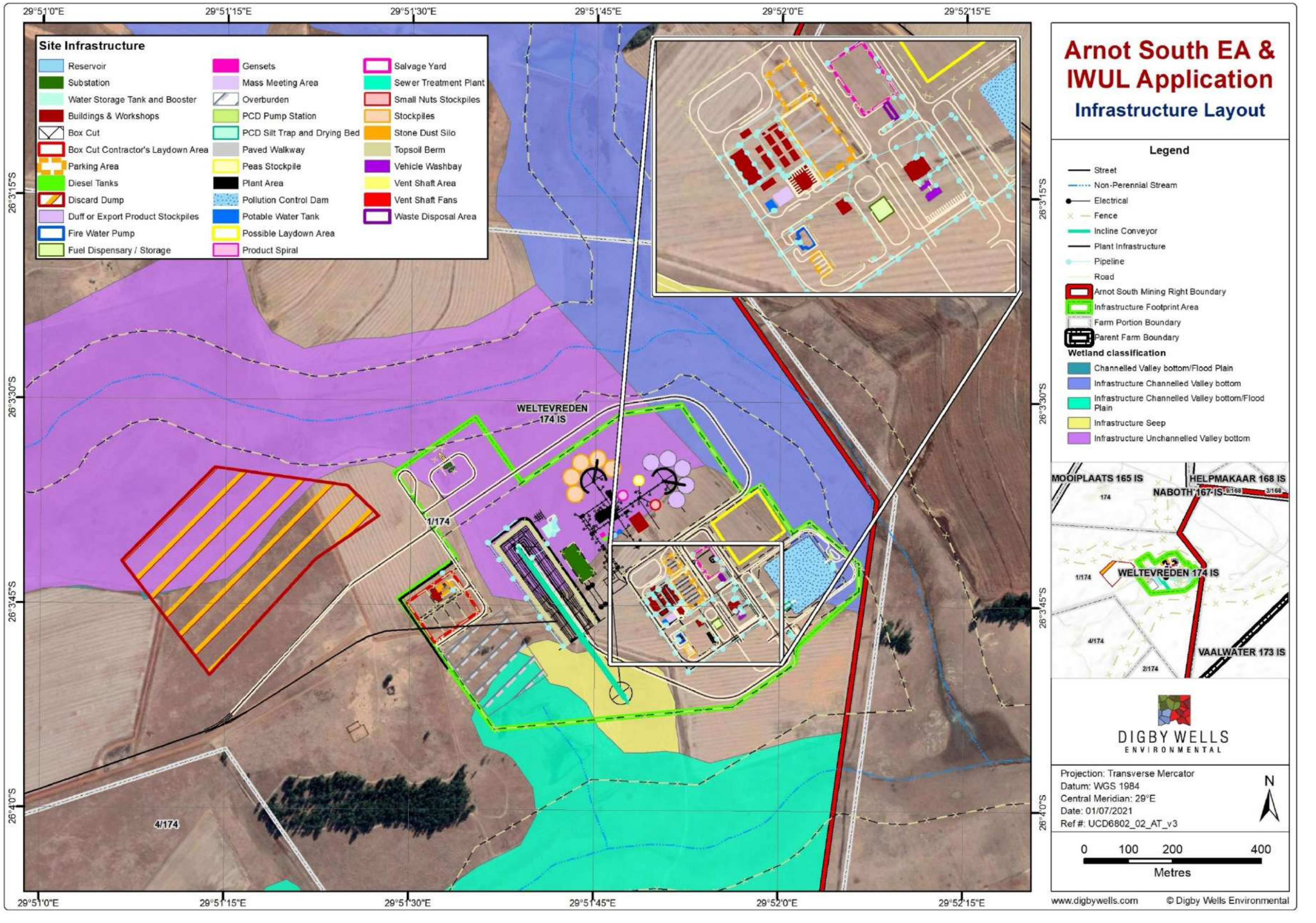


Figure 10-1 Infrastructure Layout and Wetland Delineations

10.2. Cumulative Impacts

The land uses within the Project Area have contributed to losses of wetlands and continued impacts on the remaining catchment. Historical and current agropastoral (i.e., intensive cultivation, cattle grazing, infrastructure, dams and boreholes), anthropological (i.e., housing, roads, tracks, cattle, borrow pits and firewood collection), infrastructure, (i.e., national roads, dams, powerlines and pipelines) and mining activities have led to various geomorphological, vegetation and hydrological changes (e.g., vegetation loss, overgrazing and contamination of water resources and increased surface inflows) contributing to the physical impacts on the wetlands, reducing the PES, EIS and ES.

The historical and current agropastoral activities and mining within the catchment have led to losses in wetlands and alteration to the hydrological regime that may have facilitated increased water flow and also have increased the number of pollutants flowing into the water resources and created large erosion gullies. The alteration of vegetation and surface flow has led to the onset of erosion in the wetlands and adjacent areas, and this may be perpetuated further by the proposed activities.

10.3. Unplanned and Low Risk Events

Only a small portion of the wetlands within the MRA are planned to be impacted by surface infrastructure. However, there is a risk that subsidence, dewatering, contamination and decanting might occur due to underground mining activities.

Table 10-1 outlines mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the proposed Project.

Table 10-1: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
• Entry of hazardous substances into the soils and groundwater, ending up in the low-lying areas adjacent of the project area. This includes hydrocarbons, oils and fuel in the event of a spillage or unseen seepage from the pit and spills and leaks from vehicles and machinery,	• Ensure correct storage of all chemicals at operations as per each chemical's specific storage requirements (e.g., sealed containers for hydrocarbons); • Ensure staff involved at the proposed Project have been trained to correctly work with chemicals at the sites; • If spills have occurred, clean up immediately to prevent contamination of the wetlands; • Ensure spill kits (e.g., Drizit) are readily available at areas where chemicals are known to be used; • Conduct monitoring after construction and during operation with continuous rehabilitation if and where necessary to prevent secondary impacts to the adjacent and downstream wetlands; and • Staff must also receive appropriate training in the event of a spill, especially near wetlands, watercourses and/or drainage lines.

Unplanned Risk	Mitigation Measures
• Dewatering of the adjacent and downstream wetlands (refer to the Groundwater Impact Assessment, DWE, 2021),	• Reinstate the pumped-out water from the underground mining activities back into the catchment and freshwater systems after treatment; and • Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present, and if so that a remedy is put in place as soon as possible.
• Decanting into the downstream and adjacent wetlands and water courses (refer to the Groundwater Impact Assessment, DWE, 2021).	• Prevent decanting by keeping the groundwater levels low post-closure; • Abstraction boreholes placed down gradient of the decant point to reduce decant generation and will lower the impact; • Prevent decant water from entering the wetlands; • Treat decant water before it is put back into the natural systems; • Fence off decant areas to prevent human and animal consumption; • Rehabilitate and mitigate areas where decanting has taken place; and • Monitor decant of AMD and implement management measures which include in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses.
• Subsidence	• Evaluate the subsidence/sinkholes to determine the rehabilitation method and impacts to the wetlands (i.e., depth, cause, ingress of water, groundwater drawdown, geology, blanket layer and thickness, • If the subsidence is determined to be unstable, fence off and prevent animal and human entry; • If subsidence is stable, the land can be rehabilitated back to pre-mining land use; • Compact the surface material (blanket layer) to stabilize the area; and • Backfill and revegetate.

11. Environmental Management Plan

The EMP is described in Table 11-1 below.

Table 11-1 Environmental Management Plan

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
Construction Phase	Site/vegetation clearance (52.28 ha) Diesel storage and explosives magazine Establishment of infrastructure (Infrastructure footprint - 13.28 ha; linear infrastructure - 51 501 m) Ventilation fans, change houses, offices, ablutions, workshops, cable workshop, weighbridge, weighbridge control room and access control office Construction of access and haulage road (19 113 meters), Power line construction 22kV line, 2.3 km long Construction of Pollution control dam (PCD) (1.61 ha), Raw water pipeline, Process water, Sewage treatment plant (STP)	• Direct loss of 79.76 ha wetlands; • Loss of habitat and biodiversity; • Erosion and sedimentation of adjacent wetlands and water courses; • Erosion and sedimentation from stockpiles, rock dump and discard dump; • Water and soil contamination and deterioration; • Increased runoff from hardened surfaces; • Decreased water supply to the wetlands systems; and • Change in habitat and potential change in species composition.	• **Control.** if the destruction of wetlands is unavoidable disturbance must be minimised and suitably rehabilitated; • **Control.** At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing; • **Control.** Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; • **Control and Remedy**. Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • **Control and Remedy.** Monitor infrastructure, stockpiles and dumps to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • **Control and Remedy.** Monitor PCD, STP, raw water, processed water and washing plant, if spills have occurred, clean up immediately and implement a monitoring program for at least three months after the spill has occurred; • **Control and Remedy.** If spills have occurred, it should be cleaned up immediately; • **Control and Remedy.** Stockpiles must be vegetated and allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; and • **Control and Remedy.** Locate stockpiles and dumps outside wetlands and at least a 100 m buffer.	Concurrent rehabilitation through the life of mine	Life of Construction Phase

Operational Phase	Operating STP (18.32 m (combination of two delineations)), PCD, raw water pipeline, process water, washing plant
	
	Mining of coal by underground mining (underground) (5 050.83 ha)
		• Infrastructure area:
		  ◦ Water and soil quality contamination and deterioration;
		  ◦ Loss of habitat and biodiversity;
		  ◦ Erosions and sedimentation;
		  ◦ Increased runoff and flow from hardened surfaces; and
			• **Control.** Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact (e.g., subsidence, dewatering, contamination and erosion) to the freshwater resources present, and if so that a remedy is put in place as soon as possible;
			• **Remedy**. If it is unavoidable that any of the wetlands will be affected, the disturbance must be minimised and suitably rehabilitated;
			• **Control.** All vehicle maintenance must occur within designated areas and inspected regularly for leaks;
				Concurrent rehabilitation through the life of mine	Life of Operational Phase

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
	Removal of rock (blasting). Rock/discard dumps, soils, ROM, discard dump (discard dump Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste Maintenance of haul roads, pipelines, machinery, water, effluent and stormwater management infrastructure and stockpile areas.	• Change in habitat and potential change in species composition. • Underground mined areas: • Subsidence; • Dewatering; and • Groundwater contamination;	• **Control and Remedy**. All spills must be cleaned up immediately to prevent contaminants to enter the wetlands. Monitoring must take place at least three months after the spill have occurred to determine any contamination; • **Control.** Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil; • **Control and Stop**. All areas of increased ecological sensitivity adjacent of the Project Area should be designated as "No-Go" areas and be off-limits to all unauthorised vehicles and personnel; • **Control and Stop.** No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines; • **Control and Remedy.** Culverts, roads and river crossings must be maintained, cleared and monitored; • **Control and Stop**. No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their Zone of Regulation areas. All vehicles must remain on demarcated roads and within the operational footprint; • **Control and Remedy.** Stockpiles should be monitored and vegetated to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems; • **Control and Remedy.** Stockpiles must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • **Control and Stop**. Stockpiles must be located outside wetlands and at least a 100 m Zone of Regulation; • **Control and Remedy**. A SWMP should already be implemented. This should consider all wetlands and other watercourses adjacent and downstream of the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey contaminated water to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • **Control and Remedy**. Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present, and if so that a remedy is put in place as soon as possible; • Control and Remedy. Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; and • **Control and Stop.** Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions.		
Rehabilit	Demolition and removal of infrastructure.			Concurrent rehabilitation through	

<table>
<thead>
<tr><th>Phase</th><th>Project Activity</th><th>Potential Impacts</th><th>Mitigation Measures</th><th>Mitigation Type</th><th>Period for Implementation</th></tr>
</thead>
<tbody>
<tr>
<td rowspan="2"></td>
<td>Post-closure monitoring and rehabilitation.</td>
<td rowspan="2">Impacts to the wetlands and watercourses include:
Erosion and sedimentation;
Increased AIPs;
Change in habitat and potential change in species composition;
Soil and water contamination due to decanting and the groundwater contamination plume;
Subsidence; and
Dewatering.</td>
<td rowspan="2">Control and Stop. Rehabilitation should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands;
Control and Stop. No stored mine-affected water should be reintroduced into the environment without treatment and a WUL;
Modify, Control and Remedy. Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation into wetland areas;
Modify, Control and Remedy. Implement and maintain a Wetland and AIPs Management Plan for the duration of the rehabilitation phase and into closure;
Control and Stop. No material should be dumped/stockpiled within any wetlands or watercourses;
Control and Stop. No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads;
Control and Remedy. Wetland monitoring must be carried out during the Rehabilitation phase into mine closure to ensure no unnecessary impact to wetlands takes place;
Modify, Control and Remedy. Rehabilitation must be done as soon as any impacts are observed (decanting, dewatering, subsidence and contamination;
Modify. Monitor subsidence and possible decant of Acid Mine Drainage (AMD) and implement management measures which include for example an abstraction borehole placed down gradient of the decant point and in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment, 2021);
Modify, Control and Remedy. Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion; and
Modify, Control and Remedy. Implement a Wetland Offset Strategy to compensate for the wetlands lost.</td>
<td rowspan="2">the life of mine and after mine</td>
<td rowspan="2">Life of Rehabilitation Phase</td>
</tr>
<tr>
<td>Closure of the underground mine.</td>
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12. Monitoring Programme

Guidance Note:

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring effectiveness of the management measures in place.

Monitoring should be done in terms of:

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

The Mine Manager and the Environmental Practitioner are responsible to report on results of the monitoring program. Internal monitoring reports should be required, reporting on the progress of the state of the monitoring and rehabilitation programme. This should be completed after each external monitoring report.

Table 12-1 below describes the monitoring plan which should be followed from the Construction Phase through to the Rehabilitation and Monitoring phase. The table below includes each aspect of monitoring together with the frequency of monitoring and person responsible thereof.

The monitoring programme is based on the following points:

- Undertake monitoring on the wetlands within the infrastructure areas, adjacent and downstream of the infrastructure areas as well as within the entire underground mining area to detect and rectify any secondary impacts caused by the Project;
- Commence with monitoring prior to the Construction Phase to collect baseline information regarding adjacent and downstream wetlands, soils and vegetation and to monitor any changes due to the proposed activities;
- Upon closure and rehabilitation, undertake annual monitoring for another three years to ensure there are no emerging impacts identified, which may need to be addressed;
- If subsidence, dewatering and decanting has occurred, wetland monitoring must be done bi-annually (twice a year) to determine any deterioration of wetlands; and
- Update the monitoring programme once a wetland offset plan has been developed and offsetting has been implemented.

Table 12-1: Monitoring Plan

Monitoring Element	Comment	Requirement	Frequency	Phase	Responsibility	Duration
Wetland extent (size)	Implementation of intervention measures.	Wetland update report and recommendations for impact mitigation, if any.	Annually	Construction	Environmental Officer	Up to Rehabilitation
				Operational		
				Rehabilitation		
Wetland health (PES, ES, EIS)	Implementation of intervention measures.	Wetland update report and recommendations for impact mitigation, if any.	Quarterly	Construction	Environmental Officer	3 years after Rehabilitation
			Annually	Operational		
				Rehabilitation		
Wetland physical attributes (Vegetation, erosion, habitat, open water extent)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take photos of wetlands and record any impacts seen.	Quarterly and after storm events.	Construction	Mine Environmental Manager	3 years after Rehabilitation
				Operational		
			Annually	Rehabilitation		
Surface water and soil contamination assessment (incl. decant points)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take water and soil samples for laboratory analysis, measuring heavy metals and potential harmful elements	Only after a spill/decanting has occurred	Construction	Environmental Officer	3 months thereafter (monthly) the spill has occurred
				Operational		
				Rehabilitation		
Subsidence, decanting and dewatering	Report any irregularities to the Environmental Officer for assessment and mitigation measures. Implementation of intervention measures.	Wetland update report and recommendations for impact mitigation, if any. Take photos of wetlands and record any impacts seen.	Only when impacts are observed	Construction	Environmental Officer	Bi-annually (twice a year) for three years or subsidence are stable and land use (wetlands) are remediated
				Operational		
				Rehabilitation		

13. Stakeholder Engagement Comments Received

Notes

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

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

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

14. Recommendations

The following actions are recommended to reduce adverse effects on the **wetlands within the proposed infrastructure area as well as the wetlands to be undermined** (Table 14-1):

Table 14-1: Possible Impacts and Recommendations

Possible Impacts	Recommendations
Decreased PES, EIS and ES of wetlands within the entire MRA due to mining related activities (i.e., infrastructure, subsidence, dewatering, decanting, contamination)	Avoid sensitive areas (Moderate and High) as far as possible by implementing no-go zones and buffer zones of at least 100 m (refer to Section 0). Monitor underground mine impacts to wetlands.
Loss of wetland vegetation and habitat.	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. The establishment of hydrophytic plants and facultative hydrophytes that are native to the area. 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. Monitor underground mine impacts to wetlands.
Soil disturbance (erosion), and decreasing biodiversity resulting in increased sedimentation and increased erosion.	Improved vegetation cover through the establishment of hydrophytic plants and facultative hydrophytes that are native to the area. Reduced risk of erosion and sedimentation.
Linear infrastructures resulting in fragmentation of wetlands, the creation of preferential flow paths, and the onset of erosion.	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.
Erosion/Sedimentation.	Reduced risk of erosion and sedimentation of downstream wetland areas by re-vegetation and sediment traps. Monitor underground mine impacts to wetlands.
Increased run-off and sedimentation, the input of pesticides and fertilisers and reduced buffer zone of wetlands due to crop farming and AIPs.	Employment of a protective vegetated buffer zone strip around the adjacent and downstream wetland in proximity of the infrastructure area and implement an AIPs Programme. Monitor underground mine impacts to wetlands.
Livestock impacts.	Limit livestock in the sensitive wetlands to prevent overgrazing, trampling and erosion. This will lead to improved wetland integrity and functionality.
Water quality impacts from decanting.	Monitor the decant of AMD, contamination and dewatering and implement management measures which include for example, an abstraction borehole placed down gradient of the decant point and in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses (refer to Groundwater Impact Assessment, 2021).
Complete loss of wetlands	Execute a wetland offset calculator to establish the hectare equivalent of wetlands that have been lost or mined out which will have to be offset during the rehabilitation phase.
Underground related impacts (i.e., decanting, dewatering, subsidence and contamination)	Monitor the area for related impacts and report to authorities as soon as possible. If areas are unstable and hold a risk to animals and humans, the area should be fenced off.

15. Reasoned Opinion Whether Project Should Proceed

The overall impacts of the Project were determined to be **Minor** to **Major** prior-mitigation 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. Underground mining contains the risk of subsidence, dewatering, decanting and contamination which might impact the wetlands significantly. However, post-mitigation the impacts are reduced to **Negligible** and **Major**. 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 MRA.

Underground mining activities should not have major impacts on the wetlands, unless decanting, subsidence and dewatering occur. The removal of wetlands in the headwaters of the catchment may cause loss of water inputs to the lower catchment and therefore have various effects on the downstream biodiversity, aquatic systems, fauna and flora. It is recommended to follow the mitigation hierarchy which includes firstly the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction and Operational Phases, the next step is or to minimise the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, Wetland Offsets need to be implemented.

The wetland management and monitoring requirements as set out in Sections 11 and 12 and the recommendations in Section 14 should form part of the conditions for the EA. A wetland offset strategy should be implemented to compensate for residual wetlands lost and should improve wetland health and functionality of wetlands and freshwater systems in the adjacent area and catchment. It is recommended to include at least a 100 m buffer around the wetlands for the surface infrastructure. Wetlands and natural water resources are a valuable natural asset, especially within the Highveld area.

16. Conclusion

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 HGM units were categorised into 15 HGM systems comprising floodplain wetlands, CVB wetlands, UVB wetlands, depressions (pans) and hillslope seep wetlands.

The dominant land use activities affecting the wetland PES, EIS and ES include agropastoral activities (e.g., increased AIPs, intensive cultivation, cattle grazing and infrastructure), anthropological activities (e.g., national roads, dams, powerlines, fence lines) and current and historical mining activities (e.g., underground mining, dewatering, groundwater contamination, roads, stockpiling, excavations, housing, AIPs and rehabilitated areas).

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 SCC were observed across the Project Area, increasing the ecological importance of the wetlands. Based on the PES, ES and 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.

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. 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 MRA.

The wetland management and monitoring requirements as set out in Sections 11 and 12 and the recommendations in Section 14 should form part of the conditions for the EA. Wetlands and natural water resources are a valuable natural asset, especially within the Highveld area.

17. References

Climate-data.org. (n.d.). *Climate-data.org*. Retrieved from Climate-data.org: https://en.climate-data.org/

Darwell, W., Smith, K., Tweddle, D., & Skelton, P. (2009). *The status and distribution of freshwater biodiversity in southern Africa.* Gland, Switzerland: IUCN and Grahamstown, South Africa: SAIAB.

Darwell, W., Smith, K., Tweddle, D., & Skelton, P. (2009). *The status and distribution of freshwater biodiversity in southern Africa.* Grahamstoen, South Africa: SAIAB: Gland, Switzerland: IUCN.

Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute. (2013). *Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector.* Pretoria.

Department of Water Affairs. (2013). *National Water Resource Strategy 2.* NWRS AND DWS.

Department of Water Affairs and Forestry. (1999). *South African Version 1.0 of Resource Directed Measures for Protection of Water Resources.*

Department of Water Affairs and Forestry. (2005). *A practical field procedure for the identification and delineation of wetlands and riparian areas.* Pretoria: DWAF.

Department of Water Affairs and Forestry. (2008). *Updated manual for identification and delineation of wetlands and riparian areas.* Pretoria: DWAF.

Department of Water Affairs and Forestry. (2011). *Groundwater dictionary (2nd edition).* . Retrieved from http://www.dwaf.gov.za/Groundwater/Groundwater Dictionary.aspx

Driver, A., Nel, J., Snaddon, K., Murray, K., Roux, D., & Hill, L. (2011). *Implementation Manual for Freshwater Ecosystem Priority Areas. Draft Report for the Water Research Commission.* Retrieved from http://www.wrc.org.za/Knowledge Hub D

Friedman, Y., & Daly, B. (2004). *Red Data Book of the Mammals of South Africa: A Conservation Assessment.* South Africa: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust.

Kleynhans, C. (2000). *Desktop estimates of the EISC, DEMC, PESC, present AEMC and best AEMC for quartenary catchements in South Africa.* Pretoria, South Africa: DWAF.

Kleynhans, C., & Hill, L. (1999). *Determination of Resource Quality Objectives for Habitat Integrity. RDM Riv_AppR23-Version1.0. Institute of Water Quality Studies. .* Pretoria, South Africa: Department of Water Affairs and Forestry.

Kleynhans, C., Thirion, C., & Moolman, J. (2005). *A Level 1 River Ecoregion classification System for South Africa, Lesotho and Swaziland.* Water.

Kleynhans, C., Thirion, C., & Moolman, J. (2005). *A Level 1 River Ecoregion classification System for South Africa, Lesotho and Swaziland.* Water.

Köppen, W., & Geiger, R. (1936). *Handbuch der klimatologie.* Berlin.

Kotze, D., & Ellery, W. (2009). *WET-Outcome Evaluate: an evaluation of the rehabilitation outcomes at six wetland sites in South Africa.* Pretoria: WRC: TT 343/09.

Kotze, D., & Marneweck, G. (1999). *Guidelnes for delineating the wetland boundary and zones within a wetland under the South African Water Act.*

Kotze, D., Ellery, W., Macfarlane, D., & Jewitt, G. (2012). *A rapid assessment for coupling anthropogenic stressors and wetland ecological condition.* Ecological Indicators.

Kotze, D., Macfarlane, D., & Edwards, R. (2020). *WET-EcoServices (Version 2): A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas.* WRC Project K5/2737.

Kotze, D., Marneweck, G., Batchelor, A., Lindley, D., & Collins, N. (2009). *Wetland-EcoServices: A rapid assessment procedure for describing wetland benefits.* Pretoria: WRC: TT339/09.

Kotze, D., Marneweck, G., Batchelor, A., Lindley, D., & Collins, N. (2009). *Wetland-EcoServices: A rapid assessment procedure for describing wetland benefits.* Pretoria: WRC: TT339/09.

Macfarlane, D., Kotze, D., & Ellery, W. (2009). *WET-Health: A technique for rapidly assessing wetland health (TT 340/09).* WRC Report.

Macfarlane, D., Ollis, D., & Kotze, D. (2020). *WET-Health (Version 2.0): A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Systems.* WRC Report No. TT 820/20.

Mpumalanga. (2003). *Mpumalanga State of the Environement Report 2003.*

MTPA. (2014). *Mpumalanga Biodiversity Sector Plan Handbook.* Mbombela (Nelspruit): Mpumalanga Tourism & Parks Agency.

Mucina, L., & Rutherford, M. C. (2012). *The Vegetation of South Africa, Lesotho and Swaziland.* Pretoria: South African National Biodiversity Institute.

Mucina, L., & Rutherford, M. C. (2012). *The Vegetation of South Africa, Lesotho and Swaziland.* Pretoria: South African National Biodiversity Institute.

Nel, J., Murray, K., Maherry, A., Petersen, C., Roux, D., Driver, A., . . . Nienaber, S. (2011). *Technical Report for the National Freshwater Priority Areas project.* WRC: 1801/2/11.

Oberholster, P., & Myburgh, J. (2011). Bioaccumulation of aluminium and iron in the food chain of Lake Loskop, South Africa. *Ecotoxicology and Environmental Safety*, 132-141.

Ollis, D., Snaddon, C., Job, N., & Mbona, N. (2013). *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems.* South African National Biodiversity Institute, Pretoria: SANBI Biodiversity Series 22.

Rountree, M., Malan, H., & Weston, B. (2013). *Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0).*

SANBI and DWS. (2016). *Wetland Offsets: A Best Practice Guideline for South Africa.* WRC.

Skinner, J., & Chimimba, T. (2005). *The mammals of the Southern African Subregion. 3rd Edition.* South Africa: Cambridge University Press.

South African Weather Bureau. (1986). Climate of South Africa. In D. o. Weather Bureau, *Climate Statistics up to 1984. WB40.* Pretoria.

WRC. (2007). *WET-RoadMap: A Guide to the Wetland Management Series.* Water Research Commission.

WRC. (2015). *Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries.* WRC Report No. TT 610/14.

Appendix A: Methodology

Literature Review and Desktop Assessment

Relevant literature was reviewed with respect to the historical wetlands associated with the Project Area, habitats and vegetation types as well as the wetland state prior to development. This was completed to obtain relevant information on the wetland ecology of the Project Area and its vicinity to acquire enough information to compile a Wetland Environmental Impact Assessment Report.

For the purpose of this assessment, wetland areas were identified, and preliminary wetland boundaries were delineated at the desktop level using detailed aerial imagery and wetland signatures, along with 5 m contours. Baseline and background information were researched and used to understand the area on a desktop level prior to fieldwork confirmation. This included but was not limited to:

- A practical field procedure for the identification and delineation of wetlands and riparian areas (Department of Water Affairs and Forestry, 2005);
- WET-RoadMap: A Guide to the Wetland Management Series (WRC, 2007);
- National Freshwater Ecological Priority Areas (NFEPA) (Driver, et al., 2011; Nel, et al., 2011);
- Mining and Biodiversity Guidelines, DEA et al. (2013);
- Mpumalanga Biodiversity Sector Plan (MTPA, 2014); and
- Wetland Offsets: A Best Practice Guideline for South Africa (SANBI and DWS, 2016).

Relevant and available historical studies conducted within, or surrounding the Project Area, the South African National Biodiversity Institute (SANBI), Water Management Areas (WMA) and Quaternary Catchments, the National Spatial Biodiversity Assessment, Governmental reports such as the Mpumalanga State of the Environment Report (2003), Vegetation types of South Africa (Mucina & Rutherford, The Vegetation of South Africa, Lesotho and Swaziland., 2012), and Fauna distribution and identification books of South Africa (Friedman & Daly, 2004; Skinner & Chimimba, 2005) were some of the platforms used to identify and create a background study of the area.

National Freshwater Ecosystem Priority Areas

The NFEPA Project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel, et al., 2011). The spatial layers (FEPAs) include the nationally delineated wetland areas that are classified into Hydro-geomorphic (HGM) units and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetlands.

The NFEPA Project represents a multi-partner Project between the CSIR, SANBI, WRC, DWS, DEA, WWF, SAIAB and SANParks. The NFEPA Project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel, et al., 2011).

More specifically, the NFEPA Project aims to:

1. Identify FEPAs to meet national biodiversity goals for freshwater ecosystems; and
2. Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity within the context of equitable social and economic development. The second aim is comprised of two separate components: the (i) national component aimed to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems, while the (ii) sub-national component is aimed to use three case studies to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes. The Project further aimed to maximize synergies and alignment with other national level initiatives, including the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation (Driver, et al., 2011).

Based on a desktop-based modelled wetland condition and a combination of special features, including expert knowledge (e.g. intact peat wetlands, presence of rare plants and animals, etc.) and available spatial data on the occurrence of threatened frogs and wetland-dependent birds, each of the wetlands within the inventory were ranked in terms of their biodiversity importance and as such, Wetland FEPAs were identified in an effort to achieve biodiversity targets (Driver, et al., 2011). Table 1 below indicates the criteria that were considered for the ranking of each of these wetland areas. Whilst being a valuable tool, it is important to note that the FEPAs were delineated and studied at a desktop and relatively low-resolution level. Thus, the wetlands delineated via the desktop delineations and ground-truthing work done through this study may differ from the NFEPA data layers. The NFEPA assessment does, however, hold significance from a national perspective.

Table 1: NFEPA Wetland Classification Ranking Criteria (Nel et al., 2011)

Criteria	Rank
Wetlands that intersect with a Ramsar site.	1
• Wetlands within 500 m of an International Union for Conservation of Nature (IUCN) threatened frog point locality; • Wetlands within 500 m of a threatened water-bird point locality; • Wetlands (excluding dams) with most of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; • Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and • Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by SANBI, the DEA, the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum (2013). The purpose of the guideline was to provide the mining sector with a manual to integrate biodiversity into the planning process thereby encouraging informed decision-making around mining development and environmental authorisations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning process. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining Project. The country has been mapped into biodiversity priority areas including the four categories each with associated risks and implications (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013) (Table 2).

Table 2: Mining and Biodiversity Guideline Categories (DEA et al., 2013)

Category	Risk and Implications for Mining
Legally Protected	Mining prohibited; unless authorised by ministers of both the DEA and DMR.
Highest Biodiversity Importance	Highest Risk for Mining: the EIA process must confirm significance of the biodiversity features that may be a fatal flaw to the proposed Project. Specialists must provide site-specific recommendations for the application of the mitigation hierarchy that informs the decision-making processes of mining licences, water use licences and environmental authorisations. If granted, authorisations should set limits on allowed activities and specify biodiversity related management outcomes.
High Biodiversity Importance	High Risk for Mining: the EIA process must confirm the significance of the biodiversity features for the conservation of biodiversity priority areas. Significance of impacts must be discussed as mining options are possible but must be limited. Authorisations may set limits and specify biodiversity related management outcomes.
Moderate Biodiversity Importance	Moderate Risk for Mining: the EIA process must confirm the significance of the biodiversity features and the potential impacts as mining options must be limited but are possible. Authorisations may set limits and specify biodiversity related management outcomes.

Mpumalanga Biodiversity Sector Plan (MBSP)

The MBSP is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for national legislation and policy. The MBSP was published in 2014 by the Mpumalanga Tourism and Parks Agency (MTPA) and comprises a set of maps of biodiversity priority areas accompanied by contextual information and land-use guidelines for use in land-use and development planning, environmental assessment and regulation, and natural resource management. Strategically the MBSP enables the province to:

- Implement the NEM:BA, 2004 provincially, and comply with requirements of the National Biodiversity Framework, 2009 (NBF) and certain international conventions;
- Identify those areas of highest biodiversity that need to be considered in provincial planning initiatives; and
- Address threat of climate change (ecosystem-based adaptation).

The publication includes terrestrial and freshwater biodiversity areas that are mapped and classified in Protected Areas (PAs), Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) or Other Natural Areas (ONAs) (Table 3).

Wetlands in Mpumalanga Province have been extensively degraded and, in many cases, irreversibly modified and lost through a combination of inappropriate land-use practices, development, agriculture and mining. Wetlands represent ecosystems of high value for delivering, managing and storing good water quality for anthropological and animal use yet they are vulnerable to undesirable impacts. It is therefore in the interest of national water security that all wetlands are protected by law.

Table 3: Mpumalanga Biodiversity Sector Plan Categories

Map Category	Definition	Desired Management Objectives
PA	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazette protected environments.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
CBAs	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes. CBA Wetlands are those that have been identified as FEPA wetlands that are important for meeting biodiversity targets for freshwater ecosystems.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
ESAs	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services. ESAs Wetlands are those that are non-FEPA and ESA Wetland Clusters are clusters of wetlands embedded within a largely natural landscape that function as a unit and allow for the migration of species such as frogs and insects between individual wetlands.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorization process that ensures the underlying biodiversity objectives are not compromised.
ONAs	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritized for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.

Map Category	Definition	Desired Management Objectives
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritized for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximize ecological functionality and authorization is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilized and restored where possible, especially for soil carbon and water-related functionality.

Wetland Identification, Delineation and Classification

Due to the size of the MRA, a detailed desktop delineation was done prior the field assessment for budget and time purposes. The site survey was therefore done for ground truthing purposes to verify the desktop delineations as well as compiling data and information to assess the wetland health, ecological state and importance and sensitivity.

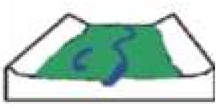
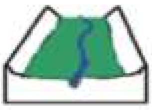
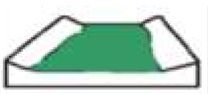
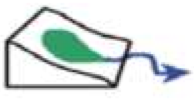
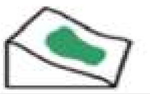
The wetland delineations were verified according to the accepted methodology from the Department of Water and Sanitation 'A practical field procedure for identification and delineation of wetlands and riparian areas' (Department of Water Affairs and Forestry, 2005) as well as the "Updated manual for identification and delineation of wetlands and riparian areas" (Department of Water Affairs and Forestry, 2008). These methodologies use the:

- **Terrain Unit Indicator**: Identifies those parts of the landscape where wetlands are more likely to occur;
- **Soil Form Indicator**: Identifies the soil forms, which are associated with prolonged and frequent saturation;
- **Soil Wetness Indicator**: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- **Vegetation Indicator**: Identifies hydrophilic vegetation associated with frequently saturated soils.

Terrain Unit Indicator

Terrain Unit Indicator (TUI) areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, contour data, aerial photographs and engineering and town planning diagrams (Department of Water Affairs and Forestry, 2005). In accordance with the guidelines provided by the DWS (Department of Water Affairs and Forestry, 2005) wetlands are identified and classified into various HGM units based on their individual characteristics and setting within the landscape. The HGM unit classification system focuses on the hydro-geomorphic setting/position of wetlands in a landscape which incorporates geomorphology; water movement into, through and out of the wetland. The HGM unit is dependent on various aspects, including whether the drainage is open or close, water is dominating the system or is sub-surface water, how the water flows from and into the wetlands and how water is contained within the wetland. Once wetlands have been identified, they are categorised into HGM units as shown in Table 4.

Table 4: Description of the Various HGM Units for Wetland Classification

Hydromorphic Wetland Type	Diagram	Description
Floodplain		Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.
Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.

Hydromorphic Wetland Type	Diagram	Description
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

Soil Indicators

Soil Form Indicators

Hydromorphic soils are characterized as soils that has undergone redox reactions because of the fluctuation of water and oxygen within the soil profile, creating segregations of iron (Fe) and manganese (Mn) particles. This fluctuation of water and oxygen in the soils can be attributed to the fluctuating ground water table, creating seasonal, temporary and permanent wet zones. Hydromorphic soils are thus Soil Form Indicators (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (Department of Water Affairs and Forestry, 2005). The permanent, as well as occasional saturation of soil results in anaerobic conditions of the soils causing a chemical, physical and biological change to the soil.

Hydromorphic soils are often identified by the colours of various soil components. The frequency and duration of the soil saturation periods strongly influences the colours of these components. Grey colours become more prominent in the soil matrix the higher the duration and frequency of saturation in a soil profile (Department of Water Affairs and Forestry, 2005). A feature of hydromorphic soils are coloured mottles (iron and manganese accumulation) which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils and are less abundant in temporarily saturated soils (Department of Water Affairs and Forestry, 2005). The hydromorphic soils must display signs of wetness within 50 cm of the soil surface, as this is necessary to support hydrophytic vegetation.

Soils that are commonly associated with wetlands are: Champagne, Rensburg, Arcadia, Katspruit, Kroonstad, Longlands, Fernwood and Westley soil forms. These soil forms are associated with high clay content and accumulation of clay, promoting water logging and creating low drainage, thus water logging conditions. These soils are commonly associated with low-laying landscapes such as valley bottoms, foot-slopes and mid-slopes.

Soil Wetness Indicators

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (Department of Water Affairs and Forestry, 2005). Iron and manganese accumulation in a soil profile, termed mottles, are some of the recognized ‘wet-indicators’. These two elements are insoluble under aerobic (unsaturated) conditions and become soluble when the soil becomes anaerobic (saturated). The fluctuating water table creates these conditions by increasing and reducing the oxygen levels in the soil profile by increased and reduced water levels. Iron is one of the most abundant elements in soils and is responsible for the red and brown chroma of many soils.

During anaerobic (saturated) conditions, the iron and manganese in the soils are mobile and thus begin to leach out of the soil profile. Where oxidation takes place around for example roots, aggregate surfaces and pores, relatively insoluble ferric oxides is deposited leading to formation of red/green mottles and concretions. These soil profiles are commonly known as leached soils, gleysol, E-horizons or Albic horizons. Resulting from the prolonged anaerobic conditions, the soil matrix is left a grey, greenish or bluish colour, and is said to be “gleyed”. Recurrence of the cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is gleyed and has mottles within the first 0.5 m of the surface are indicating a zone that is seasonally or temporarily saturated, interpreted and classified as a wetland (Department of Water Affairs and Forestry, 2005).

Vegetation Indicator

Plant communities undergo distinct changes in species composition along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze & Marneweck, Guidelnes for delineating the wetland boundary and zones within a wetland under the South African Water Act, 1999; Department of Water Affairs and Forestry, 2005). This is summarised in Table 5 below.

When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (Department of Water Affairs and Forestry, 2005). Areas where soils are a poor indicator (black clay, vertic soils), vegetation (as well as topographical setting) is relied on to a greater extent and the use of the wetland species classification as per Table 5 becomes more important. If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (Department of Water Affairs and Forestry, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineate wetland areas.

Table 5: Classification of Plant Species According to Occurrence in Wetlands

Type	Description
Obligate Wetland Species (OW)	Almost always grow in wetlands: > 99% of occurrences.
Facultative Wetland Species (FW)	Usually grow in wetlands but occasionally are found in non-wetland areas: 67-99% of occurrences.
Facultative Species (F)	Are equally likely to grow in wetlands and non-wetland areas: 34-66% of occurrences.
Facultative Dry-land Species (FD)	Usually grow in non-wetland areas but sometimes grow in wetlands: 1-34% of occurrences.

(Source: (Department of Water Affairs and Forestry, 2005))

Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane et al. (2009; 2020), the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A Level 1 WET-Health assessment was done on the wetlands in accordance with the method described by Macfarlane et al., (2009) to determine the integrity (health) of the characterised HGM units for the wetlands associated with the Project Area. A Present Ecological State (PES) analysis was conducted to establish baseline integrity (health) for the associated wetlands. The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions. The overall health score of the wetland was then calculated.

Central to WET-Health is the characterisation of HGM units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated, or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described above.

The overall approach is to quantify the impacts on wetland health and then to convert the impact scores to a PES score. This takes the form of assessing the spatial extent of the impact of individual activities and then separately assessing the intensity of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores and PES categories are provided in Table 6 (Macfarlane, Kotze, & Ellery, 2009; Macfarlane, Ollis, & Kotze, 2020).

Table 6: Impact Scores and Present Ecological State Categories (WET-Health; Macfarlane et al., 2009 and 2020)

Impact Category	Description	Combined Impact Score	PES Score (%)	PES Category
None	Unmodified, natural.	0-0.9	90-00	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota has taken place.	1-1.9	80-89	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	60-79	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	40-59	D
Serious	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39	E
Critical	Critically modified. Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19	F

Once all HGM units have been assessed, a summary of health for the wetland needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM unit. Recording the health assessments for the hydrology, geomorphology, vegetation and water quality components provide a summary of impacts, PES, Trajectory of Change and Health for individual HGM units and for the entire wetland.

Wetland Ecological Services (WET-EcoServices)

The importance of a water resource in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class (Department of Water Affairs and Forestry, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described Kotze et al. (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided (Table 8).

Table 8: Ecosystem Services

Regulating and Supporting Services	Provisioning Services	Cultural Services
Flood Attenuation	Provision of Water for Human Use	Cultural and Spiritual Experience
Streamflow Regulation	Provision of Harvestable Resources	Tourism and Recreation
Sediment Trapping	Food for Livestock	Education and Research
Phosphate Assimilation	Provision of Cultivated Foods	
Nitrate Assimilation		
Toxicant Assimilation		
Erosion Control		
Carbon Storage		
Biodiversity Maintenance		

The characteristics were used to quantitatively determine the value and, by extension, sensitivity of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland (Table 9).

Table 9: Classes for Determining the Likely Extent to Which a Benefit is Being Supplied

Score	Rating of the Likely Extent to Which the Benefit is Being Supplied
<0.5	Low
0.6-1.2	Moderately Low
1.3-2	Intermediate
2.1-3	Moderately High
>3	High

Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. The methodology outlined by DWAF (1999) and updated in Kotze and Rountree (Kotze, Ellery, Macfarlane, & Jewitt, 2012; Rountree, Malan, & Weston, 2013), was used for this study.

In this method there are three suites of importance criteria; namely:

- **Ecological Importance and Sensitivity:** incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS and thus enabling consistent assessment approaches across water resource types;
- **Hydro-functional Importance:** which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- **Importance in Terms of Basic Human Benefits:** this suite of criteria considers the subsistence uses and cultural benefits of the wetland system.

These determinants are assessed for the wetlands on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category of the wetland system, as defined in Table 10.

Table 10: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Very High Systems that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4
High Systems that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate Systems that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/Marginal Systems that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1

Impact Assessment

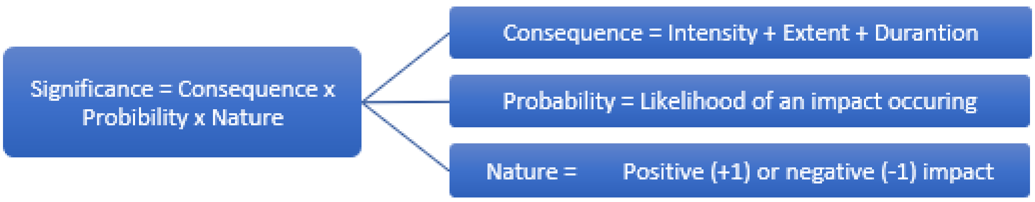
The wetland impacts were assessed based on the impact's magnitude as well as the receiving environment's sensitivity, resulting in an impact significance rating which identified the most important impacts that require management. Based on international guidelines and legislation, the following criteria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

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

Significance Rating

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

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



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

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

The matrix calculated the rating out of 147, whereby intensity, extent, duration and probability were each rated out of seven as indicated in Table 13. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

Parameter Rating

Impacts are rated prior to mitigation and again after consideration of the mitigation proposed in this report. The significance of an impact is then determined and categorised into one of seven categories, as indicated in Table 12, which is extracted from Table 13. The description of the significance ratings is discussed in Table 14.

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

Mitigation Hierarchy

The aim of the Impact Assessment is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is represented in Table 11.

Table 11: Mitigation Hierarchy

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

Table 12: Impact Assessment Parameter Ratings

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

Table 13: Probability/Consequence Matrix

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

Table 14: Significance Rating Description

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